International Conference on Research on Health Care Architecture

Conference Proceedings

Ira Verma, Laura Nenonen (edit.)

ARCH 14

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INTRODUCTION

ARCH14 CONFERENCE - INTRODUCTION

The amount and quality of research on Healthcare Architecture has grown rapidly in recent years because of the current needs of the society. There is a lot of interest on new healthcare architecture in Nordic countries at the moment. Healthcare reform processes are going on in many countries and demographic changes are happening all over the world. The care is given more and more at homes instead of hospitals. The commissions, therefore, are both to make existing international research knowledge available and to carry out research projects focusing more specifically on the healthcare and elderly care situation in a variety of contexts.

Sotera Institute is the Research Institute for Health Care Facilities operating within the Department of Architecture at Aalto University. The institute was founded in 1983. The area of research is in the field of buildings in the social and health sector, especially architectural design and usability. The recent researches have been about environments of the elderly and new hospital concepts. Also the service architecture has been in the focus. The Institute carries out basic and applied research, publication of topical literature and various expert assignments. The research is also combined with teaching. The advanced design studios for master level architecture students are organized on topics of health care buildings and environments of the elderly.

The mission of Aalto University includes the promotion the welfare of people. Aalto University has founded the Health Factory, which is an organization supporting the establishment of new companies in the field of Health Care. The Health Factory bridges the gap between research and innovations and it works as a network for the research done in this field in our university in different departments and disciplines. Meantime, big changes are happening in the society in Finland in the re-organizing the social and health care sector. The amount of ageing people is growing and the economy of public sector needs savings.

The ARCH14 conference was realized in collaboration with the Nordic Research Network for Healthcare Architecture and was held at Aalto Design Factory. The conference was a joint event between Aalto University, Finnish Institute of Occupational Health (FIOH) and National Institute of Health and Welfare (THL International). The ARCH14 was the third Nordic Research conference on Healthcare Architectrure. The ARCH10 and ARCH12 were held at Chalmers University in Gothenburg, so this was first time the conference was in Finland.

The researchers and practitioners from across disciplines and countries discussed the following themes: healing design, hospital design, usability, elderly care and tools for health care planning and care. This booklet includes the proceedings of the presentations. I hope the articles encourage to further research in the field of care.

Pirjo Sanaksenaho
Associate Professor, Aalto University
Director of SOTERA Institute

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Laura Nenonen, Architect, Aalto University

HEALING DESIGN

EVIDENCE-BASED CONCEPT PROGRAMS FOR HEALTHCARE ARCHITECTURE

Peter Fröst

Adj. Professor
Chalmers University of Technology
peter.frost@chalmers.se

ABSTRACT

This paper describes how new models and tools for planning healthcare buildings is recently developed in Sweden. Their purpose is to facilitate implementation of both evidence and best practice in a collaborative and dynamic planning process. Multi-professional collaboration is a significant part of the planning process in Sweden today. Up to the 1980:s, healthcare planning was centrally managed by a system of norms and standards. Following a general decentralization of the healthcare system in the 1990:s, the overall responsibility for knowledge development and planning of healthcare buildings was transferred to the individual County Councils. A local and dynamic model replaced the normative planning model. Such a model is supportive for innovation in a constantly changing healthcare. A weakness, however, is that individual projects risks be too focused on currently experienced needs and do not use available research and best practice. The dynamic model needs to integrate collaborative planning and local dialogue with systematically processed best practice and evidence-based knowledge. Therefore, an "integrated" planning model is sought for. "Evidence-based Concept Programs" for Healthcare Architecture (EBCP) is a set of planning tools that has been developed by the Centre for Healthcare Architecture at Chalmers in collaboration with PTS-Forum - a national network consisting of 15 (out of 21) Swedish County Councils. EBCP has been developed in cross-disciplinary collaboration between different stakeholders - healthcare professionals, planners, project managers, architects and researchers from different disciplines. EBCP consists of visualized design concepts and explanatory text based on research and best practice. EBCP should be seen as a tool for supporting discussions rather than as solutions to copy. The purpose is to form a basis for the planning dialogue in the collaboration process in each particular project.

Keywords

Healthcare design, Planning tool, Evidence-based knowledge, Collaborative design.

1   INTRODUCTION

1.1   Sweden - from centralized to decentralized facility planning

In Healthcare Architecture, a movement from centralized to decentralized planning has occurred in many western European countries during the last decades of the 20:th century. This is also the case in Sweden, where the management of knowledge on how to design hospitals has followed the changes in healthcare policy from the 1970s and onwards. Today, responsibility for financing and running hospitals is decentralized to the County Councils (landsting). According to the Swedish health and medical care policy, every County Council must provide residents with good-quality health services and medical care and work toward promoting good health in the entire population. A County Council is a political body whose representatives are elected by the public every four years. It governs its own taxes and finances and therefore has a high degree of independence.

The decentralization also reduced the need for central support and control. During the 1960s - and 1970s, and well into the 1980s, tools such as generic programs and guidelines regulated and gave instructions for planning and construction of hospitals. These were produced and provided by the state organisation SPRI (Healthcare Planning and Rationalization Institute). 60s and 70s planning model grew out of this period's linear and technical rational approach. It was designed to address fairly well known and solid targets in the expansion of healthcare as part of the modern Nordic welfare state. These included formal and structured methods to identify the needs and requirements. It also provided a repertoire of tools such as standard rooms for different functions. Belief in rationality and the efficiency of technological development was dominant in the hospital architecture. The hospitals built at that time accordingly had a high degree of structural similarity.

This type of tools disappeared in the late 1980s. One reason was that generic norms and guidelines was regarded as a preservation of old practices and also inflating for standard and hence cost. A general movement in the Swedish society toward deregulation and decentralization of planning activities and decisions were another cause. SPRI, who had been responsible for the coordination of knowledge and guidelines, was therefore abolished in the early 1990s. With SPRI's decommissioning, overall responsibility for knowledge development and planning of healthcare buildings was transferred from the state to the individual County Councils. Now, that they no longer had the general guidelines to lean on, instead local operational knowledge and staff involvement became key factors in the design work. They developed their own planning processes and tools. Hospital buildings of this time are characterized by varying design and individual solutions. As long as what was left of the overall national building regulations was followed, County Councils were free to make a wide range of decisions to meet locally identified needs and prerequisites. In the County Councils, user participation with healthcare professionals started to play a new important role. This made local solutions different from each other and created difficulties in the exchange of knowledge on a national level.

Decentralization was hence followed by a shortage in systematic management of knowledge. As a reaction to this, the Swedish Healthcare Facilities Network (Forum vårdbyggnad) was formed 1993. This non-profit association was founded with the goal to maintain competence and knowledge within the field. It soon had all the Swedish County Councils and healthcare designing architectural firms as members. This informal network became increasingly an important node in the flow of knowledge from both practice and research within Healthcare Architecture in Sweden. In parallel, the County Councils themselves also identified a need for common systems to ensure the technical quality of the hospital buildings. Some of them merged to create common platforms for knowledge networks. The biggest knowledge network is the PTS-Forum. PTS, Program for Technical Standard, was initially a part of the SPRI system and has today established itself as a national actor.

1.2   Normative – dynamic planning model

Sweden has thus gone from what you can call a normative to a dynamic planning model with dialogue and interaction in the centre of the process, se Figure 1. This journey can be illustrated by a comparison between Sweden and the UK (Lindahl et al 2010). Their respective systems take different positions in the span between the normative/generic/centralized and dynamic/specific/decentralized design process. Somewhat simplified, one could say that the normative model is characterized by a centralized system where a collective body of experience and knowledge are centrally converted into generic standards and guidelines, which are then applied in the concrete construction projects. Development and innovation in this system is expected to take place in the central expert organization that has an overview and can make informed evaluations. Sweden today is characterized by the opposite, with a decentralized structure and minimal central knowledge management. Here specific knowledge is produced in the individual building projects.

The advantages of the dynamic model are several. It ensures that the healthcare organizations' updated knowledge with its specific needs and wishes are integrated in the process. Decisions are locally anchored and supported throughout the process. It is also well suited to support innovation and organisational development, and thereby to meet the needs of a healthcare with an extremely high rate of change. But there are also several risks. Individual projects might not have access to current knowledge and best practice and "the wheel is invented over and over again." Individual projects can be too focused on currently experienced needs (Eriksson, 2014) and do not use available research and best practice. It can also be time and resource consuming (Hansen, GK, Jenso, M, 2009)

1.3   Search for an integrated model

Many have argued for that Healthcare should be viewed as a complex dynamic system (Ingvar, M, 2014). Complex systems, like Healthcare, are filled with hundreds of moving parts, scores of players of varied expertise and independence. It does not have a "mission control" that runs all these different parts within an ever-changing political, economic, and societal environment. (Zimmerman, B, 2005). A linear and technically rational design method is not always sufficient for handling both complexity and simultaneous change of

requirements. Today, with high rate of change and complex design challenges, the healthcare design process needs to be interactive and collaborative to address complexity and constantly changing programmatic requirements. Collaboration and dynamic planning processes is well suited to handle complex problems.

Many organisations and facility providers in healthcare all around Sweden are striving with developing new processes that can handles today´s challenges. Here the collaboration between planners and healthcare staff is central. But many also have identified the need for generic and coordinated knowledge from best practice as well as evidence-based knowledge from research. Following development from a normative to a dynamic planning model, today there is a strong movement towards what you might call an "Integrated" planning model, see Figure 1. The aim with this is to take the best elements from the two previous approaches.

Figure 1 Normative – Dynamic – Integrated planning model

The overall research questions are - how can an "Integrated" planning model, which builds on collaborative design dialogue around systematically processed knowledge from practice and research, be arranged? What tools does it need?

The discussion that follows below is based on three cases. In each of these cases "Evidence-based Concept Programs for Healthcare Architecture" has been developed. These concept programs have then been used also in other planning and design projects in Sweden (PTS 2014). Based on experiences from participants in these cases and systematic reflection a few standpoints are formulated. They are also taken as starting point for a discussion pointing to conclusion from work done so far as well as proposals for further research.

2 STATE OF THE ART

2.1 Design process for healthcare architecture

Healthcare is among the most complex architectural commissions there are. Many and often conflicting parameters have to be prioritized with many stakeholders involved. You are requested to create the highest architectural quality where you coordinate a good patient and healing environment, efficient and good working conditions and at the same time handle environmental sustainability and long-term facility interests. Furthermore, in hospital design both the scale and the briefs are large. To design and build healthcare buildings therefore takes a long time. It is not unusual that there are five and even ten years from the initial stages until the first patient can be received. Besides being functionally and logistically complex, hospitals also have special types of infrastructure as advanced ventilation, medical gases, heating and cooling equipment, etc. This affects also the design of the premises. Technical aspects must always be investigated in the planning process, both in small and large projects.

The design process is carried out in several phases. From the initial analysis of needs to evaluation of the completed building. Initial analysis and preliminary design in a conceptual stage is often called the "early stages". This stage clarifies needs and define objectives - why you need new facilities, what the problem is and what you expect to achieve. During the preliminary design you display the various options, evaluate them and choose a main option. Here usually an architect are engaged, sketching various suggestions for solutions. In the building program and detailed design phases, you decide gradually in detail how the healthcare environment should be designed. It involves making accurate descriptions and drawings of the building and of the different rooms with their materials, color scheme, installations, equipment and furnishings.

In the different phases, many actors are involved. The main group, beside the healthcare organization itself and its staff is the County Council's Real Estate department. They work together with various consultants, architects, contractors and other suppliers. A steering group is typically managing the work and decides on the goals and requirements for the project. The project manager together with a project team is responsible for lead, plan and implementing the project and delegate various tasks. During the planning process, a wide range of user groups with staff representatives and different experts are established to develop solutions for different functions and units. These groups are characterized by multi-professional collaboration. Their identified needs must, however, be considered together with Real Estate-related requirements for long-term sustainability that includes technical, legal and logistical demands as well as cost efficiency, adaptability and more. The user group process needs a frame of clear management and structure as well as the support of generic and evidence based knowledge.

Furthermore, designers need to access the healthcare professional knowledge, not only as goals and future needs but also in the form of detailed demands for functions, connection and room sizes that can be translated into descriptions and factual information. But it's not always easy to go straight from the experienced needs to a requirements specification. It is difficult to translate healthcare knowledge to spatial needs that can be used in the design and construction process. Knowledge about how we use and need different rooms is largely embedded in action

when using the room. It is often not-articulated knowledge that doesn't immediately allow itselves to be formulated in terms of specified requirements. However, one can often tell when something is wrong and does not work so well. It is therefore also difficult to see how a different spatial solution could influence the daily work. It is even harder to articulate the need for a particular spatial structure or plan based on overall professional objectives. The individual employees can f.ex. request a private room for their specific task, but how this solution fits with the healthcare organisations superior spatial model may be difficult to grasp. You therefore also need knowledge that comes from outside the local experience. It involves the collection of other good examples – best practice - and evidence-based knowledge from research. The challenge therefore is to find models for collaborative planning of healthcare architecture that balance special and local demands from staff/patient influence with generic knowledge and evidence.

2.2   Collaborative design

User groups in healthcare design often consist of several stakeholders and professions. Doctors, nurses and other healthcare professionals are the key carriers of knowledge about future healthcare needs. The user groups are both cross disciplinary and multi-professional. Sweden has a long tradition of involving users and staff in decision-making and planning processes. One important reason is the political endeavour for the democratization of the workplace as expressed in the co-determination act (MBL) in 1976 and the Work Environment Act (AML) in 1978 (Granath et al 1996). Focus has since the 1970s shifted from the question of democracy to a matter of quality with the common aspiration that through dialogue and involvement create better workplaces. In healthcare planning in Sweden today, the question is not if the users/staff shall be involved in the design work, but how. Additionally, how to include patients' views also needs to be further developed.

In order to articulate their requirements of future premises, healthcare staff needs to look at what it actually does and how flows and processes work. Simultaneously, healthcare operations are involved in constant change due to internal and external driving forces. Many changes in healthcare operations are taking place in conjunction with the design of new facilities Accordingly, knowledge of how these changing conditions might affect in what way healthcare will be organised and delivered in the future also needs to be described simultaneously. This leads directly into trying to see how things could be done differently and better; you need to raise your gaze and formulate goals for the future. In this way, the process when designing healthcare architecture also works as a key organisational development process. The creation of new or modified facilities creates an opportunity to thoroughly review work methods and processes. This is especially true in the early stages when goals are formulated, needs identified and the first solutions developed. If this can be coordinated in a conscious and knowledge-based way the design process will be an important driver for improving healthcare practices.

2.3   Design methodology and dialogue

The design process is characterized by complexity, uncertainty, instability and value conflicts. Requirements and needs are therefore usually not initially fixed. They are formulated and reviewed in parallel as different options and ideas are worked out. From this you continuously achieve new insights about how things could be. This distinguishes the design process from problem solving in the traditional manner. In complex design tasks it is generally impossible to handle, identify and address all elements of the current problem before the design work begins. Therefore, an important point in a design driven approach to planning is that it allows you to immediately develop and visualize ideas and suggestions – making models - before you have a clear understanding of all included apparent and underlying conditions. Working with visualized proposed solutions is a way to explore and frame the problem in a complex situation. In this way one reduces the complexity but are constantly working on the whole. (Fröst, 2003, 2004. Schön, D, 1992) The models developed in this process help the participants to see future opportunities but also what is missing and what does not work. This approach is different to the established project process in the construction industry, but is closer to how he design work really happens. A design driven approach requires an interactive process between parts and the whole in order to manage projects with unclear and vague objectives that involve many different actors and issues. The elements must also intersperse because in parallel you are forced to clarify that the ideas developed really can be done.

A design process that is tailored for healthcare's dynamic reality builds on the notion that awareness of what is possible to achieve emerge gradually in the meeting with conceptual models of the planned building. Requirements and needs are identified and formulated while spatial solutions are worked out. It is typically structured around workshops where you simultaneously discuss the way of work, formulating goals, identifying the needs of the functions and relationships, and develop solutions. To facilitate this, it is very effective to work with concrete visual methods - for example images, cardboard pieces or Lego; it's a great way to promote dialogue. It is also a good way to allow the needs, requirements and solutions to be worked out in parallel. Such an approach, which expands the traditional planning with various tools and activities, is supportive for jointly formulate goals, identify spatial needs, and develop and evaluate ideas. In this way, the design process provide an opportunity for staff to learn more about their own work by being themselves active in the design. (Fröst, 2004)

3   APPROACH

3.1   PTS

PTS (Program for Technical Standard) can be described as network driven management system for achieving the right quality in design, construction and management. Today 15 out of 21 Swedish County Councils are members/part-owners (equals 85% of Sweden's population). This makes PTS the leading network for coordinating knowledge and support for planning healthcare facilities in Sweden. PTS consists of an IT-based management system for controlling and supporting the building process. This system aims is to "*strengthen the client's role through active assumption of responsibility, for acting correctly from start, involving clear instructions, guidelines that set value related goals and good solutions that can be reused*". (PTS webpage) Key features until now of the system are the "standard rooms". The standard rooms are used to make general solutions in f.ex. hospital wards and clinics. The guidelines set the overall value and demand of standards but the particular requirements are specified in the technical and functional chapters. In the technical part there are complementary and clarifying requirements related to building regulations and where applicable legislation from Sweden's law for health- and medical care. They contain all demands of a hospital room such as interior equipment and functional-requirements together with visualizations of the rooms.

Each part-owner has one representative person in the board of PTS-Forum. The board make the decision of the framework for how and when the system should be updated. In this way, PTS will be regularly updated after collecting information from the client, contractor, tenants and experience from individual building projects. Also, when healthcare develop f.ex. their workflow or implement a new treatment method, PTS will be updated with new demands and information.

3.2   Evidence-Based Concepts Programs (EBCP)

To meet the need for support of integrated knowledge from both practice and research (evidence) PTS has initiated the development of a new set of tools, namely Evidence-Based Concepts Programs (EBCP). The aim with EBCP is to develop guidelines on how healthcare environments on a structural level – wards, units, departments etc - can be designed. There is currently no coherent documentation in Sweden showing how these could be designed. The EBCP strive to coordinate identified fundamental demands and needs in order to achieve the best overall healthcare environment possible. The result shows illustrated examples of proposed design solutions for different healthcare environments.

The starting point for the work with EBCP has been that well planned healthcare architecture is an essential part of healthcare and its processes. Good healthcare architecture can support patients, families and staff in several ways. With functional and practical premises the business becomes more efficient and can help to improve patient safety. Architecture can also facilitate meetings, conversations, and good nursing as well as offer room that allows privacy, integrity and family presence. Not to mention deliver a beautiful environment that provides positive distraction and creates a relaxing atmosphere.

Three EBCP has been developed, for somatic wards, OP departments and ICU (intensive care) (Fröst et al 2012, Fröst et al 2013). They have been conducted by PTS in collaboration

with the Center for Healthcare Architecture at Chalmers (CVA). CVA has been responsible for developing the individual projects in collaboration with an executive project-group of PTS members. Extensive workshops and research seminars are performed as part of concept development. Participants are representatives from the County Councils, healthcare professionals, facility planners, project managers, architects and researchers from different disciplines such as medicine, medical technology, healthcare, architecture and building technology.

As been described, collaborative dialogue is important in the design process for healthcare in Sweden. But we also need knowledge and facts. EBCP consists of explanatory text and visualized design concepts based on knowledge from research and best practice. It is intended to be a transparent material where proposed layouts, spatial organization and rooms are motivated. They should be seen as illustrative examples for dialogue rather than solutions to copy outright. In this way, one can apply evidence and new research into practice. By clearly showing what knowledge - best examples and/or research-based - EBCP are supposed to facilitate a dialogue/collaboration around research-based examples of solutions. The aim is that thereby they should be inspiring rather than normative. The purpose is to form a basis for the planning dialogue in the collaboration process in each particular project.

The set of tools are presented on the PTS website (in Swedish) in three ways: as a research report with a coherent structure available for download/out-print, as a condensed illustrated "handbook" and as a partly interactive website. The material is supplemented with many illustrations. The illustrative section shows and describes: proposals for individual rooms; suggestions for functional units and a support unit; research results regarding the patient's room, application and consequences; opportunities for the organization and couplings of functional units; teamwork possibilities in a variant of functional units.

4   RESULTS

As a part of the Eracobuild project "Value Driven Procurement in Building and Real Estate" (ValPro 2012) the Swedish PTS system was studied and evaluated. The result of the studies is that PTS has many valuable advantages. It makes the process more efficient and enables capturing of requirements, facilitates information transfer and a united vision of the project. PTS also enables the exchange of knowledge due to the fact that a number of County Councils in Sweden use and develop PTS in collaboration (Bruun et al, 2012).

Initial assessments of how EBCP has been evaluated and used among the County Councils have also been completed. A workshop with property managers from 15 County Council healthcare real estate organisations was performed in Linköping, Sweden in May 2013. One of the purposes was to evaluate EBCP on an overall management and quality level. Another purpose was to monitor new areas where additional EBCP is needed. The result from this workshop have been compiled and evaluated by a research team at Chalmers. The result shows that 1. The EBCP are highly prioritized on the management level in the County Council real estate organisations. 2. The need for more EBCP is high and urgent and a number of new ideas was collected and ranked.

With the purpose to understand how the EBCP was used "on the floor" in projects, an interview survey was made after the first EBCP (somatic hospital wards) had been in use for two years. (Berezecka et al, 2013). From this survey we can conclude that EBCP has beneficial effects for planners and healthcare staff and is used as it was intended. It was found that the tool facilitates collaboration and knowledge support during the initial process to define a project. It is also used in discussions with consultants and architects. Internally, the tool is used when trying to identify the requirements for healthcare buildings. From the survey we also found that the EBCP moreover is used as reference when investment decisions are made by the County Councils and as a support in discussions and negotiations at the municipal level. Architects use the material when designing hospital wards and as a basis for discussions with healthcare staff in the early stage of the project. There is also great interest in EBCP from healthcare itself. It is often used for supporting discussions with relevant illustrations and examples as a reference and starting point.

5   DISCUSSION

In literature, the focus in evidence-based design has until recently much been on the importance of implementation and the strength of the evidence. Not so much on how research based knowledge can be implemented into the design process (Ulrich, R et al 2010). Research findings have been translated into architectural recommendations and guidelines to improve the environment and subsequently be applied in future constructions and rebuilding. There are also inspiring proposals of systematic approaches built on a traditional sequential notion of the design process (Hamilton, DK and Watkins, DH, 2009). The awareness that a participatory design process helps ensure the designer is well informed and that professional knowledge from healthcare in that way can be integrated into the planning process is growing (Burton, A 2014).

Traditionally, we would like to see that healthcare first describe their needs and then architects design buildings that support this. But from experience, it is much more complex and many significant improvements in healthcare practices occur simultaneously with the planning and design of new or altered buildings. When planning of new buildings begins, healthcare is required to formulate their long-term goals. Then you need to consider care environment, organization, technology, healthcare process, modes of treatment, patient perspective, work environment etc. as a whole. In healthcare operations planning processes, there is knowledge of the conditions and needs. The meeting of different perspectives - medical, organizational and architecture - creates new images of the conditions that exist. Innovations and new opportunities must be captured in this design process. The arena that is created around the design process includes several different areas and involves a meeting between various disciplines and is also an important platform for the creation of new knowledge and innovation. This arena, where an integration between healthcare operations planning and facility planning is supposed to happen, new models of planning as well as supporting tools are needed. The EBCP is an example of this.

6   CONCLUSION

After decades with low activity, Sweden now faces major investments in healthcare facilities in the coming years. Therefore, it is important that decisions concerning the design of hospitals are supported by the best current research and knowledge based on good examples. The healthcare system is currently undergoing rapid and dramatic changes in Sweden. Design and operation of hospital wards, operation environments (OP) and intensive care units (ICU) are the focus of many of these processes. For example - there has been a rather abrupt shift in the design of hospital wards. Today, almost 100% of new wards are planned and built with single-patient rooms combined with decentralized nursing-stations. Operation rooms today are around 60 sqm each, have access to daylight and new types of support facilities mirroring the changes in surgery. ICU design is moving rapidly towards single-room solutions. Due to research results, it is becoming clearer that there also is a growing awareness of environmental impact on healthcare performance.

The collaboration between PTS-Forum and Centre for Healthcare Architecture at Chalmers was initiated with three main purposes. First – to create a national knowledge base of best practice and good examples. Second – to ensure implementation of evidence - based knowledge. Third – to support the development and availability of research. The effort is unique because it includes a vast majority Swedish County Councils. It is based on the identified needs of healthcare and County Council`s real estate organizations to coordinate their know-hows and take part in research-based knowledge and translate it into operative alternatives in their many current investment projects.

The proposed integrated model – structured participatory dialogue supported by a set of tools as illustrated evidence-based concept programs – constitutes a design-driven dynamic planning process. Here, the healthcare organisation and real estate can formulate their needs and possible solutions coordinated. The model emphasizes the collaborative design process as the driving force. This "integrated model" needs to be further described, structured and developed, so we can work with various kinds of knowledge in a deliberate manner. County Councils need a common, systematically built knowledge platform as a basis for their individual investment projects. Knowledge that needs to be developed in the future is partly methodological issues such as improving knowledge, organisational issues and planning methodology. It is also evidence-based knowledge on the importance of the environment that we collect from nursing research, environmental psychology, architecture and landscaping. In order to develop an integrated model there is also a need for strong leadership and clear decision-making processes that supports a structured dialogue around healthcare activities and its premises. It must be firmly grounded on coordinated knowledge of best practice and evidence-based on solid research. It is also crucial to involve patients in the process.

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PATIENTS MAKING PLACE. A PHOTOGRAPHY-BASED INTERVENTION ABOUT APPROPRIATION OF HOSPITAL SPACES.

Erling Björgvinsson
Malmö University
erling.bjorgvinsson@mah.se

Gunnar Sandin
Lund University
gunnar.sandin@arkitektur.lth.se

ABSTRACT

Hospitalised patients are faced with a brute reorientation of their normal spatial needs and preferences and forced to adjust spatially to a new environment. Patients start to re-arrange their own situation according to personal needs and the site-specific circumstances. It is a re-arrangement that includes furniture, private objects and spatial positioning, but also the adjustment to the presence and needs of the staff and other patients. What types of spatial and aesthetical preferences and actions emerge in this alignment with the hospital culture and how can preferences and everyday spatial production by patients be investigated? Here, a methodological approach is suggested where patients look upon their stay at the hospital by discussing photos that they have produced themselves while hospitalised and answers to a set of questions they have written on image cards produced by the researchers in order to stimulate discussion. The investigation was carried out in 2012 at Helsingborg Hospital in Sweden. It shows that patients are primarily concerned with spatial ordering within the hospital environment and less with decorative aesthetic aspects. The study also shows that the understanding of patients' daily occupation with shared spaces, negotiable spaces and delegated spaces would gain from further investigation of spatial appropriation and its relation to the existential necessity of spatial vagueness. In relation to this, we suggest that architectural consultation and environmental research could take into account a more varied range of views of space within the hospital environment, apart from already established categories or functions. It could be done, we suggest, practically as well as theoretically, by acknowledging certain qualities of vagueness in the continual everyday production of hospital space. By allowing meetings and negotiation between otherwise separate, contradictory or completely unheard opinions, this may in the end have a positive effect on future architectural outcomes.

INTRODUCTION AND THEORETICAL BACKGROUND

1.1   Previous research on patients' experience of hospital environments.

Research with a patient perspective on hospital environments has previously addressed issues such as: medical safety; privacy; social interaction with family and friends as well as with the staff; security; the value of good lighting; having a view of nearby nature; calming colours; and the impact of installed art. The studies are mainly from the domain of environmental psychology and aim to prove how the hospital environment is improved due to changing environmental parameters.

The discussion has in recent years to a large extent focused on the pros and cons of single versus shared patient rooms. Ulrich (2006) has pointed out that single rooms lowers the risk for spreading infections, are quieter, and allow for more social support from family and friends and more flexible visiting hours. The evidence for increased risk for spreading of infections is also discussed, but is in shared rooms estimated as not as great a risk as in intensive care units, according to Ulrich (2000)). Schweitzer, Gilpin and Frampton (2004) also state that a single room policy lower the risk for spreading infections, as well as bring medical benefits such as fewer medicinal mistakes, and a higher rate of patients that are pleased with the ward. Single rooms, furthermore, bring some social benefits as they allow a more private, and comfortable environment for patients, relatives and close-others. Single rooms also improve the quality of the communication between patients and the staff and decrease the moving of patients due to conflicts with fellow patients. Chaudhury, Mahmood, and Valente (2005), based on staff interviews, state that single rooms are to be preferred as they allow for greater patient integrity and professional secrecy and that the patient receive greater ward attention. Edvardsson, Sandman and Rasmussen (2005), however, point out that elderly patients often prefer shared rooms, as they otherwise feel lonesome.

Ulrich (2000, 2001, 2006) as well as Schweitzer, Gilpin and Frampton (2004) discuss, in relation to intensive care patients, the healing power of sunlight and a room with a view of nature. Similarly, Walch et al (2005) has shown that patients at a post-operative ward placed in rooms with less sunlight were given more sedatives while those on the bright side were less stressed and had lower pain. For intensive care ward patients to have a view of nature, according to Ulrich (2001), leads to better recovery and shorter care, apart from also resulting in less complications, pain and medication. Schweitzer, Gilpin and Frampton (2004) furthermore discuss how colours can either encourage active and passive behaviour. They also state that fragrances can lower the breathing frequency and step up patients' pain tolerance. Torre (2006), likewise, states that colours can have a powerful impact, where blue and green colours are relaxing while orange and yellow promote action. The thematic content of art in hospitals has also been discussed. Most patients, according to Ulrich (2000), prefer art that depicts tranquil scenes of nature. Schweitzer, Gilpin and Frampton (2004) along similar lines argue that nature motives in art leads to increased sense of security and less sedatives, while abstract art leads to slower recovery. Emotional and negative expressions in art, likewise, generates more stress. This view about art's restoring capacity has to some extent been confirmed, however also diversified in other reports with more specified attention towards the types and quality of art, as well as towards the type of background of the patient (experiencer) (Nanda et al 2008).

1.2   Theories on spontaneous production of space and place.

As the above summary shows, privatization has been an important issue. It has, however not connected very much to socially oriented spatial theory on appropriation and privatization. This theory, contrary to earlier health-oriented theory about the providing of space, emphasizes the spontaneous and relational productions of space where people actively rearrange dominant functions. To acquire a sense of belonging, and resist what in the philosophy of social space has been called spatial domination (Lefebvre 1991), i.e. the imposition of foreign ordering principles upon lived space, we, as human beings, have different ways of managing our own socio-spatial circumstances (Ranciere 2010), or create our own "modalities" of place (Sandin 2003). Such emancipatory spatial production can be described as techniques of appropriating space. Korosek-Serfaty, an early proponent for environmental studies with sociological as well as psychological implications, introduced (1973) in an interpretation and application of Lefebvre's philosophy of spatial production, a tangible view of space appropriation. She formulated a range of subjective and spontaneous modes of spatial production. Her analysis for example describes the spontaneous, appropriative and emancipatory acts that are performed when someone starts to inhabit a new apartment or adjust to a renewal of a public square. Such appropriative production of space occurs, according to Korosek-Serfaty, in acts of creating territorial delimitation, in inviting other people in using forbidden zones, in personalization through the displaying of objects, as wells as through partial destruction of material elements. Korosek-Serfaty thus (1973) pointed to the importance of making a place into your own for the sense of belonging, but also for the sense of overturning the spatial order you enter.

Within health care architecture, mobility and movement has become an issue in relation to the daily routines of medical and care staff, however it has only scantly been addressed from a patient perspective despite the fact that hospitals are full of movement of all categories, and that fairly often recurring material reconfigurations result in considerable amount of spatial movement of patients. The notion of mobility within the discourses on place, as Cresswell (2006) points out, has been dominated by two metanarratives, sedentarism and nomadism, both of which are unaware of the ideological consequences of the meanings they ascribe to mobility (Creswell 2006, p.55). According to the nomadists "everything is in motion" (p.55) and any place is thus constantly changing and becoming. Both perspectives, Cresswell argues, have their ideological blind spots. Nomadism is blind to the fact that "mobility is differentiated socially" (p.55). For people living in forced exile, mobility is not necessarily a positive force. Sedentarism is likewise ideologically blind as it does not address the problematic sides of rooted places, for example how the stability of a place can result in resistance to cultural exchange and for that matter to change as a positive force.

The emancipatory drive, the politico-aesthetic desire, and the manoeuvring of mobility are dimensions of making one's space more satisfactory. Emancipatory appropriations, desirable aesthetics, and agreeable mobility are components of space that are not easily provided for by pre-given functions, as these dimensions are defined relationally. Despite efforts of providing rooms with clear functions spaces within hospitals contain considerable vagueness. Vagueness can be seen as the condition in which people try to bring some kind of order to a given

circumstance. But it can also be seen as the condition where there is enough room for making personal or unplanned manoeuvres. Generally speaking, vagueness is seen as a problem where space or information causes inexact use of terms or directives. Miller reflects (2006) on the problematic side of vagueness as a disorientation, but he also points to the anti-essentialism, heterogeneity and temporality of spatial vagueness, in accordance with Massey (2005) and Deleuze and Guattari (1986), where vagueness is more of a "generative possibility" to handle with care, rather than a problem to be solved. Vagueness, in this sense, allows for inter-subjective negotiation where the subjective standpoints and identities are simultaneously transformed.

The notion of vagueness has scantly been addressed within hospital architecture. Studies done within the field of environmental psychology have, as previously discussed, pointed out how being fooled by the physical space can lead to interpreting it as unsafe, which is a form, or a stage, of vagueness. Douglas and Douglas (2004) for example describe how patients interpreted the reflection from shining floors as wet floors, which made them uneasy when leaving the bed when going to the bathroom. In our study it has been an objective to understand if spatial vagueness plays a role when patients express their hospital environment preferences.

Now, for patients in hospitals, it is hardly a surprising fact that they put considerable effort into constructing private zones, and at times find it difficult to do so. In order to investigate the existence of patient's attempts of appropriation of social spaces, at the same time as testing ways to elaborate patients' presence in architectural proposal-making, we saw it sufficient to use a method with observational as well as design-oriented components. Furthermore, our choice of method was made in recognition of the fact that all types of research design do have an influence on the participant's response, and that this influence can be accepted and taken into account, rather than brushed over or believed to be possible to avoid.

2   APPROACH

Much research on patient perspectives on health care environments is done in controlled experimental settings, whereas observation directly in the environment is more rare. Few observations allow patient's preferences to appear: 1) as situated in space instead of in relation to controlled image-based presentations, 2) as ad hoc instead of in temporally controlled sequences, or 3) as categorically undetermined as opposed to theoretically pre-categorized. In this paper we propose an investigatory procedure that allows a high degree of situated influence, relies on ad hoc observation, and uses as much as possible an a posteriori logic of categorisation. This does not of course exclude a certain measure of theoretical preconditions. The present study started by reconsidering a couple of the sources of inspiration from environmental psychology that evoked ideas about appropriation of space common in philosophical place theory and urban studies.

The method of this study is a participatory design (Björgvinsson 2007) approach in combination with a visually stimulated ethnographic study. It includes interaction and conversation with three patients at a ward for kidney-related sickness, about how their recent stay at the hospital was experienced from a spatial and aesthetic point of view.

Central to participatory design processes is that all those that are affected by the design should be included and have a say in the design decisions, not least those that are typically not included. In this case, meetings were therefore arranged – mixed group discussions – that gathered viewpoints from different types of concern, competence, perspective and profession. The conversation in the meetings was recorded, and a first analysis was reported back into a follow-up meeting with those concerned.

The visual ethnographic inquiry was conducted by handing over an inquiry kit to the three patients that included six questions and a camera with instructions to take photographs. The initial plan was to involve up to six patients, but the ward found it too demanding to engage that many patients. When choosing what patients to include in the study consideration was paid to age, gender and the temporality of the stay, but also to the patient's presumed ability, (due to their state of health), to pursue the task. One woman and two men, within an age range of 45 to 56 years, participated. The duration of the chosen patients' stay were within the range of weeks, not months, but longer than a couple of days. The duration of stay was chosen as we wanted the insights from patients that had started to develop quite elaborated opinions about the environment, but on the other hand had stayed short enough not to start regarding the ward as their "home" or primary place of living.

The patients were asked to photograph the hospital spaces they were in. No patients or staff were to figure in the photographs, a restriction imposed by the hospital. The patients signed a photo agreement where they agreed on these terms as well as to our statements about how the images, their comments, and the interviews could be used; for instance whether they could be used for discussions at the ward, at research seminars, and in scientific publications. Six questions guided their requested inquiry and these were split into two categories: firstly about their experience of the hospital architecture and secondly about how this situation could be improved. Each patient was thus asked to read the questions, and then photograph places at the hospital that they would associate to the questions, within the ward or outside of it, thereafter to answer the question in writing on one of 20 possible answering-cards (also called "postcards" in the experiment) with 20 different images. The motives on the postcards had been chosen beforehand by the researchers in collegial evaluation of each image capacity to trigger positive as well as negative associations. This insertion of images into the survey had three purposes: 1) to make the inquiry, consisting of the six item questionnaire, more stimulating and engaging in the first place; 2) to compensate, by including images of human activity, for the restriction that no human interaction could be photographed by the patients themselves; 3) at the stage of meetings and conversations, to stimulate the discussion with the patients and staff about their experience of hospital spaces, and finally.

3   RESULTS FROM THE PHOTO INQUIRY

3.1   Private and semi-private room-making

On a general level the results from the three patients showed the efforts made by them in dealing with the spatial and social orders so as to produce their own spatial experience. In that sense, even though a pre-existing regime/order/program is perceived, the patients perceive and find ways of negotiating these programs, but at times they fail to do so. Their spatial experience thus comes about as a negotiation between normative programs and their own personal needs and desires. This silently negotiated production of space thus involved different modes of private and semi-private room-making.

It is well known that most patients wish to have a private room, and also that being moved around in the hospital is unwanted. Despite recent ambitions to realise those wishes architectonically, many patients still share rooms, which forces them to hunt for, or create private partitions of space for social gathering elsewhere. This spontaneous production of a temporary private social space within the shared room environment emerges due to a negation of privacy in the (bed-)rooms. However, a less acknowledged type of space-making is the fact that patients also wish to create their own rooms within other common spaces at the ward, such as in the shared lunch room kitchenette, coffee room, and the lounge room. The patients in this instance see the spatial production as a bonus rather than as a spatial arrangement or activity that they expect to be provided by the hospital.

3.1.1   Making arrangements for visits and for personal belonging

One patient (P1) pointed out how difficult it is to arrange private visits in the patient room and how he was several times forced to scout for locations where he could create a private space in shared spaces:

"One is forced to go to the coffee room for private conversations. Bringing the children to the patient rooms does not work. It is far from everyone that respects that we are more than one staying in the patient room."

First of all, his statement points at how he perceives the patient room to be first and foremost a private space. He expressed that if you share a room with other patients you should aim to uphold privacy. Each patient should, in other words, aim to uphold the borders between each other's social activity. When they blend, they are perceived as disturbing the order and the perceived purpose and social "programming" of the room. When he states that: "far from everyone respect this", he is referring to how some visitors act as if other patients are not present by speaking loudly and by being too close to the neighbour's bed and so forth. Given that the patient room is shared, (and easily disturbed), social activities are therefore thought of as best conducted elsewhere. At the same time he points out how difficult it can be to be forced to go scouting for shared rooms that he can temporarily turn into a more private room for his family and himself. This is because shared spaces – be it the lounge, the coffee room, or the kitchenette – are programmed as perfectly public, fully shared spaces. Making it into a temporary private space is thus subsumed under the main programming and can easily be disturbed or interrupted. Such spontaneous production of space can thus be experienced as

negative or shameful action, in the sense that it is a negation of the perceived or expected rights among patients. Furthermore, it is perceived to be produced only by the necessary act of breaking the established order of the spatial regime in place, which may further increases the laborious aspect of this particular private place-making.

On the other hand, P1 also states that he appreciates that he was given the opportunity to create his own space within a shared space. He expressed how he appreciated being able to store his own food in the refrigerator and in the cabinets in the shared kitchen. He said:

"The kitchen, I don't know why I chose that, it is like a really nice place in a desert. I really appreciate that I can have my own things [food], as I am a diabetic. The staff know too little about my diabetes and I prefer to take care of it myself. It is also good to have [the cabinet spot] when you don't like the food here."

Again, given that the kitchen is programmed as a shared space, he does not take for granted that he can create his own space within it. Being given the opportunity to create his own partition/dedicated space within a shared spatial order and use it for his own needs, the space is positively described by him. However, it is interesting to note that he does not perceive this form of spatial production as a right, but rather as a privilege. A privilege that furthermore produces a "nice place" as it gives him greater control over his own daily routines, his medication and what he eats. He can increase his own well-being and self-care, and thus his autonomy.

3.1.2   Media for shielding off and expanding patient rooms

Two of the patients used media to give their shared rooms a private character and shut out their immediate surroundings as well as to connect to their social world outside the hospital. P1, who photographed his own Ipad, (figure 1) stated:

"I have music, books, and I surf and mail. I appreciated that I was able to shield off a bit."

Another patient, P2, stated:

"What I am interested in reading they don't have at the hospital. When I look through the book trolley there is nothing there to read. Once I brought a photograph of my dogs."
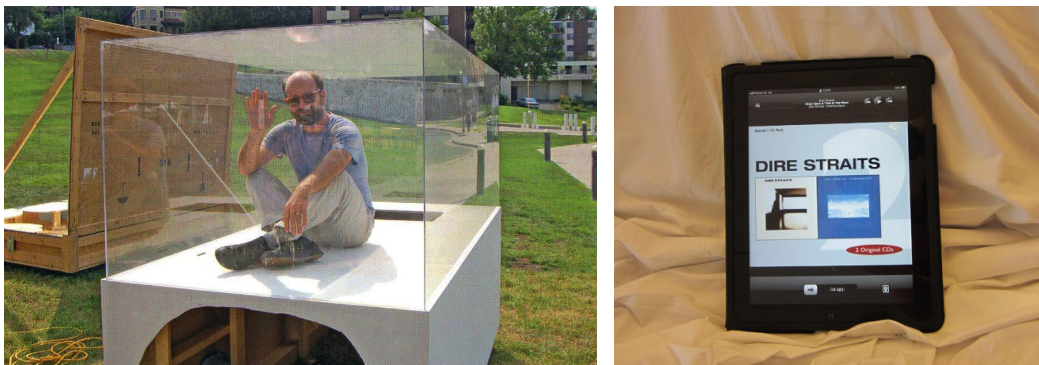

Figure 1 From left to right: Answering card and patient's photo.

