

ORIGINAL ARTICLE

Can Lean Thinking enhance research administration?

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Abstract

Background: Hospital research administration is expected to provide improved work efficiency and service delivery in the upcoming years. Meanwhile, resources to support scientific research are dwindling, as is the amount of research support personnel. The aim of the study was to investigate the research administration's user needs, their opinions on the state of today's scientific research and also to assess its future development needs and find out whether a customer-oriented management philosophy such as Lean Thinking could be implemented in the research administration setting to enhance work processes and services.

Methods: In this study, thematic interviews were used as a method. Kuopio University Hospital researchers (n = 7) and research administration personnel (n = 11) were interviewed. The interviews were carried out by one researcher and lasted on average approximately 60 minutes per interviewee.

Results: The interviews revealed that several issues, such as bureaucracy, decreased attitudes towards research, lack of transparency and face-to-face customer service by the research administration, have hindered and complicated research work and service delivery. The study addressed a need for a comprehensive, linear, efficiency- and quality-oriented, user-focused management philosophy.

Conclusions: The results of the study support implementation of a customer-oriented management philosophy into the research administration to improve its work processes and service delivery. Although Lean Thinking remains untested in the research administration setting, its fundamentals and strengths seem to answer many needs of the research administration.

Key words

Hospital, Research administration, Lean Thinking

1 Background

Hospital research administration faces increasing pressure from several directions ^[1]. Today's regressing economic situation in the developed countries places challenging expectations on the research administration for attaining and sustaining improved process efficiency and meeting customer needs and preferences more cogently. Although excessive bureaucracy has been a burning topic for the past few decades, no major breakthroughs have been accomplished ^[2]. It is still visibly hindering research administration process efficiency and making maintaining a customer-oriented approach

significantly more difficult. As a matter of fact, due to growingly complex legislation, governance, regulation and political control the bureaucracy issues have become increasingly troublesome^[3, 4]. Furthermore, different procedures in research administration are amounting to the already excessive burden of bureaucracy^[4]. For instance, the ethical review process varies greatly within Europe and a need for harmonization has arisen^[5, 6]. Although some attempts to alleviate these problems have been undertaken, we are painstakingly far from an ideal situation^[7, 8]. The future of medical research is under threat and thus urgent reform is needed^[9, 10].

The amount of conducted clinical research work is decreasing due to several factors^[11]. Economic regression has led to decreased research funding and grants to support clinical research. In addition, the appreciation of clinical research work has been on the decline during the past few decades^[12]. Research work has previously been chiefly voluntary and carried out during the clinicians' spare time. Due to an increase in the clinicians' work expectations, young researchers have become hesitant to devote their diminished spare time to research^[12]. Instead, young physicians prefer spending their limited spare time on leisure activities and on clinical hospital work. Thus a lack of researchers is plaguing today's healthcare organizations^[11, 13].

All in all, the field of healthcare research is a very complex environment^[13]. According to research, task complexity and productivity pressures cause difficulties for healthcare professionals^[14]. In addition, the multidisciplinary nature of the workforce creates additional challenges for organizing administration issues in healthcare organizations. New innovations for enhanced work processes and services are desperately sought after. How could we develop a well-organized, functional research administration to deal with these demanding issues?

A customer-oriented management philosophy created by the Toyota Production Systems; Lean Thinking has exhibited considerable success among several fields of industry^[15, 16]. It has demonstrated ability to improve organizational work process efficiency, quality of service delivery and is an efficient philosophy for change management. Lean is tailor-made for streamlining complex, unorganized environments and resource-driven processes. The increasingly popular philosophy is expanding into new areas of industry and has also lately had its share of success in the field of healthcare^[17, 18].

According to our knowledge, research administration remains unimplemented by Lean. Thus the applicability of a management philosophy such as Lean to the research administration setting is assessed in this paper. A semi-structured interview process was carried out in an attempt to find development ideas and solutions for improving research administrations in Kuopio University Hospital (KUH), Finland and also worldwide. The goal of the interviews was to find out whether Lean Thinking could be implemented to develop research administration work processes and services.