In P1's case, a media device has the function of shutting out the surroundings. Film, music and earphones allow him to create a private section within the room. These devices help to shut out the surrounding sounds and in particular when it comes to books and films they create a narrow field of "vision." The headphones also signal to the staff and fellow patients that he does not want to be disturbed. The media device helps him create a transparent chamber. The section function of the media device in relation to private place- making is expanding his spatial circumstances by allowing him to be in touch with family and friends through mail. P1 was frustrated by the restrictions imposed by the hospital on digital/networked devices, as there was not any wireless network and because he was not supposed to use his device. In P2's case, privatization through media is associated with personalization, in the sense that the media she can access fits her personal taste. The shielding off aspect of media consumption is not seen as important, or not at least expressed explicitly. Her photographs from her home had a similar function as P1's use of a personal media device to expand the room by connecting to a familiar remote space, in the sense that they functioned as a reminder of a life world beyond the hospital walls. Thus media, whether analogue, passive or working by way of association, or networked and literally plugged to the life outside, had the function to normalize, de-hospitalize, the stay.

3.1.3 Oasis-making – erasing the traces of others

The need to completely shield of the presence and traces of other patients and staff, in order to create the illusion/sense of a room of one's own, was expressed by one patient. A "transparent chamber" was as such not enough. P1 stated:

"This shower room is not proper [the way I want it]. People have left behind various things; old tooth-paste tubes can be left behind. One is not at home… and one shares this room with a lot of people so one cannot demand that it stays the way one wants it. But it's the only chance to get away. One wants to go there and wishes that it is pleasant/agreeable and that it is not [merely] a storage room."

His statement points out his need to construct a place within the hospital where he temporarily can escape and forget that he is hospitalized. He realizes that this is perhaps too much to demand, but the need to create the illusion of a room that is one's own is still expressed. With the statement he also points out that creating such an oasis or imaginary space is made more difficult by other patients' remains or when the staff use the shower rooms for temporary storage. The presence of others' remains means to him that he cannot simply enter an "empty stage" that he can populate with his own things/props, but that he has to first clear the stage, before building up his own. In other words, creating a sense of a completely private space is made more difficult, if not impossible, when traces from previous activities are present.

3.2 Mobility – moving or being moved

In our investigation mobility was seen as both positive and negative. This partly depended on the degree to which the patients controlled the mobility and partly to what degree they were located within the spatial regime defined as patient space as opposed to the parts within the hospital that were regarded as fully public/civic, i.e. beyond the space shared between patients at the ward.

Negative spatial mobility, in the sense loss of spatial control, was expressed when P3 stated: "The bed at home does not move between different wards." (See figure 2). The statement was a clear and concise statement on how uncomfortable the patient found it when he was being moved from one place to another for a logistical reason, rather than because the treatments demanded it. The patient therefore finds it more pleasant, more secure to be given a particular space, as moving around decreases a gained sense of rootedness, adds to the sense that you are one amongst many within an impersonal logistical system, that the hospital is undersized and crowded, and that you have little or no say. Place-making is here seen as completely beyond personal control, or at least beyond what you can significantly influence. Similarly P1 expressed: I had to run away from my hectic room, so it [the photo inquiry] was something that kept me occupied. Even though the patient expressed that the photo inquiry in itself was a positive experience because it helped kill some time he also points out that the hectic nature of the room forced him to leave it, which is seen by him as negative, since it is not up to him to decide whether he wants to stay there or not. The loss of control, sensed by both patients, is therefore the root of their negative view of mobility.

Figure 2 From left to right: Answering card and patient's photo.

3.2.1   Visiting vs. being visited

Both patient P1 and P3 expressed that there was a considerable difference between being visited and visiting. P1 said:

"It would have been highly positive if…a small shop a bit closer would have been nice. One does not want to go down [to the shop in the main entrance foyer] in hospital clothes when you look crummy."

P2 similarly said: "I felt dirty with those bags – even though they were not visible." Both patients experienced leaving the ward – going to the hall and especially to the kiosk in the foyer at the main entrance – as uncomfortable, even shameful. Spaces readily open and accessible to the general public are thus perceived as first and foremost belonging to the public and only secondarily as belonging to the patients. The ward, and in particular the patient bedrooms, are considered as more suitable to carry the appearance of being patients. Hence, one of the patients stated that it is considerably more acceptable to have local access to "outer" activities, such as "a kiosk wagon coming into the ward", than the other way around [personally leaving the ward], since these external objects or events become part of the patients' territory where they to a larger degree are in control and can set the agenda.

3.2.2   Professional intrusions

Various forms for meeting places were considered positive in our study. This included shared patient spaces as well as patient-nurse, patient-nurses aide or patient-doctor interactions. Sharing experiences with others was considered positive, and facilities for this were appreciated. This incudes also possibilities for staff to have time for, and space supporting the exchange of a few words on a personal or a more common level. Even test-taking, which seldom is considered enjoyable or as something to look forward to, was in one case considered to be a positive break from unexciting days and hours. However, the presence and attention from the staff is not always considered positive.

In our study, the patients pointed out how the medical and care staff may intrude into their lives. One patient stated, while having the right not to be entangled with the staff's workload or the state of other patients, that he is involuntarily made to become involved, given that the alarm system pierces (the soundscape of) the whole ward. This intrusion is linked to the issue of the varying number of patients per room, and has thus recently been given more profound attention in contemporary hospital architecture.

Literature on healing architecture, environmental psychology, evidence-based design has mainly focused on how patients disturb each other's need for privacy and composure. When it discusses patient-staff relations it has pointed out, apart from the importance of limiting the spreading of infections, that single rooms allow for more attentive care.

Several statements showed, as in other investigations, that shared bedrooms are problematic in ways that not only concern direct patient-patient-relations, but that the traffic and presence of staff and visitors makes the patients feel that their bed is placed as if in a corridor. In other words, the corridor function is extended into the patients' room. This in turn has the effect that they become unnecessarily involved in the treatment of other patients. At times, the involvement becomes explicit, as for example when confused dementia patients cannot tell the difference between the staff and patients. However, the shared room concept does not, as an all-pervasive solution, necessarily have to be replaced by a single-room concept. One of the patients suggests for instance that a confinement of spatial separation between dementia patients and other patients would significantly increase the sense of privacy. And a simple logistical move is also suggested by one patient in our survey: the one who needs most care could simply be placed closest to the door, which would give the other patients an increased sense of having a space of their own.

3.3   Aesthetic decorations, homeliness and unfamiliarity

Aesthetic decoration is to some degree, as some of the patients' comments show, connected to the notion of the home and homeliness. Tuan sees the home as an ideal space that satisfies people's biological and "aesthetic-political aspiration" (Tuan 1991, 102). On the other hand, a home can also be oppressive, as Creswell (2004) notes in reference to Rose (1993) and Martin and Mohanty (1986). Creswell also points out that homelessness may mean not simply being without a home, but can be associated with "disconnection from a particular form of place" and "'displacement' – an existential lack that is perhaps even more fundamental than being without shelter (Creswell 2004, 111, 115).

3.3.1 Aesthetic decoration

Elements of space that has specifically been denoted as aesthetic, including lighting, window view, colouring and art, has received considerable attention within patients perspectives on hospital architecture. In our study these issues, however, received only a limited attention among the patients. P2 stated that the ward had "sharp annoying light and bad air." The same patient also stated:

"The colours are bright here, but more colour would be good, for example green lines. It's a bit sterile… To furnish the balcony with some bamboo would make it cosier… and birds chirping, that is home to me." (See figure 3).

To the contrary, it was also stated by P3 that: "A functional environment is good, it [the hospital] does not necessarily need to be homely." All of the statements, except the last one, are in line with previous results accounted for earlier. Certain colours, greenery, and the sound of nature are associated with pleasure, cosiness or homeliness. The patient does not explicitly state that it has a calming effect, but the attribute "cosy" is often closely associated with a calm and relaxed atmosphere. The last statement, however, implies that the hospital does not need to aim for a homely feeling, which is contrasted to a functional environment. It can be also interpreted that the patient does not want the hospital to become his second home, because it may be felt as an oppressive an uncanny sense of entrapment, as the hospital environment is strongly associated with difficult experiences.

Figure 3 From left to right: Answering card and patient's photo.

3.3.2. Unfamiliarity and unreadability

In our study the patients experienced unfamiliarity when there was a gap between the socio-spatial arrangement and the patients' comprehension of it. The arrangement did not "speak" clearly to P2, or reversely, the patient could not "read" it clearly. She was not able to decipher or read the socio-spatial order, which could create uneasy feelings and unnecessary projections/fantasies. P2 stated:

"If one is not used to hospitals one thinks – Oh, will I have to use this, this looks scary. There is no one who goes through everything. One can easily be taken by embroidered phantasies." Furthermore, she stated: "I shared a room [with somebody], she turned around the rhythm of the day and then there was a lot of spitting and such things…And then, a thing I reacted to, when one is transplanted then maybe

one should not be lying next to a person that coughs and has a lot of bacteria. One does not have great resistance. If I cough and hawk I could infect [the other patient]".

In the first statement she points out how the medical equipment hanging on walls or standing in the patient rooms or in corridors can appear scary, if the patient does not know what it is for. Secondly, she makes the argument that not knowing why things and circumstances are what they are can result in projections, interpretations that are completely wrong. Imbuing things with meaning, in this fuzzy medical environment full of equipment and activities, is a central human impulse, as the absence of meaning is often more uncomfortable than a "wrong" reading. Reading some sort of intentionality into space, things and activities are simply hard to refrain from. In the second statement she assuredly states that it is wrong to have a coughing and hawking patient close to another patient. However, there need not be a clear relationship between coughing and hawking and infection. Coughing could for example simple be induced by dry hospital air. In any case, as the patient cannot read the situation – the socio-spatial arrangement – understandably appears to be medically unsound and frightening. Spatial misreading, we suggest, is not limited to environmental issues such as floors, but also includes socio-material configurations relating to medical treatment and care. Besides being "fooled" – as when something appears to be something else – we also suggest that spatial misreading can include explicit and implicit non-understanding of the socio-material semiotics of the space, its equipment and fellow patients.

3.4   Design suggestions from the patients

The patients showed not only considerable agency in producing and interpreting the wards spatial arrangements, but they also provided several concrete suggestions for improvement. The suggestions were: a wearable alarm system, a mobile kiosk as well as a kiosk placed in a less public space, a shared kitchen, small or temporal visitor rooms, increased possibility to affect their rooms by for example choosing furniture, hide certain functions (such as medical equipment), as well as how interior decorations could make the ward more cosy. The patients are thus good at both reading and coming up with suggestions that could improve the hospital environment. It is interesting to note that most of the suggestions concern socio-spatial arrangements and to a lesser degree what can be categorized as decorative aspects of the environment. The hospital environment is to them fundamentally to a larger degree a social and relational space and to a lesser degree a place filled with aesthetic issues in the decorative sense.

4   CONCLUDING DISCUSSION

4.1   Mobility and vagueness in hospitals and in patients' place-making

This interview study, based on photographs taken by patients, confirms in many respects previous results and theories concerning private space as being important for emancipation and well-being. Our study shows that patients want privacy so as to be able to relax, uphold their integrity, socialise with family and friends, but also because they fear increased risk for infections. Results that add to the discussion on (preferred) privacy are that patients when staying in shared rooms feel uncomfortable with being reminded - (through noise or lack of communication) - about unwanted existential issues, such as the pains of growing old (with dementia). However, our study also shows that the making of private space should not only be delimited to an issue of single rooms versus shared rooms, but must concern co-owned partitions of space, including also specifically shared spaces such as showers, kitchenettes and lounge rooms. In the shower room, for instance, the traces of others may be unwelcomed while a shared space for private objects in the kitchenette is appreciated. The study also shows strategies that patients employ when not given enough privacy by the hospital, including how to shield off the surroundings through watching screens and listening to music, or through turning to personal artefacts like photos that remind them of their life outside the hospital.

The inquiry also confirms that patients do not enjoy being moved around. Previous studies have pointed out that shared rooms can lead to conflicts between patients that in turn can lead to increased mobility. In our study this concern was not explicitly stated as an issue. However, all of the patients were unhappy with sharing rooms and specifically with lying next to the door, as that placement was associated with disturbing traffic. Shared rooms may lead to forced exile, hence a needed reactive production of new temporary private space in more public areas of the ward. However, this type of place-making activity needs continual monitoring and constantly risks being overturned. Negative mobility is not only associated with shared rooms, but also with how treatments at various locations generate what the patient perceives as unnecessary movement and unsafe temporary location in exposed places such as corridors or in places where the patient can perceive that they have become forgotten. On the other side, mobility is considered positive when the patients themselves initiate it. Moving around on your own is used to counter boredom and stasis and to socialize by bumping into other people or by going to "meeting places." One patient saw drifting around as positive, while it was also emphasized by the patients a need for purposeful or directional mobility. The photo inquiry task itself provided this, and going to the shop would provide it too, if it were closer and less associated with unpleasant public exposure of their condition.

In relation to vagueness, as a spatial condition, our study shows that a refined understanding is needed in relation to the fact that spatial vagueness in a movement-of-freedom oriented place discourse has been ascribed in positive and productive terms, while in a patient-oriented preference research perspective it has mainly been considered as a negative attribute. Our study showed that the absence of understanding, or the possible "misreading" of hospital spaces, its equipment and the symptoms of adjacent patients can create an uneasy feeling of not knowing how to deal with immediate surroundings. Spatial vagueness in this sense is

thus not limited to "being fooled" by environmental material conditions such as the surface of floors, or the appearance of unknown equipment, but it also includes socio-material configurations relating to medical treatment, the amount of care, and the quality of relations to other patients.

Vagueness appears in this study as both negative and positive attribute. On the one hand, it was seen as generating negative feelings, or unease, when the relationship is unclear between the physical environment and patient, or between the equipment and patient or when the proximity to a nearby patient causes also an unwanted proximity of that patient's condition. A patient, especially a newcomer to a ward, has not learned through practice what these relationships mean. What these – to the patient unknown – things, proximities and conditions mean cannot be remedied through inscribing into objects, proximity, and conditions a clearer signification/meaning, as in functionalist semiotic attempts. Their meaning arises relationally, between practice and object and between practice and medical condition. Vagueness appeared in this study for instance precisely because a patient had not been sufficiently introduced, or cultured, into these relations. A too object-oriented view on communication, believing that a precise (socio-material) language conveys the message, does not acknowledge how meaning is relationally constructed. A more feasible way is to take seriously the need for patients to become cultured into the environment and its practice, but also avoid unnecessary exposure to parts of the practice that may provoke frightening associations or uncertainty.

On the other hand, vagueness is also, in this study, seen as a positive attribute. The patients for example productively "reprogram" some of the semi-public areas – the kitchenette, and the coffee room - into temporary private zones. This is possible since they are read to have vaguer programming allowing the patient to appropriate them for various needs. Furthermore, the term vagueness productively points at how meaning-making is relationally produced and negotiated and therefore needs to be constantly attended to.

4.2   Patients' agency in health care architecture

On a general level, in relation to the issue of room-politics of hospital wards, previous studies have focused to a large degree on what types of spaces should be provided to patients. A consequence of such views may turn out as conceiving the patients as passive spatial agents in need of private, safe and calm rooms. Our study shows instead that patients are actively engaged in producing spatial orders and experiences, and that a certain measure of spatial vagueness is needed for this. The results show that private calm rooms are wished for, but also that calmness can tip over into boredom. The study also shows that mobility, as previous studies also tend to emphasize, is mainly negative (however depending on type of stay and type of movement). Our study shows a differentiation where enforced mobility is negative, while other forms of mobility are considered positive. This, we suggest, calls for a more nuanced view, where modalities of calmness and mobility go beyond a prevailing dualism. Calmness, as said, may spill over to become boredom and stasis. Mobility needs to be "differentiated socially" (Cresswell 2006), and as we have seen here it can lead to stress, irritation, and a sense of having been forgotten while it can also be invigorating when the patients can control to a larger degree their mobility and identity.

The study clearly shows that patients are more concerned with constructing privacy, sociability, mobility and spatial readability than with decorative dimensions of the hospital environment.

Finally, the study shows that patients are actively and continuously engaged in the production of space and that space production is intersubjectively and dialogically produced. Obviously certain fundamental stable environmental or spatial dimensions need to be in place that caters to the needs of the patients. That said, an essentialist or mono-functionalist perspective risks ignoring the fact that spatial arrangements need on-going attendance as they are relationally produced. In fact, the study seems to suggest that certain difficulties that the patients experience can be solved through local and logistic rearrangements, and do not always require new buildings or new types of spaces. In relation to architectural proposal-making, as reflected in the results discussed here, as well as in the practice–oriented research method here accounted for, the professional handling of programs and design could benefit from more direct consultation, and be more attentive to the patients' spatial awareness, including their own spontaneous spatial production.

4.3 Endnotes on methodology

The validity of the study is grounded in its qualitative and ethnomethodological approach that aims to catch and understand the everyday manoeuvres and methods used by patients when negotiating and producing spatial orders. Central to the approach is to make the "constructed data" as transparent as possible and generate categories and theoretical discussion from the data, rather than forcing them into preconceived categories or social structures. The ward chosen is a type of ward frequent within Swedish hospitals. It is a specialised ward, but at the same time showing a commonly occurring spatial arrangement as well as a common need to treat mixed patient groups. Several findings in the study would of course be different if conducted at wards with single patient rooms or highly specialized wards such as intensive care units. Further, it can be debated if three patients is a sufficient number for this kind of study. Through the rich accounts given by the three patients we were able to get sight of and develop our analytical categories and the patients showed considerable concordance, yet also deviation, in their experience, which means that it is possible to get a quite rich and complex view of spatial production through few accounts. By including more patients in the study, thus gaining consistency, it is not unlikely that other discernible categories and a more nuanced and complex view of the ward would surface, but on that we can only speculate. Further studies in this domain could of course also combine a qualitative approach with the application of quantitative methods on certain parameters, some of which could be based on the findings of this study.

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STUDIO

THE AESTHETICS OF CARE ENVIRONMENTS: A Q METHODOLOGICAL STUDY OF TEN CARE ENVIRONMENTS IN JAPAN AND EUROPE

Freja Ståhlberg-Aalto

architect M.Sc., doctoral candidate
Aalto University
freja.stahlberg@aalto.fi

ABSTRACT

This article presents the preliminary findings of a qualitative Q-methodological study on the aesthetic dimensions of the care environment, especially as viewed by the users and stakeholders of ten case study buildings.

In the current evidence-based research tradition, first-hand experiences of actual users are often neglected in favour of comparing medical reports, environmental features or survey questionnaires – leaving much of the underlying reasons unaccounted for. In the domain of environmental psychology aesthetics in often reduced to the appearance of things, and assessed by random respondents reacting on photographs. This study instead approaches the aesthetics of the care environment in a holistic multi-sensory manner, asking users and stakeholders to react on their proper environment. The idea of the care environment as being healing and contributing to the well-being of patients and residents is viewed as an inseparable part of the experience of architecture – as a human interface in architecture, translated in methodological terms into operant subjectivity. With this methodological orientation, this study compares different types of healthcare buildings; hospitals, clinics, physical and psychiatric rehabilitation centres, and facilities for the elderly.

To operationalise this framework a Q methodological study was conducted, comparing the experiences of care environments by their users and stakeholders, through ten case studies in Japan and the European countries Finland, Sweden, the UK, France and Austria. Q-methodology is a qualitative method for systematically analysing human subjectivity. In Q-methodological experiments, 45 respondents – including patients, residents, care staff, the administration and architects – were asked to arrange a set of statements describing the aesthetics of the care environment on a scale of preference. The preferences were then analyzed by statistical procedures, comparing the experiences and preferences both in relation to the different user groups and the care environments. The following aesthetic discourses were identified; A) "respect for integrity and privacy – the Quality aware", B) "hygienic, utilitarian and safe – the Nightingale discourse", C) "nature, well-being and personalization – the supportive care environment", and D) "the way-finding system – care as a rational experience".

Keywords

1   INTRODUCTION

This article presents the preliminary findings of a research project focusing on the aesthetic dimensions of the care environment, especially as viewed by the users and stakeholders of ten case study buildings. It aims at exploring three aspects that too often are neglected in healthcare related architectural research. Firstly, in the domain of evidence-based research, a majority of studies focus on other than aesthetic features of the environment. More easily and non-the-less important measurable variables are preferred, such as ergonomic, functional, hygienic, or, issues related to staff working conditions, walking distances and stress levels (Ulrich et al., 2004). This study uses the concept of aesthetics as a conceptual tool in an attempt to investigate the care environment in the case studies at hand.

Secondly, when addressed, aesthetics is commonly reduced to the appearance of things, viewed by the sense of sight and detached from contextual or moral considerations. However, while being inside a building, the experience of architecture seldom is two-dimensional, purely visual nor is it separated from values and personal expectations of the perceiver. We hear, feel, see, touch and smell the buildings we occupy. The meanings we attach to our surroundings are multi-faceted and ambiguous. Hence a research methodology that conveys the experience of architecture in a broader sense is called for and developed by adapting Q-methodology to the study of care environments. As a research method, Q methodology is far from new. It was introduced in the 1930's by the behavioural scientist William Stephenson (1953) and has since been applied in numerous fields such as social sciences, politics, health care and organisational research. However, its application in the field of aesthetics and architecture has been limited.

Q methodology – commonly known as Q-sorting technique – is a qualitative method for examining and systematically analysing human subjectivity (McKeown & Thomas, 1988). In this context, subjectivity is defined as a person's communication of his/her point of view. The approach relies on the twofold premise that subjective points of view are communicable and that they are anchored in self-reference. The experience of architecture shares the premise of being based on a person's internal frame of reference, but the communicability of this experience may not be so self-evident for those who are not professional designers. In Q methodological experiments, participants react on a set of statements, in this case statements describing the aesthetics of the care environment, by arranging them on a scale of preference, followed by an interview addressing the preferences made. The results of the Q-sorts are then analysable and comparable by statistical procedures.

Thirdly, many studies leave out the point of views of the main users of care environments, in other words the patients and residents, and focus on care staff ratings, behaviour mapping or comparison of medical records. In fact, in many studies on aesthetics, respondents are chosen on random without any personal relation to the subject under inquiry. This study on the contrary, lets a multitude of users and stakeholders, including patients, residents, visiting family members, care staff, administrators and the architects who had designed the buildings, react on the environment in search for differences and nuances underlying the aesthetics dimensions. In 45 Q-methodological interviews, the respondents of the ten case

study buildings give their proper account of the aesthetic experience of the care environment. The central methodological concept of *operant subjectivity* implies this very operationalization of the experience of architecture – a human interface in architecture.

As such, care environments represent huge investments on a societal level and complicated puzzles of care processes and logistics on an organisational level. Yet they also have very concrete and physical consequences on a personal level on the people experiencing them. In the framework of this study, the care environment is defined as the physical environment in which a person in need of care is living in as a resident or receiving treatment in as a patient. This general definition opens up the possibility to include into the study and to compare different types of care buildings; such as hospitals, clinics, physical and psychiatric rehabilitation centres, and care facilities for the elderly. This definition also reflects the diversification of the healthcare field. Future trends see a division of the treatment and living facilities of today into on one hand an acute high-tech hospital environment and on the other hand the low-tech living environments of rehabilitation centres and care homes (Nakayama, 2008; Huttunen et al., 2011). In order to test care environments that should serve as models for the development future care facilities, the case studies were chosen among awarded buildings that represent high aesthetic quality.

The main research questions of the project at large are: 1) In what different ways can aesthetics be defined in the context of the care environment, and 2) how do the different users and stakeholders experience the aesthetic features of their care environment? 3) Are there differences in aesthetic definitions and solutions between different building types and 4) do aesthetic definitions and solutions differ between the different cultural contexts of Japan and the European countries? In a broader sense the question is 5) can the architecture of care environments affect quality of life, well-being and healing processes of the users? As a by-product of the Q-experiments, the users and stakeholders of the care environments also test the assessment of architecture; is the architecture deemed the best by experts and acknowledged by design awards, really experienced as such by the users? The preliminary results reported in this article will tentatively address the two first research questions based on the review of aesthetic theory and the analysis of data retrieved from 45 Q-methodological interviews in ten case study building.

2   THEORETICAL CONTEXT

Generally research on aesthetics has been divided into two major approaches: the philosophical and the empirical. While philosophical aesthetics falls into the domain of philosophy defining diverse modes, concepts and theories of the aesthetic, empirical aesthetics is a kin to the behavioural sciences and environmental psychology attempting to measure how the aesthetic affects us or is experienced. This study positions itself in the middle of these two disciplines, as it on one hand turns to aesthetic theory for an aesthetic framework adaptable to the care environment, and then puts this framework into practice in the empirical study of ten case study buildings and the experiences by the users and stakeholders of these buildings.

During the last thirty years, empirical healthcare architecture research, especially in the domain of evidence-based design, has tried to prove the importance of the physical environment as part of the healing process. Healing powers have been attributed to single patient rooms, improved lightning, ventilation, ergonomic designs and space layout, by claiming that they affect sleep, feelings of stress and pain as well as the use of drugs (Ulrich et al., 2004). Other research reviews have found positive effects for environmental features such as sunlight, windows, odour and seating arrangements, but inconsistent results for the effects of sound, nature and spatial layout (Dijkstra et al., 2006). The restorative and potentially healing effects of nature have been either contributed to cognitive (Kaplan, 1995; Berman et al., 2012) or to evolutionary origin (Orians & Heerwagen, 1992; Ulrich et al., 2003). The debate on the role of art and especially art content divides the academic field. While some propose that the content of artwork in the care environment should be strictly regulated to particular art styles and content, namely representative art with views of nature and people with "positive facial expressions" (Ulrich & Gilpin, 2003:137) and that abstract art can even be detrimental (Nanda et al., 2011), others argue that art on the contrary should be challenging and address the fundamental existential issues patients face (Jencks, 2010; Perry, 2007).

A methodological challenge seems to be to on one hand isolate and on the other hand *prove* the effects of specific environmental stimuli on healthcare outcomes. This has resulted in an abundance of studies trying to approach the subject from different angles. In fact the information explosion connected to evidence-based design have led some to develop computer aided 'knowledge modelling tools' in an attempt to assess the cumulative effect of environmental aspects (Durmisevic & Ciftcioglu, 2010). Although evidence-based notions largely influence design solutions in new care environment projects, both considering the layout of spaces and choice of architectural elements, at present, on the basis of available research, it seems premature to formulate evidence-based guidelines for designing healthcare environments, resulting in diverse praxis and a wide range of different typologies of care environments. The debates on issues such as single vs. multiple patient rooms, 'nature vs. brick walls' as well as the spreading out or centralization of staff work stations are in flux.

Now when turning to philosophical aesthetics, the seemingly simple meaning of the word *aesthetic* in common usage[1], as a synonym for beautiful, pleasing in appearance or artistic, is in contrast with the multifaceted nature of the discipline of philosophical aesthetics. Although aesthetics has been defined as "a branch of philosophy dealing with the nature of beauty, art, and taste, and with the creation and appreciation of beauty"[2], it has recently encompassed not only pleasant but also unpleasant or even indifferent reactions towards elements of our surrounding environment. Indeed, the etymological origin of the term aesthetic was not related to beauty, but derived from the Greek word *aisthanesthai*, meaning to perceive, feel or sense. The term aesthetic was first introduced into the philosophical context by Alexander Gottlieb Baumgarten in 1735 in the German form *epistêmê aisthetikê*, designating knowledge

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1   Even the common usage of the word aesthetic varies according to different cultures. In Japanese, the word 'esthé', short for aesthetics, is commonly associated with beauty parlours. Subsequently, when I was conducting preliminary interviews at Japanese healthcare facilities, the term caused confusion and I had to start each interview with a discussion on its meaning.

2   Merriam Webster Online dictionary

based on sense perception. In his foundational treatise Aesthetica, Baumgarten envisaged that "Aesthetics, as the theory of the liberal arts, science of lower cognition, the art of beautiful thinking […] *is the science of sensory cognition*" (Schusterman, 1999).

The discipline of contemporary aesthetics has expanded from the narrow focusing on art to incorporating a wide range of human activities, objects, environments and cultures. *Environmental aesthetics* has been likened to a continuum of things ranging from the pristine nature of wilderness areas, through rural landscapes and man-made nature, cityscapes and the built environment to the very limits of traditional art forms (Carlson, 2000). The new domain of *everyday aesthetics* has further enlarged the scope to include everyday objects, phenomenon and activities (Saito, 2007). The body at the centre of the aesthetic experience has indulged researchers to propose new sub-disciplines of aesthetics, such as *somaesthetics* (Schusterman, 1999) or *neuroesthetics* (Nanda, et al., 2009). The aesthetics of architecture can be seen as a part of this environmental continuum in a very tangible way as it not only creates a physical cadre for diverse forms of art and our everyday life, but also relates to the surrounding nature and to the body as we move through and interact with buildings.

The aim of this study is not to claim a definite stance in the philosophical and metaphysical debate on what is the true essence of the *aesthetic* that has preoccupied thinkers during the last millennia. Rather the question is; how can the concept of aesthetics serve as a contextual framework enabling us to retrieve the most of the multifaceted dimensions of the care environments at hand? In this study, the aim is to provide a platform that allows the users and stakeholders to bring forth their own conceptions of the aesthetic environment they live and work in. Hence, a theoretical model of aesthetics that allows for a broad definition of aesthetics is needed in order for all respondents to be able to operationalize their personal point of views. The fundamental methodological principle of *operant subjectivity* refers to the very idea that interview respondents are not given readymade concepts, but rather themselves participate in the construction of these conceptions by arranging a set of statements that form a central part of Q-methodological interviews. The point of departure is thus a 'stakeholder-driven' or 'user-driven' conception of aesthetics and the experience of architecture.

Along these lines, aesthetics will here be viewed as *any reaction we form to the sensuous and/or the design qualities of the care environment*. This broad sense of the term aesthetic adapts the concept of *everyday aesthetics* as defined in contemporary philosophy onto the field of architecture, by narrowing the focus to concern the care environment. In the realm of everyday aesthetics, aesthetics has been defined as "any reaction we form towards the sensuous and/or design qualities of any object, phenomenon or activity" (Saito, 2007:9). Contextual and social considerations as well as reactions connected to the experience of function are included when these relate to sensuous and/or design qualities of the environment. The built environment refers not only to the surfaces and spaces created by the building itself, but also to the nature and surrounding cityscape incorporated into the environment through gardens, courtyards or views framed by windows. Furniture and items of the interior design are seen as indistinguishable from the architectural experience as a whole.

Building on this broad conception of aesthetics on one hand being anchored in the experience of the environment and on the other hand as being constituted of physical features of a particular environment, the aesthetics of the care environment will be examined and cross-tabulated along two main axes. The first axis comprises the *sensuous level* consisting of different ways in which the built environment can be experienced aesthetically. These dimensions are retrieved from aesthetic theory, environmental psychology and the architectural discourse related to well-being and the care environment, distinguishing four main categories: *sensory qualities, contextual qualities*, the *social dimension* and *function*. The sensory qualities include dimensions of our environment that we perceive through all our senses; sight, hearing, tactile, olfactory, gustatory and kinesthetic senses. These sensory qualities are not isolated from each other; they fuse and are present simultaneously, creating a quality of ambience or an atmosphere. The aesthetic experience of architecture is contextual in the way we attach personal meaning and significance to places; a 'sense of place' influenced by our personal history, experiences and memories, and reflected in cultural values and traditions. The social dimension is in a different way contextual in that it denotes the social character of a place. The respect for the integrity of the users, include notions of privacy, the way in which the private and the public are combined and graded. A sense of control of one's personal life implies control of the amount and the nature of social interactions, privacy and use of time, as well as control over the physical environment. Function is considered only to the extent it is conveyed into the sensuous or design character of the building. The doctrine of healing, notions of safety, hygiene, maintenance and the presence of medical equipment directly affect design outcomes. Way-finding and the ability to orientate inside the building are functional aesthetic features distinct to the care environment.

The second axis addresses the *design level* denoting the architectural effects of the care environment, in other words the essence of the case study buildings. The *design level* will examine the case studies through the following building layers: *stuff, surfaces, space and light*, and the relationship to the *surroundings*[3]. These layers are representative of different size and lifespan in the continuum of design elements, ranging from the easily replaceable personal objects to the more stable exterior surroundings. Surfaces include not only the materials used and their textures, but also colours, details and the quality of finishing. Space and light are viewed as fundamental architectural elements.

In an everyday familiar experience of architecture, the sensuous and the design level intertwines and interferes, forming a continuous and at times even automatic response to the surrounding environment. The aim is not to oppose these dimensions to each other, rather the purpose of this matrix of aesthetic dimensions – a model of concourse – is to grasp, in a systematic and comprehensive manner, the different nuances and potential implications of aesthetic solutions. This theoretical model, presented in table 1, functions as a tool in covering an as comprehensive as possible universe of statements concerning the care environment and forms a key component of Q-methodological inquiries.

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3   Adapting a modified version of the six S's of Stuart Brand (1994), by excluding those which are not distinctly aesthetic.

Table 1 Theoretical model: The Concourse of Aesthetic and Architectural dimensions

DESIGN LEVEL / SENSUOUS LEVEL	a. STUFF	b. SURFACES	c. SPACE & LIGHT	d. SURROUNDINGS
A. SENSORY QUALITIES	A a	A b	A c	A d
B. CONTEXTUAL FEATURES	B a	B b	B c	B d
C. SOCIAL DIMENSIONS	C a	C b	C c	C d
D. FUNCTION	D a	D b	D c	D d

Many non-aesthetic factors influence our experience of the care environment, such as care processes, staff attitudes, logistics, how long we have to wait for treatments or move between activities in different parts of the building, as well as technological, structural and ecological solutions. In the contemporary field of architecture, many of these dimensions that go beyond even the broadest definition of aesthetics must be taken into consideration and mastered during the design process of a building. However this study ignores many of the above mentioned dimensions that would fall into the realm of demands for the architect. This study situates the aesthetic factors of the care environment within the broader realm of architecture, referring to the architectural dimensions which are perceivable by our senses. This is illustrated in fig. 1.
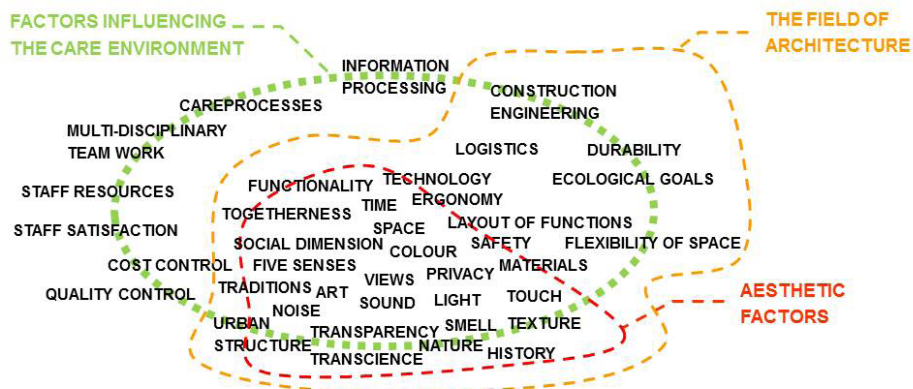
Figure 1 The relation between aesthetic and architectural factors influencing the care environment

3   RESEARCH METHODS

The overall methodology applied in this research project is qualitative and consists of ten case studies in Japan and the European countries of Finland, Sweden, the UK, France and Austria. Research methods included a pilot study on Japanese care environments (Ståhlberg-Aalto, 2013); the selection process of case study buildings; the adaptation of Q-methodology to the investigation of care environments; and, visits to and documentation of case study buildings in Japan and Europe. The case studies comprised Q- interviews with 45 respondents. The results of the Q-experiments are analysed using correlational and factor-analytical techniques (McKeown & Thomas, 1988). This article will present some preliminary results of the statistical analysis that will serve as a basis for the development of in-depth analysis and interpretation of the collected interview data.

3.1   Case study selection

In order to evaluate best-practises that could serve as models for future care environment design, the buildings for the case studies were chosen to represent high aesthetic quality. This quality was evaluated by the following criteria: the building must have been acknowledged in some way, e.g. published in an architectural journal, received a prize or be the result of an architectural competition; the project must score high on the *design levels* in the theoretical model mentioned above; and, in order to be part of the current health care discourse, the project must have been built in the year 2000 or thereafter. The selection process itself of the buildings was made part of the methodological work, surveying architectural competitions and awards, hearing experts of healthcare architecture and consulting existing evaluation criteria for healthcare buildings of the different countries that would participate in the study.

The Japanese case studies are: 1) Katta Public General Hospital, 2) Katsura Ladies Clinic, 3) Senri Rehabilitation Hospital, 4) Baum Haus Psychiatric Rehabilitation Centre, and 5) Yuraku nursing home for the elderly, see fig. 2. The European case studies are represented by: 6) Marne-la-Vallée Hospital Centre, 7) Malmö University Hospital, 8) Maggie's Cancer Centre Gartnavel, 9) Käpylä Autism Centre and 10) Centre for seniors in Steinfeld, see fig. 3.
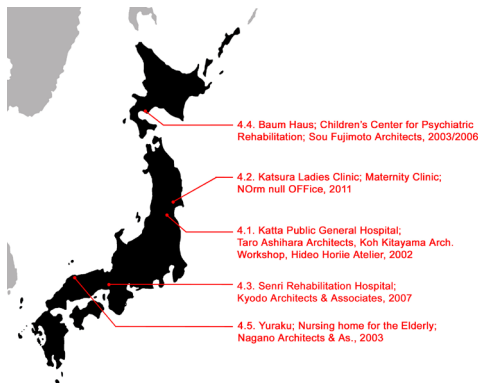
Figure 2 Japanese Case Studies
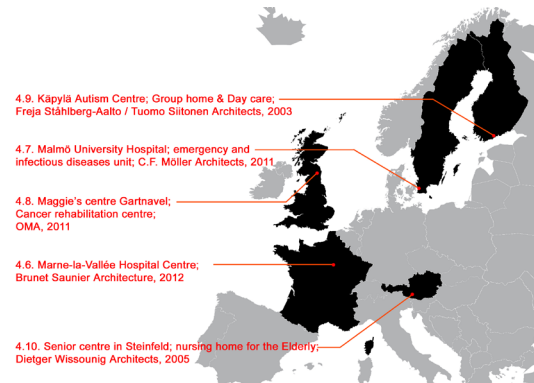
Figure 3 European Case Studies

The structure of this multiple-case study design is on one hand guided by architectural visions for future healthcare design and on the other hand by methodological concerns related to case study design. Global visions of future healthcare architecture envisage a division of the field into 'acute' high-tech hospital environments and the low-tech 'chronic' living environments of rehabilitation centres and care homes (Nakayama, 2008; Huttunen et al., 2011). In multiple-case study designs, a theoretical replication refers to cases that predict contrasting results within anticipatable reasons while a literal reproduction predicts similar results emerging from a similar context (Yin, 2009:54). In this study, theoretical replication was established by selecting cases representing both 'acute' and 'chronic' care environments. In order to cover the diversity of the healthcare architecture arena, five different building types were selected within this rough outline. It was hypothesized that different aesthetic dimensions would emerge from the different building types and care contexts; in other words that the users and stakeholders would hold in value and appreciate different aspects of the environment in an 'acute' hospital versus a 'chronic' living and rehab setting. The two geographical locations, Japan versus Europe, represent literal reproduction and thus an equal number of 'acute' and 'chronic' case

study buildings were chosen on both continents. To further illustrate the diversity of care settings, these ten case study buildings are depicted as ten *narratives* of contemporary care discourses, and accordingly labelled and illustrated in Table 2.

The 'acute' high-tech environments comprised four hospitals or specialized clinics. Katta public General Hospital (case1) is a 308-bed and 25.860 sq. m. hospital, designed by Taro Ashihara Architects and colleagues. Located in the city of Shiroishi, Japan, the spaces of the three storey-high building are scattered on a 120x140 metre area in a functionalist manner. The ground floor comprises an out-patient lobby, treatment rooms and cafeterias; the first floor is only partially built beholding the administration and a surgery ward; and, the second floor contains six hospital wards. Exceptional for the building is that patient rooms and outdoor roof gardens form a network allowing patients to access the gardens directly from their room. The building was labelled *'machine à guérir'* since the design was influenced by Le Corbusier and modernist design principles of access to natural light, nature and ventilation. The Marne-la-Vallée Hospital Centre (case 6), situated in the Paris metropolitan area, France, can be considered a European counterpart to Katta Hospital, albeit in a bigger scale. The Marne-la-Vallée hospital is a 585-bed and 67.685 sq. m. general hospital designed by Brunet Saunier Architecture. It is here labelled *'monospace hospital'* based on the founding design concept of *monospace*, referring to a neutral basic space unit, that systematically connected may create an endlessly expandable hospital structure (Blin, 2013). In the Marne-la-Vallée monospace system spaces are accessed by means of double corridors and grouped around fifteen differently coloured interior courtyards within a 200 x 110 metre three-storey building volume. These courtyards bring natural light to the inner parts of the compact building volume and serve as landmarks helping the users to orientate.

Case 1 Katta General Hospital
Image courtesy Taro Ashihara Architects
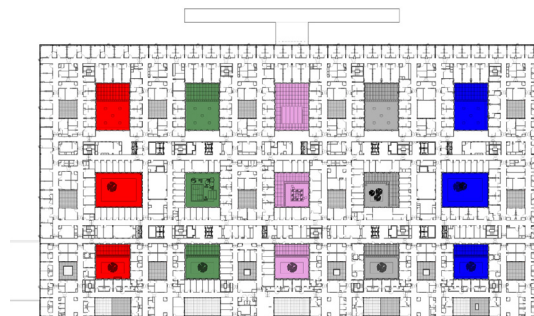
Case 6 Marne-la-Vallée Hospital Centre
Image courtesy Brunet Saunier Architecture

Katsura Ladies Clinic (case 2) in Sendai city, Japan, and Malmö University Hospital's Emergency and Infectious diseases unit (case 7) in Sweden represent high-tech, for a distinct purpose built, special clinics. The Katsura Clinic is a small 19 bed maternity clinic of 930 sq. m., designed by Norm Null OFFice. The clinic is labelled *'individuality pro prima'* stemming from the main aesthetic strategy according to which every patient room or delivery theatre is articulated as an individual box – concrete on the outside and wooden on the inside – making the building itself resemble a collection of enclosed boxes with no windows towards the exterior. The Malmö Infectious diseases unit on the contrary, is a doughnut-shaped six-storey building, the main design principle being based on hygienic doctrines and the isolation of patients; here labelled *'hygienic formalism'*. The main idea of this 24.000 sq. m. and 51-

bed extremely specialized high-tech facility, designed by the Danish architect C.F.Møller, is to separate the circulation of contaminated patients from that of staff and visitors. The doughnut configuration thus allows for patients to enter their rooms directly from an outdoor corridor on the exterior circle of the building, while a separate interior corridor and adjacent service spaces for staff and visitors are located around the circular interior courtyard.

Case 2 Katsura Ladies Clinic
Image courtesy Norm Null OFFice
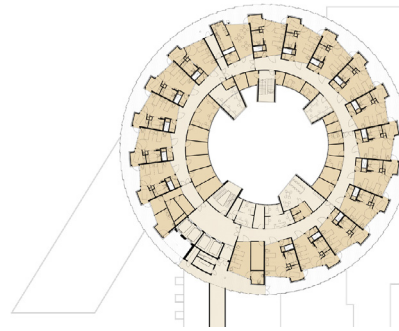
Case 7 Malmö University Infectious diseases unit
Image courtesy C.F.Møller Architects

The 'chronic' low-tech rehabilitation centres and care homes include six case study buildings. Senri Rehabilitation Hospital (case 3) is a 120-bed and 7.254 sq. m. physical rehabilitation hospital, designed by Kyodo Architects & Associates and located in a residential area in Osaka district. The building is here labelled *'residential hospital'* as it is stripped from any hospital-like features such as hand railings, half-panels protecting the walls, dominant signage systems or clinical smells. In Senri, there are no hospital wards in the traditional sense; patients stay in small one-person 'flats' divided into 12-bedroom residential units, sharing a common kitchen, living and dining room. Patients learn how to manage a normal life in a normal setting; shoes are taken off before entering the unit, patients wear their own clothes and toilets are small sized residential toilets, not huge institutional ones. Maggie's Cancer Centre Gartnavel (case 8) represents another type of rehabilitation in that it does not provide any clinical treatments at all; instead it functions as an aesthetic and psychological *"refuge"* for cancer patients. Designed by the architects of OMA, the small pavilion of 534 sq. m. is located in a park of a 1970's Scottish hospital complex. The spaces, designated for get-togethers, therapy sessions, guidance, information browsing or simply meditation, circle around and enclose a small garden. From this spatial sequence, views are selectively open in different directions towards the surrounding cityscape. The building is like an anti-hospital; every detail is carefully thought of and every space filled with beautiful artefacts and works of art.


Case 3 Senri Rehabilitation Hospital
Image courtesy Kyodo Architects & Associates

Case 8 Maggie's centre Gartnavel
Image courtesy OMA

The BaumHaus (case 4), located on the northern island of Hokkaido on a scenic slope overlooking the Pacific Ocean, is a children's psychiatric rehabilitation centre comprising three buildings designed by Sou Fujimoto Architects. The main building of 50 beds and 2.530 sq. m. is composed of two-storey high white boxes randomly scattered and connected to each other through a series of more public spaces. The polymorphic common spaces created in-between the white boxes has been thought to provide the children places for casual activities and privacy, as all niches and corners cannot be seen or easily surveyed by the staff. This spatial composition has been described as a toy for the children to discover. However, due to the lack of homelike and residential atmosphere, that one could expect from a rehabilitation centre for children, it is here nicknamed *"institutional toy"*. The Käpylä Autism Centre in Helsinki, Finland (case 9), designed by the author at Tuomo Siitonen Architects, departs from the premise of being the home of the autistic residents, as opposed to being an institution. The 1.790 sq. m. building aims at blending in with the surrounding residential area as it is composed of two visually and spatially separated parts; a five storey high residential part comprising 3 group homes with altogether 12 residents, and, a two-storey wooden day care centre providing rehabilitation for 36 persons living in the community. Aesthetic dimensions such as the use of materials and colours in combination with a clear and simple spatial layout were enhanced to support a structured way of life – a rehabilitation method found supportive in the organisation of daily life activities of persons with autism. The building will be nicknamed *"structured city home"*.
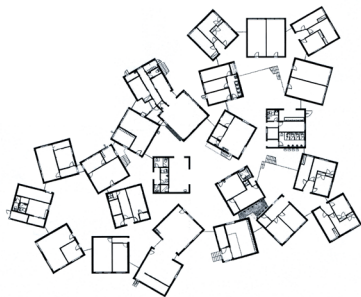
Case 4 BaumHaus children's centre

Case 9 Käpylä Autism Centre

Yuraku Nursing home for the elderly (case 5), a 6.558 sq. m. care facility designed by Nagano Architects and Associates and located in the rural area of Tottori Prefecture, Japan, accommodates 100 residents and a day activity centre. The main aesthetic strategy is related to the social dimension. A homelike small scale living environment is created by dividing the otherwise big building into nine care units of 9-12 residents according to 'unit care' principles. These care units symbolize both home and family for the elderly; values translated into the architectural expression by making the building resemble a dense village of smaller family houses; accordingly labelled *"nursing home village"*. The integrity of residents is reflected in a spatial hierarchy of private, semi-private, semi-public and public spaces. As a European counterpart, the Centre for seniors in Steinfeld (case 10), Austria, designed by Dietger Wissounig Architects, houses 50 elderly residents in a three-storey compact wooden building block of 3.658 sq. m. In contrast to the village concept of Yuraku, this *"nursing home in a box"* is a freestanding solitary building that can and is probed to be circled. In fact, a pathway going around the building underneath the cantilevered first floor is called "the high-way" as

residents with dementia use it for their daily wandering tours. The main architectural concept evolve around an interior healing garden; a central greenhouse running the full height of the building and comprising a botanical garden, where the elderly can take their nap on special patios. The residents' apartments, located on the first and second floors along the exterior façades of the building, encircle this healing garden.

Case 5 Yuraku nursing home for the Elderly
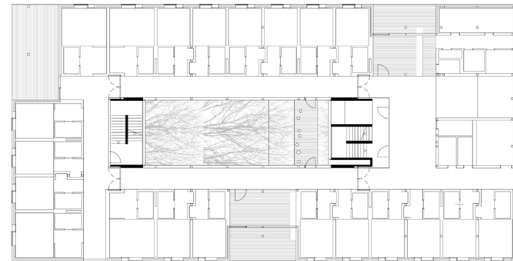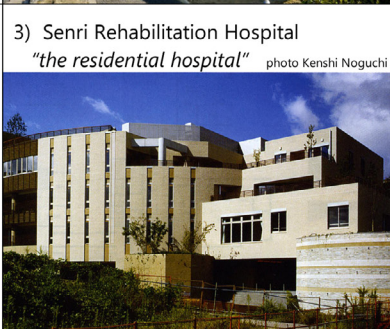
Case 10 Centre for Seniors in Steinfeld
Image courtesy Dietger Wissounig Architects

3.2   Q-methodological procedures

Q-methodology has been defined as a qualitative method for systematically analysing human subjectivity (McKeown & Thomas, 1988). In Q methodological interviews, also named a Q-sort, participants were asked to react on 48 statements describing the aesthetics of the care environment by arranging them on a scale of preference ranging from +5 (most like my opinion) to -5 (the least like my opinion). At the start of the Q-sort a normal distribution sheet was shown to the respondents with the instruction to try to follow the distribution pattern when possible. However, it was allowed to deviate from the normal distribution if one's personal view would have been compromised otherwise. The interview instructions furthermore specified that, when possible, the reactions vis-à-vis the statements should be evaluated especially in relation to the particular case study building at hand. This instruction was found important when considering that some of the architect respondents were professional designers of a wide range of different care environments. The results of the Q-sorts were documented on the distribution score sheet together with the respondent's demographic information, including age, gender, user/stakeholder group, occupation and length of stay.

The Q-sort was followed by an interview including five questions asked of all respondents with the purpose of checking that the statements as well as the Q-sorting instructions had been understood correctly. This was followed by a set of fit for the purpose open-ended questions put if the respondent was available for further discussion. At the end of the interview, each interviewee was additionally asked to, on site, indicate features and spaces that they find especially supportive or valuable, and these were then documented by photographing. In the cases where stakeholder interviews took place elsewhere than in the case study building, the respondents identified important features on photographs when available.

Table 2 The Case Study typology

	Literal Reproduction **JAPAN**	**EUROPE**
Theoretical Reproduction **HOSPITALS & SPECIALIZED CLINICS**	1) Katta Public General Hospital *"machine-à-guérir"*	6) Marne-la-Vallée Hospital Centre *"monospace system"*
	2) Katsura Ladies Clinic *"individuality pro prima"* photo Norm Null OFFice	7) Malmö University Hospital *"hygienic formalism"*
REHABILITATION CENTRES & CARE HOMES	3) Senri Rehabilitation Hospital *"the residential hospital"* photo Kenshi Noguchi	8) Maggie's Centre Gartnavel *"information refuge"*
	4) Baum Haus Rehabilitation Centre *"institutional toy"*	9) Käpylä Autism Centre *"structured city living"* photo Michael Perlmutter
	5) Yuraku Nursing home for Elderly *"nursing home village"*	10) Centre for seniors in Steinfeld *"nursing home in a box"*

The Q-sample

The Q-statements, presented in Table 3, were built upon the theoretical model of Table 1, with the aim of collecting a concourse as comprehensive as possible of aesthetic and architectural dimensions. The four sensuous levels of A. *sensory qualities*, B. *contextual qualities*, C. the *social dimension* and D. *function* were cross-tabulated with four design levels composed of a. *stuff*, b. *surfaces*, c. *space & light*, and d. the *surroundings*, forming 4 x 4 matrix. The Q-sample of statements was created by replicating three times every theoretical category of the matrix (Aa, Ab, Ac, Ad, etc.) resulting in 48 statement items. The statements were collected from existing literature on healthcare architecture and related research reports, as well as from the interviews of the pilot study on Japanese care environments. From a 'raw material' of over 300 potential statements fitting the different categories of the matrix, the number of selected statements was reduced to 48 by eliminating overlapping statements and adding some theoretically constructed otherwise missing statements. A prototype set of statements was then tested in a group Q-interview session composed of one of the respondents as well as academic researchers, who commented on the statements and interview details. Based on the feedback minor changes were made on the statements and interview instructions.

The P-sample

In line with the aims of the study to highlight the experience of care environments in a holistic manner, giving a voice to different viewpoints and interpretations of the aesthetic, the respondents for the study were selected among different user/stakeholder groups. It was hypothesized that the different users and stakeholders would perceive and value their environment in different ways. Five user/stakeholder groups were identified as follows: 1) the architect, who had designed the building, 2) a person from the administration with insight into how the building functions as a whole, 3) a person from the care staff with insight into the practical everyday life and care work in the building, 4) a resident living in or a patient receiving treatment in the building, and 5) a family member or a visitor. For each case study building the aim was set to make five Q-methodological interviews; one for each user/ stakeholder group. In general, the goal was reached in that the 45 respondents participating in the study were evenly distributed on the user/stakeholder spectrum both in Japan and in Europe, see table 5. Special priority was put on attaining patients and residents viewpoints (n=12), considering that these often are neglected in prior research.

The respondents were heterogeneous. The average age was 46.7 years, yet the age of individual persons ranged from 12...87 years. Twenty-four of the respondents were male and 21 female. There were no significant differences in age and gender distribution between Japan and Europe. In the selection process of respondents, the architects were approached separately and their Q-interviews were conducted elsewhere than in the case study buildings due to large geographical distances. The other user and stakeholder interviews predominantly took place at the case study buildings and respondents were pointed out by the administration. The patient and resident users were selected with respect to somatic and psychological abilities. In the case of patients or residents requiring support, the interviews were conducted as group sessions with the assistance of either care staff or family members.

Analysis

The results from the Q-sorts were run through the standard PQMethod statistical program, tailored to the requirements of Q-studies, and factor-analysed with a principal components analysis and a Varimax rotation. These are the first steps in retrieving preliminary results of Q-analysis, as it shows the statistically generated factor scores for each statement as well as the distribution of factor scores for each respondent, see tables 3 and 4. The resulting factors represent clusters of opinions, in the case of this study, on the experience of aesthetics and architecture of care environments. A respondent is statistically significant on a factor when the factor score is 0.37 or higher.

4   RESULTS

The results of the statistical analysis identified four factors, in other words four different ways of relating to the experience of aesthetics and architecture in care environments, see table 4. These factors represent clusters of opinions expressed by the respondents of the study in the Q-sorts. The preliminary result is representative of a total of 44 % of variance among the responses.

Factor A: "respect for integrity and privacy – the Quality aware"

Defining for factor A is the high priority put on the integrity and privacy of patients and residents; lack of privacy is viewed as intolerable. When being a patient or resident in a care environment, a person adhering to factor A, does not want share their personal sphere or sleep with others, nor have their integrity breached by the sounds and the smells of co-patients or co-residents. It is important that this personal sphere is not too small and that the transition from private to public is not too abrupt (gradation of space). The idea of the building being designed so that staff can easily supervise and control patients and residents is found offensive. (st.32 +5, st.34 -5, st.22 -5, st.25 +3, st.33 +3)

Furthermore Factor A is opposed to pragmatic concerns; aspects of maintenance are not important and should not dictate aesthetic choices, and matters of safety should be subordinate when choosing materials. High quality materials and carefully designed details, on the contrary, are viewed as signs of good care and the fact that the users are considered valuable. A high quality environment is even seen to influence care quality by prompting the care staff to give better care. (st.23 -5, st.20 +4)

Factor A is opposed to rationality: space efficiency, functionality and high-tech equipment do not define good care environments. The slogan "put the patient first" rings true, and the care environment as a homey place to live in should overrun practical issues of aid equipment and staff working conditions. (st.12 -4, st.36 -4, st.30 +4)

The idea of staying connected to the world outside the care environment, both through views out of windows – also for bedridden patients and staff – or through feelings evoked by the environment, is highly valued. The role of the surroundings in evoking a sense of passing of time, the sensory qualities of different seasons and nature as a source of well-being are found important. (st.42 +5, st.29 +5, st.39 +3)

Factor B: "hygienic, utilitarian and safe – the Nightingale discourse"

Defining for factor B is the high priority put on safety and hygienic matters. Materials and surfaces should foremost be safe to use or walk upon, and safety issues should overrun ambient and sensory features such as the softness of carpets or the use of natural materials such as wood – these are but a home for germs. The layout of spaces should enhance the surveillance of patients/residents by staff. Hygiene is an essential part of the safety discourse and a hygienic doctrine aiming at preventing the spreading of bacteria and diseases is at the core of factor B. Materials should be hygienic; washbasins, fixtures and equipment are there to uphold hygiene. (st.25 +5, st.11 +5, st.17 -5, st.18 -2, st.22 +2)

Factor B stresses the functional and utilitarian task of the care environment to "cure" a person. The care environment is definitely not a home, and therefore contextual features, such as the personification of the patient/resident room with personal items or furniture is uncalled for. Furthermore, topical trends such as family participation or extracurricular functions of the building to engage the users in activities are not in line with the mission of the facility. On the contrary, functional features of the care environment such as the distance between bed and toilet and the size of the patient/resident room top the scores. (st.4 -5, st.30 -4, st.37 +4, st.25 +5)

However, factor B is not oblivious of privacy and sensory qualities altogether, as long as these are in line with the main task of curing. Views outside from windows, as well as the access to nature and outdoor air are highly ranked, as in the case of factor A, but not for the cognitive reasons of staying aware and connected to the outside world. Nature is considered healing and empowering and thus important. Special attention should be put on the quality and amount of natural and artificial lighting. (st.29 +4, st.39 +4, st.40 +4, st.3 +3, st.27 +3, st.42 +3)

Factor C: "nature, well-being and personalization – the supportive care environment"

An all-pervasive theme of factor C is a strong emphasis on the supportive role of the environment in the care of residents and patients. Nature is viewed as a prime medium for inducing well-being by activating our senses and making us relax, and therefore the importance of bringing nature inside the building and having an easy access outdoors is highly valued. Nature and the surroundings make us feel good by animating the interior spaces, providing views to contemplate and by giving us energy, but opposed to factor B, the role of nature is not to cure. At the same time, the surroundings have a supportive role on a social level by providing different places to spend time in, meeting people. It is important that the building and its inhabitants are part of the surrounding neighbourhood, and that the care environment is open towards the community and easy approachable by people from the outside. (st.39 +5, st.40 +5, st.48 +5, st.29 +4, st.44 +4) (st.45 +3, st.44 +4)

In line with this supportive narrative, the building and its surroundings should be designed with respect for the user's restricted abilities to move in and perceive their environment. The surroundings should be easily accessible also without the help of staff and family members and it should foremost be safe. Safety is a key issue when choosing materials and hence carpets that the user could trip on should be avoided and the space layout should be kept simple and easily understandable. (st.48 +5, st.24 +4, st.26 -5, st.22 -4)

However, safety issues do not overrun residents' or patients' right to privacy. The staff is not allowed to intrude onto the private realm of residents and patients, and spaces should have different degrees of privacy and public quality. Furthermore the personalization of the private room with personal familiar object has a major supportive impact by evoking a sense of personal history and feelings of attachment. (st.34 -4, st.22 -4, st.4 +4, st.33 +3)

Factor C is opposed to the more pragmatic views on easy maintenance and the flexible and efficient use of spaces, as these are practical matters related to staff working conditions or facility cost efficiency and have little to do with the well-being and support of the main users of care environments, namely the residents and patients.

Factor D: "the way-finding system – care as a rational experience"

Distinctive for factor D is a strive for a rational and systematic approach to the care environment. The building should be flexible and bend to potential future uses and at the same time be efficient and easy to maintain and clean. Within this systematic approach way-finding is yet another system; spaces should be different so that they are easy to recognize, artwork or special furniture can be used as landmarks to guide the visitor. The entrance should be clearly articulated and the building itself function as a way-finding system supported by the use of colours and materials. (st.14 +5, st.46 +3, st.23 +3, st.35 +3, st.23 +2)

Although factor D embraces privacy and find the single room important, there is no need for fuzzy gradation of spaces on the private-public axis, or intimate get-together lobbies with small groups of chairs. The care environment is not a home and therefore there is no need for personal objects, nor is it a recreational centre with the aim of amusing its users. (st.33 -5, st.34 -5, st.8 -4, st.28 -4, st.47 -3)

In fact, Factor D likes it when there is only the minimum; when the materials, surfaces and details are restrained and simple. Medical and technical equipment is good hide as these tend to intimidate and frighten people. When the surroundings are calm and simple, the views outside from windows and works of art can fully be appreciated. Works of art get your attention and make your sensitivity active, while the scenery gives you energy to go on. It's important that windows are placed so that people really can see outside, also from their bed. (st.40 +5, st.29 +5, st.1 +4)

Table 3 List of Q-statements and Factor scores

Factor Q-Sort Values for Each Statement: Factor Arrays

No. Statement	code*	A	B	C	D
1. "There should be works of art in the care environment. When I see paintings or handicraft work, they get my attention and make my sensitivity active – they give me power! They initiate conversation in a natural way."	A-a	0	-1	-3	4
2. "Furniture made of plastic or metal is disagreeable to touch, for example when the bed is made of cold metal frame or the plastic gets all too sticky. Bad materials just make people feel bad."	A-a	-2	1	-1	-2
3. "The artificial lights should be soft and indirect, not strong and bright. This makes us feel comfortable and creates a soft atmosphere. Glaring lights on the other hand cause headache and fatigue."	A-a	4	3	3	4
4. "It's of prime importance to have personal familiar objects in the resident/ patient room, e.g. a lamp from home, photographs, decorations. These objects evoke memories – a sense of personal history – and make you feel attached to the place."	B-a	2	-5	4	-2
5. "The architect is the best person to choose the furniture for the facility; not the patients or the residents. The care environment shouldn't be personal – it's not a home, but a place to get cured."	B-a	-4	-4	-4	1
6. "It's good that there is nearly no visible medical equipment or technical aids in the rooms. These intimidate people and remind them of the fact that they are frail/sick and in need help."	B-a	-1	-2	1	4
7. "Family participation is vital! The rooms should have couches for family members to sleep on and the family should be able to influence the interior decoration. This activates them to participate in the care and in creating a good care environment."	C-a	1	-4	0	2
8. "There should be many small groups of chairs and tables in the common spaces/lobbies, so that people can choose their favourite place to sit in and choose with whom they socialize. It's easier to talk with people in smaller groups. That's real empowerment!"	C-a	1	0	2	-4
9. "I hate it when the television dominates the common spaces/lobbies. I don't want to watch the programs and it's impossible to talk with people when the television is on all the time."	C-a	1	-2	-4	2
10. "If a patient/resident wants to break a piece of furniture, it's good that it breaks. Otherwise you wouldn't feel the satisfaction of destroying something. In that sense furniture and other objects can have an educational function."	D-a	-3	-5	-3	-5
11. "Materials should foremost be hygienic and the placement and design of fixtures, such as washbasins and disinfectants, should encourage people to wash their hands. It's really a question of bacteria and the spreading of diseases."	D-a	-2	5	-1	-2
12. "The medical equipment/technical aids make me feel safe and protected. A high-tech environment attracts me and instils confidence in the facility's ability to provide the latest care and treatments."	B-a	-4	0	-2	-1
13. "Colours should be stimulating and activating; not too neutral or soft. The colours of the walls and other surfaces are of great importance, because they affect how we feel, what we do and how we recognize places. Colours guide us inside the building."	D-b	0	1	1	1
14. "The entrance of the building should be clearly articulated, have a reception desk or a legible and clear signing system to show the way to the different spaces. Doors should be clearly discernible from the walls, by the use of a different colour or material."	D-a	-3	2	-1	5
15. "Surfaces made of hard materials, such as concrete or metal, are cold and hostile. These cold surfaces alienate us and really should be avoided in the care environment."	A-b	-4	0	2	-3
16. "I like it when there's only the essential; when the material, surfaces and details are restrained and simple. It's reposing and calm."	A-b	-1	0	0	3
17. "I like the feeling of textile carpets under my feet: they are soft to walk on and suppress hard noises. This creates a nice atmosphere. Too much noise is a big problem in the care environment."	A-b	-1	-5	-5	-4
18. "It's important to have as much as possible natural materials, such as wood, stone or brick, on the surfaces of floors, walls or fixtures. Natural materials are so sensuous – not just to look at; but to touch and feel."	A-b	0	-2	0	0
19. "The materials and colours of surfaces; floors, walls and ceilings; and the way they are detailed, should express traditional values. It's therapeutic and makes you feel comfortable – makes you connect to it."	B-b	-1	-2	-2	-1
20. "High quality materials and carefully designed details make the place unique and special. It makes the users feel valuable – that they are important beings – and it makes the care staff give better care."	B-b	4	2	-1	1
21. "Patients/residents should be able to alter the ambience of the room; by adjusting the window blinds, the reading light by the bed, the room temperature and moisture, or the amount of openness and insight into the room – this is empowerment!"	C-b	2	1	0	2
22. "The staff should be able to see all spaces. A clear layout of spaces and the use of transparent walls, such as wooden grids, glass or other material, make it possible to supervise the users. Too complex spaces should be avoided because they prevent control and visibility."	C-b	-5	2	-4	-1
23. "Easy maintenance is essential; I can't stand it when it's dirty! Surfaces should be easy to clean and not too sensitive. The colour white for example gets easily dirty and a wooden floor or tatami-mat scratched or soiled. These should be avoided."	D-b	-5	2	-2	3
24. "Safety is the key issue when choosing materials. Surfaces should not be rough so that users hurt themselves, nor slippery so that they fall. The way the light is reflected on shiny floor, can make it difficult to walk on it."	D-b	-3	5	4	0

#	Statement	code				
25.	"The resident/patient rooms shouldn't be too small, otherwise you feel cramped. The size of the room is important."	A-c	3	5	1	0
26.	"I prefer it when spaces are placed in random, not strictly aligned. A certain complexity makes the spaces rich and more varied – the building should be like a toy to be discovered. It's so boring when rooms are aligned along a strait corridor."	A-c	1	-3	-5	-2
27.	"For maximum comfort, spaces should have just the right amount of natural light. Being able to feel the sunlight is one of the most important features, but to be able to sit in the shadow is also soothing. The heat of direct sunlight can be disturbing."	A-c	3	3	2	4
28.	"The common spaces/lobbies should be divided into smaller intimate spaces. Big spaces are institutional and intimidating, while small spaces have a human scale and make you feel at home."	B-c	0	-1	-1	-4
29.	"To have a view from a window is a key issue. The windows should be placed so that people really can see outside when sitting or lying in bed – not only the sky. It connects the inside with the world outside. This is very important, also for the staff."	B-c	5	4	4	5
30.	"The patient/resident room is foremost a place to live in; it symbolizes the home. A homey ambience weighs more than practical issues of aid equipment, maintenance or staff working conditions. Put the patients first!"	B-c	4	-4	2	-1
31.	"Different spaces reflect traditions and cultural identity; like the tea room, a café or a bar, the sauna or a spa. Users value these, because they convey that the facility respects their cultural identity."	B-c	0	-2	1	0
32.	"The only place to be alone in is the toilet – this is intolerable! The smell and sounds from the other patients/residents in the room is very disturbing. You can't even have visitors, without everybody in the room listening to your conversation."	C-c	5	3	-5	-5
33.	"Spaces should have different degrees of privacy. The resident/patient room is the most private and its entrance should be set apart from the more public common spaces/lobbies so that you do not stumble directly from private to public."	C-c	3	-1	3	-5
34.	"The private room is not important at all and I don't mind that the toilet is accessed by the corridor. In fact, it feels safe and good to sleep in the same room with others."	C-c	-5	-4	-4	-5
35.	"Spaces should be different so that it's easier to recognize where one is! A striking piece of furniture, art work or a view through a window act as landmarks that help people orientate inside the building. Not to get lost gives a sense of control and reduces stress."	D-c	4	2	-3	3
36.	"Space efficiency and functionality is everything – the building should be compact! The scattering of spaces on a large area and long distances between the spaces prevent staff from doing their job and force patients/residents and visitors to walk too much."	D-c	-4	1	0	2
37.	"The distance from the bed to the toilet should be as short as possible. It gives a feeling of safety when the toilet is near and you can use it as independently as possible."	D-c	-2	4	1	-3
38.	"An important function of the building is to activate the users; to get them to be interested in things and to move. In that sense long walking distances inside the building are good because they make the users exercise."	D-c	-1	-3	0	0
39.	"All resident/patient rooms should have direct access out on a terrace or balcony, or, nature should be brought inside the building in courtyards or through plants. Nature is an important source of well-being; it activates all our senses, makes us positive and relaxed and think of less stressful things."	A-d	3	4	5	1
40.	"The views outside animates the spaces and makes being in the building a real experience. I really love to just sit and contemplate the scenery. It gives me energy to go on; it gives me power."	A-d	2	4	5	5
41.	"Materials and colours should stem from the surroundings; local materials, local culture and local history. This attitude gives an identity to a place; makes it part of a larger context in time and space."	B-d	1	-1	2	-1
42.	"The surroundings enable us to feel the passing of time and the different seasons; the sun rising in the morning or setting in the evening, the heat of summer or the typical smell of autumn. This scenery initiates discussion in a natural way."	B-d	5	3	3	0
43.	"I don't mind that the building stands out in the surrounding s or is flashy! An area may have historical traditions, but these traditions evolve and we are part of this evolution."	B-d	-3	-3	-2	-2
44.	"There should be many places to spend time in outside; in the courtyards surrounded by trees or in the open places; in the shadow or in the sun. I feel that it's easier to meet people and chat outdoors, because it's a neutral place to talk in."	C-d	2	0	4	2
45.	"It's good that there are no walls or fences around the building site. That way you can look at what's going on in the neighbourhood and the building feels part of the surroundings. The building should also be used by people from outside, from the community."	C-d	-2	-3	3	-3
46.	"The flexibility of a space is the key issue! The spaces should foremost be designed so that it's possible to use them in many different ways, and adopt them to the needs of different users and their way of life. The users define the spaces."	D-c	0	1	-3	3
47.	"The surroundings should provide lots of activities for the users; walk around or sit in the courtyards; dry laundry; grow vegetables and gardening. These activities are important because they turn the care environment into a real healing environment – they make us live."	D-d	2	-1	-2	-3
48.	"The surroundings should be easily attainable, flat, clearly articulated and well-lit. This makes it easier for the users to go outside without help of staff or family members. It gives a feeling of safety."	D-d	-2	0	5	1

Variance = 8.333   St. Dev. = 2.887   *code = matrix code in the theoretical model

Table 4 The Respondents of the Q-sorting experiments (N=45) and their Factor Loadings

N	user status	country	case study	age/gender	A	B	C	D
1.	architect	Japan	'acute'	50 / M	0.43	0.24	0.22	0.21
2.	architect	Japan	'acute'	58 / M	0.60X	0.11	0.32	-0.02
3.	admin	Japan	'acute'	46 / M	0.06	0.73X	0.39	-0.03
4.	care staff	Japan	'acute'	58 / F	-0.24	0.58X	0.17	0.09
5.	family	Japan	'acute'	31 / F	0.19	0.30	0.61X	-0.23
6.	architect	Japan	'acute'	- / M	0.80X	-0.01	0.02	-0.06
7.	architect	Japan	'chronic'	56 / M	0.68X	0.09	0.12	0.09
8.	admin	Japan	'chronic'	56 / F	0.78X	-0.13	0.20	0.01
9.	care staff	Japan	'chronic'	26 / M	0.29	0.23	0.27	0.16
10.	patient	Japan	'chronic'	52 / F	0.13	-0.03	0.08	0.01
11.	patient	Japan	'chronic'	46 / M	0.35	0.25	-0.01	0.15
12.	family	Japan	'chronic'	53 / F	0.50	0.26	0.37	-0.16
13.	admin	Japan	'chronic'	59 / M	0.37	0.11	0.32	-0.04
14.	care staff	Japan	'chronic'	53 / M	0.45	0.35	-0.03	-0.16
15.	patient	Japan	'chronic'	12 / M	-0.03	0.25	0.06	-0.46
16.	patient	Japan	'chronic'	18 / F	0.28	0.21	-0.06	-0.06
17.	architect	Japan	'chronic'	59 / M	0.63X	0.05	0.29	0.20
18.	admin	Japan	'chronic'	61 / M	0.76X	0.01	0.01	-0.08
19.	care staff	Japan	'chronic'	46 / F	0.76X	0.09	0.31	-0.09
20.	resident	Japan	'chronic'	79 / M	-0.08	0.00	0.18	0.05
21.	family	Japan	'chronic'	43 / F	0.34	0.35	0.39	0.04
22.	architect	Europe	'acute'	59 / M	-0.04	0.14	0.12	0.74X
23.	admin	Europe	'acute'	54 / M	0.05	0.48	-0.29	0.20
24.	care staff	Europe	'acute'	62 / M	-0.06	0.62	0.22	0.33
25.	patient	Europe	'acute'	29 / F	0.20	0.34	0.19	0.68X
26.	patient	Europe	'acute'	32 / M	0.27	0.64X	0.11	-0.10
27.	architect	Europe	'acute'	52 / M	0.54X	0.37	0.09	0.25
28.	admin	Europe	'acute'	54 / M	0.01	0.76X	-0.07	0.19
29.	care staff	Europe	'acute'	44 / F	-0.21	0.60X	0.30	0.35
30.	patient	Europe	'acute'	79 / F	0.32	0.66X	0.05	-0.09
31.	patient	Europe	'acute'	45 / M	0.62X	0.25	0.07	0.01
32.	architect	Europe	'chronic'	33 / F	0.64X	0.07	-0.10	-0.07
33.	admin	Europe	'chronic'	30 / F	0.30	0.13	0.07	0.05
34.	visitor	Europe	'chronic'	23 / F	0.34	-0.13	0.09	0.25
35.	visitor	Europe	'chronic'	23 / F	0.53	-0.03	0.02	0.21
36.	architect	Europe	'chronic'	40 / F	0.76X	-0.22	0.20	0.07
37.	admin	Europe	'chronic'	- / F	0.26	0.01	0.17	0.04
38.	care staff	Europe	'chronic'	47 / M	0.62X	-0.01	0.00	0.27
39.	resident	Europe	'chronic'	50 / F	0.12	0.02	0.20	-0.14
40.	resident	Europe	'chronic'	38 / F	0.35	0.19	0.36	0.21
41.	architect	Europe	'chronic'	44 / M	0.51	-0.11	0.49	0.38
42.	admin	Europe	'chronic'	45 / M	0.14	0.10	0.76X	0.30
43.	care staff	Europe	'chronic'	46 / F	0.12	0.08	0.84X	0.08
44.	resident	Europe	'chronic'	87 / F	0.10	0.10	0.75X	0.06
45.	family	Europe	'chronic'	30 / M	0.39	0.20	0.56X	0.26
Factor % expl.Var.					19	10	10	5

X = defining sort, statistically significant factor loading > 0.37

Table 5 The respondents: user/stakeholder information

N=45		total	Japan	Europe
respondents		45 persons	46,7% (n=21)	53,3% (n=24)
average age		46,7 years	48,1 years	45,5 years
gender	/male	53,3 % (n=24)	61,9% (n=13)	45,8% (n=11)
	/female	46,7% (n=21)	38,1% (n=8)	54,2% (n=13)
user/stakeholder status				
architect		22,2% (n=10)	23,8% (n=5)	20,8% (n=5)
administration		20,0% (n=9)	19,0% (n=4)	20,8% (n=5)
care staff		17,8% (n=8)	19,0% (n=4)	16,7% (n=4)
patient/resident		26,7% (n=12)	23,8% (n=5)	29,2% (n=7)
visitor/family member		13,3% (n=6)	14,3% (n=3)	12,5% (n=3)

5   DISCUSSION

The comparison of table 3, showing factor scores of each statement, and table 4, indicating respondent's factor scores, make it possible to connect the opinions expressed within the factors and the individual persons expressing these opinions. In the following discussion an attempt will be made to address each factor in relation to the geographic location and building typology of the case study building, the user status, age and gender of the respondents, as well as in relation to the aesthetic dimensions of the theoretical model.

Factor A is the strongest factor explaining 19% of the results, comprising 13 respondents defining the factor. These respondents are evenly distributed between Japan and Europe, which would indulge the interpretation that the aesthetic values and preferences expressed in the factor go beyond cultural dimensions, and perhaps stem from a universal sense of a human right to integrity, privacy and respect. When looking at the user status of Factor A's respondents, the majority are architects (7/13), while the rest are evenly distributed on the spectrum of user/stakeholder groups (admin 2/13, care staff 2/13, patients 1/13, visitors 1/13). Interestingly, the fact that the building was an 'acute' (4/13 respondents) vs. 'chronic' (9/13 respondents) care setting does not explain factor A, although the users and stakeholders of rehabilitation centres and care homes are more represented than those of the acute hospitals and specialized clinics. This underlines the interpretation that discourse of factor A might indeed be universal.

At the risk of generalizing, the points of view of factor A are not in line with the reality of many care environments of today. At least, when looking at new hospital buildings in Finland you are frapped by floor plan efficiency at the cost of privacy and integrity (the common standards is still two-person rooms where the person next to the corridor is forced to spend his/her day without a view outside and without privacy) and easy maintenance at the cost of ambience and sensory qualities.

Eight respondents belong to **Factor B** corresponding to 10% of the variance among the respondent's Q-sorts. The user status of these respondents is dominated by persons from the administration (3/8) and the care staff (3/8). Two of Factor B's adherents are patients; none are architects. Defining for factor B is that the case study buildings represented by the respondents belong to the large scale 'acute' high-tech hospital setting. This explains the strong focus on hygiene, safety and functionality. In a large hospital environment where patients are ambulatory passers-by there is no need for softness, personalized spaces or social contacts – at least not from the perspective of care staff and administrators. They are in the strictly curing business; not the caring.

Factor C is representative of the opinions of five respondents, corresponding to 10% of the variance among the respondent's Q-sorts. Four out of these five users and stakeholders originate from the same care facility, a European care home for the elderly, classified into the "chronic" care setting category. The user status of these respondents is varied covering persons from the administration, the care staff, a resident and a family member. An important feature of this care environment is indeed the integration of nature inside the building as well as an active and open location in the centre of a small rural village. The fifth respondent belongs to the opposite category; a family member of a patient at a Japanese "acute" hospital environment. However, this respondent has one thing in common with the others; she was the relative of a long-term elderly person who received palliative care at the hospital, which could explain the priority put on well-being, nature and a supportive environment.

Factor D represents a narrow view in the whole aesthetic spectrum with only two respondents explaining 5% of the variance. Yet it differs from the other factors, through the systematic and rational views on the care building as a flexible, pragmatic way-finding 'machine' guiding visitors through the care experience. The respondents both come from the same case study building, a large European "acute" hospital environment, their user status being completely different; one is designer and the other a patient.

6   CONCLUSION

This article presents the preliminary results from a qualitative study investigating the aesthetics and architecture of care environments through the case study of ten case study buildings in Japan and Europe. The results from 45 Q-methodological interviews is analysed using statistical methods, identifying four factors. These factors represent clusters of opinions that illustrate much of the healthcare design discourses of today, yet with a personal dimension of being the opinions of specific user and stakeholder groups in relation to specific care environments. The following discourse are identified A) "respect for integrity and privacy – the Quality aware", B) "hygienic, utilitarian and safe – the Nightingale discourse", C) "nature, well-being and personalization – the supportive care environment", and D) "the way-finding system – care as a rational experience".

Research limitations of the article: only the results of a preliminary analysis, which at best grasps the most evident, statistical data, are presented. Further analysis and hermeneutic perspectives will aim at retrieving a more complete picture of the experience of care environments by looking at the underlying reasons expressed by the respondents.

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HOSPITAL DESIGN

TWO HOSPITALS: FINNISH MISSIONARIES AND SOUTH AFRICAN APARTHEID

Catharina Nord

Associate Professor
National Institute for the Study of Ageing and Later life
Linköping University
catharina.nord@liu.se

ABSTRACT

This paper presents two hospitals in northern Namibia and discusses the architectural design as embedded in two different political discourses which generates entirely different forms. One is Onandjokwe hospital constructed by Finnish missionaries in 1911. The other, Oshakati hospital, inaugurated in 1966, was the first governmental hospital in this part of Namibia as a response to the international critic of apartheid neglect of black people's health. There are major differences between the hospital design and construction management of the two hospitals. Discursive differences are visible in construction, building material and layout including spatial separation of patients as well as staff.

The paper also frames the hospitals in the wider politico-geographical process in which South African warfare in the area from 1966 to 1989 is central. The two hospitals became associated to the two different antagonists in the conflict. Oshakati hospital became a part of the South African war machinery, while Onandjokwe became a "terrorist" hospital where wounded guerilla soldiers searched for care. The major South African army base was constructed just adjacent to the Oshakati hospital. Three other governmental hospitals were also constructed in the area during the conflict as a part of the strategy to "win the hearts and minds" of the local people

Keywords

architectural design, apartheid, hospital, missionary medicine, Namibia, warfare

1   INTRODUCTION

South African apartheid ideology involved social engineering ambitions. This included a separation of races, which was fulfilled by the spatial organization of 'homelands'. The apartheid ideology also produced design of various different buildings and environments (Judin and Vladislavic', 1998). This paper presents the design of two hospitals in Northern Namibia; one, Oshakati hospital, in which the apartheid ideology is clearly enacted in architectural form. As a contrasting example, the Finnish missionary Onandjokwe hospital was constructed with a different ideological standpoint.

Northern Namibia was entrusted to South Africa as a Mandate after the 1st World War. Over time the South African mandatory regime turned into a full scale occupation in defiance with the decisions of the United Nations. One aspect of the international criticism was the neglect of the health of the black people living in Namibia. Oshakati hospital, the first governmental hospital in northern Namibia, was constructed mainly as a response to this criticism and as part of the formal introduction of apartheid in this part of the country. At the time the Oshakati hospital was opened in 1966, the Finnish Missionary Society had provided biomedical healthcare to local people during fifty years, partly funded by the South African government.

2   A MISSIONARY HOSPITAL

In 1908, Dr. Selma Rainio arrived in Ovambo from Finland. During her first posting, she saw outpatients in huts outside the little building where she stayed. However, the plans for the construction of proper buildings soon started.
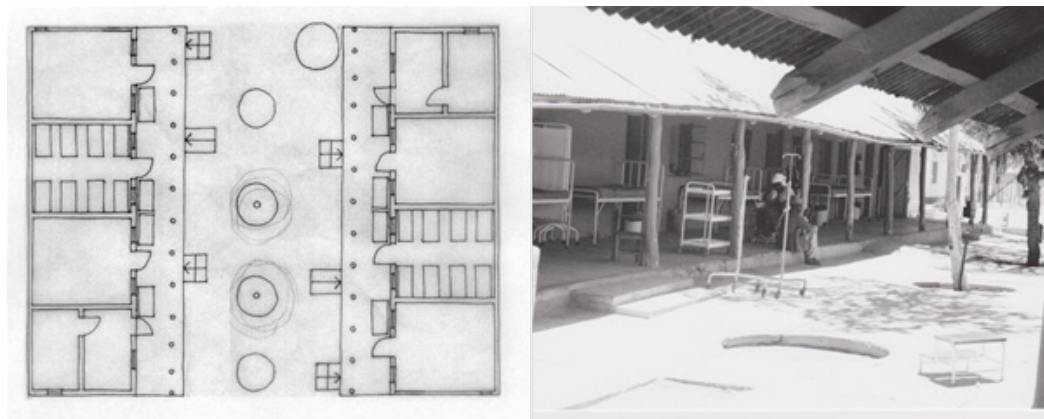
Plan   Space in between the two wards

Figure 1 Two original wards in Onandjokwe Hospital still in use in 1995. Photo: The author.