1.1 Basic fundamentals of Lean Thinking

Lean Thinking attempts to maximize the value provided to the customer by minimizing as much "waste" in the work processes as possible. Anything that does not create value to the customer is seen as waste (or non-value-adding activity). In other words, Lean attempts to crop out all work steps that produce waste and focus on the value-adding activities^[23]. Furthermore, Lean attempts to create highly visual, flowing work processes (Lean uses a term "just-in-time") while striving to minimize inventories, process errors and quality deficits ("Jidoka"). Lean implementation projects have yielded extra time and energy resources for the personnel, which they have utilized in for example direct communication with the customers^[25]. In order to gain sustaining benefits the basic Lean ideology of "Continuous improvement" must be understood^[17, 24]. This means that every employee within the organization works endlessly towards elimination of waste and in pursuit of perfection. Several benefits such as increased work efficiency, customer and employee satisfaction, increased well-being, improved communication and teamwork, empowerment of employees, increased employee know-how, *etc.* have been reported in various Lean implementation projects among healthcare^[17, 18]. More information on the basics of Lean can be found from following references^[26, 27].

1.2 Aim

The aim of the study was to investigate the research administration's present situation; user/customer needs and find out their views on the state of today's scientific research. The aim was also to assess its future development needs and see whether a customer-oriented management philosophy such as Lean Thinking could be implemented into the research administration setting for enhancing work processes and improving services.

2 Materials and methods

The Science Service Center (SSC) provides research administration services for KUH. The services consist of i.e. guidance and education for researchers and other stakeholders involved in scientific health research. The personnel of the SSC provide guidance concerning research permits, legal and ethical questions and other issues related to governance.

Thematic interviews were used as a method in this study. Researchers ($n = 7$) and the SSC personnel ($n = 11$) were interviewed in April 2013. During these interviews ($n = 18$) the saturation point was achieved. The interviews were carried out by one researcher (EI), and lasted on average approximately 60 minutes per interviewee. The interview themes were created by a multi-professional development team. The interviews included following themes: 1) The present state of scientific research in KUH, 2) the role of the SSC in research administration, 3) the development of the SSC's work processes and service delivery and 4) future challenges for scientific research and research administration. A thematic interview sheet was made for the interviews. The interviews were not recorded. Instead, notes were made by the interviewer. The notes were written on the interview sheet. Afterwards the notes were sent to the participants to ensure the collected information was correct.

2.1 Data analysis

The notes were given a specific code. After this, only the code was used and the data was stored in a locked place. The data was analysed using thematic content analysis and the answers were grouped. The groups were used to identify elements that described the data, and the concepts with similar content were combined to form upper concepts^[19-21]. The elements were either one or more sentences or one word. From the data, simplified expressions were sought (an example: "to increase individual guidance and education") from which upper concepts were created (the simplified expression in this case is "customer orientation"). The results were presented as quotes to show the meaning that the participants gave to the theme in question^[19].

2.2 Ethical consideration

According to the Finnish law, this type of research does not require approval from an official research ethics committee. Mutual discussion about research administration cannot be regarded as providing sensitive or potentially harmful information about the participants^[22]. Informed consent by each participant was asked, understanding was ensured verbally, and data were handled without personal identifiers^[22].

3 Results

3.1 The present situation of scientific research in KUH

The research work carried out in KUH was seen as valuable and important by all participants. The interviewees experienced the atmosphere as mainly supportive towards research. On the other hand, lack of innovativeness, as well as lack of willingness to renew and develop within the organization was noticed. According to an interviewee: "...in order to maintain our competitiveness, we must have a will to reinvent ourselves". Some of the interviewees have lately experienced decreased appreciation of research within the entire organization. This was explained by a poor motivation

towards performing research work outside clinical work hours by the young generation of researchers. In addition, a decrease in research funding was seen as a significant factor. Also, competition for research funding and grants has become tougher nationally in Finland, and the movement of organizational research projects into other healthcare districts was seen as a factor for decreased research work. The participants pointed out a need for increasing research support personnel. Especially the lack of research nurses and their uneven distribution was seen as a significant shortcoming.

Increasing bureaucracy was seen by the researchers to terminate many small pilot studies and research projects. Otherwise, researchers thought that the threshold for initiating a new research project had risen remarkably. Due to increased bureaucracy, the SSC personnel had noticed a change in the attitudes and willingness of researchers to conduct research.

The SSC was seen as a unit that reacts to changes in a dynamic work environment. It is guided by a relatively new research strategy, which directs KUH health research and is part of KUH's organizational strategy. The research strategy was seen as a future benchmark for scientific research. However, both the researchers and the personnel felt the research strategy had not been thoroughly integrated as a part of hands-on research work nor as a guideline for funding and leadership. The interviewees reported that making the research strategy visible for patients, business associates, and urban district decision-makers was valuable.

In KUH, the leadership was mainly seen as supportive towards research, although this was invisible from the perspective of research. The highest management in KUH along with the research administration was seen to provide a solid link with district decision-makers. The researchers were all unanimous that the district decision-makers see research as a burden and expenditure. According to a statement by an interviewee: "The decision-makers are not aware of the benefits of scientific research, for example about significant economic savings". Both the researchers and the personnel agreed that scientific research is a part of the core mission of KUH and invaluable in enhancing patient treatment and well-being. The researchers emphasized savings that were created from research to the healthcare district. Research was believed to produce humane and economic benefits immediately and during a long time interval. KUH leaders should make these observations visible to the district decision-makers.

3.2 Future implications for research management and scientific research

The SSC's role in the future was seen as being more comprehensive towards administrative issues. Also, the interviewees hoped it would initiate and oversee more research projects. The SSC should strive to offer personal and user-centric research administration services in direct interaction with the client. This would free up more time for researchers to pursue actual research work. Additionally, development and use of electronic forms might ease work and increase accessibility of information. Tables of the interviewees' future research management and scientific research are presented below (see Tables 1 and 2).

The future of scientific research was mainly seen as gloomy. Described by one researcher: "I do not believe the amount of research work conducted in KUH will grow in the future. I hope it will at least maintain the current level of research". The interviewees did not expect an increase in the amount of research work carried out at KUH in the near future: "The funding for research will decrease in the future. On the other hand, future research projects will be bigger and more expensive. The research will be conducted in countries, wherein research expenses are smaller". This view was influenced by global economic and political insecurity. The interviewees hoped that the amount of national research and the level of competence will not decrease further. This was due to i.e. increasingly preferred use of developing countries as research locations. The researchers suggested uniting all research administrations in Finland into one single center for research administration. A centralized national research administration was believed to offer opportunities and a competitive advantage for international multi-center studies and for uniting procedures and policies.

Another significant challenge was changing the attitudes to support research, especially among young researchers. The interviewees agreed that current opportunities to unite research, work and personal life are inadequate. As one researcher pointed out: “In an ideal situation, clinical and research work would be integrated. At present, clinical work is seen as more important, and research work has been left more or less abandoned”. More work time should be reserved for scientific research to inspire young researchers. The interviewees note that spare time and hobbies are seen as more valuable than scientific meriting.

Table 1. Interviewees’ needs for improving customer-oriented services

Decreasing bureaucracy		Increasing need-driven service and education	
Decreasing bureaucracy outside the organization	Decreasing bureaucracy inside the organization	Researching need-driven service and education	Need-driven education for the research organization
Development of expertise between the EU, legislators and researchers	Coordination of monitoring, research support personnel, and finalization of publications and biobank administration	Personal service throughout the entire research process	Education of research processes, permit arrangements and statements from the research ethics committee
“...decreasing bureaucracy should be done by the Science Service Center as much as possible”	“Clinical research should pursue a situation, wherein both the researcher and the research nurse will recruit the patients. Other bureaucracy is performed by the SSC.” “Editorial service. Nowadays researchers have a lot of research manuscripts lying on the shelves of their office desks. These papers should be modified to meet the preferences of scientific journals...”	“The SSC should help initiation of research and administration so that the researcher is left with time to do more actual research work. All bureaucracy according to research is handled by the SSC.” “..personal education and information should be increased about Clinical Trials.gov and EudraCT.”	“..increasing education, for example in the form of a course on “Moodle” and brief education courses thematically”

Table 2. Interviewees’ needs for improving services in a dynamic work environment

Developing electronic services		Developing communication	
Modified answer sheets for research permits	Statistics programs used in research work	Development of scientific communication	Co-operation with other research administration organizations
Electronic forms	Administration and coordination of statistic programs	Focused and timely information about official and legislative changes and increasing the recognizability of research	Co-operation with the university and integration of services
“...Simplifying instructions and more efficient updating. Also, automatically filled electronic forms sorted by research types...”	“..Coordination of statistical programs for researchers (i.e. SPSS).”	“The SSC could increase functioning as an advertiser for scientific research, both inside the organization and municipally.”	“Communication with different faculties of the university could be further enhanced.” “..More intensive co-operation with the university enables flexible research and work in both organizations. This also lowers barriers between the two organizations.”