The first building of Onandjokwe hospital was constructed of adobe bricks. It contained seven living rooms, a kitchen and a storage room for groceries. This building, which also contained an outpatient clinic and an operating room, was inaugurated on 9 July 1911. During the following decades, the hospital was extended with both smaller and larger buildings for dwelling or for healthcare purposes. Some were simple structures, such as storage rooms,

workshops or sheds. Accommodation for staff and patients and a few larger buildings for medical services were finished between 1912 and 1926. The larger buildings had a veranda, which followed the entire length of the house with an overhanging roof giving shadow to the veranda as well as the interiors. All were clay buildings. The roofs, often covered with thatch, were supported by tree trunks, and provided shelter for patients waiting to be seen by the doctor (Kyrönseppä, 1965). These buildings were hybrids of local architecture and western types of hospital buildings (Nord, 2014). Much of the healthcare was provided on an outpatient basis although the hospital also had the capacity to provide inpatient care. Surgery was carried out at the hospital. Inpatient accommodation was provided in huts erected for the purpose, where patients and accompanying family could stay.

To the missionaries, medical care was not a healthcare undertaking alone but was intermixed with religious ambitions and proselytizing. Healthcare was used to attract people to the Finnish missionary hospitals where they were approached with a religious aim (Miettinen, 2005). This was a successful strategy. Even people who wanted to have little to do with missionaries in general could be approached by means of medical care (McKittrick, 2002).

3 A NEW HOSPITAL IN OSHAKATI

The plans for the introduction of apartheid in northern Namibia was presented in the Odendaal Plan, an official governmental report (Odendaal Plan, 1964). It was suggested that a homeland would be established, Ovamboland. There was a particular focus on the improvement of health services in the report. The plans to construct a governmental hospital was presented.

The South African government may have expected that the fact that it was a large capital project of strong symbolic value would impress the international audience (cf. McPake, 2009).
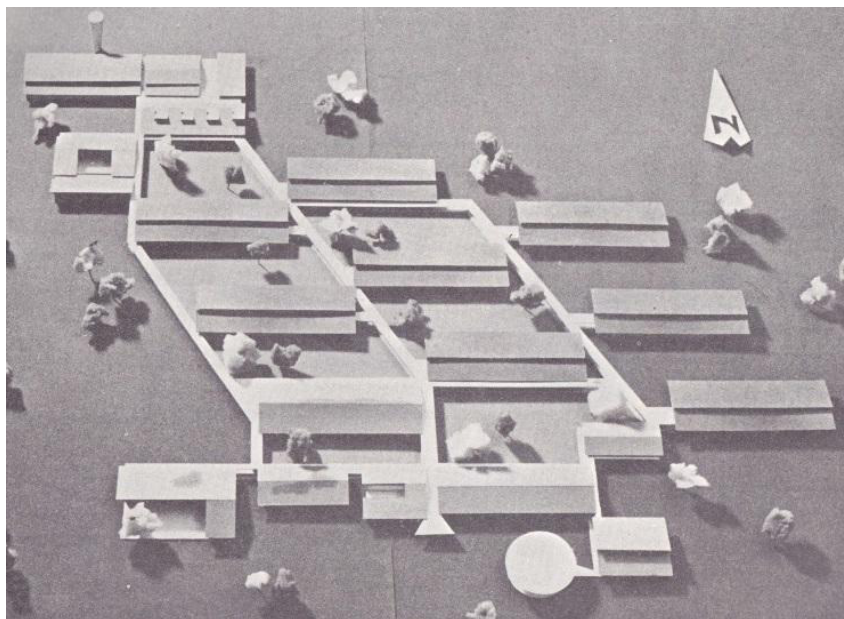
Figure 2 A model of the Oshakati hospital in the Odendaal Plan, p. 177.

However, the international audience was not satisfied. The same year as the hospital opened in 1966, South Africa lost the Mandate and South African presence was declared illegal.

The construction of Oshakati hospital was carried out in a notable way which revealed little confidence in the resources of the north. The use of local materials and architectural forms that were applied by the missionaries were absent in the South African construction (Nord, 2014). The hospital buildings were made of prefabricated asbestos walls and iron sheet roofing produced in South Africa and transported an approximate distance of 2500 kilometres by train to Tsumeb, 300 kilometres south of Oshakati. The large and heavy building components were reloaded from the train to lorries and the transportation continued to Oshakati where the walls were erected (Bremer, 1966).

When the hospital was inaugurated it was severely undersized for its mission of serving the approximately 230 000 people living in the area. The hospital had 444 beds. Beds for black patients were divided among three general wards for adults, one ward for children, one maternity ward, and four TB wards of which one was for children. Each inpatient ward contained about 40 beds. There were also a surgical theatre, an outpatient department and a dispensary. There were offices for administration and buildings for the nursing school (Bremer, 1966). The buildings were robust and rough, both the exteriors as well as the interiors. A simple corridor ran through the greyish inpatient wards. Meals were served in the dining-hall on sturdy tables to patients who sat on benches made of wood. Covered walkways connected the wards and protected patients and staff from the harsh climate, sun and sand (Own observations).

Figure 3 Entrance to Oshakati Hospital 1995. Photo: The author.

The apartheid ideology was visible in the design of the hospital. White patients were offered a substantially higher standard than blacks, with a special inpatient ward with four private en-suite rooms with patios and baths, and a delivery ward. Staff accommodation was subject to similar considerations. The quality of accommodation for the various types of staff reflected both their respective place in the hospital staff hierarchies, as well as the colour of their skin. White doctors and senior non-medical staff were provided with a family house or flat. Two types of accommodation for nurses were provided. "European Sisters" were accommodated

in double-room flats with a kitchen in the patio and shared entrance and bathrooms. "Non-European" nurses, auxiliary nursing staff and nursing students lived in so-called single quarters (Own observations). White staff were also provided with a tennis court and a swimming bath. The separated accommodation had a practical rationale. Black and white staff members were not allowed to socialize outside working hours.

4   WIN THE HEARTS AND MINDS STRATEGY

In 1966 the civil war started between the liberation movement and South Africa. The conflict completely changed the conditions for the hospital in Oshakati. The immediate surroundings of the hospital were fortified and fenced when a major South African base was established in the immediate vicinity. The entrance to the base was opposite the entrance to the Oshakati hospital. The hospital became an asset in the South African war machinery, staffed with military medical personnel. Both hospitals in received many patients produced by warfare and torture. In Onandjokwe, also guerrilla soldiers searched for care. In the 70s the missionaries openly chose the liberation movement (SWAPO) side in the conflict. As a consequence the Onandjokwe hospital was labelled as a 'terrorist' hospital by the South Africans. It was raided by militaries at a number of occasions.

The South African defence force embarked on the strategy of winning the hearts and minds of the local people in order to improve their relations with them and to facilitate their presence. The provision of medical services to an area they had previously neglected was a part of this campaign. In a few years in the 80s, three new governmental hospitals were constructed in close vicinity to each other not far from Oshakati hospital, Ombalantu (Nakanyale), Tsandi and Okahao hospitals. Tsandi and Okahao hospitals were about 25 kilometres apart and the hospital in Ombalantu was about 40 kilometres away from the others. This was a "seductive donation" to local headmen in order to make them cooperative (Hangula, 1993, p. 17). The hospitals were located in the respective jurisdiction areas of three ethnic groups, Ombalantu, Uukwaluudhi and Ongandjera. The three hospitals were akin to the hospital in Oshakati in type and in building techniques. All were a model type of hospital. They had similar layouts (the Tsandi and Ombalantu hospitals were identical) in which inpatient wards and other buildings were connected with a system of covered walkways. Their sizes were comparable. Although very close to each other, they did not represent a parallel facility provision for whites only. These hospitals were for civilian use, and were intended for black patients.

5   EPILOGUE

In 1988, diplomatic endeavours put an end to the border war. The new Namibian government took on the arduous task of renovating, refurbishing and reorganizing the apartheid healthcare system they took over at independence. In the mid-90s, renovation works started in the now Intermediate Hospital Oshakati that was to replace the whole hospital. This work was finished just over ten years later. The three hospitals Okahao, Tsandi and Outapi were adapted to the district level and totally renovated. Onandjokwe hospital was now run by the Evangelical Lutheran Church of Namibia and was also renovated. It celebrated its 100-year anniversary in 2011. The first adobe building is kept and renovated as a museum.

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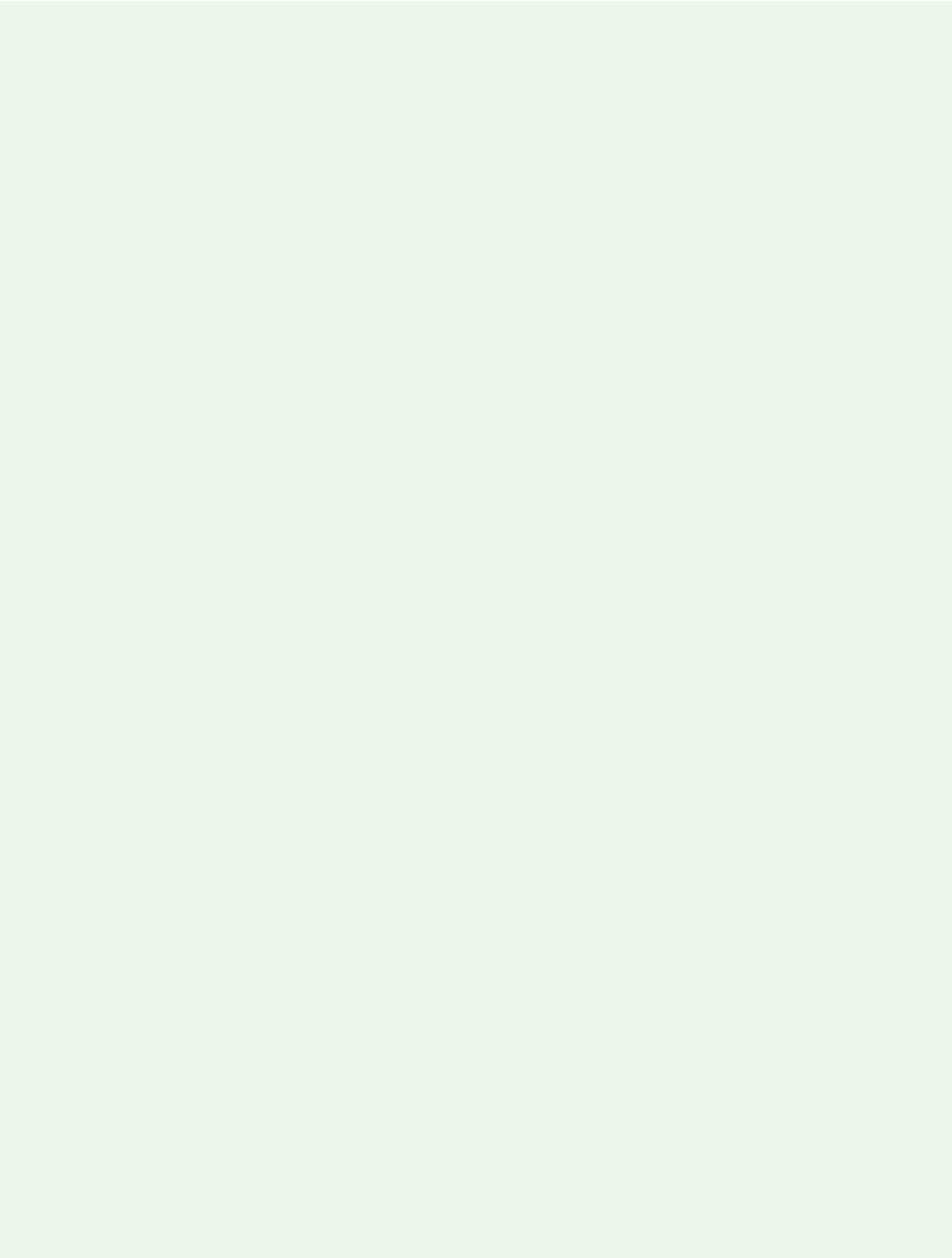
STUDY OF THE ENVIRONMENT AT A PSYCHIATRIC HOSPITAL IN FINLAND

Shuang YAN
Ph.D. Professor
Miyagi Gakuin Women's University, Japan
yan@mgu.ac.jp

ABSTRACT

Finland underwent a major reform of its psychiatric healthcare services in the 1980s, which proved to be a great success. The number hospital beds has fallen to around the same level as the EU, which is partially attributed to the adoption of a home-oriented healthcare approach. This study addresses some aspects of the care environment of Finland's psychiatric wards that helps explain the successful transformation of psychiatric healthcare in Finland.

The institution for this study is an eight-ward psychiatric hospital on the outskirts of Helsinki. I conducted an observational investigation of each ward of Aurora Hospital from October to December 2012, and the chief findings are summarized as follows.

1 Insights regarding the organization and deployment of spaces

- It was apparent from this study that private rooms may not be necessary or even appropriate for all patients.
- Patients seemed to prefer the corridors and other buffer zones for a range of diverse activities and uses. It suggests that "ambiguity" and "flexibility" should be incorporated into the design of common spaces in psychiatric wards.
- In addition, the placement of staff stations, smoking rooms, and other facilities with clearly defined functions should be carefully considered in the layout and design of psychiatric wards, and optimally located.

2 Insights regarding nursing staff

- The staff spent far more time chatting and interacting with the patients.
- The closeness of this interaction between staff and patients gave the patients a sense security and reassurance, encouraged patients to interact among themselves, and seemed to break down barriers to interpersonal communication.
- This supports the primary objective of the psychiatric hospital, which is to promote the early release of patients back to their communities and homes.

Despite a modest investment in the buildings of Aurora Hospital and rather confined interior spaces, they nevertheless succeeded in creating a very warm and supportive ward environment. And by building up a larger medical staff, the hospital is able to provide more robust emotional support and psychiatric care. This enables patients to be released early, which further promotes the downward trend in the number of hospital beds in Finland.

1 INTRODUCTION

1.1 Research Background

While the number of psychiatric hospital beds per 1,000 population in OECD member nations has continued to decline in the U.S. and other advanced economies since the 1960s, Japan has moved in the opposite direction. In Japan, the number of psychiatric beds continued to increase well into the 1970s, then slowed to a marginal increase before leveling off, and Japan has become somewhat backward in terms of psychiatric care (Figure 1). In addressing this situation, Japan has had some success strengthening its emergency medical services and shortening the length of hospital stays by revising reimbursements of medical fees for acute psychiatric services and other measures. Yet none of this has had much effect on reducing the number of hospital beds in Japan.

The Nordic countries of Sweden and Finland shared Japan's sorry reputation for psychiatric care with more beds per capita than Japan into the second half of the 1980s, but subsequently implemented psychiatric health-care reforms beginning in the 1980s that brought these countries up to roughly the same average level as the EU.

The primary objective of this study is to describe the psychiatric care environment of Finland in some detail. Through this observation study of the behavior of patients and nurses in the eight wards of Aurora Psychiatric Hospital in Helsinki, we will highlight the care environment of inpatient wards of Helsinki's primary psychiatric hospital.
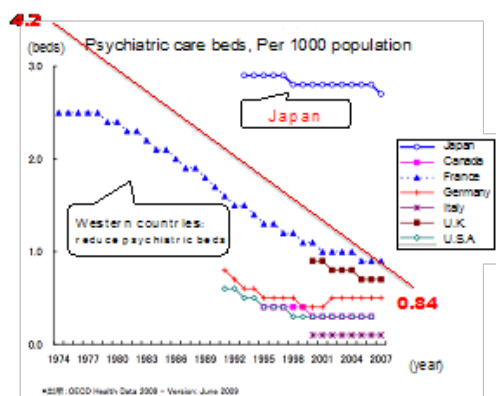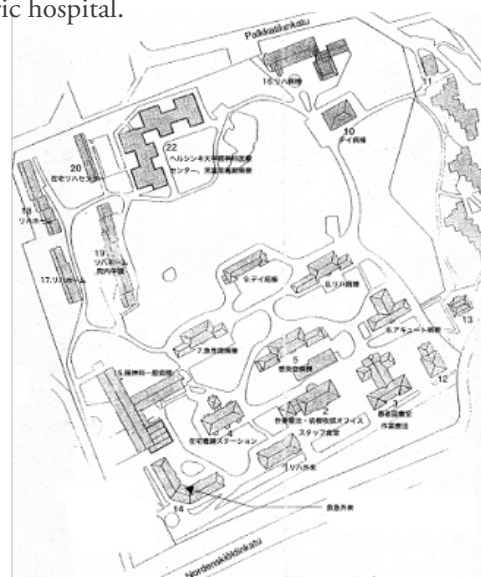
Fig 1 The number of Psychiatric care beds/1000 population   Fig 2 Site plan of Aurora hospital Survey Wards

1.2. Overview of Survey Objectives

1.2.1. Overview of Survey Hospital (Wards)

Aurora Hospital is the facility providing specialized psychiatric healthcare services to the citizens of Helsinki. This study will focus on the eight wards of Aurora Hospital including acute wards 6-1, 7-1 and 7-2, Nomal psychiatric wards 15-3C and 15-6C, rehabilitation

wards 8-2 and 16-2A, and the Laakso Ward which is located off-campus at a different site. Average number of hospitalization days for these three types of wards are 16.7 days stay in the acute wards versus 27.5 days in the nomal psychiatric wards, and a rather lengthy 149.5-day stay in the rehabilitation wards.

There are 11 to 15 patients in each ward, with a ratio of 1.7 staff members (including nurses) to each patient in the acute wards, and approximately the same number of staff as patients in the psychiatric and rehabilitation wards. During the day shift, a ward doctor, nurses, and assistant nurses (equivalent to assistant nurses in Japan, but requiring additional specialized training) are on duty in each ward. The staff also includes a secretary to take care of administrative matters and a part-time social worker who provides consulting to patients on finance-related matters. There are roughly three times more staff members on duty than a typical ward of a Japanese hospital.

1.2.2 Patients Covered by the Survey

Patients in the acute wards with the most serious mental disorders have a range of different conditions, but approximately 46% of patients have some sort of mood disorder and 38% have been diagnosed with schizophrenia. I also observed that some 40% of the schizophrenic patients are in rehab and have been in and out of Aurora Hospital in the past.

More than 70% of patients in the nomal psychiatric wards where hospitalization stays tend to be longer have acute schizophrenia, and all patients in the rehabilitation wards are long-term rehab schizophrenia patients.

Complete recovery is elusive, but patients could be broadly divided between schizophrenics with recurring symptoms who are treated in the open and rehabilitation wards, and the patients with mood disorders and other mild mental conditions who are treated during short-term admissions to the hospital. I would note that even in the case of mood disorders, they can only be treated after assessing whether the disorder is accompanied by other symptoms of mental illness.

Table 1 Day shift of staff

Wards	No.6-1	No.7-1	No.7-2	Laakson	No.15-3	No.15-6	No.8-2	No.16-2A
	Acute Wards				Psychiatric Wards		Rehabilitation Wards	
Total number of staff(M/F)	25(17/8)	19 (15/4)	19 (15/4)	17	25(18/7)	25(16/9)	23(20/3)	23(19/4)
head nurse	1	1/2	1/2	1/2	1	1	1	1
assistant head nurse	1	1	1	0	1	1	1	1
nurse	8	5	5	5	6	5	5	5
mental nurse	5	4	4	4	6	8	8	8
secretary	1/2							
senior ward psychiatrist	1.5	2	2	2	1	2	1	1
assistant chief of psychiatry	1/3	1/3	1/3	1/2	1/4	1/4		
social worker	1	1	1	1/2	1	1	1/2	1/2
occupational therapist	1/2	1/2	1/2	1/2	1/2		1/2	1/2
psychologist	1/2	1/2	1/2	1/2	1/2	1	1/2	1/3
orderly staff	1.5	1	1	2	2.5	3.5	2	1
nurse student	1					1		
mental nurse student	1							
staff : patient	1.3 : 1	1.5 : 1	1.5 : 1	1.2 : 1	1.5 : 1	2.0 : 1	1.3 : 1	1.3 : 1
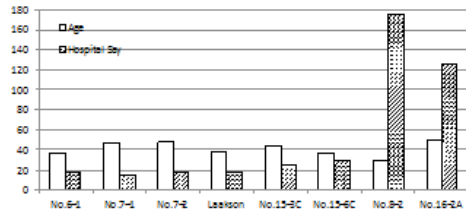
Fig 3 The length of hospital stay and age of patients
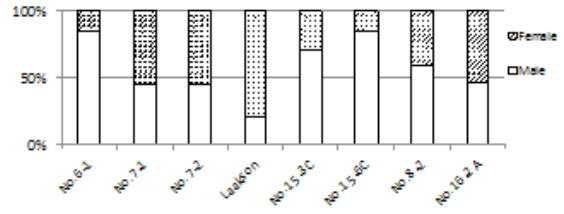
Fig 5 The sex of patients in different ward
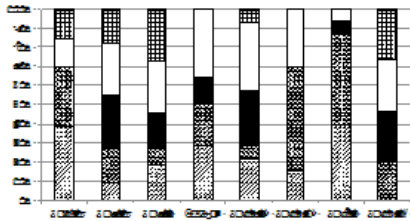
Fig 4 The age of patients in different ward
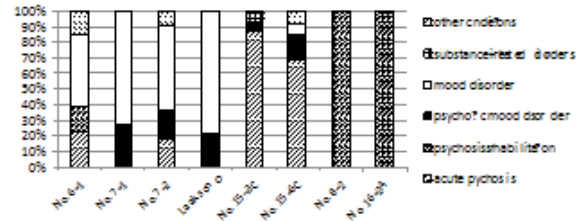
Fig 6 The primary season for admittance / hospitalization of patient in different ward
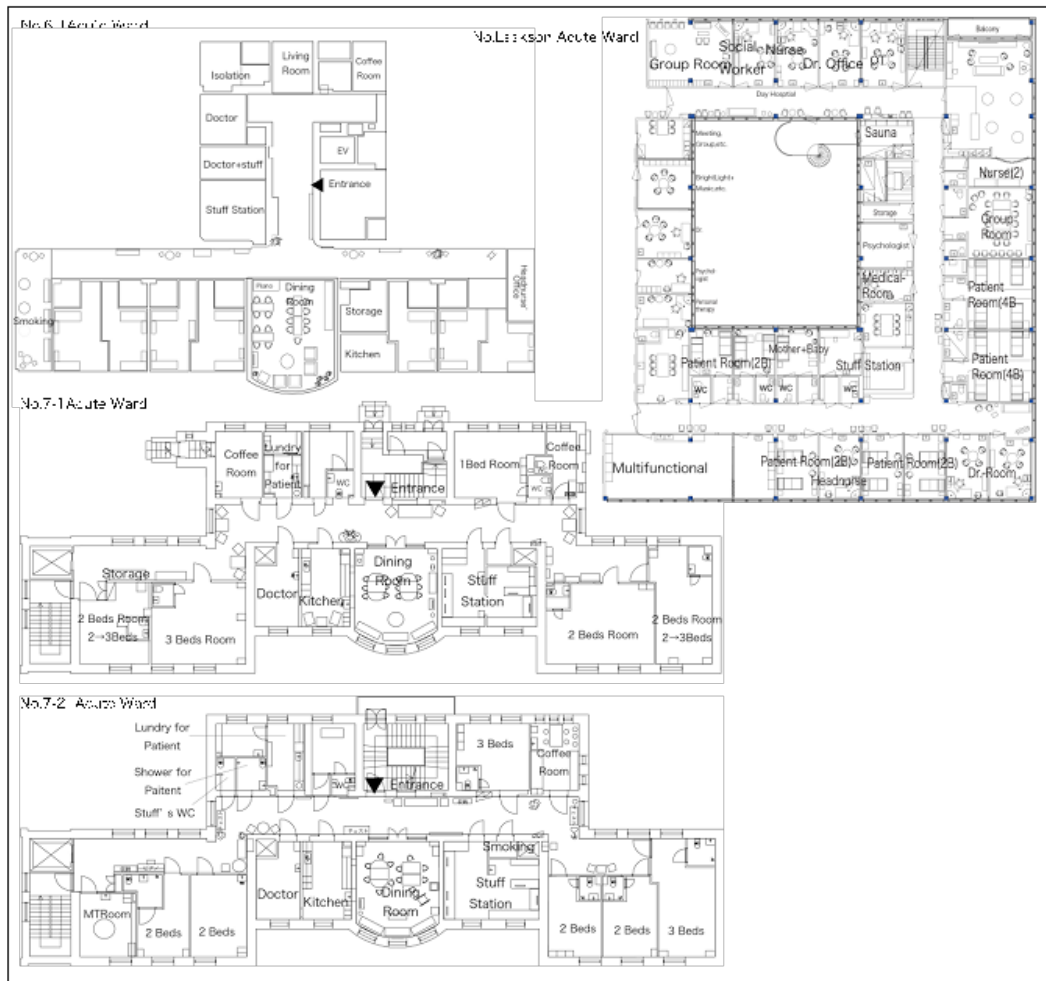
Fig 7 Plans of Acute Wards
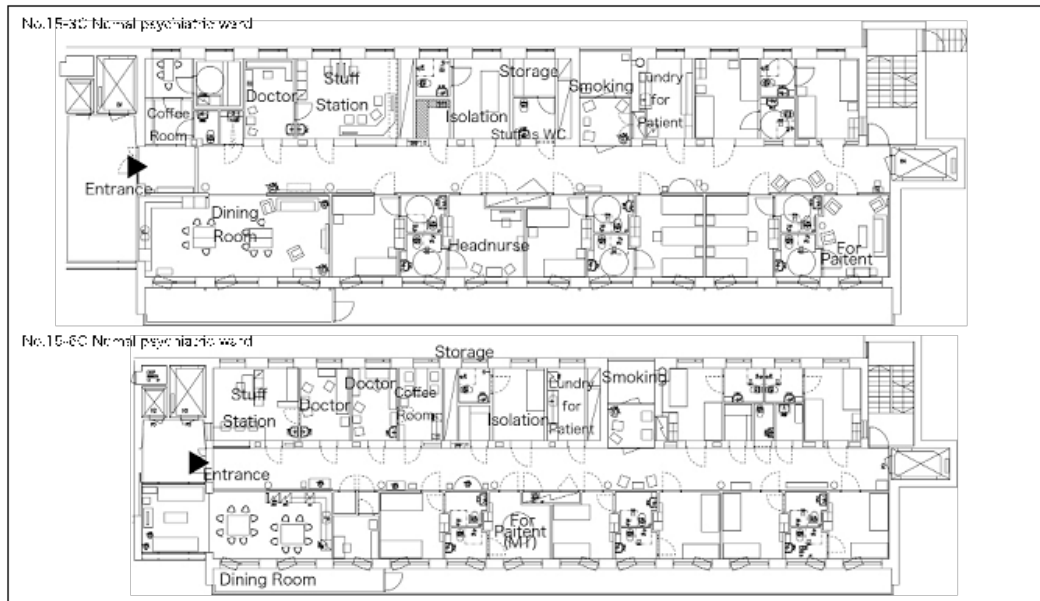
Fig 8 Plans of Normal Psychiatric Wards
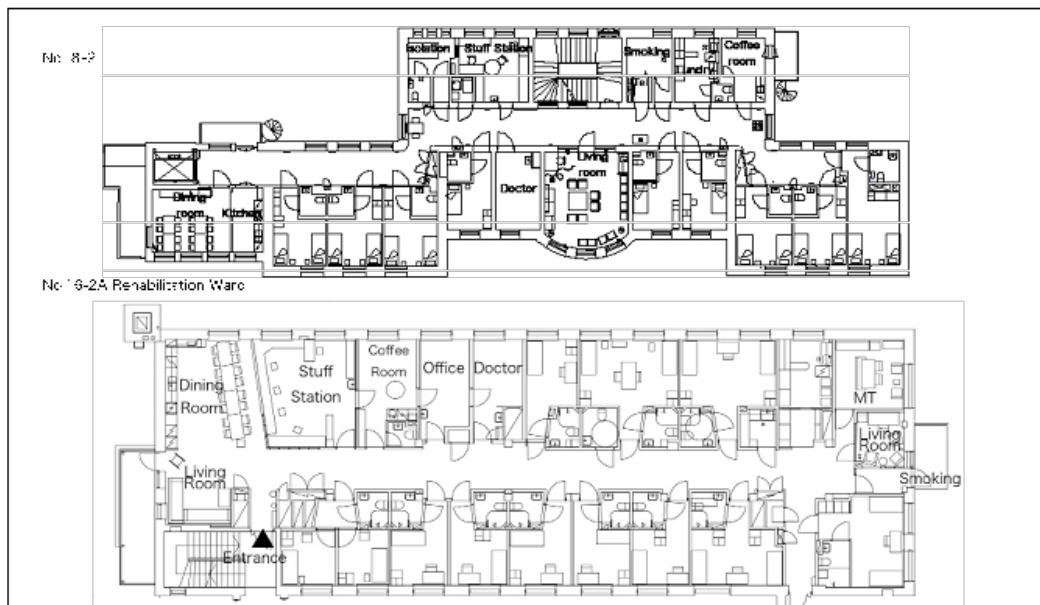
Fig 9 Plans of Rehabilitation Wards

1.3. Spatial Characteristics of the Wards

The building infrastructure for all the wards consists of original large-scale buildings that continue to be used as in the past, and have never been significantly remodeled or renovated. An interior designer/planner has been retained who uses all his professional skill and ingenuity to select furniture and other décor to create a warm home-like atmosphere in all of the wards.

2   APPROACH

This study was a purely passive non-participant observation study where data was collected by observing behavior without interacting with the staff or patients. The whereabouts and the activities of every person on a floor plan of the ward recorded at ten-minute intervals from 8:00 AM to 4:00 PM, which corresponded to the working hours of a regular day-shift nurse. Observational entries on each day of the study are 49. The information about patient attributes, working hours of the nurses followed up with a questionnaire to obtain.

3   RESULTS

3.1. Characteristics of Patient Space Utilization by Different Ward

The occupancy rate of patient rooms throughout the facility exceeds 50% (Figure 11). Ward 16 has the greatest number of single rooms and an occupancy rate of 56.6%, which is below the average of 64.5%. Two of the acute wards—Ward 7-1 and the Laakso Ward—have single rooms, but only one single room each. The occupancy of Ward 7-1 is 52.5%, the lowest at the hospital. The ward with the longest average hospital stays and longest occupancy of its rooms is Ward 8. While different hospital room configurations, including single rooms and rooms with as many as four beds, did not directly affect the utilization and occupancy rate of the rooms, I would speculate that long-term stays might exacerbate the tendency of some patients to isolate themselves in their rooms.

Let us next consider the characteristics of common space usage in the various wards.

3.1.1 Acute Wards

In all of the wards, a good deal of time is spend in the dining rooms (36%-52%) (Figure 12). The next most widely used common space is the corridors. The utilization rate of corridors was around 30%, with the utilization of the Laakso Ward actually approaching 40%.

Aside from dining rooms, Ward 6-1 and the Laakso Ward have living rooms, common lounge areas that see 11% and 21% usage, respectively. While Ward 6-1 has a separate room that it uses as a living room, Laakso Ward has created a living room space at the end of a corridor with sofas and a TV.

Accommodation for smokers varies from ward to ward—Ward 6-1 has a balcony that is used as a smoking room while Wards 7-1 and 7-2 employ cramped storage spaces as smoking rooms—the utilization rate for smoking rooms throughout the facility hovers around 15% (this excludes the Laakso Ward which doesn't have a smoking room).
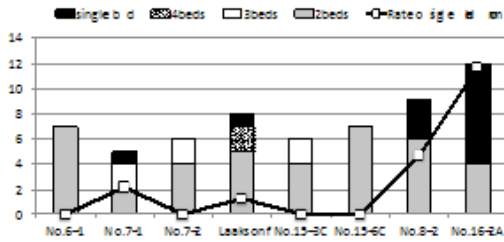
Fig 10 The number of beds in Patients' room
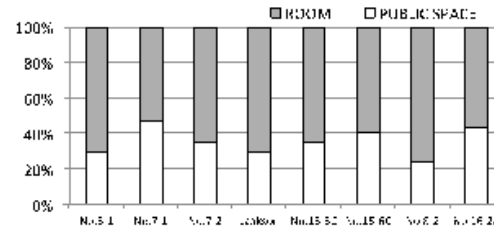
Fig 11 Patient space utilization by different ward

3.1.2 Nomal psychiatric wards

Among all the wards at the hospital, only Wards 15-3C and 15-6C have a central corridor down the middle with rooms on either side. These central corridors are slightly wider than the corridors in other wards, and patients tend to congregate in the corridors rather than in the dining rooms (41% vs. 34% in Ward 15-3C, 38% vs. 28% in Ward 15-6C). This is despite the fact that the corridors are artificially lit, totally enclosed, and have no outside view (Figure 13).

Use of smoking rooms is largely the same throughout the facility, but Ward 15-6C is unique in that many of the patients tend to smoke in the area in front of the smoking room. Wards 15-3C and 15-6C have the same floor plan, but in Ward 15-6C a portion of the corridor right in front of the smoking room has been furnished with a sofa and a small shelf on the wall next to the sofa (Figure 14). In addition to the sofa, there is a radio-cassette player and an odd collage made of cigarette butts that is displayed on the adjacent shelf in the area in front of the smoking room. A full range of activities could be observed in this area as patients congregate to smoke, listen to music, relax on the sofa, and chat with other patients while they puff cigarettes. In addition, there is a sliding door between the hall area and the smoking room that can be opened or closed to flexibly expand or contract the space as desired. This area makes for a very lively location where many of the patients come to pass the time of day. Note that in Ward 15-3C there is no corridor area in front of the smoking room, so in this ward smoking is confined to the actual smoking room.

3.1.3 Rehabilitation Wards

Length of stays in Wards 8-2 and 16-2A are the longest—126 days and 175 days, respectively—but the difference in average age of patients in the two wards is striking: age 30 in Ward 8-2 and 51 in Ward 16-2A.

While the corridor of Ward 8-2 saw the greatest use among hallways in the rehab wards (35%), the dining room area (furnished with cushy sofas) was even more heavily used (44%) (Figure 15). In addition, the smoking room of Ward 8 saw a high rate of usage at 23%. I also observed that the computer room in Ward 16 had a relatively high rate of usage at about 13%.

Based on these observations, I concluded that although there wasn't much difference in patterns of where patients spend their time from ward to ward, it was apparent that patients in all the wards used the corridors as a primary place to hang out.

I also noted that it was not so much the layout or floor plan of the spaces per se, but rather the way the spaces were furnished that influenced how the spaces were used by the patients.
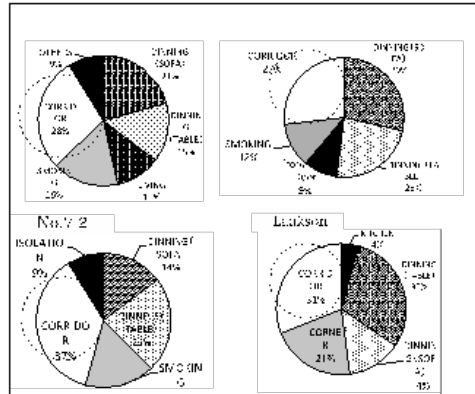
Fig 12 Patient space uitilization in acute ward

Fig 14 The arrangement in front of smoking-room
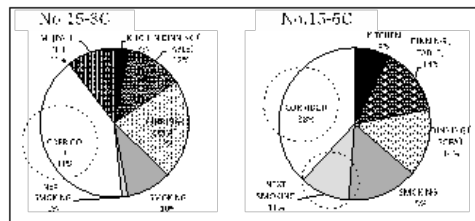
Fig 13 Patient space utilization in psychiatric ward
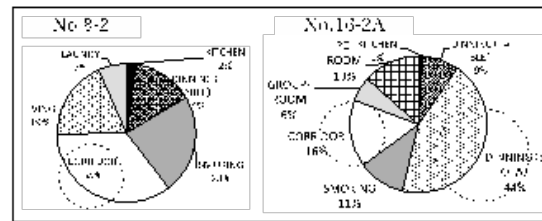
Fig 15 Patient space utilization in rehabilitation ward

3.2 Time Spent in Common Areas

In this section I will consider commonalities and differences in the manner in which patients "singly," "in pairs," or "in groups of three or more" tend to spend time in common spaces of the different wards. Meal times and other programmed time frames shall be excluded from the analysis.

3.2.1 Acute Wards

I observed that most of the patients in Ward 4 tended to be "by themselves," while patients in Ward 7-2 congregated in "groups of three or more" and patients in Laakso Ward were often seen in "pairs" (Figure 16).

Figure 17 shows the manner in which the acute ward patients tend to congregate or group themselves broken out by different locations. One can see that in Acute Ward 6-1 where the severest cases are treated, the patients tend to be "by themselves" in virtually all places throughout the ward except in the dining room (furnished with sofas) where they are escorted by nurses. The corridors appear to be an exception, where the patients are often seen in "pairs."

Acute Wards 7-1 and 7-2 exhibit similar grouping patterns in the dining room (furnished with tables) where patients gather in "groups of three or more," but patients typically interact with nurses in front of the staff station in Ward 7-1 and in the corridor of Ward 7-2. Patients confined to the padded protection room in Ward 7-2 are constantly attended by a nurse.

Laakso Ward was somewhat unique in that roughly the same number of patients were seen "by themselves" as in "pairs." I was also told that nurses generally accompany patients in the dining room (furnished with sofas) and in the corridor.

3.2.2 Nomal psychiatric wards

The patterns in which patients grouped themselves in Wards 15-3C and 15-6C that admit many schizophrenic patients is quite similar. Some 4-5% of patients "keep to themselves," 2-3% were observed "in pairs," and the rest formed "groups of three or more" (Figure 18).

Examining the different places throughout the facility where patients hang out, I observed that many patients were seen in the various kitchens together with nurses (Figure 19). In Ward 15-3C, I saw quite a few patients "in pairs" in the corridor, which can probably be attributed to the fact that they tend to associate "in pairs" at the end of the corridor just outside the smoking room. As noted earlier, the vestibule area in front of the smoking room and corridor can be flexibly combined to make a continuous space for any occasion or purpose.

3.2.3 Rehabilitation Wards

The way patients group themselves in the two rehabilitation wards is strikingly different. Roughly 40% of patients "stick to themselves" and 40% form "pairs" in Ward 8-2, while fully 70% of patients are "alone" in Ward 16-2 (Figure 18).

One factor explaining this difference is the manner of interaction with nurses (Figure 20). In Ward 8-2, nurses were present in every location where patients congregated, while in Ward 16-2A the nurses were primarily only present in the living room lounge area that was equipped with sofas and a TV. Ward 16-2A also had a computer room where patients could use the computers, and a group activity room where patients could work on group projects. The availability of these amenities was clearly one reason that some of the patients were "by themselves" for prolonged periods.

3.3 Interaction With Nurses

Figure 21 shows the proportion of scenes or settings in which patients are seen together with nurses for all of the wards covered by this study. While Ward 8-2 has an extremely high proportion of 40%, the proportion of such scenes at Ward 16-2A is much lower at only 20%. Similar trends are seen at other acute wards and nomal psychiatric wards with proportions ranging from 20 to 30%.

In the acute wards, the situations where nurses and patients are most likely to be seen together are the corridors and the sofa area in the dining room. At this facility, the corridors are regarded as open spaces where the patients are free to roam.

In the nomal psychiatric wards where many of the more serious schizophrenic patients are being treated, I observed many nurses mingling with patients in the kitchen areas mentioned earlier, and after that, in the sofa areas of the dining rooms. In Ward 15-3C, I saw quite a few nurses in the conference room showing patients who had bought PCs how to use their computers.

In the rehab wards, I noticed that Ward 8-2 had the most interaction between patients and nurses, while Ward 16-2A had the least interaction. While both wards are involved in rehabilitation of schizophrenics, the fact that the average age of patients is so much younger and the length of stays so much longer in Ward 8-2 might account for this disparity. In other words, the nurses are sticking close and keeping a closer eye on the younger schizophrenics who apparently are harder to completely cure.

3.4 The Object of Behavior

In this section, I will consider how patients pass the time or behave in common spaces.

For the purposes of this study, I will classify patients who are together with another person but not involved or engaged with that person as "person"; physical objects sought but in the absence of activity as "something(physical objects)"; objects one seeks to achieve by oneself as "doing something(abstract objects)"; objects one seeks to accomplish in collaboration with another person as "person + person"; objects one sees by looking outside as "outside(scenery)"; and psychotic states of immobility or unresponsive stupor as "nothing(inaction)."

Approximately 50% of patients admitted to Ward 7-1 and the Laakso Ward with mood disorders are capable of interpersonal behavior (person, person + person). On the other hand, I observed that many of the schizophrenia patients admitted to Wards 8-2 and 16-2A were obsessed with achieving something on their own (abstract objects). I also noted quite a few patients admitted to Wards 15-3C, 15-6C, and 16-2A for longer stays at the facility who exhibited unresponsive inactive behavior. Yet it was also apparent that there were fewer among the younger patients admitted to Ward 8 for longer periods of treatment who exhibited this unresponsive inactive behavior. This suggests that a patient's socializing behavior is affected not only by age and attributes of the patient's disorder, but also by the length of a patient's stay at the hospital.

Besides patient attributes and the spatial layout of the wards, interaction with nurses plays an important role in affecting a patient's behavior. Indeed, one can infer that patients become increasingly preoccupied with interacting with others as the length of their hospital stay increases.

3.5 Consideration of the Meaning of Place

Let us next consider the meaning or significance that psychiatric patients attach to different spaces based on the usage that we described for the various wards.

I observed earlier that many patients tend to hang out in the corridors of the wards either by themselves or in pairs (including patients accompanied by a nurse), and it was apparent that some of the patients interacted with others while other patients were unresponsive and inactive. This suggests that, while certainly individual attributes, length of stay, and spatial conceptions of the patients varied, the patients I observed in this study all tended to regard the corridors as appropriate places to communicate and interact with others.

I also noted that, except for Ward 8-2, the smoking rooms were primarily places to engage in individual behavior (i.e. smoking), and came to be perceived as places for individuals.
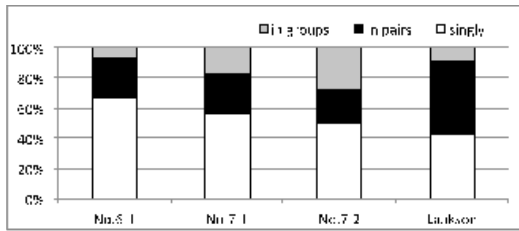
Fig 16 Time spent in common (Acute ward)
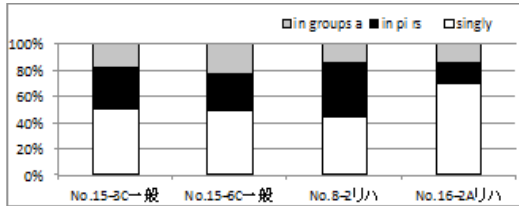
18. Time spent in common (Nomal/Rehabilitation)
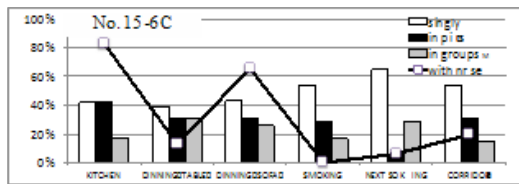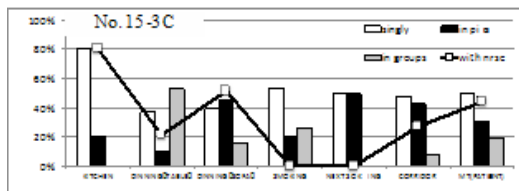
Fig 19 Time spent in different place (Nomal ward)
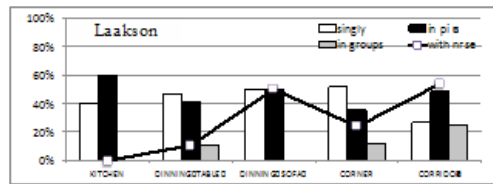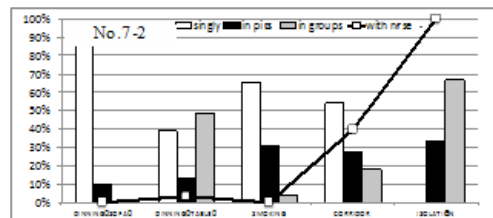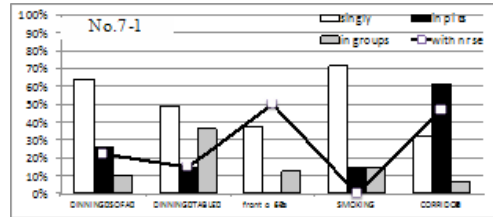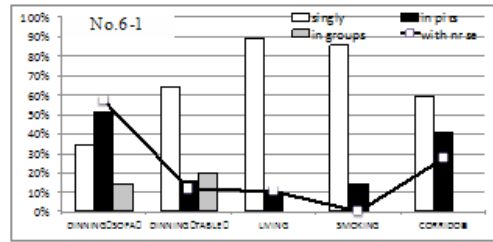
Fig 17 Time spent in different place (Acute ward)

Next, by identifying commonalities and differences in how patients grouped themselves (alone, in pairs, in groups of three or more) and other behavioral patterns in the wards, I tried to determine the meaning associated with different spaces (other than the corridors) in the minds of the patients.

3.5.1 Acute Wards

Although patients in the acute wards regard common spaces other than the living rooms and smoking rooms as places to interact and communicate, interestingly they did not necessarily attach significance to places such as dining rooms (either the sofa or table variety) that have clearly defined functions as "places to interact and communicate."

3.5.2 Nomal psychiatric wards

I found that patients in the nomal psychiatric wards perceived dining rooms (both those furnished with sofas and with tables) as places to be alone. Yet, I noticed the patients grouped themselves in a range of different configurations in the kitchens, sometimes including the nurses who were also present, so clearly the kitchens were endowed with significance as places to interact and communicate with others. Finally, the areas set aside for smoking—the

balcony and vestibule area between the smoking room and corridor—tended to drew in other people and fostered interpersonal behavior, so these spaces were also clearly endowed with significance as places to interact and communicate.

Fig 21 The rate of patient stay with nurse
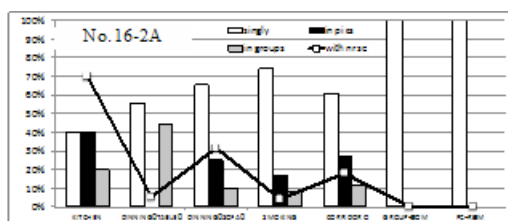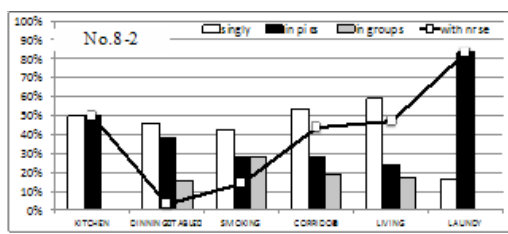
Fig 20 Time spent in different place (Reha.ward)
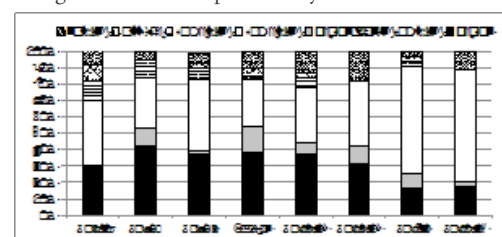
Fig 22 Object of behavior in different ward

3.5.3 Rehabilitation Wards

Patients grouped themselves in different ways in the rehabilitation wards, but since most of the patients kept to themselves in all places throughout the ward, it was apparent that these patients perceived most common spaces as "places to be alone." Indeed, there was a pronounced tendency for patients in the rehab wards to regard common spaces as places to be alone and to not interact with others, a trait that clearly distinguished these patients from others at the hospital.

It should be apparent from these observations that the acute ward patients, the nomal psychiatric wards patients, and finally the rehab ward patients (in that order) showed a diminishing tendency to regard common spaces as places to interact and communicate with others.

4   DISCUSSION

4.1 Factors Affecting Patient Admissions

The key factors in determining which ward would be best suited for a newly admitted patient and whether the patient can get along with others are based on a diagnosis of the patient's mental disorder and the approximate length of the patient's stay at the hospital. For example, schizophrenic patients tend to lack motivation, which results in a reluctance to interact with others and unresponsive inactive behavior. Yet at the opposite extreme, there are female patients and patients with uncomplicated mood disorders who are often quite sociable. I would add that a lengthy stay at the hospital is often one factor that diminishes a patient's motivation.

4.2. Interaction with Nurses

Approximately the same high ratio of nurses to patients is available in all of the wards of the hospital; the nurses are able to keep a close eye on patients, and particularly in the ward with younger patients there is a good deal of interaction between the nurses and the patients. Since the nurses do not participate directly in the patient's circle of acquaintances, they look after their patient charges indirectly from a sofa in the dining room or some similar vantage, so one can observe a tendency for the patients to hang out in the same places as the nurses.
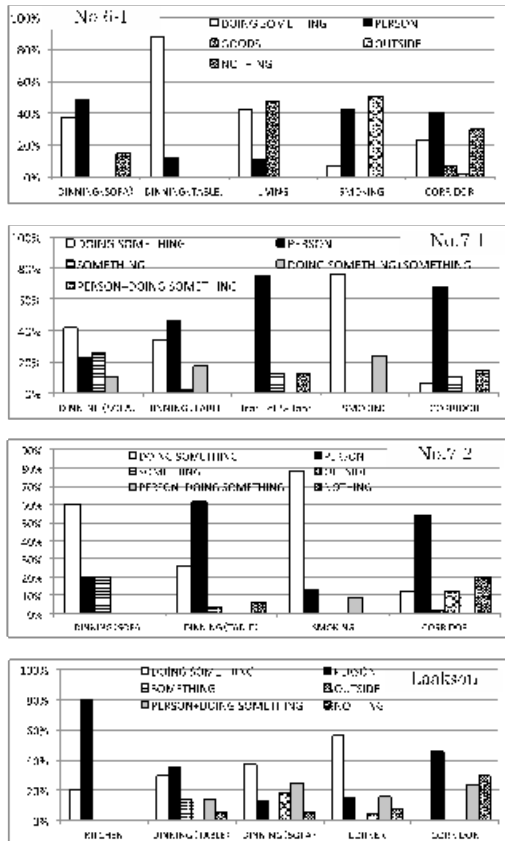
Fig 23 Object of behavior in Acute ward
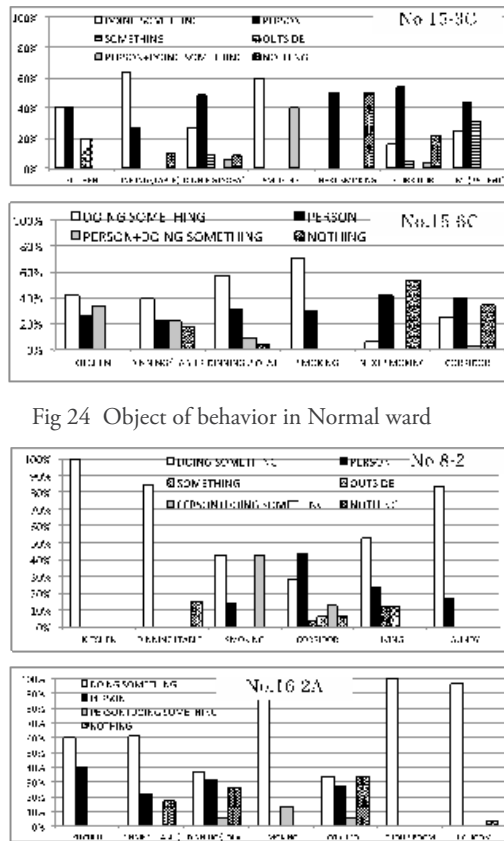
Fig 24 Object of behavior in Normal ward

Fig 25 Object of behavior in Rehabilitation ward

4.3. Attachment of Meaning to Spaces

I. Considerable interpersonal behavior was observed taking place in corridors, and indeed hallways were frequently endowed with special significance as spaces to interact and communicate with others.

II. Although tables in the dining room would seem to provide a perfect shared space with others, many of patients preferred to eat alone without interacting with other people which strongly suggests that the dining room space was endowed with meaning as a place where patients expect to be left alone.

5   CONCLUSION

-How Psychiatric Treatment and Care Environments Should be Implemented-

Here I will briefly highlighted some of the key points of the study regarding the treatment and care environment in psychiatric wards.

5.1 Insights Regarding the Lay Out of Spaces

I. All of the so-called stress care wards in Japan for dealing with mood disorders and other stress-related illnesses are private-room facilities. This despite the fact that not all patients need or even want private accommodations.

II. Rather than attempting to pre-design a shared space such as dining room as a place to promote interaction and communication, there are certain buffer zones with an air of ambiguity like the corridors in this study that have enormous potential for a wide range of uses that could well serve to promote exchange and interactive behavior among patients.

III. Presence of nurses, spatial continuity, comfortable furniture all have a significant effect on where a patient wants to hang out, whether a patient wishes to be alone or with others, and how a patient behaves and acts toward others. When planning and designing a hospital ward, careful consideration should be given to where the staff station and smoking room are positioned, and by extension, the optimum layout and organization of spaces throughout the facility.

5.2 Insights Regarding the Nature of Nursing

I. Staffing at the hospital analyzed in this study was approximately three times the level that prevails in Japan, so one can always be sure there is a nurse nearby watching over the patients.

II. Where patients are concerned, nurses rarely have to ask about the patients because in most cases they are nearby and can see for themselves. This close proximity gives patients a sense of well being and security, it promotes closer interaction with nurses, and by developing closer relations with other patients, it helps overcome barriers to interpersonal communication.

III. Prolonged stays at the hospital can erode a patient's will power and motivation, and even exacerbate a patient's symptoms. Clearly, the most meaningful role a psychiatric hospital can play is to rapidly deal with a patient condition and return the patient as a well man or woman to society a quickly as possible.

Through this study, I found that Aurora Hospital in Helsinki, Finland occupies a modest cluster preexisting buildings that clearly required the bear minimum investment for construction. While far from opulent, the interior spaces are laid out and furnished in a way that provides a warm and home-like atmosphere. By taking full advantage of their medical staff and manpower, the Aurora Hospital is able to provide excellent psychiatric care while sticking very close to their patients, and this facilitates early discharge from the hospital and a significant reduction in the number of hospital beds.

ACKNOWLEDGEMENTS

INPATIENT HOSPITAL CARE MODEL AS A SPATIAL CONCEPT

Jonna Taegen
Architect MSc, Design Manager
Central Finland Health Care District
jonna.taegen@aalto.fi

Tuula Antinaho
MNSc, Manager of Nursing Development
Central Finland Health Care District
tuula.antinaho@ksshp.fi

Tuula Kivinen
PhD, Head of Research and Development in Nursing
Central Finland Health Care District
tuula.kivinen@ksshp.fi

ABSTRACT

Purpose The aim is to describe the planning and design of spaces for inpatient care to improve delivery and efficiency of care and to optimize resources.

Background Globalisation, new technology, environmental issues, ageing population and the tightened economic situation affect the way services are organized. New objectives are quality, effectiveness and timeous availability of the services. These are also important aspects when evaluating hospital processes and planning hospital environment. New lean-based care models provide more direct nursing time for the patients while reducing the amount of errors and wasted time such as waiting or searching for items. Nevertheless, the structure of the existing healthcare facilities does not support lean-based patient care. Therefore, new space solutions are needed.

Approach The study is done within the new hospital project of Central Finland Health Care District. The study uses participatory action research methodology. The planning process is contemplated in three phases; each having its own field of attention. The study activates a wide range of participants, from the executive level to the staff working at the wards. Data is collected with both quantitative and qualitative methods.

Results The study makes clear the changes of attitude towards health care services; the future inpatient ward is a service environment, where spatial solutions improve customer experience and the work of personnel. The study provides new knowledge of the planning process and shows the importance of a strategic concept determined right in the beginning of the project.

Discussion A lot of research is done on capacity planning, care pathways and evidence based design, but there is only a limited amount of research on healthcare planning as a synergy of dialog processes between all persons involved such as consultants, personnel and architects. Considering the lifetime of a hospital, the costs for planning are only a fraction of the whole-life costs. Anyhow, the decisions that are done in planning affect the running costs of the building. In a collaborative planning process, solution possibilities can be discussed and verified before spaces are cast concrete. Architecture is not only an exterior; it is part of the new inpatient care model.

Keywords

Inpatient hospital care, lean principles, spatial concept, user orientated, architectural design process

1   INTRODUCTION

Hospitals never reach the stadium, where the building would be fully completed (Martikainen, 1971). Our society is changing all the time. Globalisation, information communication technologies, environmental issues, ageing population and the tightened economic situation affect the way services are organized.

In Finland the central hospitals built in the 1950s, 1960s and 1970s have grown during last decades to a multiple thereof what they have originally been. Especially the amount of consultation and examination facilities has increased due to new specialities (Paatela, 2006). The hospitals have expanded piece by piece without having a real master plan (Huttunen et al., 2011). This development has led to a situation, where health care services are based mainly around organisations; operations are scattered around and a great amount of personnel and space is needed for carrying out the operations. The patient perspective has stayed on the sideline (Jones, 1995).

Any time soon the investments in health care facilities in Finland will be large. Plenty of the buildings are in a bad condition and need to be renovated. New remarkable hospital projects are on the stocks (Punnonen, 2013). The social welfare and health care reform will have an influence on, how services are arranged in the future. Key objectives of the reform are to promote health, well-being and social safety of the population. The aim is to ensure equal access to social welfare and health care services in all parts of the country and to implement a cost-effective, customer oriented service structure (Social welfare and health care reform, 2014)[1]. The quality and timeous availability of the services will be emphasised more and this leads to a reorganisation of health care processes and systems. New processes and models of care require spatial concepts, which are corresponding to the future challenges.

This study focuses on the models of inpatient hospital care, and how these models are changed to spatial solutions. The architecture of the inpatient wards has changed during the centuries. The typical ward in the nineteenth century was a large hall, containing about 30 beds arranged at right angles to the windows. The sister's room was at one end, the bathroom and toilets were at the other (James and Tatton-Brown, 1986). Later the open ward structure was broken up into smaller rooms or compartments. In Finland the wards at central hospitals were planned with 1, 2, 3 and 6 patient rooms. The dimensioning was based on a room size of 3 beds depth (Kokko, 1968).

Today the length of stay in hospitals has become shorter and the amount of beds is decreasing. The impact of day hospital and home care functions is growing. The movement from institutionalised care to outpatient care is seen also in the free form design of hospital environments. Nevertheless, the primary meaning of the inpatient ward will stay same: to deliver proper care to the patients. Good architecture alone is not a guarantee for well-working care processes. The question is how the wards should be planned to respond to the changing needs of the society.

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1   Social welfare and health care reform, available at: http://www.stm.fi/en/ministry/strategies/service_structures (accessed 9.10.2014).

An integral way of viewing things is often missing in planning. Users, personnel and patients, have usually played only a minor role in the design process. Architects on the other hand have been involved in the planning first, when strategy, concept and room program were already accomplished. Can a participatory and collaborative planning process affect better outcomes in health care design?

The purpose of the study is to describe the planning and design of spaces for inpatient care to improve the delivery and efficiency of care and to optimize resources. In this article the focus is on the early stages of the planning process, where main concepts and spatial principles of the inpatient ward are determined.

2   STATE OF THE ART

There are some recent trends in health care delivery that seem to continue also in future, for instance the shorten length of stay, the effort to improve the quality of care and the increasing use of ambulatory care and home care (Braithwaite and Hindle, 1999). It is possible to forecast future trends in population or changing patterns of disease, but the effects of technological development are much more difficult to predict. What can be expected is that the changes in the 21th century will happen faster than ever before (McKee and Healy, 2002). A key challenge for the future hospitals will be to process a high degree of flexibility, so they can adapt to the changing needs (Rechel et al., 2009a).

In the Netherlands the building guidelines for new general hospitals emphasise already the importance of both flexibility and standardisation. The building structure should be simple to extend at different points and should be able to cope with internal displacement (The general hospital, 2002)[2]. To improve the flexibility, a model has been developed that divides the hospital to four different segments according to the structural character of the spaces (Bjørberg and Verweij, 2009):

- HOT FLOOR, with A&E, operating rooms, diagnostic imaging, intensive care
- OFFICES, with administration, staff departments, outpatient units
- HOTEL, with inpatient wards
- FACTORY, with laboratory, pharmacy, kitchen etc.

Nevertheless, apart from agile, flexible and modular buildings that respond to the changing needs of society, another crucial trend, when designing and constructing health care facilities, are the care processes. Previously the number of beds or bed occupancy was a predominant metrics in hospital capacity planning. Nowadays, the measure of the services provided inside hospitals is becoming more essential (Rechel et al., 2010)

Basis for the reorganisation of health care is the concept of lean thinking, where the aim is to arrange the health care services according to the patient needs rather than around buildings, beds or specialities. The reorganisation of operational procedures leads to more efficient use of resources and savings in the annual costs (Rechel et al., 2009b).

2   The general hospital, available at: http://kennisplein.zorgenbouw.nl/Pdf/CBZ%20Website/English/Full%20Reports/english_general_hospital.pdf (accessed 21.4.2014).

The concept of lean has its origin in Japanese automobile industry. The key principle was that each step in the production had to produce some value for the customer and all sources of waste, such as unnecessary inventory, mistakes or waiting, should be eliminated (Deans and Wade, 2011). Afterwards the same methods have been applied in other manufacturing companies, service industries and recently also in health care context (Poksinska, 2010).

In health care lean thinking principles become apparent in terms of new care processes, where the focus is to provide better and safer care for patients, with the resources available, and to reduce non-valued added activities (Antinaho and Kivinen, 2014). Due to lean thinking organisations have started to develop multi-faceted competence (Capuano et al., 2004). Also the meaning of teamwork has been emphasized (Liker, 2004). The systematization of work processes enables more flexibility and savings in money; however the outcome relies much on modern ICT techniques, where the professionals in the care chain have all information digitally available independent of time and place (The general hospital, 2002).

Considering the architectural implementation of care processes to spatial solutions, the importance of the quality becomes clear. In the recent hospital architecture competitions the emphasis is placed on themes such as adaptability, accessibility, sustainability and lifespan. Also the positive image of the hospital, a non-clinical building with pleasant environment for patients, relatives and personnel, has become an important criterion for the design. The hospital is not anymore an isolated institution, it´s a vibrant part of the city structure (Kjisik, 2009).

Nature and natural elements, such as daylight, fresh air and quiet, have traditionally played an important role in the design of hospitals as healing environments (Van den Berg & Wagenaar, 2006). Whereas evidence-based design endeavour to create hospitals and other health care buildings informed by the best available evidence on the effectiveness of environmental interventions (Ulrich, 2006). The quality of the physical environment of the hospitals has an impact on the wellbeing of both patients and personnel. Studies have shown that the healing process of patients is promoted by an environment that among others: provides confidence and privacy, promotes the relationship with nursing staff, pays attention to the relatives, provides contact with the outside world, and is safe, secure and bright (The general hospital, 2002).

An even more fundamental principle, than the architectural quality of health care facilities, is the strategic planning context, which contributes to improving the health of the population. A vision for the future is needed (Cole, 2006). The strategic principles that guide the planning of the new hospital in Central Finland Health Care District are as follows (www.ksshp.fi):

- Patient first: The needs of the patient determine the content of care and the services related to care. Supportive services are determined by the care process.
- Healthy, safe and good working environment for the personnel
- Effective and advanced ICT that steers and supports the process
- Good logistics
- Partly integration of primary and specialised health care functions

- Health prevention and promotion
- Effectiveness and cost efficiency
- Management structure supports processes

From the planner's point of view these strategic principles mean, that spaces are planned to improve the care and healing process of the patient and to facilitate the work and collaboration of personnel. Central in the concept is to increase bedside caring, which means that more care work can be done next to the patient's bed (Antinaho et al., 2014).

3   APPROACH

The study uses a case study approach. The primarily focus of the study is to describe the implementation process of new inpatient hospital care models to a spatial concept. The study is done within the new hospital project of Central Finland Health Care District.

Central Finland Central Hospital is built in 1950s. At the time it was an operative, effective entity, responding to the needs of the area and shaping a pleasant and human environment for both staff and patients (Cedercreutz and Railo, 1955). During the last decades the hospital has increased in size. The internal connections have become longer and more complex. In 2011 the Finnish Institute of Occupational Health reported 60% of the Central Finland Central Hospital facilities would need urgent and complete renovation. Because of interior air quality problems, bad experience of previous renovations, high running costs and too low floor height, the conclusion was to build a completely new hospital next to the existing one, and to find another use for the remaining buildings.

The new hospital project started in 2012 and has come now to the preliminary design phase. The construction will start in 2015 and the building will be completed in 2019.

3.1   Participatory action research

The study uses participatory action research (PAR) to achieve effective dimensioning, well-working processes and patient-oriented space solutions. PAR has in its implementation and philosophy a problem solving purpose. The problem solving purpose differentiates PAR from methods whose primary aim is to research or investigate (Walter, 1998). PAR refers to a range of research methods that emphasise participation and action, using methods that involve iterative processes of reflection and action (Peters et al., 2013). PAR can be defined as collaborative research method where the researcher works explicitly with and for people rather than undertakes research on them (Meyer, 2000). The interaction between the researcher and participant's provides expertise and understanding and contributes to more workable and innovative problem solutions (Swann, 2002).

PAR operates as a cyclic model of research consisting of four major moments: planning, acting, observing and reflecting. The process is self-evaluative, involving a constant evaluation of its process and modifications to adjust the research problem articulation and research practice (Walter, 1998). PAR enables cooperation across interprofessional boundaries. PAR has the ability to empower practitioners, getting them to engage with research and subsequent

"development" or implementation activities. Hence it's important that the researcher obtains the trust of the practitioners and agrees on rules how to control the data (Swann, 2002).

In considering the contribution of action research to knowledge, it is important to note that generalisations made from action research studies differ from those made on the basis of more conventional forms of research. The documentation of the proceedings, the relation to what has been learnt from the experience of undertaking the work, can be even more valuable than the results in particular (Meyer, 2000).

The study contemplates the change process, how new inpatient care models are converted to a spatial solution, in three stages: project planning phase, preliminary design phase and implementation planning phase (Figure 1). Each stage of the development has its own field of attention.
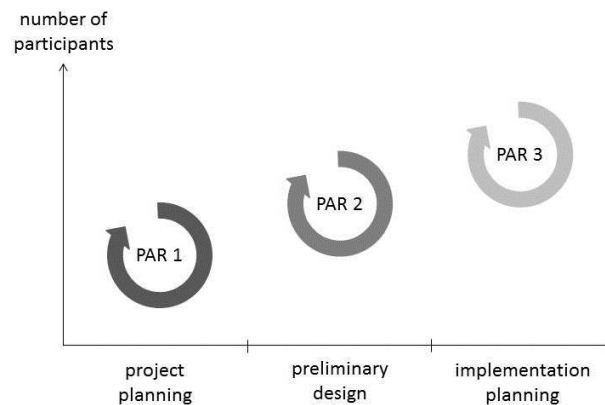
Figure 1 Participatory action research (PAR) takes place in all three planning phases. The amount of participants is increasing, when the spatial solutions of the inpatient wards are getting more detailed.

In the project planning phase feasibility and alternative problem solutions are studied and evaluated. The results are summarized in the project plan that fixes the total size, costs and schedule of the project. In the project planning phase the focus of PAR is on defining key figures, such as population, performances and employment plan. Based on those figures the future capacity of the inpatient ward can be calculated.

In the preliminary design phase views on the overall concept are specified. Alternative solutions for layout, placement of functions and connections between units are tested. The result of this process is a rough sketch of the whole entity, where every room and space has found its right location. The function of PAR in the preliminary design phase is to determine spatial relations to ensure a well-working overall solution for the inpatient ward.

In the implementation planning phase the design is developed to exact drawings with construction details, equipment layout, dimensions and design criteria. After this phase all the necessary information for the construction process is ready. In the implementation planning phase PAR is mainly used for defining details in the space solutions. The selection of proper equipment and materials is important for the quality of the inpatient ward. Those are the features that the user will recognise in daily use.

The study activates a wide range of participants starting with the executive level of the Central Finland Health Care District through to the staff working at the inpatient wards. The composition of people involved in PAR varies in each phase.

The amount of participants in the project planning phase is limited to the very key persons, representatives from the executive level, researchers and planners. The aim of PAR in this phase is to determine strategic guide lines and capacity of the future ward configuration. Information about new concepts and ideas on planning health care facilities is exchanged in terms of seminars and study tours in Finland and Europe. The capacity is calculated with the aid of quantitative methods. Each one of the participants has a certain role in the process and brings own knowledge to the whole. Regular meetings are organised, but main work is done between those meetings. Information about present performances is gathered and analysed. Based on this data estimations for the future capacity are done. The results and suggestions for specifications or changes are discussed in the meetings. The cycle of planning, acting, observing and reflecting continues so long until a solution with an acceptable size, cost and schedule proposal is reached.

The amount of participants increases in the preliminary design phase. Each field of operation has one or two representatives in the monthly arranged meetings. Also researchers, planners and persons from the executive level are participating in the meetings. The aim of PAR in this phase is to inform the users about the new concepts. It is important that the staff working at the inpatient ward understands and accepts the strategic principles which are defined in the project planning phase. A common databank helps in sharing information. When the users are familiar with the working method and the main principles, the development of the operational processes starts. The users are in an important role here, because they have the knowledge and experience of real life. Based on analyses of the present situation, procedures that need to be enhanced are discussed. Process diagrams for the future operations are done. Aim is to standardise processes as far as possible. The researcher works as a facilitator, taking part in the meetings, gathering the information for the meetings, documenting the different aspects which appear in the discussions and analysing the effects on other processes. The described PAR cycle will continue through the whole preliminary design phase.

The amount of participants is extended even more in the implementation planning phase. Next to the people from Central Finland Health Care District, the planners and the researchers are now also representatives from various organisations and associations involved in the PAR process. Patients, artists and disabled persons bring their own special knowledge and expertise to the project. Seminars, workshops and meetings with selected topics are organised. Model spaces are constructed and tested with participants. The aim of PAR in this phase is to validate the space solutions from different viewpoints. The results are analysed and evaluated together with the participants and possible changes to the dimensioning, equipment and materials are done. The PAR process controls the quality and functionality of spaces. The cycle continues until the building is ready to come into operation.

3.2   Provision of data

The data for the study is collected with both quantitative and qualitative methods. Quantitative methods, such as statistical models, trend analysis and simulations, are used mainly in the beginning of the project, whereas qualitative methods, including interviewing, observation, discussions and review of documents, are used more at the end of the project.

The capacity of the future inpatient ward is calculated in the project planning phase on the basis of key figures. Already in the 1950s, when the current Central Finland Central Hospital was planned, key figures determined the volume of the building. In the dimensioning of the inpatient ward important key numbers are: amount of patients and staff, days of nursing, average length of stay and number of beds. When using key numbers in quantitative research, it is important to clarify what the terms content. For instance the amount of beds is counted without A&E places, ICU, recovery, dialysis and day hospital. Only if the terms are clear, performances and effectiveness can be compared and discussed.

Present key numbers are collected from the database of the Central Finland Health Care District. The future amount of patients and staff, days of nursing and average length of stay are estimated by trend analysis. The utilization rate of the inpatient wards is determined in the strategic principles, and amount of bed is counted therefrom. Key figures are discussed with experts from Finland, the Netherlands and Switzerland. With simulations alternatives for key figures are tested. Aim of the quantitative methods is to find out solutions to improve the efficiency of current operations.

The processes of the future inpatient ward are defined in the preliminary design phase based on process diagrams. Interdepartmental connection requirements in Finnish central hospitals were evaluated and documented first time in the 1980s (Kekäläinen, 1982). Lately hospital process analyses have become relevant again. In the planning of the inpatient ward processes are divided into two categories: the care processes and the supportive processes. Care processes are directly related to the patient care, whereas supportive processes ensure that food, medicaments, linen are delivered in time.

Present processes are observed on site, discussed with the users and reviewed from the database of the Central Finland Health Care District. Problems and difficulties of the present processes are documented and analysed, and possible problem solutions are pointed out. The strategic principles of the project plan give guidelines to the organisation of the new care processes. Based on simulations comprehensive care processes are developed. When the care processes are defined, alternative solutions for the supportive processes are investigated. Both quantitative and qualitative methods are used to guarantee efficient and well-working processes. The new processes are partly carried out as early as in the existing wards.

The quality of the future inpatient ward is reviewed in the implementation planning phase on the basis of model spaces, both real and virtual. The terms "healing environment" and "evidence based design" have become familiar in the resent years. For the inpatient ward the quality of the spaces is studied from two viewpoints: the sustainability aspect and the user perspective. A sustainable hospital includes elements such as day light, indoor air quality,

waste, energy efficiency, security and accessibility. A user-oriented hospital cares for patient satisfaction, privacy, presence of the family, views to the nature, colours, art, activities, comfort and so forth.

Present facilities are observed on site and improvement suggestions are collected with questionnaires from the county. Options are evaluated based on study tours, reviews, seminars, workshops and meetings. Qualitative methods for data collection and an active, multidisciplinary collaboration enable the development of sustainable and user-oriented space solutions.

4 RESULTS

The study makes clear the changes of attitude towards health care services. The average length of stay at the hospital shortens, and the efficiency of the wards increases, on the basis of new care models, space solutions and ICT.

When considering the drawings and data of the inpatient wards in the year 1954, when the Central Finland Central Hospital was opened, and the new spatial solutions for the wards in 2020, similarities in the overall concept and figures show up. The spatial solution is kept simple and clear. All wards are grouped together at one place and the connections to other supportive functions are short and easy to reach. The wards are to 80% standardised, with the exception of the psychiatric ward that has specific requirements for space solutions, for instance the need of seclusion rooms.

The total size of the inpatient wards has increased from 1954 to present, and will continue increasing also in future (Table 1). One reason is the change from 6 and 3 person bedrooms to 4 and 2 person bedrooms, and in future to 1 person bedrooms. Another feature is the structure of the ward that has changed. In 1954 the ward had one central corridor that was 2.5 meters wide. In the later expansions the wards were planned with a two corridor model. The spatial solution of the new inpatient ward is again a structure with one corridor, but the corridor is now ca 5 meters wide. This enables a multifunctional use of the corridor. The corridor is not anymore a long, narrow, institutional space; it has more a living room like atmosphere.

Table 1 Size of the inpatient ward to amount of beds ratio.
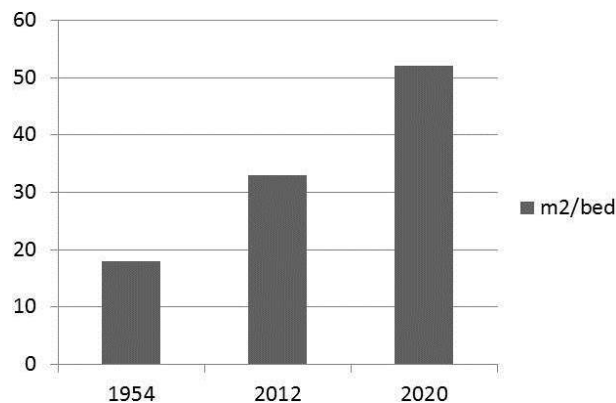
The patient rooms to other rooms ratio has changed at the inpatient wards of Central Finland Central Hospital (Table 2). In 1954 the quantity of patient rooms was 41 %, in 2012 it was 37 % and in the new inpatient ward it will be 46 %. The amount of other rooms and spaces will be reduced in future. Only the needed supportive functions are placed at the wards. This coincides with the new inpatient care model, with the patient first strategy, where the aim is to increase time to value added care and reduce waste time, such as unnecessary walking or searching of things.

Table 2 Patient rooms to other rooms ratio at the wards.
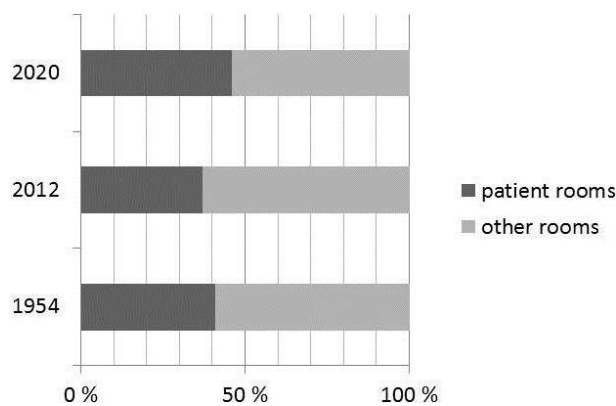
Investigations of the present processes at the inpatient wards make clear that operational procedures can be developed. For now outpatient treatment is partly organised at the wards; in future the outpatient consulting rooms will be located elsewhere. A review of the present patient profiles shows that there are unnecessary patients at the inpatient ward, meaning patients, who could be nursed in future at A&E or day hospital. The discharge process, the time between discharge decision and patient leaving the ward, varies from minutes to several hours. New care models reduce the waste time and speed up processes. The work tasks are reorganised, the nurses are responsible for the care processes, and other personnel is in charge for the supportive services.

The future inpatient ward is customer-oriented. All patient rooms are standardised single bedrooms with own bathroom. This provides a higher privacy for the patients and reduces the amount of infections. Treatment, discussions with patient and family members and registering can take place at the patient rooms; less room for meetings, treatments and offices are needed at the wards. Nursing personnel uses mobile devices for registering.

The rehabilitation process starts already at the ward. Aim is to increase the individual initiative of the patients. The patient has at disposal a bedside terminal whereby he can regulate the coverage of the windows, order meals or watch TV. The central corridor at the wards is changed to a living-dining room area, which attracts and motivates patients to get out of their bed and move. At the central corridor are also working places for nurses. The space solutions at the inpatient ward enable participation of family members in the care process. They have the possibility to stay overnight at the hospital. Patient and family members can go to the restaurant, located in the entrance hall of the hospital, if the condition of the patient makes it possible.

The future inpatient ward is a service environment. The spatial solution improves the customer experience as well as the work of personnel. Considering the main principles and strategies but also the very small details in planning, makes the experienced environment meaningful.

The study provides new knowledge of the planning process. Even though the planning is divided into three phases, the process is not linear (Figure 2). When developing the concept into spaces, new information, requirements, ideas arises and they can affect the whole design. The process is iterative. Nevertheless, it is important to obtain the main principles, strategies and goals, which were determined in the beginning, on not to forget them during the long planning process.

In the case study the total amount of square meters and the budget for the project were fixed in the project planning phase. In this way the costs of the project were under control; if some units seemed to become bigger in size, then square meters had to be cut from somewhere else. Based on this method the architects could start with the overall planning in an early phase and the participants understood the framework of the project.
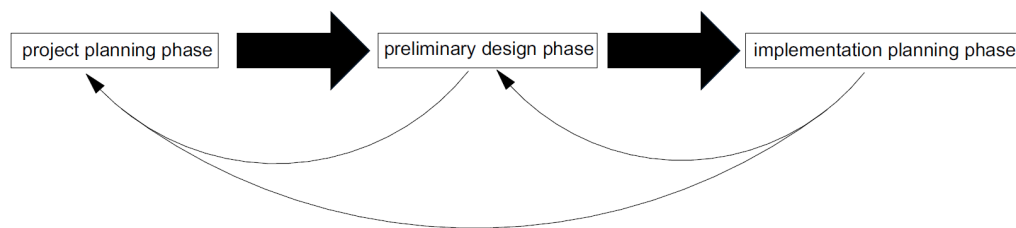
Figure 2 Process of changing new care models to a spatial solution doesn´t follow a linear scheme.

5   DISCUSSION

The purpose of the study was to describe the planning process of spaces for inpatient care to improve the delivery and efficiency of care and to optimize resources. Even though a lot of research has been done on capacity planning, care pathways and evidence based design, there is only a limited amount of research on the planning processes of health care facilities (Huttunen et al., 2011). This may result from the different culture of scientists and architects; where researchers publish their findings and describe how they were obtained, architects publish their buildings, but not typically share what they learned in the process of creating the building (McCuskey Shepley, 2006). The health care reform, the reorganisation of services and care processes, demand a new approach towards the design and planning process.

In the 1950s and 1960s, when most of the Finnish central hospitals were planned, the health care projects were measured on the basis of key numbers, statistical models and according to present knowledge. Dimensioning and requirements have changed as time passed and will probably continue changing also in future. Nevertheless, all the coming projects and investments in the health care sector need some basis for the capacity planning and dimensioning. With a common well-defined methods and dimension principles projects can be compared with each other and discussed in a wider range.

On the other hand, a certain critical attitude towards the dimensioning principles is needed, at least when considering the capacity planning from the past. A too effective dimensioning of spaces, measured by volume, led to minimal floor heights where today's technology does not fit in. Capacity planning should leave a margin for the adaptability of spaces.

In the planning of health care facilities the focus is on functional space solutions rather than on special architecture. The spatial result of the inpatient care model in Central Finland Central Hospital is a standardised model, where the space structure is clear and the distances between functions are short. The logistic rooms are concentrated at central points, so they can serve multiple ward units. Also the spaces for supportive functions can be mixed-used by the wards. The room program was developed in close cooperation with the users and the architects, in this way dimensions could be tested outright in architectonical drawings.

The planning process of the inpatient wards in Central Finland Central Hospital is not yet completed. The third PAR cycle, the implementation planning phase, is just starting. First seminars on art, sustainability and accessibility have been successful. Work with the participants will continue over the whole planning and construction period and maybe even longer.

Another aspect that is leaved out of the study is the use of building information modeling (BIM) in the planning phase. It is still dubious if 3D images can contribute to a better collaboration between users and architects, but at any rate the use of BIM will certainly have an effect on the whole planning process.

The study shows the importance of communication and participation. The regular exchange of information and the visibility of processes generate an atmosphere, where people are motivated. This facilitates the planning process. The understanding and acceptance of the project on all levels of the organisation is vital for the process, otherwise problems and delays can occur.

The planning process in Central Finland Central Hospital involved a wide range of participants with different backgrounds. One main criterion for the successful collaboration was that the participants were able to forget their own interests and think first, what improves the strategic principles of the project. It is understandable that people often consider things first from their own viewpoint. One emphasises the architectural values, another maybe the amount and size of workstations and for someone are costs and efficiency the most important things. The involvement of outsider experts, who were familiar with the strategic principles of the project, led back from wrong tracks to the clear and simple main idea.

The researcher took over a variety of roles during the research process, some of them occurred even at same time. The researcher was one of the participants in the working groups. He acted as an outsider expert, with an architectural background, taking part in the change process. His tasks were to produce information, to promote the research and to confer the information to the working groups. In the role of a developer the researcher's task was to discuss with the working group members about, how the care processes and spatial solutions

could be developed based on present information and explored knowledge. He did not solve the development-related problems on behalf of the participants, but he presented constructive points of view as base for the progress. In addition the researcher had during the whole process an active role in gathering data and forwarding information towards other parties.

Considering the lifetime of a hospital building, the costs for planning and construction are only a fraction, less than 6%, of the whole-life costs (Radical improvements in hospital design, 2003)[3]. Anyhow, the decisions done in the planning affect, and indeed to a large degree also determine, the cost of running the services. In a comprehensive planning process solution possibilities can be discussed and verified before spaces are cast concrete. Architecture is an integral part of the new inpatient care model, not an execution of an outside consultant's research product. Architects need to understand the user perspective and the strategic principles which are guiding the project. In this way architects are able to make design decisions and spatial innovations, which promote the new care concepts.

Later studies will show how same participatory action research methods can be used in the planning of other hospital spaces, such as in the outpatient department, and how the objectives are reached in the completed building.

6   CONCLUSION

The future planning projects in health care sector need a well-working collaboration of different parties during the whole process, starting from the project plan through to the implementation. The participants involved in planning are persons from the executive level, planners, researchers, outside experts, personnel, patients and representatives from various organisations and associations. Here the users, both personnel and patients, represent an important viewpoint.

Along with the users a realistic picture of new service production possibilities, the future performances and resources can be created. Otherwise the result might be a melting pot of wishes that is impossible to realise both from economic and functional point of view.

Besides the planning of processes and spaces, management of change, personnel training, ICT and other technological solutions need to be planned. Especially the possibilities that technology supply are essential in the service production as well as in the management. The main aim is to determine how the building will function in future in order to correspond to the changing needs of the society.