4 Discussion

According to our study, research administrations should pursue to avoid bureaucracy and decrease it. The overly complex tasks and procedures within research administrations and the requirements to gain approval from various organs have made it difficult for researchers to initiate, manage and conclude research projects. In fact, bureaucracy has been raised as

one of the leading factors to inhibit scientific research. Some factors concerning bureaucracy lie within the control of national legislation and are thus out of research administrations' reach. However, plenty of bureaucracy could be avoided by simply enhancing the research administrations' organizational performance and efficiency^[28]. Therefore, research administrations must aim at making work processes more fluent and flowing. This calls out for continuous development work processes – a key fundamental of Lean Thinking. It means eliminating as many excess work and work steps as possible while sharpening the focus of work tasks to maximize the value created to the customer. Lean makes the work processes follow a linear, designated path from beginning to end, in contrast with organizations where work flows tend towards the next available resource often resulting in convoluted paths^[29]. As dynamic, changing work environments easily and often lead to increased bureaucracy, it is vital to stick to an ideology, which “counter-attacks” this by carefully and continuously designing new, leaner and less-complicated, less waste-producing work processes.

Decreased appreciation and poor attitudes towards research have contributed to diminished research administration funding and personnel. Although its resources dwindle, the research administration must maintain its competitiveness by exhibiting enhanced process efficiency and providing increasingly competent services. Lean has shown to provide significant results concerning work productivity, efficiency and service delivery; frankly, doing more with less. However, full commitment and dedication to the Lean ideology is required. It will not be a walk in the park, but is very likely to pay dividends.

Research into health care organizations varies greatly across Europe and this has caused unclear goals for i.e. organization and delivery of health care^[30]. Research administration in Europe is in urgent need of harmonization^[6]. For instance, too many research studies are being forced to undertake review by an ethics committee even though they do not interfere with a person's autonomy^[31]. This causes unnecessary process steps amounting to increased delay and bureaucracy, which could be avoided by simply rationalizing the types of research studies that actually need an ethics committee review^[31]. There are also a plethora of other committees and bureaucratic organs that unsystematically require approval from certain research studies, largely depending on the local research administration. In our study, Centralization of research administration has been proposed by the interviewees as a means to clear organizational focus and decrease bureaucracy. According to research, centralization of research administrations will help in making work processes flowing, linear, and less time consuming, as a larger number of research studies are processed in a single location^[32]. This has also been shown to deepen know-how within the research administration. From a Lean perspective, centralization of research administration may remarkably ease work process organization. Lean tools named “Value Stream maps” could now be drawn to visualize research administration work processes for the entire organizational process chain. This would enable relatively simple means of standardization for all work processes within the research administration. This in turn makes streamlining work processes and elimination of waste less demanding, as the same optimization methods apply for all linked research administration offices.

In the future, research administration should strive to quickly react to customers' needs and development ideas and emphasize face-to-face customer services. Lean is a customer-driven philosophy that attempts to enhance work and service process delivery in order to improve the value customer receives. Clear and direct interactions with customers are emphasized by Lean to communicate requests for services^[29]. Improved work efficiency, noticed in several Lean implementation healthcare projects, has created more time for physicians allowing them to spend increased time face-to-face with patients^[25]. By implementing Lean Thinking into research administration, increased time to spend face-to-face with the customer could be achieved as well.