3   Radical improvements in hospital design, available at: http://webarchive.nationalarchives.gov. uk/20110118095356/http:/www.cabe.org.uk/publications/radical-improvements-in-hospital-design   (accessed 5.6.2014).

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USABILITY

IMPACT OF VIRTUAL ENVIRONMENT UTILIZATION IN POST OCCUPANCY EVALUATION RESULTS

Tiina Yli-Karhu

Design Coordinator, Etelä-Pohjanmaan sairaanhoitopiiri
PhD candidate, Tampere University, SIS
tiina.yli-karhu@epshp.fi

ABSTRACT

This paper introduces results of post occupancy evaluation conducted after one year function of new hospital facilities. Questionnaires were completed by 182 members of staff and 227 patients. The form consisted of demographic information and 106 statements on nine different topics, which included yards and entrances, architecture, indoor conditions (lighting, acoustics and atmosphere), durability, functionality, safety, comfort (privacy, community and aesthetics), accessibility and usability. Topics were compiled from observation and studies in virtual environment, literature and similar studies. Studies of evidence based design assist to focus on relevant topics. The special interest of study was to compare the difference between the evaluations of the end-users/staff members who had visited the virtual environment (CAVE) during the design phase and the evaluations of those who did not participate in this design process.

HospiCaseY project (2009-2011) investigated end-user participation in the design and evaluation of healthcare facilities. The project was part of the Spaces and Places 2008-2012 program by the Finnish Funding Agency for Technology and Innovation (TEKES). One patient room, one consulting room and almost 1000 square meters of emergency outpatient facilities were modeled in the virtual environment (CAVE). The total number of visitors during years 2009-2010 in CAVE was just over 280. The actual hospital was opened in September 2012 with the post-occupancy evaluation being undertaken in October 2013.

The evaluation of the success of the design, construction and operational processes is poorly undertaken in the Finnish healthcare system. The use of the systematic evaluation process has not been introduced in any hospital district in Finland. The design process could assist the advancements of other construction projects with the use of systematic evaluation.

In comparison of questionnaire statements the defined criteria between CAVE-visitors and other staff members was over 10 % difference. The number of those statements was 36 (34 %) in total. The CAVE-visitors were more satisfied with the design outcomes than other staff. The statements covered topics which included architecture, acoustics, functionality, comfort, accessibility and usability. There were seven statements achieving a difference of more than 20%. Only in two statements other staff was more satisfied and this related to entrances and number of windows.

Keywords

Virtual environment, post occupancy evaluation, evidence based design, end-user participation

1   INTRODUCTION

HospiCaseY project (2009-2011) investigated end-user participation in the design and evaluation of healthcare facilities (Yli-Karhu et al., 2011). The project was part of the Spaces and Places 2008-2012 program by the Finnish Funding Agency for Technology and Innovation (TEKES). One patient room, one consulting room and almost 1000 square meters of emergency outpatient facilities were modeled in the virtual environment (CAVE). The total number of visitors in CAVE was just over 280. There were 34 multi-professional groups, and all the visits were recorded and videotaped. The actual hospital was opened in September 2012.

The HospiCaseY project supported the design process of the real hospital facilities of the Hospital District of South Ostrobothnia. The "Y-talo" hospital building was a 58 million Euros extension project and was one of the biggest hospital projects in Finland at that time, resulting in increasing the capacity of the whole hospital by nearly a third, 33870 square meters in total. This extension has been in the strategic plan since 2003 and was completed in 2012. It involves almost the building of 1400 rooms, 134 beds and facilities for 20 different units. The new building employs approximately 450 people. Part of the new facilities is occupied by the primary healthcare services of the City of Seinäjoki.

The computer-assisted virtual environment (CAVE) used in the project is a room comprising of three walls, a ceiling, and a floor. The fourth wall is open allowing entrance into the CAVE. Images generated using computer graphic cards are projected onto these surfaces, which, when viewed through stereoscopic glasses, are transformed into a three-dimensional full-scale environment. Surrounding the CAVE there is a larger, darkened room where the projectors are placed. The CAVE solution used in the project comprised five surfaces onto which images were projected. The size of walls is measured 3.0 x 2.5 metres. Modelling was based on Autodesk 3DS Max software. The virtual environment (CAVE) is situated in Seinäjoki University of Applied Science.

One important property of a CAVE-type virtual environment is its scale, i.e. the ability of visitors to perceive the environment as almost real. Visitors are able to move to some extent within the space itself and to travel longer distances with the help of a 3D mouse. Another important characteristic is the quality of the virtual environment; in this case, the environment also featured realistic lighting and shadows, surface structures, colours, views out of windows, and the furniture/accessories situated in within the room.

The project included models for three different environments: 1) a patient room, 2) a consulting room and 3) an emergency centre. These environments were selected because hospitals regularly have multiple identical consulting rooms and patient rooms. The emergency centre is a new kind of unit, and its design involved several new functionalities.

The end-users visited the virtual environment in multi-professional groups of 6–10 visitors on average. Each visit lasted for an hour. All conversations that took place in the virtual environment were recorded and video-taped. After the visit, each visitor was asked to

complete a questionnaire in which they could analyse the properties of the projected spaces more systematically. The objective behind using several simultaneous evaluation methods was to ensure the scientific scope of the analyses. The visitors were also asked to give feedback on the usefulness of the virtual environment.

The HospiCaseY project included another design tool to promote end-users´ participation. A systematic user-orientated feedback system, a web-based post occupancy evaluation (POE) was developed for renovation and construction projects of healthcare facilities in order to assess the success of design, construction and operational processes. A package of statements was compiled from the literature, other similar POE questionnaires and through experiences and studies in CAVE during the project. The feedback system enabled to support the end-user participation, to learn from each project in order to design better healthcare facilities. The feedback system will also strengthen qualitative knowledge and other attributes which are difficult to measure. For this purpose, the feedback system includes statements on topics on evidence based design studies.

Post occupancy evaluation was conducted one year after the opening of the new hospital facilities. Questionnaires were completed by 182 staff members and 227 patients. The form consisted of demographic information and 106 statements on nine different topics: yards and entrances, architecture, indoor conditions (lighting, acoustics and atmosphere), durability, functionality, safety, comfort (privacy, community and aesthetics), accessibility and usability. From all the staff members 36 had visited the CAVE and had participated in the design process during HospiCaseY project in 2009-2010.

This paper introduces results of post occupancy evaluation conducted in October 2013 after one year function of hospital facilities. **The special interest of study outcome is the difference between the evaluations of those end-users who had visited virtual environment (CAVE-visitors) and the evaluations of those (other staff members) who did not participate this design process.**

This paper is structured as follows. First the previous studies of virtual environment, evidence based design and post occupancy evaluation are described. Secondly the studies and the research processes are outlined. Third the study results are presented. The paper concludes with discussion of implications and limitations.

2   STATE OF THE ART

The evaluation of the success of a design, construction and operational processes seems to be poorly reported in the Finnish healthcare system. Some independent evaluation has been undertaken, but the use of a systematic evaluation process has not been introduced in any hospital district in Finland. The use of evaluation in the design process would be advantageous for the future projects. The lack of evaluation is puzzling, since there is ongoing period of intense construction of Finnish hospital facilities for the future (Punnonen, 2013).

Evaluation is extensively utilized for decades internationally (Preiser, 1995). Evaluation was launched to identify problem areas in existing building, to test new prototypes of buildings and to develop design guidance and criteria for future facilities (Preiser, 1995). With the use of evaluations and studies a lot of valuable information of usability and the relevance of facilities to patients and staff members' well-being have been gained (Apple, 2012, Kotzer et al., 2011). Evidence based design has contributed for decades requirements of patient recovery and well-being and staff's job satisfaction (Ulrich et al., 2008). Furthermore there should be more consideration about the impact of healthcare facilities on economical and functional outcomes (Carthey, 2006, Friesen et al., 2008). Other important outcomes are staff productivity, work process efficiency and sustainability from the organizational point of view (Steinke et al., 2010).

Evidence based design is a process for the use of current best evidence from research and practice in the making of decisions about the design of the project together with an informed client (Hamilton and Watkins, 2009). The studies have revealed a great quantity of environmental issues to support patient and staff outcomes (Ulrich et al., 2008). Besides positive distractions, like art, nature, high-quality material and furnishing there are multilateral economical impacts to patients, staff and healthcare in its entirety (Ulrich et al., 2008). The means to decrease infections, falls, medical errors or stress and shorten the time spend in hospitals (Ulrich et al., 2008).

The outcomes of evidence based studies are exploited in the design of new healthcare facilities as well as in contemplating questionnaires for pre- and post occupancy surveys (Kotzer et al., 2011). The outcomes from surveys return new evidence. Carthey (2006) defines POE as "the systematic evaluation of health service buildings or facilities" assumed to occur sometime after their occupation and usually after a defined period of use such as 12 months to 2 years. The systematic use of POE encounters number of obstacles such as not being part of standard design services or adequately funded (Carthey, 2006). POEs are produced as case studies and not utilized continuously in organizations. In many countries orientation is to establish and adopt the methodology as a standard for use on all its projects (Carthey, 2006; Learning from our buildings, 2002).

It is crucial that end-users participate in the design process and provide their expertise for future developments with the design process. The design process requires seamless cooperation and new tools to enhance end-user participation. New tools to facilitate communication between designers and end-users are continually studied, but the systematic use of these tools appears to be rare but growing in number (Haapalainen, 2007, Tiainen et al., 2013).

The use of 3D modeling, BIM (Building Information Modeling) and virtual environment facilitates end-users to specify their requirements and review the design solutions (Dunston et al., 2007, Shen et al., 2012; Yli-Karhu et al., 2011). The use of virtual environment enables to model larger areas than physical mock-up rooms. In HospiCaseY project area for the emergency center was modeled on 1000 square meters (Yli-Karhu et al., 2011). Virtual environment can be utilized with professionals to test prototypes and observe working routines (Tiainen et al., 2013) as well as be to study user experience and perceptions in the design process (Kaapu

& Tiainen, 2010). CAVE can be utilized with single end-user (Wahlström et al., 2007; Yli-Karhu, 2008) or with multi-professional groups (Yli-Karhu et al., 2011).

The use of technological applications without common language for communication and understanding is challenging. The end-users are not usually familiar with the design and construction process, but experts in their own field and need to be considered as equal partners. Absence of common language and suitable methods create a gap between designers and end-users (Shen et al., 2012).   Methods to simulate daily activities, working routines and work flows are crucial for designers (Shen et al., 2012, Davies, 2004). Such methods studied to facilitate end-user participation are pre-occupancy evaluation, user pre-occupancy evaluation (Kotzer et al., 2011, Shen et al., 2012), and participatory design (Davies, 2004). Participation in the design process contributes learning and is essential to stipulate common objectives (vision) and methods of planning (Haapalainen, 2007). Participation in the design process appears to be a critical psychological and social occasion (Davies 2004, Wahlström et al., 2010). The design process involves that end-users' feel to be included and their needs to be considered (Davies 2004). In the design process of healthcare buildings not only the impact of staff members is enough. Though nursing is increasingly turning to patient- and family- centered, should even more attention to be paid on collaborative design of physical environment supporting patients and families (Kotzer et al. 2011).

3   APPROACH

HospiCaseY project developed and explored tools to encourage and strengthen end-user participation in the design process of a new hospital building. The project was linked to the Y-talo design and construction project, which was supported by this project. End-users (doctors, nurses, staff from administration and maintenance) visited the premises of the virtual hospital and were able to influence to some extent the design process of the new hospital premises. For example changes included the positioning of furniture, windows between observation beds and location and type of accessories. Approximately 20 changes were made in virtualized spaces, which in real terms multiply up to 100 consultation and patient rooms and bathrooms. Also valuable comments were received on colours, furniture, number of accessories and future functionality. According to the questionnaires over 90 % of visitors "strongly agreed" or "nearly agreed" the usefulness of the design in the virtual environment and in groups. The spaces in virtual environment appeared to be "real" for 65 % of visitors and "nearly real" for 30 % of visitors, where 90 % of the visitors stated that making comments in virtual environment was considered "easy" or "relatively easy".

A total of 34 recordings were made of group interviews. Ten of the recordings dealt with the patient room and the adjoining bathroom, thirteen recordings discussed the examination room, and seventeen recordings related to the emergency centre. Some of the visitor groups tested all three virtual environments.

The content analysis of recordings revealed a total of 14 primary themes. After a further analysis of comments, a total of 26 additional secondary themes were identified. The primary themes and secondary themes are listed in Table 1 below. The visitors made a total of almost 4600 observations.

Table 1 Primary and secondary themes of the analysis

Primary themes	Secondary themes	
Layout	Accessibility	Safety
Accessibility	Ergonomics	Type
Furniture	Aesthetics (art)	Accessories
Accessories	Hygiene	Lighting, daylight
Materials	Practicality	Blinds/curtains
Durability	Openability of windows	Attractiveness
Ergonomics	Furniture	Colours
Hygiene	Touchability	Privacy
Safety	Positioning	Acoustics
Lighting	Need	View
Colours	Dimensions	Durability, ease of maintenance
Blinds/curtains	Layout	Materials
Aesthetics	Functionality	Appeal
Virtual environment		

A systematic user-orientated feedback system using a web-based post occupancy evaluation (POE) questionnaire was developed to obtain views from the end-user on the renovation and construction projects of the new healthcare facilities and the success of the design. A package of statements was compiled from the literature, other similar POE questionnaires and through experiences and studies in CAVE, during the project. The feedback system enabled to support end-user participation, learn from each project and design better healthcare facilities. The feedback system will also strengthen knowledge of qualitative or other attributes difficult to measure. For this purpose, the feedback system includes statements on topics, which are objects in evidence based design studies.

The experiences and studies in CAVE generate in content analysis 14 primary themes and 26 secondary themes of discussions in CAVE. The visitors made almost 4600 observations in CAVE. These themes prove to be similar as the topics in other international questionnaires concerning POE (Friesen, S et al., 2008, Learning from our Buildings, 2002, ASPECT and AEDET, 2007[1])

The POE questionnaires were tested during the HospiCaseY project in four minor areas in order to check, if the statements were easy to comprehend, answer and to understand the length of time it took to complete the questionnaire. A few modifications were made to the questionnaires following this process.

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1   R&D Project B(04)03 – Disseminating good practice (GDP): developing an exemplar layer for AEDET Evolution and ASPECT. available at www.wales.nhs.uk (accessed 18 May 2011).

The form consisted of demographic information and 106 statements of nine different topics: yards and entrances, architecture, indoor conditions (lighting, acoustics and atmosphere), durability, functionality, safety, comfort (privacy, community and aesthetics), accessibility and usability. Architecture topic includes questions of scale, scheme, value, materials and way finding. In addition all the topics had a free space at the end of topic for comments. The questionnaire for patients and visitors had the same statements but excluded the topics of functionality, durability, safety (partially) and statements of staff comfort.

The Web based survey for staff members of the new hospital facilities was executed by Webropol, online survey and analysis software. The timing for the survey was agreed to be after one year's since the opening of the new facilities in order to ensure that there had been sufficient usage of the new facilities. Permission to conduct the survey was applied from both hospital organizations, whose staff members work in the new facilities.

Information about conducting a survey was sent by email to managers and by email to members of the common information group of workers in the new building. Information was also available on hospitals intranet news. A reminder was sent a week before the survey was to end. At the same time, the patients and their relatives received paper questionnaires at the time of their registration. A 1000 paper questionnaires were distributed to all the units according to the daily patient flow or the number of inpatients. Participation to the survey was voluntary both to the staff members and patients.

4   RESULTS

This study compared the differences between the evaluations of those end-users, who visited CAVE (CAVE-visitors) during HospiCaseY project and the evaluations of those staff members (other staff members), who did not participate in the design process. There were altogether 182 staff members who completed the questionnaire. The response rate of staff members was 40 %. 36 staff members (20% in total) had visited CAVE and 146 staff members (80%) did not participate in the design process. The table 2 below shows the demographics of the staff groups.

106 statements were in the questionnaire. The choice of the responses was "strongly agreed", "nearly agreed", "nearly disagreed", and "strongly disagreed". Response "not concerns me" was also possible to choose as an answer. The choices provided were set so, that participants should decide on either agreed or disagreed responses.

The defined criteria to claim that the statement was "good", the number of responses "strongly agreed" or "nearly agreed" had to be over 50 %. The quantity of such statements was 86 (81 %).

The number of statements where the percentile stayed under 50 % in both groups was 20 (19%) and this related to statements were concerning parking, acoustics of reception desks and open offices, patients and staff access outdoors, room temperature and ventilation. There were a big group of statements where staff answered "not concerns me". These statements related to topics such as durability, patients' privacy and community.

Table 2 Demographics of the staff groups

Demographics		CAVE-visitors	Other staff
Sex	Male	19 %	12 %
	Female	81 %	88 %
Age	Less than 30 years	3 %	19 %
	30 - 34 years	6 %	16 %
	35 - 39 years	8 %	9 %
	40 - 44 years	11 %	19 %
	45 - 49 years	19 %	10 %
	50 - 54 years	17 %	10 %
	55 - 60 years	25 %	13 %
	Over 60 years	11 %	4 %
Profession	Medical doctors	11 %	6 %
	Academic researchers	6 %	6 %
	Assistant medical doctors	0 %	2 %
	Auxiliary staff	0 %	7 %
	Nurses	56 %	46 %
	Maintenance staff	3 %	6 %
	Auxiliary nurses	12 %	24 %
	Administration staff	23 %	3 %
Working experience	Under 1 year	0 %	8 %
	1-5 years	3 %	21 %
	6-10 years	19 %	23 %
	11-20 years	19 %	17 %
	Over 20 years	59 %	31 %

To compare differences between CAVE-visitors and other staff members, the criteria was defined to be over 10 percent. The number of those statements was 36 (34 %). The CAVE-visitors were more satisfied with the design outcomes than other staff. These statements related to topics e.g. architecture, acoustics, functionality, comfort, accessibility and usability. There were seven statements achieving a difference of more than 20 percent as shown in table 3. Only in two statements the other staff was more satisfied and this related to entrances and number of windows.

Table 3 Statements with over 20 percent difference

Statements	CAVE-visitors	Other staff
Materials and details are of high quality	91 %	68 %
All applicable spaces are convertible and multipurpose	69 %	43 %
Patients have an opportunity to pray alone or with loved ones	62 %	41 %
View outside is interesting or of a comforting nature	58 %	32 %
Staff have good facilities to change their clothes and keep their belongings	94 %	73 %
All the washrooms and toilets are accessible and safe	94 %	74 %
All the important objects have a reserve power system	94 %	71 %

The best assessments (the quantity of responses "strongly" or "nearly agreed" were over 80 %) gained by 49 (46%) statements. The end users from both groups were satisfied to issues concerning architecture, lighting, cooling, quality of air, safety, possibilities to wash hands and the quality of maintenance. In some statements concerning on lighting and cooling, there was discontentment with the absence of controls to adjust lighting and ventilation. Some responses stated that there was a draught from the ventilation and that it was set on too low a temperature. Table 4 presents the best and the lowest valued statements of each topic.

After every topic there was space left for comments. Altogether 626 comments were given. CAVE-visitors made 159 comments and other staff 467 comments. The issues which generated most comments were parking, signs, acoustics, indoor conditions, furniture, distances and functionality.

Here are some selected comments on questionnaires:

Parking:

"The car park is too small as currently in this periphery province, where there is no public transportation as in big cities. This is not fully reckoned with design."

"The car park for staff is too small and other car parks are far away."

Signs:

"My opinion is that the signs outside are easy to understand, but we still have patients every week who have used the wrong entrance."

"Texts on doors are sometimes illogical; some sort of color contrast should be used in the signs along with bigger letters.

Table 4 The best and the lowest valued statements on each topic

Topic	Best valued statement	Lowest valued statement	Notes
Yards and entrances	Yards, footpaths and stairs have appropriate lighting and are well-maintained	There is sufficient car parking for patients, disabled, visitors and staff	Carparking under 50%
Architecture	Architecture of building match with the shape, materials and colours to surroundings	Parts of the building have their own appearance to help people to find their way	All statements over 50%
Indoor conditions	Automatic control of lighting is a practical solution in toilets and bathrooms	Acoustics of reception desks and open offices is sufficient	Acoustics of reception desks … under 50 %
Durability	Materials of fixtures are durable and easy to clean	Indoor ceilings are durable and easy to clean	High number of "not concerns me" responses
Functionality	Functional objectives achieved in the new facilities	Way of working and spatial design save steps	CAVE visitors all statements over 50 %, other staff 3 under 50%
Safety	Emergency exits, fire alarms, fire extinguishers are easy to find	Announcements can be heard in all necessary places	All statements over 50 %
Comfort	Spaces are clean and well-maintained	Patients can make drinks and snacks in wards	High number of "not concerns me" responses concerning patients sociality
Accessibility	All the footpaths and corridors are accessible	Acoustics are suitable for the hearing impaired persons	All statements over 50 %
Usability	Available space for units is sufficient	All controls for adjusting lighting and ventilation are easy to use	All controls for adjusting … under 50 %

Acoustics:

"The ventilation makes a loud noise, especially at nights."

"The legs of the chairs in the canteen make a nasty noise because of the type of the floor covering used when the chair is scrapped across the floor. It is very unpleasant to hear."

"There is no privacy in the emergency open offices. All the discussions of the nurses can be heard in the patient rooms."

"The consulting rooms are good. You can't hear anything from those rooms outside."

Indoor conditions:

"To keep the noises out, you have to shut the doors. Sometimes patients' rooms are too warm or doctors' offices are too cold. Sometimes you have to open the window, but then there is noise from the construction site."

"There is noise from the ventilation and the rooms for consultation and office work are too cold."

"The quality of air is superb. After shift I feel myself refreshing unwise in our old facilities."

"The ventilation is too powerful, though the temperatures are probably OK. The controllers to adjust temperature are quite tricky. Luckily we got the manual."

Furniture:

"The tables in conference rooms are too low. They don´t promote ergonomics. There is no adjustment in office furniture. No ergonomic in sitting work."

"You can't take patient bed down enough."

"Furniture in waiting lobbies should have been more high-class."

Distances:

"Compared to old, ugly, crowded and low hospital the new hospital is spacious. Distances are long from emergency center point of view."

"There is space to share. Disadvantages are long distances and getting lost."

"Distances are as minimized as possible."

"In long corridors all people vanish. You have to wander to find someone to ask."

Functionality:

"Pharmaceutical rooms are too small."

"There is not enough space. Examination rooms are crowded and in unclear order. In all spaces you can see that staff had no influence on design of spaces, furniture or the way of working."

"Our unit is practical and clear. Rooms are spacious and waiting room cozy. We have a lot of equipment, so we run out of storage spaces."

"We have not utilized all the functions, equipments and spaces efficiently due to shortage of personnel. It takes time to get everything to run smoothly though the facilities are good."

"The rooms are used for a different function to what they were actually designed for."

The large number of free comments exposes the significance of spaces to staff and the importance to collect feedback. The valuable opinions for the designers and administration of the hospital are now available for the future investments. It is obvious that the design process and tools to enhance the end-user participation are necessary from the first proposal of new premises. The design of sustainable and functional facilities for healthcare requires knowledge of significance of evidence based design, not only the environmental issues, but also consideration of the issues such as safety and better outcomes for patients and staff.

5   DISCUSSION

The results of post occupancy evaluation give an extensive overview to the successful design and construction of new facilities. The difference between CAVE-visitors and other staff members in one third of the statements reveals the importance of end user participation. CAVE-visitors were more satisfied with the statements on topics concerning on architecture, acoustics, functionality, comfort, accessibility and usability. Safety was evaluated "good" by both groups.

The post occupancy evaluation defined criteria "good" if the number of responses "strongly agreed" or "nearly agreed" was over 50 %. The quantity of such statements was 86 (81 %). The best assessments (the quantity of responses "strongly" or "nearly agreed" were over 80 %) gained from 49 (46%) statements. Since this study appeared to be the first POE conducted in large scale in the Hospital District of South Ostrobothnia, any comparison to other studies is not conducted, but will one of the objectives for the future studies. The other limitation for this qualitative study is the shortage of statistical analysis. Encouraged nevertheless by this study, there has been one POE survey and two pre-occupancy surveys undertaken to discover the best design decisions for the future hospital facilities.

The large number of other comments exposes the significance of spaces to staff and the importance to collect feedback. It revealed disorders in respect of occupancy and use of new facilities like ventilation, temperature and acoustics. It exposed also the importance of support and management related to functional changes. In addition it revealed important issues, in need of improvement, e.g. car parking spaces and some pharmaceutical rooms.

96 percent of the staff regarded POE-survey "important" or "rather important" and participants prized the opinions to be taken under consideration.

Due to long design, construction and introduction timespan, there have been changes in staff. The issue can be noticed if you study the differences of demographics of participants. The CAVE-visitors were older and had longer working experience. Other staff members were younger and had shorter working experience. New facilities and functions need recruiting and as well replace retirement. As well the healthcare processes change rapidly and the facilities should fit for functional changes for the future.

6   CONCLUSION

The latest tool to promote end-user participation in HospiCaseY project was introduced after the completion of the project. Post occupancy evaluation was conducted in October 2013 at the same hospital facilities the project supported. Questionnaires were completed by 182 staff members and 227 patients. The form consisted of demographic information and 106 statements on nine different topics: yards and entrances, architecture, indoor conditions (lighting, acoustics and atmosphere), durability, functionality, safety, comfort (privacy, community and aesthetics), accessibility and usability.

The special interest of this paper is the outcome of the difference between the evaluations of those end-users who had visited virtual environment (CAVE) and the evaluations of other staff members who did not participate in the design process. During the HospiCaseY project 280 end-users, designers and administration visited CAVE. Of those visitors 34 end-users participated in the POE survey.

In comparison CAVE-visitors and other staff members the defined criteria was over 10 percent difference. The number of those statements was 36 (34 %). The CAVE-visitors were more satisfied with the design outcomes than other staff. These statements were from topics on architecture, acoustics, functionality, comfort, accessibility and usability. Overall the results were positive. With defined criteria "good" if the number of responses "strongly agreed" or "nearly agreed" was over 50 percent. The quantity of such statements was 86 (81 %).

After each topic there was an opportunity to make comments. The survey gathered altogether 626 comments. Issues, which gathered most of the comments, were parking, signs, acoustics, indoor conditions, furniture, distances, functionality. Some adjustments and reparations are already executed in the facilities.

This study introduced the benefits of evaluation and established intention to use POE as a systematic tool for all renovations and new construction projects of the Hospital District of South Ostrobothnia. In addition the use of the virtual environment (CAVE) indicates its benefits for better end-user satisfaction.

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NORMATIVE AND RELATIVE ASPECTS OF THE USABILITY OF COMMON SPACES IN ASSISTED LIVING FOR OLDER PEOPLE

Morgan Andersson

Chalmers University of Technology, Centre for Healthcare Architecture

morgan.andersson@chalmers.se

ABSTRACT

Purpose This paper uses a normative-relative dichotomy to discuss the concept of home in relation to the usability of common spaces in assisted living facilities (ALFs).

Background ALFs for older people in Sweden contain both the residential and workplace perspectives. The common spaces have physical and organizational features that are related to traditional institutional care environments. The use of common spaces in ALFs focuses heavily on communal activities, entailing a complex relation to the concept of home in a social context and of the home as a place.

Approach A mixed QUAL/QUAN approach was applied to explore the daily use of 14 ALFs in Sweden, using participant observations, semi-structured interviews, questionnaires and statistical analyses. Residents, staff, relatives, planners and architects were included.

Results When the relative context of the building in use diverges from the normative context of planning and conceptualization, it affects the usability. It is also affected by diverging residential and workplace perspectives. The results show different objectives for use between dementia and somatic units. Although Swedish regulations include the common spaces as part of the housing unit, they are used and perceived differently and to a varying degree. The dining rooms are perceived closer and the kitchens further away from the concept of home. Furthermore, the higher degree of use on the dementia units places the common spaces closer to the concept of home here, compared to the somatic units.

Discussion The normative aspects of architecture represent a fixation in time and space as they are manifested in the design processes and, as a result, in the physical structures. Usability, contrarily, represents relational aspects as it is created in continuous negotiation between the users and the physical environment; or in the interaction between human and non-human actors. The prerequisites for use are continuously changing in relation to normative aspects. Common spaces must be understood from an extended concept of home that takes into consideration the context of the building in use and the position between the personal and public spheres.

Keywords

Assisted living; home; residential; workplace; normative-relative; Qual/Quan; usability

1   INTRODUCTION

The objective here is to discuss the usability of common spaces in assisted living facilities (ALFs) from the residential and workplace perspectives. The normative aspects of the physical environment, as a result of the planning and building processes, are discussed in relation to the relativity of the changing contexts and situations in the building in use.

The ALF is a residential facility for older people in need of daily care but it is also a workplace. People living in Swedish ALFs are increasingly old and multi-diseased (NBHW, 2008). Improved health status, increased life expectancy and more efforts within care and home services directed towards ordinary housing are the main reasons for this. According to Swedish regulations, common spaces are included in the residential environment: 'For a group of residents, the rooms in the private apartments, concerning functions and equipment for cooking, daily social interaction and dining, may partly be located to common spaces.' (Boverket, 2012).

The overarching issue is how the planned functions of a building can be described in relation to the usability of a building in use, or as a normative-relative dichotomy. The materialized idea of the building is related to the planning and construction stages (Figure 1), and to the normative aspects of architecture. The building in use is related to the users and represents the relational aspects of architecture, or user-artefact interaction. The result of this interaction can be described in terms of usability (Blakstad, 2001).
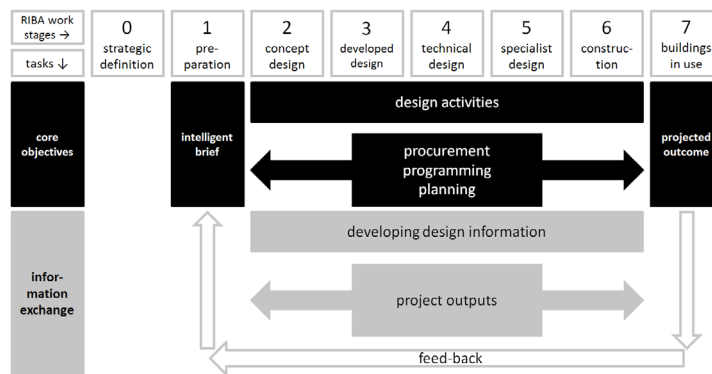
Figure 1 shows a simplified version of the RIBA Plan of Work 2013. Stages 1-6 represent the planning and construction stages.

1.1   Research questions

Two questions are posed, related to the concept of home. The first question concerns our 'images' of what an ALF is. The second question explores the position of the common spaces.

> 1. How is usability affected by the two diverging contexts; the normative context of planning and the relational context of the building in use?

> 2. How is usability affected by the functional demarcations in the common spaces?

2   STATE OF THE ART

Swedish ALFs are built over a long period of time, for different purposes and display significant variations in architectural design, size, material and location. There are, however, typological similarities in the physical structures (Andersson, 2013). This includes a subdivision of the facilities in 'units' or 'groups' with common spaces for communal activities as well as staff present at all times. This scheme is since long valid for ALFs in many countries (Anderzhon et al., 2007; Kalymun, 1991; Paulsson, 2002; Zimmerman and Sloane, 2007).

The typology (Figure 2) display physical and organizational features that are related to an institutional context rather than to residential environments (Goffman, 1961). The common spaces can here be seen as a manifestation of a collective idea rather than of individualization (Andersson, 2013). Moreover, the promotion of communal activities may even counteract a desired individualization (Nord, 2013). Common spaces for social interaction contain both the residential and workplace perspectives as the staff is the main social facilitator in ALFs (Ball et al., 2009; Bland, 1999; Nord, 2011b; Ryvicker, 2011; Williams and Warren, 2009; Zimmerman et al., 2003).
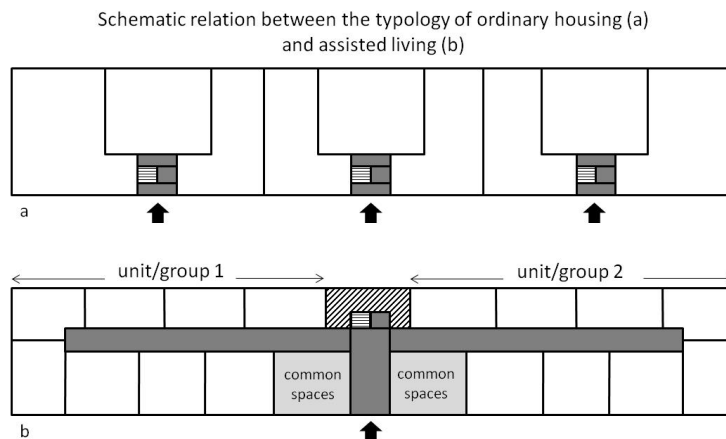
Figure 2 illustrates the typological differences between ordinary housing and ALFs. The structure of the communication areas in ALFs are compared with ordinary housing.

The common spaces present a complex relation to the concept of home (Hauge and Heggen, 2008). Swedish legislation equals ALFs with ordinary housing; the one exception being the common spaces (Boverket, 2012). On one hand, much of the activities taking place in common spaces are of a private character, normally occurring in a private home (Lundgren, 2000; Solove, 2002). On the other hand, the common spaces are intended for social interaction with other people. In ALFs, like in many institutions, most aspects of everyday life are staged within the confinement of the building or unit (Goffman, 1961). People adapt to the situation by creating private 'micro-spatialities' in public or semi-public spaces (Sommer, 1969; Nord, 2011b). There is a strong disagreement between the need for the ageing individual to move to an ALF and the emotional attachment to the home (Gurney and Means, 1993). With age comes an increasing reluctance to leave friends, neighbors and the physical home (Cadwallader, 1992; Hurtig, 1995; Lawton, 1990; Moss and Lawton,

1982). The decreasing physical range of older people also reduces the social range (Sixsmith, 1990). For many residents in ALFs, this means that the common spaces are the furthest you get from your apartment.

There is support for the idea that most residents who can chose for themselves, may participate in the communal meals but otherwise prefer to spend most of their time in their own apartments (Hauge and Heggen, 2008; Nord, 2011a; Zimmerman et al., 2007). Although staff is important as social facilitators (Ball et al., 2009; Bland, 1999; Nord, 2011b; Ryvicker, 2011; Williams and Warren, 2009; Zimmerman et al., 2003), there is a risk that ALF residents may receive poor social support (Howie et al., 2014). Studies confirm both the importance of retaining established social out-of-house contacts in the transition to an ALF (Cutchin et al., 2003) as well as establishing in-house social contacts (Street et al., 2007).

The usability of common spaces is relative to the users' disparate understanding of the spaces in a social context (Moore, 1999). Usability represents relational aspects as it is continuously created in negotiation between the users and the physical environment; or in the interaction between 'human' and 'non-human actors' (Latour, 1992). The usability of the built environments is an effect of the use in a specific context (Blakstad, 2001). Swedish legal framework defines usability in relation to accessibility: 'The built environment has to allow any individual, in spite of impairments, to perform daily activities within it' (Didón et al., 1987). The experiences of the users must be included in a discussion about usability (Rasila et al., 2010). Their experiences are related to social and cultural mechanisms (Fenker, 2008; Lindahl and Granath, 2006) and usability is related to varying social and experiential factors (Moore, 2000). There is a distinction between the socially perceived dimensions of a space and the actual function. Moore (1999) points out the interrelationship between the socially shared understanding of a place and the 'social affordance' that it provides. According to Alexander (1977: 941) a building cannot satisfy users 'unless the physical spaces are congruent with the social spaces'. In this context, it means that the actual use must fit within the projected function for the space to be used efficiently. This paper recognizes that usability is a process that is constantly created in the communicative and co-creational processes between people and environment (Alexander et al., 2013).

3   APPROACH

A mixed-methods research strategy combines quantitative and qualitative methods (Groat and Wang, 2002; Patton, 2002) to secure the validity of the results (Onwuegbuzie and Johnson, 2006; Greene et al., 1989). The studies were performed 2009-2013. Participant observations, semi-structured interviews and questionnaires were used for gathering data (Table 1). The study includes 25 units/groups in 14 ALFs in Sweden (Table 2). Ten of the units are specialized in residents with dementia and related disorders (DRD), referred to as 'dementia units'. The other 15 are referred to as 'somatic units'. Observations were made on 15 units during 200 hours (n=302). Group interviews with staff (n=24) and individual interviews with residents, relatives, planners and architects (n=21) were performed. All interviewed residents lived on somatic units. It also includes a questionnaire to staff (n=193). Method triangulation, using different methods, and data triangulation, using different data sources,

have been used (Denzin and Lincoln, 2005; Patton, 2002). Qualitative Content Analysis (QCA) based on Graneheim and Lundman (2004) was then applied. Statistical methods were used to analyze the degree of presence in the common spaces and the correlation between presence and mobility.

Table 1 Research methods

Method	Participants	Persons involved	Time of data collection
1. Participant observation	Residents	199	2009-2010, 2012
	Unit staff	103	
2. Group interviews	Unit staff	24	2011
3. Individual interviews	Residents	10	2012
	Relatives	4	
	Planners	4	
	Architects	3	
4. Questionnaire	Unit staff, heads	193	2012
Number of persons directly involved:		540	

Table 2 The 14 facilities included in the study

Original purpose	Built	Rebuilt	Residents per facility	Dementia units	Somatic units
1. Private apts.	1912	1992	39	1	
2. Home for the aged	1959	1994	66		1
3. Assisted living	1966	1984	61	1	
4. Assisted living	1966	2011	52		1
5. Nursing home	1968	2009	138	1	1
6. Nursing home	1971	2005	75	2	2
7. Service housing	1971	2005	50		1
8. Hotel	1976	2008	60		1
9. Service housing	1980	2009	98	2	2
10. Home for the aged	1993	-	24		2
11. Assisted living	1993	-	20	1	2
12. Assisted living	1994	-	71	1	
13. Assisted living	2000	-	38		1
14. Assisted living	2001	-	72	1	1
Number of units:				10	15

4   RESULTS

The results (Andersson et al., 2011; Andersson, 2013; Andersson et al., 2014) suggest that the common spaces are more used on the dementia units, compared with the somatic units (Figure 3). Presence peaked during meals on all units. This result is supported by other studies (Frankowski et al., 2011; Moore, 1999; Nord, 2011a).
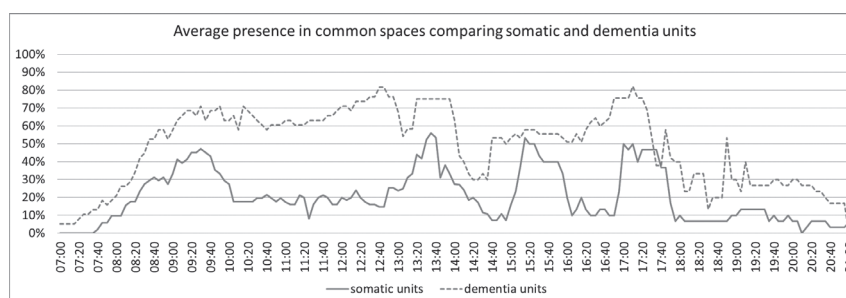
Figure 3 shows the average presence of residents in per cent of the total number of residents per unit. The peaks correspond to the daily meals. All observations are included.

The higher presence on the dementia units is substantiated by the majority of the staff, both in the group interviews and in the questionnaire. When asked whether the residents with DRD are more likely to stay in the sitting and dining rooms compared to other residents (single option answers), 24 out of 32 on the dementia units compared with 25 out of 50 on the somatic units would agree to a great extent or completely.

No significant correlation (Rider, 1932) was indicated between the average presence in the common spaces and the average mobility of the residents. Twice as many residents on the dementia units were dependent on help for their transportation but neither the average proportion of residents who could walk independently nor the proportion of residents who used a wheelchair differed significantly between the somatic and dementia units. There is support for the idea that people with cognitive disorders or higher dependency on help from others are more likely to be in common spaces but are less engaged in their situation, while those with somatic disorders prefer to be alone in their apartments (Barnes, 2006; Zimmerman et al., 2007). This can partly explain the low correlation between mobility and presence.

Regarding the social activities accounted for; two related findings are of relevance. The first show very few visits or other social contacts besides the common meals. The common spaces were used for such purposes only on three occasions. The second finding shows that the residents left the building for excursions, visits, shopping, etc., only at seven occasions. These findings suggest that the common spaces are the main venue for social contacts with the staff and the other residents on the units.

Old and multi-diseased residents use more mobility aids, which can result in a lack of space in common spaces and in apartments (Andersson et al., 2011). This indicates a discrepancy between the needs of the residents, as imagined at the planning stage, and the actual needs. In some cases, there is a lack of spaces for sanitary functions, clerical work, etc., indicating a

discrepancy between the requirements identified (or not identified) in the planning process and the actual needs of the staff.

The shortage of space is apparent because of the wheelchairs. Kitchen and dining spaces are small and wheelchairs take too much space. There has to be room for us [the staff] to help the residents eat, for instance! Carer on dementia unit.

The sitting room is large, but when there are activities [e.g. meals] it still gets crowded. I think it is made for people who can walk by themselves, not for wheelchair users. There is no room for them. Carer on somatic unit.

The big wheelchairs are in the way when other wheelchairs pass by, which can lead to conflicts. Carer on dementia unit.

The results show that the residential and workplace perspectives implicate different objectives for use (Andersson et al., 2014). While the staff actively tried to get the residents to the common spaces, the interviewed residents more tended to focus on the quality and content of the activities. Differences between somatic and dementia units are apparent. Great differences between the participants' views are also suggested.

I'm not that interested in socializing with the others. Most of them have their own TV-set. I spent more time in the sitting room before I got my own big screen TV. I don't spend much time there now. Yes, but it's sort of nice to have your meals in a group. You get together. Male resident 87 years.

They are always with us in the sitting room. It's more like their home in the dementia unit. In the somatic units, they all go back to their rooms. They don't feel comfy sitting out there. They go to their 'rooms'. That's the difference. Female carer on dementia unit.

Tremendously important [the common spaces]! It's where you socialize. The meals are the most important events during the day. The common spaces give opportunity for social encounters. They are a window to the world and describe the atmosphere on the unit. Female architect.

The common spaces are important, but you should not exaggerate their significance. When I have been to ALFs, the common spaces have been empty. The apartments are more important. Male with strategic function in building processes in eldercare.