Research administration personnel should become an active part in initiating and overseeing research projects. Several factors, such as delays in research projects can amount to significant costs. For example, Snooks *et al.* reported of three healthcare trials that were delayed by at least 12 months, and resulted in staggering 30%-40% cost increases^[4]. However, further research study evidence is needed in order to find unbiased reasons behind the research project delays. All in all, research administration could decrease initiation and throughput times of research projects by actively monitor-

ing and managing them. Lean empowers employees and encourages them to be active and participate in enhancing organizational productivity, efficiency, safety and well-being. Lean culture sees work processes as always being imperfect and encourages employees to speak out and willingly find shortcomings in the work process. Employees are never blamed for errors – humans are prone to make them, it is just a matter of mistake-proofing the work process. Lean workers are highly trained via teaching and learning to perform, inspect and fix their daily problems ^[29]. Similarly, research administration personnel could be encouraged to actively participate in helping researchers initiate and manage research projects. Ultimately, this may lead to improved mutual understanding and co-operation between the researchers and the research administration personnel.

Development of work in a dynamic work environment to shift its focus towards comprehensiveness and transparency towards researchers was seen as important by the interviewees. Clear deficiencies in communication have been noted within the field of research and there is much to do to improve the transparency of research administrations ^[33]. Lean attempts to change the organizational culture into a more open, direct, and communicative one. It is essential to secure the know-how of the personnel and make sure it is properly directed into work processes and customer service. In fact, research evidence suggests that a correlation exists between communication, team performance, and ultimately even service quality ^[34]. This requires personnel training. Lean is known for its effective, “Kaizen” workshops, that instill the fundamentals of Lean into the employees. Kaizen workshops explain i.e. the principles of continuous improvement, and have been noticed to attain several positive benefits, such as improved worker empowerment, teamwork and employees’ knowledge of their future tasks at hand. This could be highly beneficial to the research administration personnel to gain understanding of the researchers’ demands, and how to offer them more comprehensive service and information. Lean Thinking may also provide tools to more thoroughly integrate the new research strategy as a part of the research administration’s operational practice. Visualization is a key concept of Lean, and by using simple, visual informational signs and guides along with Kaizen workshops, employees and customers could be enlightened about the new research strategy. The workshops could also be used by KUH leaders to convey a more thorough understanding of the benefits of scientific research to the district decision-makers.

Development of electronic services was seen as a way to speed-up administration processes and to decrease human chance of error. Processing paper-based applications and forms causes significant time and resource investments for the research administration. Paper-based forms are slow to fill up and prone to human errors. On the other hand electronic forms are significantly quicker to complete and can be instantly sent to any location. Jidoka, which means mistake-proofing processes, is a key fundamental of Lean. Development of electronic services provides an ideal platform for accomplishing this. For instance, electronically filtering research application forms to crop out incorrect information will likely amount to significant time savings for both the researchers and the research administration personnel as electronic forms do not have to be sent back and forth between the researchers and the administration. Also, other forms of electronic services such as electronic instructions, guidebooks, libraries and guidelines for the researcher will be available for all and thus supremely useful for informing researchers and thus alleviating the workload of the research administration and freeing up time to spend in face-to-face contact with the researchers (and other customers).

5 Conclusions

In our study, we assessed the current state and future needs of the KUH research admission and investigated the need for a management philosophy such as Lean Thinking to aid in its future development. While assessing the current state of KUH research admission, the interviewees noted decreased appreciation of research within the entire organization. Also decreased research funding and insufficient amount of research support personnel was seen to bother present research projects. Poor awareness of the benefits of scientific research was also seen as a key factor to inhibit its progress.

The future of scientific research was seen as bleak by the interviewees. They acknowledged some crucial future development needs for KUH research admission. These included avoiding and decreasing bureaucracy, centralization of

research admissions, emphasizing face-to-face customer services, initiating and overseeing research projects, shifting focus towards comprehensiveness and transparency towards researchers and developing electronic services.

These issues are critical, especially in the light of dwindling resources among resource administrations in most developed countries. Thus they must be addressed immediately. In order to accomplish this, a customer-oriented management approach is needed. Lean thrives in searching and eliminating waste. A bureaucratic, complex environment such as the KUH research administration seems to provide an optimal place for Lean implementation. Lean is a customer-driven ideology that emphasizes teamwork, co-operation, directness, openness, and user empowerment. Also, efficiency in visualization, transparency, work processes and service delivery has often followed Lean implementation projects.

On the basis of the assessment results, these traits are clearly sought for by the KUH research admission. In light of the evidence presented by the study, the needs of the KUH research administration seem very similar to those accomplished by many Lean implementation projects.

Based on the gathered results, we recommend Lean implementation studies into research administration setting to provide further evidence on the feasibility of a Lean research administration. However, the KUH research admission is not the only one in need of Lean Thinking to improve and develop relatively quickly in the near future. The insights presented in this paper can be applied to most research administrations in need of work process and customer-oriented service enhancement.

Competing interests

None of the authors have competing interests to declare.

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References

- [1] Shaw S, Macfarlane F, Greaves C, Carter YH. Developing research management and governance capacity in primary care organizations: transferable learning from a qualitative evaluation of UK pilot sites. *Family Practice*. 2004; 21(1): 92-98. PMID: 14760053. <http://dx.doi.org/10.1093/fampra/cmh120>
- [2] Charlton BG. The cancer of bureaucracy: How it will destroy science, medicine, education; and eventually everything else. *Medical Hypotheses*. 2010; 74: 961-965. PMID: 20071103. <http://dx.doi.org/10.1016/j.mehy.2009.11.038>
- [3] Nicholson R. Another threat to research in the United Kingdom. *BMJ*. 2004; 328: 1212-1213. PMID: 15155476. <http://dx.doi.org/10.1136/bmj.328.7450.1212>
- [4] Snooks H, Hutchings H, Seagrove A, Stewart-Brown S, Williams J, Russell I. Bureaucracy stifles medical research in Britain: a tale of three trials. *BMC Medical Research Methodology*. 2012; 12(122): 1-9.
- [5] Dunn M. Getting the justification for research ethics review right. *Journal of Medical Ethics*. 2013; 39: 527-528. PMID: 23118467. <http://dx.doi.org/10.1136/medethics-2012-100943>
- [6] Veerus P, Lexchin J, Hemminki E. Legislative regulation and ethical governance of medical research in different European Union countries. *Journal of Medical Ethics*. In press. 2013. PMID: 23665856. <http://dx.doi.org/10.1136/medethics-2012-101282>
- [7] Jamrozik K. Research ethics paperwork: what is the plot we seem to have lost? *BMJ*. 2004; 329: 286-287. PMID: 15284159. <http://dx.doi.org/10.1136/bmj.329.7460.286>
- [8] Jones AM. The other face of research governance. *BMJ*. 2004; 329: 280-281. PMID: 15284155. <http://dx.doi.org/10.1136/bmj.329.7460.280>
- [9] Al-Shahi Salman R, Brock TM, Dennis MS, Sandercock PAG, White PM, Warlow C. Research governance impediments to clinical trials: a retrospective survey. *Journal of the Royal Society of Medicine*. 2007; 100: 101-104. PMID: 17277284. <http://dx.doi.org/10.1258/jrsm.100.2.101>