The results indicate functional demarcations between the common spaces in relation to the concept of home. An ALF provides three functions for the residents; an individual housing unit, or home; domestic care; and a social context (Andersson et al., 2014). As most residents give up their private home for economical and practical reasons when they move to ALFs, it de facto becomes their new home. Nine out of ten interviewed residents agreed that the ALF indeed was their home, as did a majority of the interviewed relatives, architects and planners. Both the questionnaire and the interviews showed that 'apartments' are closer to the home concept than 'units'. But there is a distinction between 'home' and 'residency'. Heywood and colleagues (2002) relate a residential, or housing, unit to physical structures and home to existential and experiential factors. The participants also expressed great variations in their relations to the concept of home.

They live 'in a home' but they are not 'at home'. I don't think you can feel at home any other place than when you are 'at home'. Here we try to create a 'home-like' environment. Female carer with experiences from both somatic and dementia units.

Yes, this is home, because I couldn't have two places and I couldn't cope on my own. They mistreated me with medications and I became blind. My cousin lives in the house where we all grew up. I would have liked to live there, but it's not possible. Female resident 87 years.

Her apartment is her home. She has got her own furniture and pictures from home. It's nicely decorated, no carpets but a big comfortable armchair. She can no longer watch TV. At the end she thought that TV was the reality. Female relative with mother in dementia unit.

No, it's not a home. But it's more or less home-like. You could compare it with a student hostel. Male architect.

Common spaces have three main functions; being together, dining and cooking. All units in the study had integrated kitchen and dining spaces and the majority had 'multi-purpose spaces' with all three functions spatially integrated (Yang and Stark, 2010). Since meals dominate the communal activities, the dining spaces were the most used on somatic as well as dementia units. Both the sitting and dining rooms were more used on dementia units. The kitchens were, with very few exceptions, never used by the residents. None of the interviewed residents used the kitchens. One of the interviewed female residents had, however, previously participated in baking and a male resident had cooked dinners for his fellow residents at festive occasions.

There are two strong reasons for the staff to have the residents in the common spaces; to create a social context and to maintain control (Ryvicker, 2011). The results indicate that control is more important on the dementia units, compared to the somatic. Other studies indicate that residents with higher dependency are more likely to stay in public places or places where there are people (Barnes, 2006; Zimmerman et al., 2007).

The low use of the kitchens is confirmed in the group interviews. The questionnaire also shows a functional demarcation between the kitchens and the sitting rooms. 60 out of 103 carers (single option answers) would agree that the common kitchen is their workplace rather than the residents' home. At the same time, 86 out of 104 would agree that sitting and dining rooms are the residents' home rather than their workplace. The use of the kitchens is also subject to food hygiene regulations (European Community, 2002; 2004). These regulations do, however, not prevent residents from using the kitchens, but regulate how food is prepared and stored. It is obvious that the common kitchens are functionally demarcated from the other spaces. There is also an evident demarcation between the apartments and the common spaces.

The apartment is my home. The sitting room is more like a lounge. If you want to be alone, you can stay in the apartment. Male resident 82 years.

No, I don't use the kitchen. Cooking used to be my passion but here I do nothing! Female resident 92 years.

The whole house is their home. Of course we work in their home. Female carer on dementia unit.

It's good when they are in the common spaces - you have control. Those who can manage spend most time in their rooms. Those who are not 'lucid' watch TV in the sitting room. Female carer on somatic unit.

5   DISCUSSION

5.1   Normative versus relational aspects

The first question concerns how usability is affected by incongruence between the context of planning and the context of the building in use (Figure 4). The conceptualization of a building during the planning stages represents normative aspects of architecture, materialized in the physical environment. The building in use, contrarily, represents relational aspects. The context can be described as the 'interface' between building and user (Wahl et al., 2012) and the effect of the interaction can be described as usability (Blakstad, 2001). The interface is composed by space, time and actors (Andersson, 2013). Or, expressed in other words; the 'architectural space' becomes an 'existential space' in the meeting with the user (Norberg-Schulz, 1971). A building must be able to accept a certain degree of change, an acceptable change, within which a flexible use is possible. Flexibility is here defined as a possibility to adapt the use of the artefact over time; either concerning what tasks to perform (task flexibility) or how the tasks are performed (job flexibility) (ISO, 1998; Schackel, 1991).
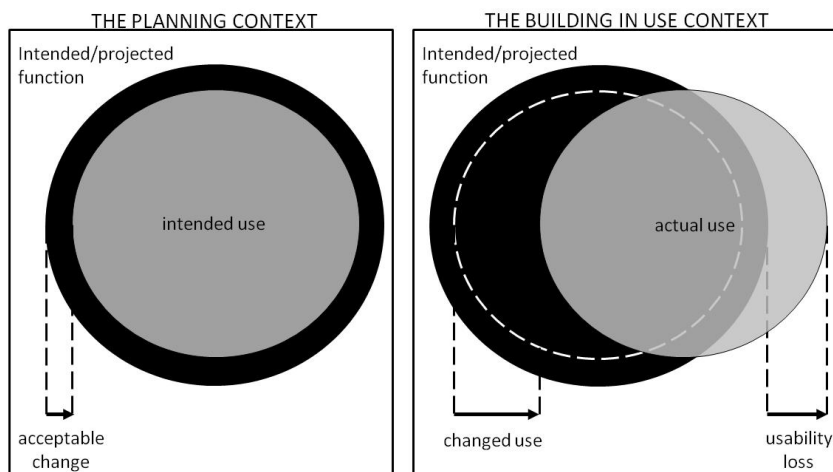
Figure 4 shows the relation between planned, or intended, function and the actual use. The picture on the left shows how the intended use fits within the projected functions. The projected function contains room for an acceptable change. The picture on the right shows how the actual use has changed and no longer fits within the intended function. The changed use causes loss of usability in the building in use.

It could of course be argued that a change of use, reversely, could result in higher usability in relation to the new situation. Although Swedish ALFs are built over long time and for different purposes they display great structural similarities. It could here be argued that people tend to get used to a place and how it is used and judge it from this experience rather than assessing it's appropriateness for a certain purpose, suggesting great influence of social and experiential factors (Moore, 2000).

Several researchers have shown the importance of feedback from the end-users throughout a building's life cycle (Alexander, 2006; Blakstad, 2001; Fenker, 2008; Kärnä et al., 2010; Leaman, 2000) and the need to continuously integrate the end-users' experiences in the planning process (Blyth and Worthington, 2001; Lindahl and Ryd, 2007). This paper takes departure in the complexity of buildings in use (Figure 5).
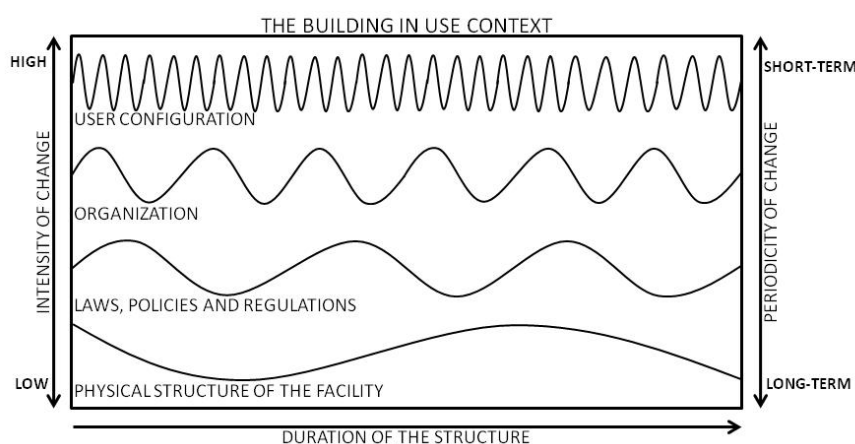
Figure 5 illustrates the complexity of the building in use context, in contrast to the static normativity of the planning context. The physical structure presents a low intensity of change, in terms of rebuilding, etc., but a long-term periodicity of change. Changes in the user configuration, contrarily, have a high intensity of change and a short-term periodicity of change.

There are several examples of the incongruence between normative and relational aspects of use. The lack of space for mobility aids can be related to incongruence between the imagined users and the actual users. The lack of space for sanitary functions, clerical work, etc., represents incongruence between the residential and workplace perspectives. In the case where the bedroom doors were too narrow to wheel the beds through, there is incongruence between the original purpose of the bedroom and the actual use, resulting in a loss of usability.

5.2   Functional demarcations versus usability

The second question concerns the concept of home in ALFs. Functional demarcations in the common spaces (Figure 6) are based on the participants' perception of their closeness to the concept of home and on the degree of use, or the average number of persons present in the common spaces (Andersson et al., 2011; Andersson et al., 2014).

The results show that the apartment is closest to the concept of home. Cutchin (2003) discusses the concept of home as an experience of place in 'service settings' and points out that 'significant activity and meaning are generated there'. Andersson (2011) suggests that the greater the number of accessible places for spending time in the common spaces, the greater the feeling of 'homeli-ness'. There is incongruence between the staff's desire to create a social context and maintain control and the residents desire to live a private life in their own apartments. It is also suggested that the staff's desire to have the residents in the common spaces is greater on the dementia units, compared to the somatic (Andersson, 2013; Barnes, 2006; Zimmerman et al., 2007). Moreover, people with DRD request more attention from staff and other people (Sloane et al., 2002).
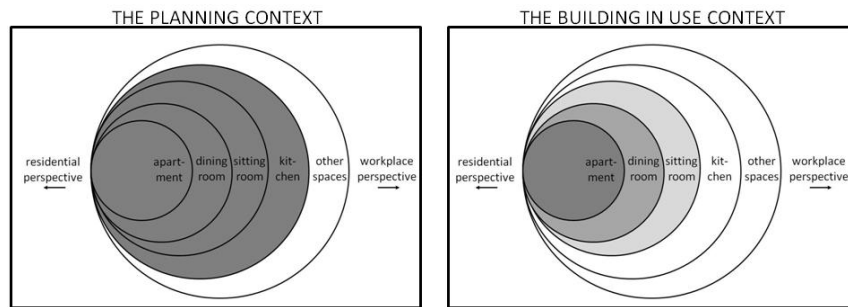
Figure 6 The left picture shows the planning context with functional demarcations in a residential-workplace continuum. The dark grey circles show the functions included in the housing unit of the individual resident (Boverket, 2012). The residential perspective is closest to the concept of home. The right picture shows the perceived situation in the building in use. The dining room is the most used space. Darker grey shades mean higher proximity to the residential perspective and to concept of home.

The results show that the participants perceived the ALF in different ways; both the ALF in relation to the concept of home and the common spaces in relation to their functions. Although the majority of the participants agreed that the ALF indeed was a home when asked directly, the results display great heterogeneity in the perception of the ALF as 'home'. Hurtig (1995) points out that the experience of home is developed in close interaction with the place, but can shift focus (Figure 7). This means that we comprehend home differently depending on the physical or mental position. The results also display differences between individuals and groups, which illustrates the influence of social, cultural and experiential factors (Fenker, 2008; Lindahl and Granath, 2006; Moore, 2000). Like Leith (2006), this paper recognizes the ALF as 'dynamic and context-bound'.
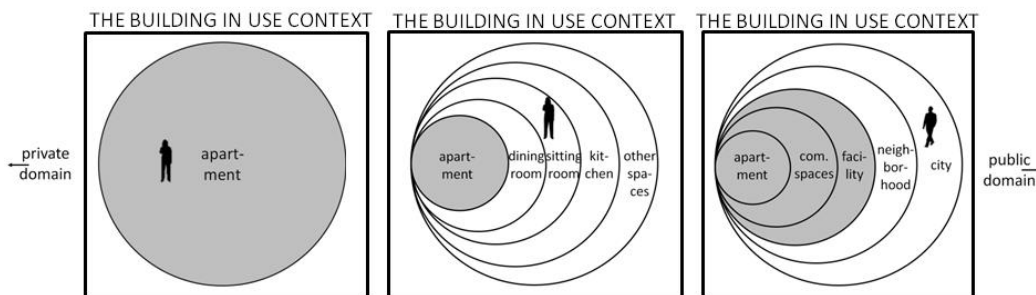
Figure 7 shows how the concept of home is relational to the position of the experiencing subject.

The common spaces are included in the housing unit of each individual. The results, however, show a clear functional demarcation between the apartments and common spaces, where the apartments are closest to the concept of home. Within the common spaces, the kitchens are perceived as a workspace. It is obvious that the dining space is the most used function and to a higher degree included in everyday life than the other functions. This places it closer to the concept of home. The common spaces can be seen as an extension of the private domain into a communal sphere. They can also, reversely, be seen as an extension of the public domain into the private sphere. Hauge and Heggen (2008) suggest that a general home-likeness of the common spaces may result in unclear and inconsistent expectations and ambiguous boundaries between the private and public spheres; how the rooms are arranged and decorated

thus determines how we position it in relation to home. In addition to their conclusion, this paper points out that the functional demarcations in themselves give the common spaces an ambiguous location between the personal and communal spheres (Figure 8).
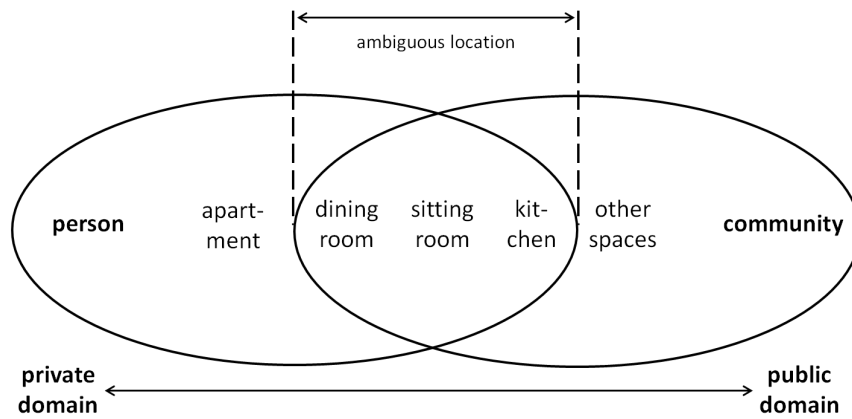
Figure 8 shows the position of the common spaces between the personal and communal spheres.

Considering the different use of dementia and somatic units, it can be assumed that the concept of home is perceived differently by people suffering from DRD than by others as they are more likely to use the common spaces. Another possible assumption is that the functional demarcations of the common spaces on the dementia units are more congruent with the planning context (Figure 4).

6   CONCLUSION

First, this paper compares the normative context of planning and the relational context of the building in use. When the actual use does not fit within the projected functions it results in a usability loss, like when an increased use of mobility aids results in space shortage or when the bedroom doors in a 1970ies ALF were too narrow to wheel the beds through. This is also the case when certain functions are *not* projected, like when spaces for sanitary functions, clerical work, *etc.* are lacking. Both cases are related to deficiencies in formulating the necessary requirements at the planning stage and affect the usability from both the residential and workplace perspectives.

Second, the common spaces have different functions. These functions can be related to the concept of home, which, in turn, is related to how 'home' in ALF is perceived. The closeness to the concept of home is discussed in relation to the degree of use. The planning context, based on rules and regulations, include kitchens, dining rooms and sitting rooms as shared parts of the housing unit of each individual resident. The results, however, demarcate the common kitchens, since they are very rarely used by the residents. This suggests incongruence between the normative apparatus for Swedish ALFs and the actual use of the common spaces. There is, furthermore, a significant demarcation between the apartments and the common spaces, showing that the apartments are closest to the concept of home. The dining room/space is the most used space and the common meals are the most important reoccurring social events of everyday life. This places the sitting rooms further away from the concept of home than the dining rooms.

It is suggested that the staff's desire to have the residents in the common spaces is greater on the dementia units, compared to the somatic. In this study, the degree of use was significantly higher on the dementia units, compared to the somatic units. The results from the somatic units, however, suggest incongruence between, on one hand, the staff's desire to create a social context and maintain control and, on the other hand, the residents' desire to live a private life in their own apartments.

The usability of the common spaces must be top priority when designing ALFs. This paper contributes to the understanding of how, and to what degree, common spaces in ALFs are used. It also contributes to the understanding of the common spaces as part of both the personal and communal spheres. The results point out a number of considerations when planning for ALFs, accentuating the necessity of including both the residential and workplace perspective. Should the kitchens be included in the residents' 'common spaces'? Is the typology for ALFs valid for the future? If the collective aspects are provided for by means of the common spaces; are those the 'right' aspects? How do we provide for the residents' individual needs in this collective context? Regarding the differences in daily use between somatic and dementia units; what implications should they have on the design of future ALFs?

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USABILITY FRAMEWORK OF SENIOR HOUSING

Leena Aalto
Finnish Institute of Occupational Health - FIOH
leena.aalto@ttl.fi

ABSTRACT

Purpose The aim of this study was to evaluate the usability of senior housing. The usability framework created in this study highlights the usability attributes in architectural design for the senior aged.

Background The aging population creates new requirements for residential housing solutions. The lifestyle of the senior aged is becoming increasingly different and more varied. Since getting older eventually means that functional capacity weakens and coping with daily duties becomes more difficult, usability issues should also be taken into consideration in architectural design.

Methods In order to investigate the usability features of the built environment, a usability evaluation process was created, and a walk-through was used as an evaluation tool. During the walk-through, five different attributes of the spaces were considered: functionality, safety/security, comfort, interaction, and orientation.

Results The usability evaluation consists of six "steps" along the way through the Loppukiri senior house case building in Helsinki, Finland. According to the results the main topics of discontent in Loppukiri were: noise, temperature, security and accessibility. In contrast, neighborly help, several cozy common spaces, and the beautiful, functional furniture in these spaces resulted in satisfaction.

Discussion The usability aspect is also an important factor in ordinary residential design. Thus, the results of this study provide valuable information on the usability of the built environment for authorities and designers, as we all grow older. In the future, the exploitation of these study results requires further research using measurable methods in different kind of senior houses.

Keywords

usability, senior, housing, walk-through, user, experience

1 INTRODUCTION

The proportion of people aged 65 or over in the Finnish population is estimated to rise from the present 18 per cent to 26 per cent by 2030, and to 28 per cent by 2060. The demographic dependency ratio, that is, the number of children and pensioners per one hundred people of working age, will also rise in the near future (Fig. 1).
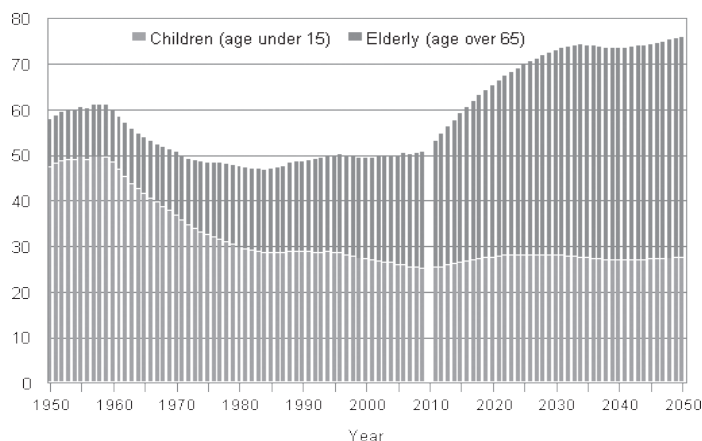
Fig 1 Demographic dependency ratio in Finland in 1950–2009 and projection for 2010–2050. Number of children and elderly per 100 people of working age. Source: Statistics Finland, Population Structure 2011

As the baby-boom generation moves through the age pyramid, older cohorts will become more numerous than the younger ones. Combined with the rapid growth in the size of the elderly population, this means that substantial development investment will have to be allocated to different forms of residential care facilities and care services for the elderly (Aalto and Saari 2009).

The spaces, the apartment and the living environment are relevant factors for elders as regards coping independently at home. The physical environment affects the environmental experience of elderly people on the functional, symbolic and personal levels. The physical environment can either support the success of functions in a space or prevent their performance.

As Windle et al. (2006) state, difficulties experienced at home by some older people are related to their functional status, and is not necessarily a reflection of the condition of the property. On the other hand, if functional limitations are exacerbated by inappropriate housing conditions, then some occupants could face an increased risk of a poor health outcome (Windle et al. 2006).

Edvardsson et al. (2005, 2008) stress, that physical and the psychosocial environments are inseparable entities, interacting in such a way that it is the atmosphere or climate that either supports or hinders the person-centered outcomes of the quality of life (QoL) and well-being.

According to the research on aging, both physical and social environments are central to the residents' experience of place and to their well-being in the residential care setting (Nair, 2005; Cheng et al., 2011). Further, Lengen and Kistemann (2012) state that recognizing

places, scenes and landmarks, and encoding new place information is central in navigation and spatial orientation. A place forms an essential basis on which experiences can be unfolded in the memory and the imagination (Lengen and Kistemann 2012).

The physical environment also needs to provide its inhabitants with a sense of independence (Schwarz and Brent 1999), facilitated by way-finding cues, symbols and proper lighting to enhance visibility (Ulrich 1992). In addition, Wijk et al. (2002) state that a conscious color design can enhance the spatial demarcation of the room, sense of familiarity, and orientation in shared spaces which reinforces the elderly person's sense of independence and autonomy.

Altman (1975) defines three types of territories that influence a human's identity. Primary territories, such as places in the home, are private places in which the owner has exclusive rights to use the space. Primary territories are outstandingly important for the elderly since they spend so much time at home. The primary territory is personal and reflects the owner's social status. Secondary territories are semipublic places in which a person interacts with acquaintances or neighbors on a relatively regular basis. Examples of secondary territories are one's residential building, stairway and backyard. Public territories are spaces in which almost anyone is allowed temporary access, providing they observe the relevant regulations. Examples include a nearby recreation area or park.

The characteristics of the neighborhood influence the mobility possibilities of older people. In an inaccessible environment, even a small impairment of functional capability hinders independent living and causes the need for help. Everyday mobility diminishes, and this expedites the weakening of functional capability.

Routio (1986) states a good living neighborhood supports the independent coping of older people. A barrier-free, safe apartment, courtyard and neighborhood offer physically impaired people possibilities to manage in everyday tasks and have physical exercise and refreshment. Figure 2 shows the spatial structure of elders' living environment.
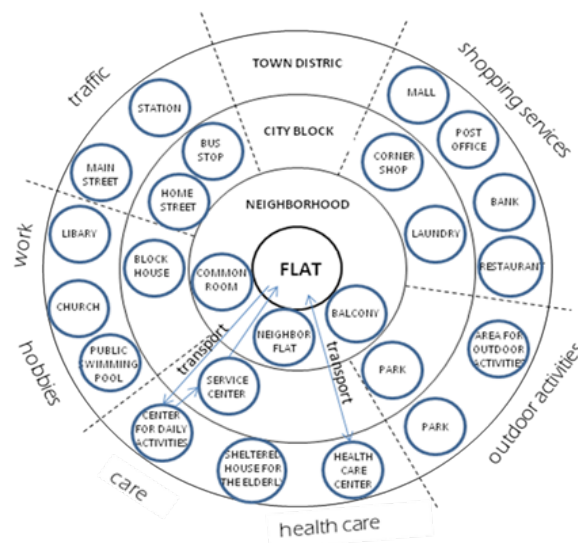
Fig 2 Spatial structure of elders' living environment (Routio 1986)

Although there is little of research on usability issues in the housing of senior aged people, a great amount of research on the housing of elderly people in general does exist (Oswald et al., 2007; Reid, 2004; Andersson et al., 2011; Fange & Iwarsson, 2005). In addition, the relationship of the residential environment with health and well-being has received particular attention in research on aging (Rioux, 2005; Wahl et al., 2009; Fernandez-Ballesteros et al., 1998; Fernandez-Mayoralas et al,. 2004; Oswald and Wahl, 2004; Rojo-Perez et al., 2007; Wilson et al., 2004; Windle et al., 2006; Iwarsson et al., 2007, and many other).

One group, whose assessment of the usability of the built environment is particularly valuable, is the elderly with physical and sensory disabilities. When human functional capacity weakens, the usability of the living environment faces great challenges in ensuring that the elderly population cope independently and have a decent quality of life.

The great amount of the older population will pose new challenges to society. According to predictions, those over 65 will be wealthier and in better physical condition. In addition, the lifestyle of the senior aged is becoming increasingly different and more varied. The resources and experiences regarding aging will consequently differ significantly from former times.

Senior housing

Independent living facilities, called senior houses, are a relatively new housing type for seniors in Finland. Senior houses are apartments for residents aged 55+ who can live independently and take care of themselves. Senior houses are not registered, and as a consequence we have no accurate data on the number of senior rental apartments or information on their locations in Finland (Tyvimaa, 2010).

This type of housing normally has no services or personnel, but leans on local services. The building, the apartments and the yard are all barrier free and the residents usually have security aids at home. According to Sonkin (1999), this kind of housing is suitable for the senior aged who are still active and participative in society, but whose need of help is approaching. They can still adapt in a new living environment, create their own social network and age in a familiar environment (Sonkin 1999).

Usability research

As increased functionality does not necessarily mean improved usability in a building (Lindahl et al., 2003), housing for senior citizens in particular must be reviewed not only from the viewpoint of functionality, but also from the viewpoint of usability.

According to Hansen et al. (2011) the study of usability was first developed in the 1950s in Human Computer Interaction and is widely known in relation to applications within User Centred Design (UCD), Usability Engineering (UE) and user experience (UX), and is associated with the friendliness criteria (Fenker, 2008; Gulliksen, 2006).

ISO 9241-11 (1998) defines usability as the "extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." For further definition:

- *Effectiveness*: Accuracy and completeness with which users achieve specified goals
- *Efficiency*: Resources expended in relation to the accuracy and completeness with which users achieve goals
- *Satisfaction*: Freedom from discomfort, and positive attitudes towards the use of the product
- *Context of use*: Users, tasks, equipment – hardware, software and materials – and the physical and social environments in which a product is used (ISO 9241-11, 1998).

According to Blakstad et al. (2010) a building's purpose is to support and shelter its users while they are performing their activities and living their lives. Depending on how well they support their users' activities, the physical surroundings contribute to efficiency, effectiveness and satisfaction in the users' lives. This is what we call the usability of buildings and built environment. Usability depends both on the physical environment and how the environment is used.

The concept of usability research has also been introduced in the research of workplaces and the built environment. According to Hansen et al. (2011) usability research on the built environment is associated with the International Council for Research and Innovation in Building and Construction (CIB) Task Group 51 "Usability of Buildings 2005", Workshop W111 – "Usability of Workplaces 2-2008" and "Usability of Workplaces 3-2010".

Usability measures the quality in use and usability evaluation is for tracking the process of quality in use (Bevan, 1995; Voordt, 2005; 2009); a process of understanding the interaction between facilities and its use, and the characteristics of that interaction. When evaluating usability, it is essential to consider what factors enhance or inhibit the effectiveness or performance of various activities.

Andersson et al. (2011) state that in order to create satisfaction and well-being, everyday life has to be made comprehensible, manageable, and meaningful. The usability of the physical environment clearly plays a major role in this context (Andersson et al. 2011)

Usability includes all aspects of the user's experience when interacting with the product, service, environment or facilities (Alexander, 2007). User characteristics, knowledge, personality, age and surrounding, and culture, also have an impact on the usability experience. Usability illustrates not only the accessibility of the environment but also the satisfaction of the residents. A well-designed living environment can provide a sense of security, as well as promote independence.

Different methods and tools can be used to make visible the usability elements that have an impact on the built environment. For instance, *Post-Occupancy Evaluation* (POE) is the process of systematic collection of data on occupied built environments, analysis of these data, and comparison with performance criteria (Preiser et al. 1988). POEs assess how well buildings match users' needs, and identify ways in which to improve building design, performance and fitness for purpose.

According to Hansen et al. (2011), POE evaluation is still about the building rather than the user experience and primary process of the occupants, and the difference between POE and usability, which is the evaluation, depends on:

- Context specificity (Lindahl et al., 2011)
- Situated action (Fenker, 2008)
- Cultural sensitivity (Lindahl and Granath, 2006) and habits (Sinkkonen, 2000) in (Alho and Nenonen, 2008).
- Elements of user experience (Alexander, 2006)
- Characteristics (Mäntylä, 2001) in (Alho and Nenonen, 2008)
- Serviceability (Hansen and Knudsen, 2006; Strawderman and Koubek, 2006).

Further, Alexander (2008) states that usability is an extension and improvement of POE but emphasizes the user experience and perspective, and that the main criteria in evaluating the ability of design measured is based on their own experience.

Alho et al. (2008) describe a *Usability Rating Tool* developed for evaluating the usability of trade centers, in a method that allows managers, owners and designers to assess and develop the usability of different places. The tool analyses relevant usability attributes. The attributes are specified using different parameters identified during the research (Alho et al. 2008).

Further, according to Blakstad et al. (2007) the *Usability Walk-through* is a simple, quick way of obtaining the first overview and indications of the usability of a building, since it focuses on the understanding of operations taking place in the built environment. In fact, walk-through is not really one method, but a common term for several different techniques, in which informants are taken on a "tour" of the building, assessing different qualities and shortcomings of different parts of the building (Blakstad et al. 2007). Hansen et al. (2011) state that walk-through can also be used to acquire knowledge that can be used in the planning of new buildings.

In accordance with Hansen et al. (2011), walk-through is a generic term for a method using on-site inspection of a building for evaluating various aspects of its usability. A walk-through can be conducted in different ways, ranging from a completely open structure with evaluation based on spontaneous, subjective evaluations by random participants then and there, to predefined stops and evaluation criteria with selected participants.

For instance, Haron et al. (2011) have used usability walk-through as a research method in order to implement usability research in hospital environments. They claim that a walk-through, with an interview and observation methods, is a suitable method for collecting data dealing with human needs. Especially when it touches on field experience and reflection of experience (Haron et al. 2011).

The group taking part in walk-through evaluation should not be too large; a maximum of 10 to 15 people. If necessary, the walking tour can be performed in several stages. It is important to document all the emerging issues during the walk (De Laval, 2004). In addition, guides

and checklists help ensure that the usability perspective is taken into account in planning (Nenonen et al. 2007, Nielsen 1993, Alho et al. 2008).

Hansen et al. (2011) and De Laval (2004) stress the importance of staging during the walkthrough. Every staging point must have a theme to discuss; to provide information for the project, while also raising questions. In addition, Dale Copp's (2008) *Customer Journey Map* consists of steps, and different user experiences at each step along the journey through a built environment (Fig. 3).

Steps, moments of truth	Different functions through the customer journey
User experience at each step	Individual elements, hopes and desires
Hot spots	Key moments of truth
Purple cows	Best practicies, success moments
Verification activities	Verification and measurement methods
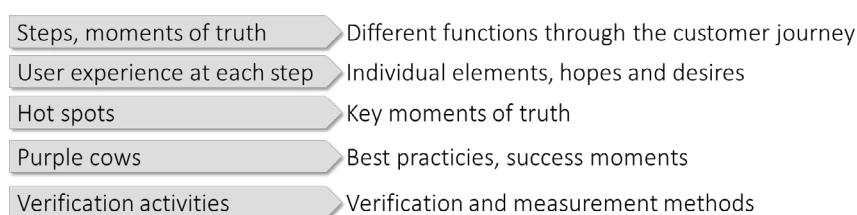
Fig 3 Frame of Reference for Customer Journey (Dale Copp, 2008)

Case building Loppukiri

The research subject chosen for the study was the Loppukiri senior house in the Arabianranta area of Helsinki. The building was completed in 2006. The residents took part in designing their own dwellings. Loppukiri represents a way of collective living, co-housing, following the philosophy of the Färdknäppen building in Sweden. The residents form six groups that clean communal spaces and make dinner for all the residents. Thus, each group of about ten people has to carry out a week's work shift about once every six weeks.

The idea of co-housing for seniors is not a new one and is an increasing trend in Northern Europe. Despite this, relatively few studies have examined the concept, and as a result, little research is available (Tyvimaa, 2011).

The Loppukiri building consists of 3115 m2 in all; 58 owner-occupied dwellings varying from 36 to 80 m2– the average size being 54 m2 – and 400 m2 of communal spaces, which are mainly located on the ground floor. In addition, a sauna, gym and one guest room are situated on the uppermost sixth floor. When buying a flat, the residents also pay a share of the costs of the communal spaces.

Loppukiri houses 70 residents: 12 couples, 5 single men and 41 single women. The average age of the residents in 2011 was 67, varying between 55 and 91. None of them use wheelchairs but some have walking stick. The housing company's regulations state that one person from each household has to be at least 48 years old. All residents of the Loppukiri building are active senior citizens and have many hobbies. Thus, the building has many communal spaces for their activities (Fig. 4 and 5).

Fig 4 Fireplace room.   Fig 5 Dining room.

2   AIM OF THE STUDY

The aim of this study was to develop a suitable process for evaluating the usability of senior housing so that users of the premises can be involved in the evaluation process. Since we will need different kinds of housing solutions in the future, we have to create a usability framework for senior housing.

In order to determine the features in built environments that support coping and housing independently; guarantee functional, physical, social and virtual environments as well as quality of life, satisfaction and well-being, we drew up the following research questions:

> 1. What usability elements of the built environment support the aging and well-being of the senior aged?
>
> 2. Is a usability walk-through a suitable method to evaluate the usability of senior housing?

We knew that this theme faces particular challenges, since for instance accessibility, mobility aids, security factors, poor visual capacity, perception and hearing have to be taken into consideration. In addition, local services are important for senior citizens in order to activate their walking in the neighborhood. Thus, this study took into account not only the building, but also the immediate neighborhood.

Since interest in the co-housing scheme has increased among the senior aged in Finland, we chose the Loppukiri building as the target in this case study. As Andresen and Runge (2002) highlight, the idiosyncratic features of co-housing communities provide the potential for healthier ways of life and, in many cases, reduce the level of ill health among residents.

3   METHODS

In order to create the usability framework of senior housing, a suitable tool was built in order to evaluate the spaces and design solutions in the Loppukiri building.

3.1 Creating the tool

Since user experience is a highly significant characteristic in usability research, the usability walk-through was regarded as a suitable method for this study. Implementing the usability walk-through in this study was seen as an evaluating process consisting of seven phases: 1) collecting the data, 2) exploring the target, 3) a professional tour, 4) planning the walk-through, 5) carrying out the walk-through, 6) analyzing the results, and 7) reporting the results. These phases are described in the next part of this paper.

3.1.1 Collecting the data

In order to collect the data on housing for the elderly, a literature review, questionnaires and interviews were carried out during 2006–2008.

Questionnaires carried out during 2007–2008 were directed at elderly people living in residential dwellings and in senior houses. A total of 164 elderly people answered the questionnaire; 76 per cent were women and 24 per cent men. Their age varied from 59 to 97.

Elderly people living in senior houses, in sheltered homes for the elderly and in ordinary residential flats were *interviewed* in the Helsinki metropolitan area. The researchers interviewed 22 people; 8 men and 14 women. Their average age was 79.1 years.

3.1.2 Exploring the target

The purpose of the exploring phase was to obtain a perception of the building and all the spaces as a place for comfortable living and coping independently. The implementation phase began by exploring the floor plans and other building documents. In addition, six Loppukiri residents were interviewed in their own dwellings: one couple and four single women. During the informal interviews, the residents talked about their home duties and any flaws or problems they had noticed in their dwellings and in the building.

3.1.3 Professional tour

On the grounds of the previously collected data, the researchers created a *usability checklist* for the professional tour of Loppukiri. The checklist consisted of 163 items. The titles of the checklist were 1) accessibility, 2) transportation and immediate neighborhood, 3) courtyard, 4) entrance hall and elevators, 5) communal spaces, 6) hallways, and 7) dwellings. During the professional tour, researchers took a closer look at the spaces, the residential environment in general, and the services in the immediate surroundings. The aim of the professional tour was to obtain an overall picture of the issues and themes to be taken into account in this particular senior house. During the professional tour, researchers made notes and took photos. One resident of the house accompanied the professional tour in order to open door locks and show them around.

During the tour, the researchers identified five main *usability attributes*: 1) security/ safety, 2) functionality, 3) comfort, 4) interaction and 5) orientation. Each usability attribute includes a variety of parameters, since usability appears in different ways in different phases during the users' journey in built environments (Fig. 10).

3.1.4 Planning the walk-through

The Usability Walk-through of Senior Housing implemented in this study is constructed by utilizing 1) Dale Copp's (2008) Customer Journey Map in order to create a customer path diagram with steps assessing the viewpoint of functions and user experiences in senior citizens' lives, and 2) Alho's Usability Rating Tool (Alho et al. 2008) in order to analyze relevant usability attributes, which are specified using different parameters identified during the research.

Next, a list of understandable *themes* for the Loppukiri walk-through was created. These themes arose during the professional tour and represented the main factors in this particular building (see De Laval 2004 and Alho et al. 2008). They are based on the usability attributes but are more precise and illustrate this specific building. The list of themes is intended to inspire the walkers to discuss different usability features in the staging points. In the Loppukiri case, the list consisted of ten themes, as shown in Table 1:

Table 1 Themes for the usability walk-through in Loppukiri senior house.

1	Accessibility and functionality
2	Indoor conditions: temperature, indoor air, acoustics, lighting
3	Coziness, aesthetics
4	Security and safety
5	Orientation: clarity of floor plan, guiding/signs, colors, lighting, acoustics
6	Views, contact with nature, contact with other spaces
7	Multiple use of spaces
8	Furniture, equipment, machinery
9	Doors, windows, buttons, handles, plugs
10	Virtual connections and interaction of the residents in the spaces

On the basis of the professional tour, the researchers made a plan for the actual usability walk-through and drew a route on the floor plans. The route covered all the important common spaces in the building. The dwellings were not visited, but the information about the usability of the dwellings were received from the interviews. All spaces along the journey are listed in Table 2, and the customer paths are shown in Figures 6 and 7.

3.1.5 Carrying out the walk-through

A usability walk-through at a senior house has to be carried out at the most appropriate time for the residents. Enough time must be allowed for the tour in order to gather all the information. If needed, more than one day can be used for the tour. It is also recommended that the tour of the immediate surroundings is made on a different day.

Table 2 List of spaces along the walk-though

Ground floor		Ground floor		Sixth floor	
1	Entry of stairway A	13	TV-room	24	Hall of stairway A
2	Hall of stairway A	14	Office room/guest room	25	Hall of sauna
3	Dining room	15	Storage	26	Toilet for disabled persons
4	Library	16	Drying room	27	Guest room
5	Kitchen	17	Laundry	28	Fireplace room
6	Terrace	18	Utility room	29	Dressing room
7	Hallway	19	Entry of stairway B	30	Shower room
8	Toilet/cleaning equipment	20	Bicycles	31	Sauna
9	Toilet for disabled people	21	Hall of stairway B	32	Outdoor terrace
10	Bicycles	22	Storage/ bomb shelter	33	Gym
11	Waste room	23	Elevator	34	Ventilation room
12	Technical equipment			35	Elevator
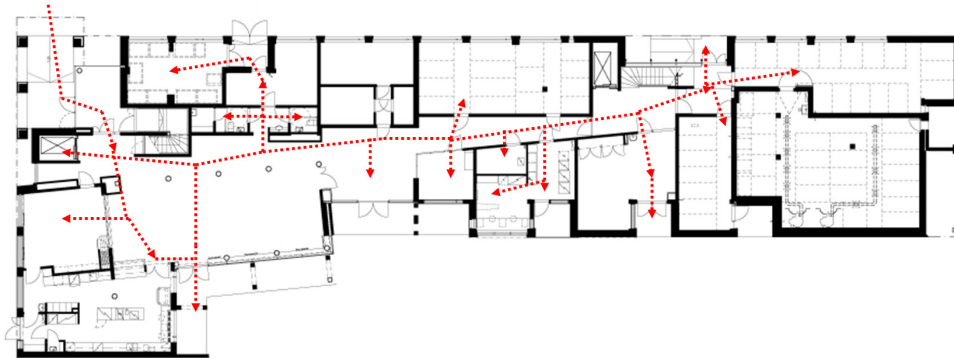
Fig 6 Customer path on ground floor
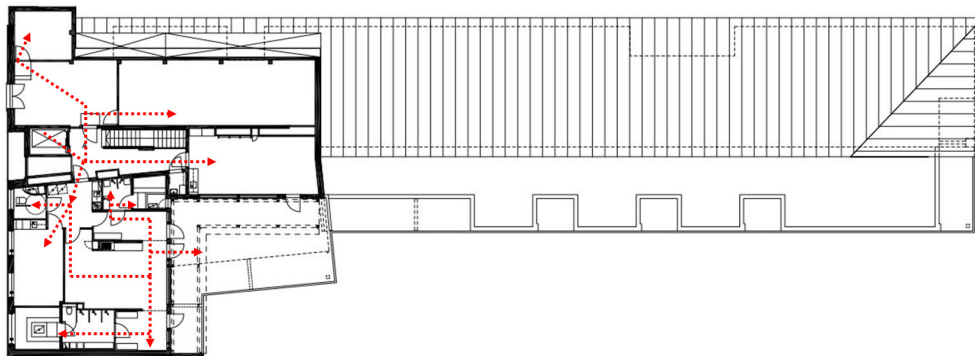
Fig 7 Customer path on sixth floor

A senior aged walk-through is best carried out in groups of 4–6 people. In a group of this size, people can easily discuss the themes and everyone has an opportunity to say something. Those with hearing and vision difficulties and those with functional ability problems contribute useful information regarding usability difficulties in the built environment.

Before the walk-through, a paper list of usability themes was given to the residents taking part in the session. At the beginning of the tour, the researchers explained the content of the themes and explained the purpose of the walk-through. During the walk-through, it is best to use a recorder and take photos, in order to help the analysis phase.

Walk-through of Loppukiri senior house

The walk-through sessions at Loppukiri were executed on three separate days with three different groups of volunteers during the spring of 2009. The first two days' tours focused on the communal spaces in the building. On both days, the tour groups consisted of four volunteer residents; two women and two men. One of the participants had a walking stick and one had a hearing aid. None of the Loppukiri residents used wheelchairs, but the subject of accessibility was discussed during the tour. In the course of the tour, the group stopped in certain places and talked about the themes. A recorder was used during the walk-through.

Walk-through of the surroundings

The walk-through of the surroundings started from the front door and proceeded to the grocery shop nearby, situated about 400 meters from the Loppukiri building, and back to the building. The participants were four women; one of them had walking difficulties because of painful knees and hips, but did not use a walking stick or other device. The themes for the walk-through of the surroundings are listed in Table 3.