- [10] Leeson VC, Tyrer P. The advance of research governance in psychiatry: one step forward, two steps back. *Epidemiology and Psychiatric Sciences*. 2013; 1: 1-8.
- [11] Treuthardt L, Nuutinen A. *The State of Scientific Research in Finland 2012*. Helsinki, Academy of Finland: 1-94.
- [12] Hammond WG. A Decline of Research at the Expense of Clinical Demands: A Realignment in Education? *Nutrition*. 1996; 12(3): 215. [http://dx.doi.org/10.1016/S0899-9007\(97\)85065-4](http://dx.doi.org/10.1016/S0899-9007(97)85065-4)
- [13] Thompson AGH, France EF. One stop or full stop? The continuing challenges for researchers despite the new streamlined NHS research governance process. *BMC Health Services Research*. 2010; 10(124): 1-8.
- [14] Mazur LM, Chen S-J. An empirical study for medication delivery improvement based on healthcare professionals' perceptions of medication delivery system. *Health Care Management Science*. 2008; 12: 56-66. <http://dx.doi.org/10.1007/s10729-008-9076-5>
- [15] Melton T. The Benefits of Lean Manufacturing: What Lean Thinking has to Offer the Process Industries. *Chemical Engineering Research and Design*. 2005; 83(6): 662-673. <http://dx.doi.org/10.1205/cherd.04351>
- [16] Dora M, Kumar M, Van Goubergen D, Molnar A, Gellynck X. Operational performance and critical success factors of lean manufacturing in European food processing SMEs. *Trends in Food Science & Technology*. 2013; 31(2): 156-164. <http://dx.doi.org/10.1016/j.tifs.2013.03.002>
- [17] Reijula J, Tommelein I. Lean hospitals: a new challenge for facility designers. *Intelligent Buildings International*. 2012; 4(2): 126-143. <http://dx.doi.org/10.1080/17508975.2012.680429>
- [18] D'Andreamatteo A, Angelé-Halgand N. Reorganizing work in hospital: an activity theoretical analysis of lean management implementation. Sub-Theme 50: Activity Theory and Organizations. EGOS - European Group for Organizational Studies, Montreal, Canada. 2013.
- [19] Malterud K. Qualitative research: standards, challenges, and guidelines. *Lancet*. 2001; 358: 483-488. [http://dx.doi.org/10.1016/S0140-6736\(01\)05627-6](http://dx.doi.org/10.1016/S0140-6736(01)05627-6)
- [20] Malterud K. The art and science of clinical knowledge: evidence beyond measures and numbers. *Lancet*. 2001; 358: 397-400. [http://dx.doi.org/10.1016/S0140-6736\(01\)05548-9](http://dx.doi.org/10.1016/S0140-6736(01)05548-9)
- [21] Elo S, Kyngäs H. The qualitative content analysis process. *Journal of Advanced Nursing*. 2007; 62: 107-115. PMID: 18352969. <http://dx.doi.org/10.1111/j.1365-2648.2007.04569.x>
- [22] Medical Research Act 488/1999. [Internet] 2013; Available from: <http://www.finlex.fi/en/laki/kaannokset/1999/en19990488>.
- [23] Womack JP, Miller D. *Going Lean in health care*. Cambridge, MA, Institute for Healthcare Improvement. 2005.
- [24] Liker JK, Meier D. *The Toyota way fieldbook: a practical guide for implementing Toyota's 4Ps*. New York, NY, McGraw-Hill Press. 2006.
- [25] Waldhausen JH, Avansino JR, Libby A, Sawin RS. Application of Lean methods improves surgical clinic experience. *Journal of Pediatric Surgery*. 2010; 45(7): 1420-1425. PMID: 20638518. <http://dx.doi.org/10.1016/j.jpedsurg.2009.10.049>
- [26] Liker JK. *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*. New York, NY, McGraw-Hill Press. 2003.
- [27] Womack JP, Jones DT. *Lean thinking*. New York, Free Press. 2003.
- [28] Yang S. Bureaucracy versus high performance: Work reorganization in the 1990s. *The Journal of Socio-Economics*. 2008; 37: 1825-1845. <http://dx.doi.org/10.1016/j.socec.2007.03.009>
- [29] Spear S, Bowen H. Decoding the DNA of the Toyota Production System. *Harvard Business Review*. 1999; 77: 97-106.
- [30] Hansen J, Schäfer W, Black N, Groenewegen P. European priorities for research on health care organizations and service delivery. *Journal of Health Services Research & Policy*. 2011; 16(2): 16-26. PMID: 21737526. <http://dx.doi.org/10.1258/jhsrp.2011.011040>
- [31] Van Teijlingen ER, Douglas F, Torrance N. Clinical governance and research ethics as barriers to UK low-risk population-based health research? *BMC Public Health*. 2008; 8(396): 1-7.
- [32] Howarth M, Kneafsey R, Haigh C. Centralization and research governance: does it work? *Journal of Advanced Nursing*. 2007; 61(4): 363-372. PMID: 18234034. <http://dx.doi.org/10.1111/j.1365-2648.2007.04524.x>
- [33] Stevens K, Ovretveit J. Improvement Research Priorities: USE Survey and Expert Consensus. *Nursing Research and Practice*. 2013; (695729):1-8. PMID: 24024029. <http://dx.doi.org/10.1155/2013/695729>
- [34] Kelleher J, McAuliffe E. Developing clinical governance in a service for people with intellectual disabilities: An action research approach. *Clinical Governance: An International Journal*. 2012; 17(4): 287-296. <http://dx.doi.org/10.1108/14777271211273170>