Table 3. Themes for usability walk-through of surroundings.

1.	Accessibility and functionality
2.	Barrier-free environment, distances
3.	Circumstantial factors: windiness, shelters, lighting
4.	Coziness, aesthetics
5.	Security, maintenance
6.	Orientation: navigation, guiding/signs, colors, lighting
7.	Views, plants, contact with nature
8.	Virtual connections and interaction possibilities
9.	Outdoor furniture, building equipment, door phone

3.1.6 Analyzing the results

After all the walk-through sessions, the recordings were transcribed. The themes and issues that were most often repeated in the text were listed. Since the walk-through sessions had been carried out with informal discussions, it was obvious that the issues that arose were

genuine concerns of the users. The results could now be compared to the original themes and checklist, and the most important usability features of this particular senior house could be determined.

3.1.7 Reporting the results

Ultimately, the researchers wrote a short report of the results and gave it to Loppukiri's housing company. In addition, the results were presented at an event held for all the Loppukiri residents.

4   RESULTS

4.1 Process description

The first result of this study formed a systematic process description for observing the factors affecting the usability of senior housing. The process developed in this study can be described as consisting of seven phases, which are listed in Figure 8.

PROCESS

1. Collecting the data
2. Exploring the target
3. Professional tour
4. Planning the walk-through
5. Implementing the walk-through
6. Analyzing the results
7. Reporting the results

Figure 8 Process of usability walk-through of senior houses

4.2 Questionnaires

According to the results of the questionnaires (N=164) directed towards the elderly living independently *in their own apartments*, the elderly were mainly satisfied with the characteristics of their apartments. The most dissatisfaction was with the functionality of the bathroom and poor access to waste containers, stockrooms in the basement and attic, and the sauna. Other factors causing dissatisfaction were access in and out of the residential building, and the laundry in the basement. Furthermore, difficulties in walking in the immediate surroundings and poor possibilities to perform everyday duties near home came up in the data (Määttä et al. 2008).

4.3 Interviews

Elders (N=22) *in three different home environments* were also interviewed for this study. Some of the interviewees were living *independently at home*, some in *senior houses* and some in a *sheltered home for the elderly*. In addition to the Loppukiri senior house, two ordinary senior houses were included in the study.

The results showed that the importance of nature, having one's own balcony and other people nearby are very important to the elderly. What caused problems was the elevator or the lack of it; the elevator did not reach the basement, where storage rooms, saunas and the laundry are usually situated. Those living *independently at home* appreciated the serenity and safety of the living environment, good transport links and local services. The familiarity of the surroundings, proximity to shops, parks and outdoor recreation areas increased their quality of life and brought ease and a sense of security. However, they wished for more benches and better lighting in the immediate surroundings (Aalto 2008).

All the interviewed *senior aged* appreciated accessibility, common spaces, good lighting and warm apartments. In contrast, domestic appliances that were too modern, slippery floor materials and noise problems caused dissatisfaction. According to the results, the senior aged of today do not content themselves with unsatisfying housing, but demand quality from their living environment and housing (Aalto 2008).

Those living in the *sheltered house for the elderly* are often so frail and sick, that they do not care much about their living environment. They most value a warm apartment and having nurses near them (Aalto 2008).

4.4 Usability framework of senior housing

One result of this study was a usability framework of senior housing (Fig. 10). The description of the framework developed in this study assesses senior citizens' living environment by "doing something". It takes into account both indoor and outdoor spaces, as well as places for physical, psychological and social activities. In this case, the framework was formed on the basis of collected data and the usability walk-through implemented in Loppukiri building. The six "steps", illustrate a normal day in a senior's life. The steps are: 1) being at home, 2) activities at home, 3) leaving home, 4) activities in common spaces, 5) running business/ shopping, 6) coming home. Figure 9 shows a usability framework of senior housing at the Loppukiri senior house.
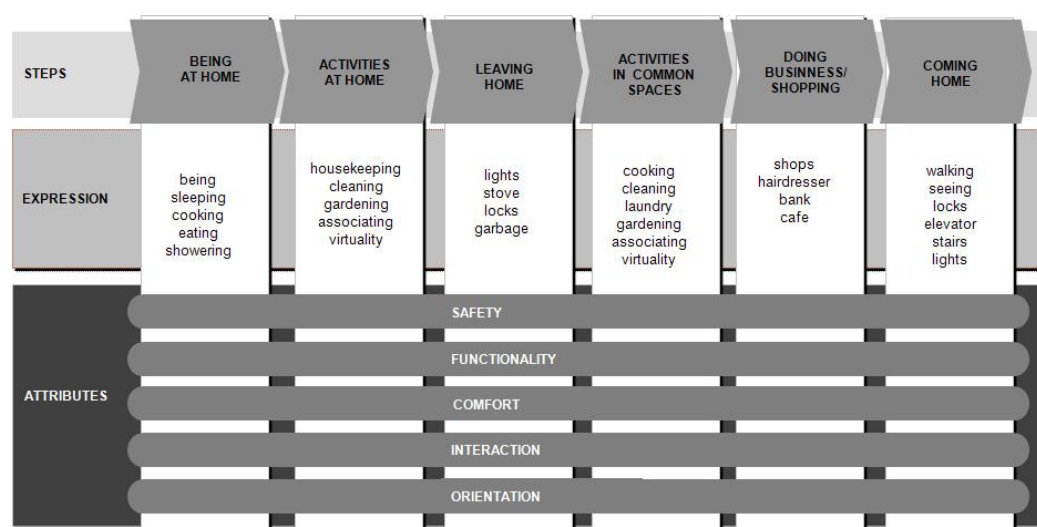
Fig 9 Usability framework at Loppukiri senior house.

The results of the Loppukiri study show that the usability framework of senior housing can also be presented as an illustration of five main attributes, which are functionality, safety/security, orientation, comfort, and interaction. All these attributes emerged strongly in discussions during the walk-through. Figure 10 shows the attributes and the parameters that arose most often during the usability walk-through in the Loppukiri pilot case.

SAFETY/SECURITY
front door buzzers
security telephone
locking
lighting
fire alarm system
materials

FUNCTIONALITY
accessibility
ergonomics
spaciousness
lighting
furnishing
storeroom
balcony
waste and laundry services

ORIENTATION
guiding signs
lighting
acoustics
colours and contrasts
materials

COMFORT
colours
lighting
surface materials
indoor temperature
indoor air
acoustics
plants
furniture
views

INTERACTION
local services
indoor temperature
acoustics
furnishing
residentTV
internet
co-operation

APARTMENT
BUILDING
COURTYARD AND SURROUNDINGS
NEIGHBORHOOD

Fig 10 Usability attributes and parameters in senior housing

Usability of the Loppukiri building

The study showed that in the Loppukiri senior house the residents were satisfied with their dwellings thanks to the co-designing model. The dwellings were small, but the residents had been able to choose the colors and materials, and even influence the lay-out. As a rule, criticism was directed towards the communal spaces.

Senior citizens at Loppukiri spend their time preferably at home or in the communal spaces. Noise problems are constant, both in dwellings and in communal spaces (ventilation, piping systems, music, conversation etc.). In addition, although everyone knows each other at Loppukiri, residents do not like the spaces with transit movement – such as the TV room or fireplace room, as they are too restless.

As regards usability in the co-housing premises, the principle of self-sufficiency has to be taken into account in cleaning and furnishing. Balcony glazing and the terrace floor have to be easy to clean, and the furniture in communal spaces cannot be too heavy to move. Adjustable worktops and electric socket placement at the height of approximately one meter help senior citizens a great deal in their daily duties.

Accessibility in the Loppukiri building has generally been implemented well. Although none of residents currently use a wheelchair, they have guests and relatives who use wheelchairs and prams, and accessibility is an important issue. According to the results of this study, the balconies and saunas in Loppukiri are not barrier free, thus a person in a wheelchair is not able to get to these spaces alone.

In addition, it is impossible for a person in a wheelchair to come to the building via stairway B. The door opens in the wrong direction, in the way of the arrival, and there is insufficient space in front of the door. In the winter time, the water freezes on the step due to the small size of the canopy, and the step is too high (Fig. 11 and 12).

Fig 11 Door opens in wrong direction.   Fig 12 Step is too high.

The feeling of security is very important for an aged person. At Loppukiri, one resident is always responsible for security issues. This person checks the front door locks and sauna premises every evening. Fire drills are also held regularly. Automatic front doors help residents come and go easily, and front door buzzers bring a feeling of security.

"Purple Cows"

The positive surprises of the walk-through of the Loppukiri building and the immediate neighborhood are listed in Table 4. These factors are significant in the process of designing senior houses, since the senior citizens of the future will be in better physical condition and demand more functional and usable environments than senior citizens today.

Table 4 Positive surprises in the Loppukiri senior house

Philosophy of collective living supports working together
Co-designing ensures satisfaction and well-being
Versatile, functional laundry facilities
Security technology solutions
Visible exits
High utilization of communal spaces
Functional waste room; facilities for recycling
Guest room
Room for bicycles

Usability of the Arabianranta area

The Arabianranta area offers a great deal of services for senior citizens within a one-kilometer radius: a shopping center, a cafe and a library. In addition, within 400 meters there is a post office, a restaurant and a kiosk, but not a bank for instance. Helsinki city center is not far and tram lines and buses run close. The Loppukiri building is situated near the sea, thus nature, cycle paths and footpaths are available to everyone.

However, Arabianranta is a new residential area and construction work has caused disturbance for many years. Dust, noise and trucks result in an incomplete, unclean environment. According to the senior citizens, street lighting, for instance, was put into place much too late.

The distance to the nearest grocery shop was reasonable but it was very difficult to do shopping there. Due to steep steps, a heavy front door and tight spaces, not many Loppukiri residents use this shop, though many of them would like to have a small grocery shop near home.

5   DISCUSSION

The aging population creates new requirements for residential housing solutions. Encouraging old people to stay in their homes is one way of achieving social and economic sustainability

According to Oswald et al. (2007) the emotional and social aspects of home are as important for life satisfaction as the accessibility and usability. Moreover, aging together – communal coping – increases the acceptance of aging and creates feelings of safety /less worry/ less social isolation (Glass 2013; Glass et al, 2013; Verma et al. 2011; Gonyea and Burnes 2013).

The neighborhood is a particularly important context for older adults, as reduced income status, limited mobility, and health decrements significantly reduce the sphere of leisure activities in later life (Kelly, 1996; King, 2001). Recent research has identified that the characteristics of neighborhoods, including safe footpaths for walking, accessible facilities, the presence of green and open spaces, the density of shops and houses, and neighborhood attractiveness affect older adults' participation in leisure time physical activity (LTPA) (Booth et al,. 2000; Li et al., 2005; Michael et al., 2006).

According to previous studies, increased functionality does not necessarily mean improved usability. The ability to cope with everyday duties weakens as a person becomes older. The user experience of the built environment is not the same for all user groups, in particular for elderly and disabled people. Good design promotes social well-being and the notion of "aging in place". Beneficial spatial design will help in way-finding and will also increase safety (Aalto and Verma 2010).

The development of independent living facilities called 'senior houses' has been increasing in Finland. However, there are no common criteria for the design of the dwellings or the common spaces in senior houses. In addition, the number of common spaces in senior houses varies largely. Some houses have just one common area, for example a salon, and the highest quality senior houses may have a restaurant, a fitness room, a physical therapy room, or other amenities and services.

The fact that Loppukiri stands for collective living and the residents have been able to influence the interior so much can be seen in the design solutions. Usability in the Loppukiri building seems to be relatively good, despite obvious accessibility and noise problems in communal spaces.

Since interaction is a self-evident issue in senior citizens' lives, having a number of common spaces in the residential building increases satisfaction. The amount of people with impaired hearing, vision and mobility will certainly increase as the residents get older, thus features in the living environment that support orientation are important. In addition, the question of accessibility for residents using wheelchairs will certainly become an important issue in Loppukiri as residents get older.

Although there is some research concerning the usability of housing for the elderly (Malmqvist 2012; Andersson et al. 2011), its focus has mainly been on accessibility, functionality and flexibility. In addition, there is a lack of usability research on the residential environments of the senior aged.

As an increasing number of elderly and senior citizens are expected to live independently in their own apartments with communal or private help and care in the future, the usability of senior housing should be taken into account more seriously. The usability aspect is an important factor in ordinary residential design, as well. Thus, the results of this study provide valuable information regarding the usability of built environments for authorities and designers, as we will all grow old eventually.

6   CONCLUSION

The aim of this study was to evaluate the usability features of senior housing. The usability walk-through proved to be a suitable method for this. The senior residents involved were evidently devoted to their role as expert members.

The main finding of this study is the framework of usability features concerning the housing of the senior aged. Certain attributes shown in Fig. x have to be taken into account in housing design for people aged 55+ who want functional, comfortable, accessible premises, where interaction with other residents is pleasant and easy.

Usability problems in the Loppukiri building seemed to appear mainly in common facilities. They were mostly related to cleaning issues, for example difficulties cleaning balcony glazing and floor material. In the dining hall and the sauna department, transit traffic caused disturbance problems. On the other hand, noise, accessibility problems and troublesome plugs caused irritation in apartments.

The strength of using a walk-through in this study is the fact that the users, with their experience and opinions, were able to take part in developing the framework of usability. In addition, using the walk-through as a tool in this study took the demands of not only the physically impaired but also of the sensory disabled into account, which is especially important in questions of usability in senior citizens' living environments.

The weakness of this method is the special feature of communality at Loppukiri, which ensures that all residents can influence their living environment. This is not usual, and thus cannot be generally applied to all senior houses. However, the living model of co-housing that Loppukiri stands for will probably become of general interest for healthy senior citizens in the near future.

In summary, the tentative results reported in this article are meant to illustrate the complex totality related to the usability dimensions of senior housing rather than give a complete solution to a specific problem. In order to assess the results more extensively, the framework developed in this study should be tested in different kinds of senior houses. Next, reliable measurement procedures must be developed for comparing senior houses to each other.

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HEALTH CARE FACILITIES AS LEARNING ENVIRONMENTS

Suvi Nenonen

Senior Researcher
Aalto University
suvi.nenonen@aalto.fi

Göran Lindahl

Ass. Professor
Chalmers University of Technology
goran.lindahl@chalmers.se

ABSTRACT

Purpose This paper aims to address and discuss this issue of what constitutes learning spaces specifically for medical education.

Background As with any environment, a learning environment can be understood in terms of space and place, wherein the physical and geographical environment is defined in terms of space. The physical space becomes a place when infused with abstract, value-laden associations and meanings.

Approach In order to understand the nature of the existing literature on learning environments within medical education, the scoping review methodology was conducted. Scoping reviews represent an increasingly popular approach to reviewing health research literature.

Results Within medical education, there are two main educational settings. Firstly, there is the traditional academic learning environment - the university space - wherein medical students learn the theoretical and fundamental blocks of medicine. Secondly, students engage in the medical environment, namely hospitals, clinics and community settings, the health care space. In order to integrate these two entities one need to focus on

1. Change: The existence of virtual environment urges redefinition of physical places for education and health care.

2. Collaboration: The identity of medical students and professionals need to cross the boarders of hierarchy in order to achieve the flow of collaboration and support of development of professional identity.

3. Spaces, Places and Scapes: The understanding of the learning and healthcare as scape and systemic ecosystem, provide possibilities to achieve the hybrid environment for hybrid development of learning practices.

Discussion The future medical learning scapes require flexibility from people, organisations and buildings. The relationships of power and identity in education (curriculum) and the workplaces (university and hospital) need to be considered. In the end the question is about engaging the achieved knowledge to become socially sustainable.

Keywords

Medical education; learning environment; spaces; places

1 INTRODUCTION

Health care facilities are learning facilities as well as university facilities. University hospitals create the identity, and thus behaviour, of future doctors and nurses and other staff. According to Gordon et al. (2000) well-organized medical school, with better vertical integration presenting the greatest challenge for schools that still use a pre-clinical/clinical model to structure the curriculum. They recommend the structuring the clinical environment in ways that will reinforce professional values. Additionally it is important to make the best use of learning opportunities and also capitalize on the potential of new IT resources to promote efficient learning in clinical settings. Hafler et al. (2011) state that understanding the tacit institutional culture shaping effective socialization and in managing the inconsistencies that so often dominate faculty life. All in al the question is about multi locational learning environment, which shapes the professional identity of medical students.

The aim of this paper is to increase the understanding on the knowledge of how to merge the clinical and medical education environments. The research question is what constitutes a learning environment specifically for medical education? The paper discusses briefly about spaces and places for medical education in the second chapter. Chapter three presents the methodology of scoping review. The rest of the paper consists on the results, discussion and conclusions.

2 SPACES AND PLACES FOR MEDICAL EDUCATION

In general learning environments are in transformation. According to Long & Ehrmann (2005), the standards of learning spaces today do not support effective learning but are out-of-date and ineffective. They recommend a shift from too discipline-specific thinking to creating spaces that are more flexible and stimulating. The traditional classrooms are not the only form of learning space, but the majority of learning takes place outside the classrooms. Social interaction is a growing part of learning and pedagogy is shifting towards collaborative methods, as students are motivated by social interaction. Learning can occur out of sequence, as students are comfortable with overlapping discussions and new learning tools with respect to the traditional tools. All in all students construct rather than just consume the learning (Milne 2006). Harrison (2014) describes this with the concept of learning scape.

The transformation of learning environments is aligned with the transformations in the work environments: employees are mobile and work whenever and wherever there is a possibility. (Dale & Burrell 2008). Additionally special hospitals, new standards for patient rooms, ideas for efficient nursing unit planning, and design for healing environments are discussed in terms of future hospitals as well as issues linked to marketing responsiveness, new technologies, and changing expectations about healthcare delivery. Changes in the way that hospitals provide care have implications for clinical training and the working environment of clinical staff (Edwards 1999).

For university students life is not only at the university. Through resources as information and communication technology, cafés and bars and even the lawn in a park they connect with

others and engage in a discourse related to their subjects and programs. The change is taking place towards more and more place-less studying and learning. The learning environments are disconnected from symbols of hierarchy, belonging and power. People interact with themselves as well as with others in specific spaces and places, e.g. students, patients and colleagues, and the way that they conceptualize their spaces and places define how they see the actual physical environment in which they act.

However, within professional education such as health care, engineering, and law very little place and space is given in the curricula to a discourse of these crucial constructs and the roles they play, both explicitly and implicitly in professional acculturation (Nordqvist, 2011; Kitto et al 2013). People are not less dependent on a place or a space even the virtual environment is surrounding us. In spite of its seemingly innocent denotation, "place" is a loaded term, the connotations of which are closely tied to perceptions of selfhood: e.g. What is my place in this new community or activity and what do I need to learn or to know in order to change/ improve my place? What would be the best place for me to learn about the affordances and constraints of place in the profession I have chosen? A similar ambivalence is inherent in the synonym "space," which some researchers tend to view in terms of its denotation, disregarding cognitive and discursively constructed connotations. Similarly to "place," the connotations associated with the term "space" are highly dependent on culture and practice and by implication then, also influence selfhood: e.g. How much space may/can I take up in particular situations and places, and how do I avail myself of space?

The significance of place, space and identity has been the interest in future learning environments e.g. in Karolinska Institutet in Sweden. The spaces are fragmented and enclaved, belonging in programs rather than place. The homogenous student group is changing, the increased diversity among students requires meeting places, networking possibilities and symbols (Nordqvist et al. 2011; Nordenstrom et al. 2013). Manifestation of identity is sought for diverse actors in universities and hospitals. Institutions such as universities and hospitals rather than containing particular subjects may actually and actively create them (Halford & Leonard 2003). This is why it is important to approach learning scape of medical education as merge of clinical and medical learning environments.

3   METHODOLOGY

In order to understand the nature of the existing literature on learning environments within medical education, the scoping review methodology has been selected. Scoping reviews represent an increasingly popular approach to reviewing health research literature (Levac, Colquhoun and O'Brien, 2010; Arksey and O'Malley's 2005). In order to increase the relevant amount of disciplines one have to get insights to research in the field of medicine, education and design of both educational and health care environments.

The phases in scoping review are applied in this research in the following way. The first phase included the identification of the research question, which in this paper was formulated around learning environment for medical education. Process continued by identifying relevant studies from diverse fields. They were medical education and pedagogy, design

of both educational and health care environments and spaces and places in learning. The study selection was chosen by defining the search strategy based on abstracts retrieved from the search. Then the charting the data was conducted based on common data matrix with emphasis of content analysis and qualitative approach by clustering the relevant findings. These clusters are presented in this paper as a preliminary version. Collating, summarizing, and reporting results are still on going within the process and the results are presented in this paper as intermediate findings.

4   RESULTS

4.1   Medical education towards social and virtual learning environments

Medical student literature has broadly established the importance of differentiating between formal-explicit and hidden-tacit dimensions of the physician education process. The hidden curriculum refers to cultural mores that are transmitted, but not openly acknowledged, through formal and informal educational endeavours. Hafler et al. (2011) state that faculty of knowledge, skills, and values can be framed as a more global process of identity formation. This process includes a subset of formal, formative activities labelled "faculty development programs" that target specific faculty skills such as teaching effectiveness or leadership; however, it also includes informal, tacit messages that faculty absorb. As faculty members are socialized into faculty life, they often encounter conflicting messages about their role. (Hafler et al. 2011)

Medical education has been the forerunner in many alternative-learning methods. Consider problem-based learning (PBL), which was pioneered in the late 1960s in the medical school. Students learn about a subject in the context of complex, multifaceted, and realistic problems. The emphasis has been in the relevance of learning to future roles, maintain a higher level of motivation towards learning, and showing the learners the importance of responsible, professional attitudes (Barrows, 1996). Likewise, the goals of PBL are to help the students develop flexible knowledge, effective problem solving skills, self-directed learning, effective collaboration skills and intrinsic motivation. Working in groups, students identify what they already know, what they need to know, and how and where to access new information that may lead to resolution of the problem. The role of the instructor (known as the tutor in PBL) is that of a facilitator of learning who provides appropriate scaffolding, support and modelling of the process, as well as monitoring the learning. The tutor must build students confidence to take on the problem, encourage the student, while also stretching their understanding (Neville 2009).

E-learning technologies offer learners control over content, learning sequence, pace of learning, time, and often media, allowing them to tailor their experiences to meet their personal learning objectives. In diverse medical education contexts, e-learning appears to be at least as effective as traditional instructor-led methods such as lectures. Students do not see e-learning as replacing traditional instructor-led training but as a complement to it, forming part of a blended-learning strategy. A developing infrastructure to support e-learning within medical education includes repositories, or digital libraries, to manage access to e-learning materials, consensus on technical standardization, and methods for peer review of these

resources. Innovations in e-learning technologies point toward a revolution in education, allowing learning to be individualized (adaptive learning), enhancing learners' interactions with others (collaborative learning), and transforming the role of the teacher. The integration of e-learning into medical education can catalyse the shift toward applying adult learning theory, where educators will no longer serve mainly as the distributors of content, but will become more involved as facilitators of learning and assessors of competency. (Ruiz et al. 2006.)

Situated learning theory emphasizes learning through participation where learning is inherently social. Knowledge is created in a social setting (Lave & Wenger, 1991). Learning is a situated practice, which takes place within a social and cultural system and a built environment. The physical space becomes a place when infused with abstract, value-laden associations and meanings.

4.2   Hospitals as learning environments and workplace learning – transformation of physical places for collaboration

Even seemingly irrelevant environmental factors, such as the hospital's architecture or the location of education activities, can impact medical education. For example, students may miss out on opportunities to learn inter professional communication skills if the hospital is designed in such a way that the different professions interact minimally. (Bleakley et al. 2011)

Through the aim to integrate students in working life students are entering the workplace at earlier phases of professional training. This not only teaches clinical skills and knowledge, but socializes students into the social and professional relationships in the workplace (identity) (Bleakley et al. 2011). A doctor in both foundation and specialty training should be a valued member of their multi-professional team, and be responsible for providing high quality and safe clinical care to the patients, relatives and carers with whom they interface during the working day. To maximize the learning from these clinical encounters all members of the clinical team are involved, both individually and collectively, in observing performance, advising, teaching, giving feedback and encouraging discussion. The culture within the workplace environment is key to the safe and successful learning of all learners. All doctors, nurses and allied health professionals have a professional duty to support and develop colleagues of their own and other professions, particularly students, less experienced staff and those new to the department. Within the nursing literature it is suggested that the experiences of a clinical placement can affect the students' perception of the entire institution, and impact new graduate retention within nursing (Andrews et al. 2005).

A variety of physical and socio-spatial issues were identified, relating to design, pedagogy and use of technology in the research project in the old Royal Children's Hospital (RCH, Melbourne, 2011) and in the new Royal Children's Hospital (RCH, Melbourne 2012). The shift from a traditional lecture theatre to a new generation learning space provided evidence that design could inhibit existing pedagogies but it was found that new generation spaces alone did not foster new approaches to teaching and learning. Observations indicated that the medical educators would benefit from opportunities to both observe and reflect on alternatives ways in which the new generation learning space might be used pedagogically. Support in the

form of observing others, discussing exemplars, coaching, mentoring, feedback with reflection, project-based learning, online programs and participation in communities of practice could supplement attendance at more traditional group professional learning sessions.

The study's recommendations included that pedagogies best suited to meeting the educational objectives of medical courses should be identified and interrogated prior to the design of learning spaces. Following design, it was believed that the key to offering high quality learning experiences for medical students was to provide health professional educators (teachers) with opportunities to reflect on their teaching, their teaching practices and support to enable them to adopt the pedagogies best suited to their educational objectives. (Barret et al. 2011)

4.3   Spaces and places in the university, hospital and in-between them

As with any environment, a learning environment can be understood in terms of space and place, wherein the physical and geographical environment is defined in terms of space (Gieryn, 2000; Nordquist et al. 2011). The physical space becomes a place when infused with abstract, value-laden associations and meanings (Nordquist et al.2011; Poland et al. 2005).

Within medical education, there are two main educational settings. Firstly, there is the traditional academic learning environment—the university—wherein medical students learn the theoretical and foundational building blocks of medicine. Secondly, students engage in the medical environment, namely hospitals, clinics and community settings. These seemingly 'non-academic' spaces become substantially influential places within learning. Moreover, the student's experience of the learning environment can reach beyond the realm of a single course or clinical rotation. Given this potentially substantial impact, it is imperative to obtain an understanding of the role of learning environments within medical education prior to implementing any new initiative, even when it is labelled as evidence-based.

Kitto et al. (2013) published a review, which shown that the nursing and medical professional literature has engaged with the concepts of space and place in health care in certain ways but not significantly in relation to education and even less attention has been awarded to these concepts in the inter-professional field. The future research needs to explore the intersections and relationships amongst these concepts.

To sum up the most significant findings the following clusters were identified from the review.

　　　1. Change
The existence of virtual environment urges redefinition of physical places for education and health care.

　　　2. Collaboration
The identity of medical students and professionals need to cross the boarders of hierarchy in order to achieve the flow of collaboration and support of development of professional identity.

　　　3. Spaces, Places and Scapes
The medical learning environment has been multi locational by its nature however the understanding of the learning and healthcare as scape provide possibilities to achieve the hybrid environment for hybrid development of learning practices.

5   CONCLUSIONS

The former reviews argue that the conceptualization of space and place can potentially impact how educational space, places and curricular are (re)conducted and utilized (Kitto et al. 2013). This paper aimed to discuss further what constitutes a learning environment specifically for medical education. Based on the results, the constitutions need to emphasise:

1. The transformation of learning environments from "old school" to new school including physical and virtual learning environments.

2. The scripts of hybrid curricula can be supported by hybrid learning environment – there is a need for mixed modes of delivery.

3. Interprofessional interactivity and boarder zones between the traditional hierarchy, space segments and organisational structures as learning environment need to be identified.

4. Collaboration and peer learning in clinical and university environments can be supported both by physical and virtual solutions

All this requires flexibility from people, organisations and buildings. The relationships of power and identity in education (curriculum) and the workplace need to be considered. In the end the question is about engaging the achieved knowledge to become socially sustainable.

Despite the progress, the knowledge of the importance of space and place issues, the holistic approach in medical university campuses, including the university hospitals, still lacks the following:

1. The knowledge of how to merge the clinical and medical education environments in socially sustainable way

2. The methodology to gather evidence of their performance as a united entity

3. The relevant key performance indicators necessary for an evidence-based evaluation of learning environments.

These are the issues for future research in trans disciplinary research integrating learning and healthcare scape.

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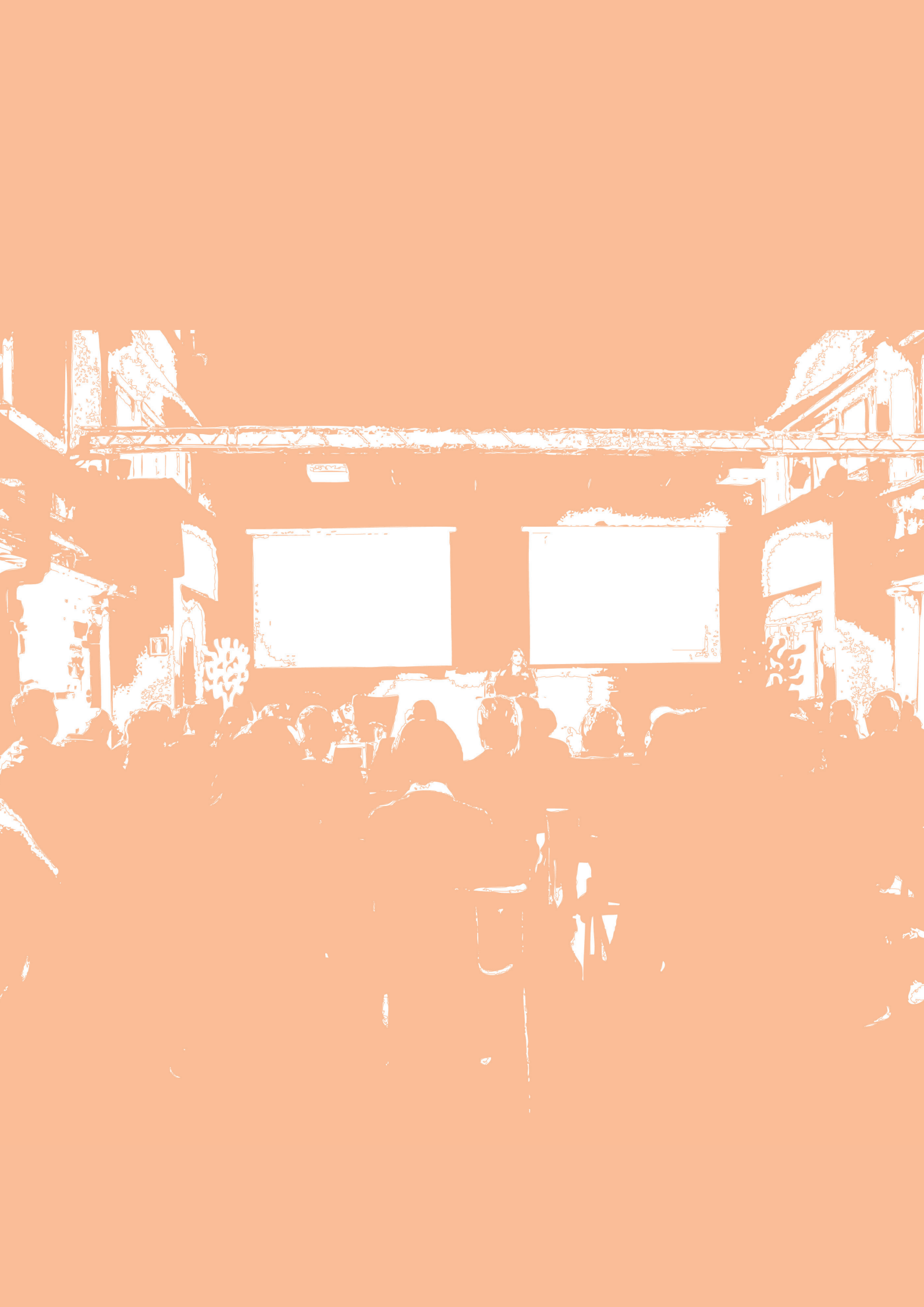
SHARED USE OF RESEARCH LABORATORIES CHANGING SPATIAL CONCEPTS

A Case Study in a Finnish Biomedical Organization

Jyrki Yläoutinen
Tampere University of Technology, Finland
jyrki.ylaoutinen@workspace.fi

Sanna Peltoniemi
Tampere University of Technology, Finland
sanna.peltoniemi@tut.fi

Suvi Nenonen
Senior Researcher
Aalto University, Finland
suvi.nenonen@aalto.fi

ABSTRACT

Purpose The purpose of this paper is to investigate diverse ways of shared use of spaces in the context of biomedical research laboratories. The paper discusses on how shared laboratory concepts impact on campus spatial solutions and practices.

Background The shared use of resources as a concept is a collaborative strategy (Bergemon 2003) to enable efficient resource allocation between group of people or organizations. The motivation for sharing resources may be economic as a cost cut tool and/or environmental as a model for sustainable consumption. The question of ownership related to the shared object or service is crucial. In biomedical research laboratory context shared use of laboratories offers ways to empower scientific work in state-of-art -level by delivering high quality laboratory environments for use.

The main challenge of getting and maintaining the best laboratory equipment are the high costs. Also the mismatch between old laboratory environments and the best ways of working causes productivity gaps and influences negatively to the recruitment attractiveness. New organizational structures and innovative leadership solutions are needed to create cost efficient organization models. All these changes has an impact to the spatial concepts of the biomedical research campuses that has not widely studied.

Approach The research is a qualitative case study research, where the data is collected via user interviews (n=10) with open-ended questions and reflecting on interviewees answers. Conventional content analysis is used as method to analyse the empirical interview data. Hence, the results derives from data itself. The existing literature about the subject is scarce. Therefore, literature review aims to clarify the key concepts of the research, and focus on the changes in laboratory organizations.

Results Results indicate that shared use of laboratories in biomedical research has its impacts to the spatial concepts in different scales and forms. Nationally and locally coordinated shared facilities offer scientific researchers both a network of state-of-the-art technologies and services. Shared core facilities is not only cost-effective but also significant brand and recruitment factor. At the same time the shared way of using laboratories seems to enhance interaction, collaboration culture and knowledge creation among researchers. According to the case study the future laboratories may become centralized physically more by research method - not based on organizational zones or borders. The idea behind method based laboratory clusters is to minimize building and maintenance costs and to enhance interdisciplinary collaboration between people from different universities and research units.

This paper contributes to the research and discussion of shared resources. It presents spatial concepts relevant for shared use of laboratories and provides evidence for designing more effective and sustainable research facilities.

Discussion The shared use of research laboratories seems to be a realistic and productive choice for increasing cost effectiveness and providing dynamic research infrastructure. The challenges of management, operations and facilities gain perspectives from the case study. The innovative and interdisciplinary collaboration is needed from the stakeholders point of view. The process of developing the shared use solutions may enable creating collaborative organization culture for the scientific organization. The innovative leadership and collaborative work culture seems to be key assets in the long term development process of shared laboratories.

As the data is qualitative in nature and consisted of a limited data the generalizability is also limited. Because the case study organization operates in biomedical sciences the research findings may not work in other fields of research labs.

Keywords:

collaboration, core facilities, laboratories, laboratory management, shared resources

1   INTRODUCTION

The discussion of shared resources runs active in different fields of human activities in diverse settings. In some fields, like transportation, the shared use of facilities has been a fundamental theory and a solution to enable cost efficient solutions, when building large and expensive network of roads and high speed railways (Nash 2003). Also in computer sciences the resource-sharing networks (Kahn et al. 2005) has been used as a way to share resources effective way. Other examples of sharing and co-using resources are shared workspaces in virtual reality, public spaces in cities, time-share systems in holiday facilities and car sharing. Some of more abstract ways of sharing resources are the ways of sharing knowledge and vision among people. Sharing objects or services is also a cultural, psychological and behavioural question. However this paper focuses on more specific manner to sharing resources in the context of university campus and research facilities.

In the context of biomedical research laboratories the shared use practises are not widely studied. Still some examples are well known, such as the international CERN research alliance in Europe. In the USA the shared services and collaborative laboratories models has been developed actively. The Nebraska collaborative laboratories has tackled the challenges of getting enough patient samples to their business via alliancing with other organizations. Great results like cheaper analyze costs to the patients has been achieved. Also the ways of sharing clinical laboratory services in a consolidated hospital system has been implemented successfully many decades ago (Garabed et al, JAMA 1985) .

A growing part of the laboratory work is done in the "dry labs" or office facilities. The big change that is happening in the ways of working in the offices may have influence also to the scientific sector. Activity-based multi-office solutions include shared space practises. Flex offices, hubs, co-working centers and hot desking practises have been used in many corporations for years. How ever, academic workplace is not as quick in transformations and dedicated single office room is the dominant solution for office work even other concepts can be identified too (Harrison, 2004).

In this study the definition of research laboratory means laboratory organizations who are working in physical environments. The research laboratories appearances in different physical sizes and forms. Laboratory may be identified as a group of buildings in a campus area or lab may mean a space for single desk for the scientist. The laboratory as an instrument includes spaces, equipment, tools and services supporting scientific research processes. The laboratories have also office spaces, social meeting and collaboration spaces, support spaces and technical infrastructure. ICT -tools and systems as well as logistics are important part of a functional laboratory environment. Compared to the basic office environments the laboratories have many critical and specific user-based needs and demands. To design a laboratory means handling a complex and holistic system of attributes. The aim of this study is to identify shared use of laboratory practices in user-centered way.

The main research questions are:

What kind shared use practises can be identified in biomedical research laboratory environments?

How shared use practises are changing spatial concepts in research laboratory campuses?

The case organization in this research is acting in Finland in biomedical technology field. The organization is situated physically in a larger medical health campus area including hospital and academic learning facilities. The reason to study this specific case was the reputation of the laboratory as an encouraging example of efficient way of sharing the use of research facilities. In addition, the case laboratory is in the middle of a design process for new premises. This gave an opportunity to interview also CREM/FM stakeholders, such as architects.

This research helps laboratory environment developers to take part to the multi-disciplinary discussion of shared resources. Different disciplines of industries and sciences can learn from each other to find new models in the shared ownership of facilities and services.

After introduction this paper discusses on the changes in laboratory work and describes the influences the shared use of facilities have to the spatial concepts. The paper is finalized by discussing the practical applications and conclusions.

2   STATE OF THE ART

Literature review focuses on the on-going and upcoming changes in laboratory organizations and everyday work in laboratory, in order to give an overall view of the unique nature of the laboratory work. The existing research about the topic is scarce. Hence, literature review is conducted as an integrated review, which allows to include more widely selected data sources in the review. Four international (Google Scholar, PubMed, Scopus and Science Direct) and one Finnish (Nelli) search engines are used to find relevant literature sources. The review focuses on finding information about research laboratories and the theories of sharing resources. Hence, sources that concern about teaching laboratories are left outside the review. Nor the type of the data source or the year of publication is defined, in order to provide wide scope of the review.

The main keywords used in the literature search were: *shared space, shared services, shared resources, research laboratory, laboratory work, workplace, health architecture, scientific workplace, laboratory life, work culture, cultural change and flexibility in laboratory architecture*. In addition, the references of the discovered sources were tracked down, and the most relevant references were included to the review.

The overall character of research work is anticipated to change radically over the next ten years. According to Laboratory Equipment's survey, the researchers will expect to spend more time in meetings and office. Therefore, the time spend in a laboratory will naturally decrease (Studt 2009). A study by the Royal Institution of Chartered Surveyors indicates similar result;

According to the study, researchers spend about 60 percent of their time outside the laboratory (Watch & Kliment 2008). There are several reasons that spur on this change. The scientific equipment and instruments are becoming more and more faster and powerful, which means they process data more efficiently. In addition, automatic instruments, and eventually robots, will perform the laboratory work, which untether researchers from their laboratories. (Studt 2009; Stringer & Ostafi 2013)

Outsourcing a routine work is also a one significant change in research work: Researchers can focus on their core competency as well as more demanding tasks and experiments in laboratories. Naturally, outsourcing will lead to the increasing amount of data-analysis, and therefore, researchers spend more time in their offices (Studt 2009).

Furthermore, research is turning global. Especially the increasing influence of Asia in the field of research is opening new possibilities for co-operation and outsourcing tasks. International research teams are working 24/7, and keep in connection via virtual applications and video conferences. In addition, the complex research problems are forcing researchers to collaborate outside their own organisation, nationally and internationally (Stringer & Ostafi 2013).

Under these circumstances, the significance of offices as work environments will naturally increase. Hence, many companies are remodelling their office workplaces in order to support various working methods and innovation (Joroff et al. 2001, Robertson 1999). Also the health, job satisfaction and well-being issues are rising to the agenda (Bodin Danielsson 2010). The development of ICT (Information and Communication Technology) has changed the ways office work is done. In academia the development has been slower but is still happening. Paperless work is increasing by the use of tablets, big desk top monitors and virtual co-working systems.

Academic research is first and foremost creative knowledge work. Hence, also the workplace environment should support creativity. According to Wright et al. (2010) how people are organized have a substantial influence on creativity and innovation. Workplace should enable natural interactions between people from different units and decrease competitiveness, which may suppress creativity. Several studies ponder on, does physical co-locality have an influence on possible collaboration between researchers, and does it encourage creativity. Therefore, many companies create informal common areas and other places for serendipitous encounters. (Wright et al. 2010)

Allen & Fusfeld (1974) have studied also the collaboration between researchers. They discovered that communication between people happens more often with 30 meters range. After this range, the level of communication remains more or less the same, even though the distance would grow. The research found out that shared spaces, especially corridors and cafeterias, increased the level of communication. Communication between different research units improved, when all the units were located within the same building. (Allen & Fusfeld 1947)

Stringer & Ostafi (2013) point out that knowledge work requires concentration as much as collaboration. Hence, today's workplace environment should offer different kind of places for different phases of scientific work. (Stringer & Ostafi 2013) According to Watch & Kliment (2008), researchers spend most of their collaboration time in a laboratory or in informal break areas or conference rooms. Offices are generally seen private places, where researchers can focus on their individual work.

In conclusion, the character of the scientific research work seems to be under a radical change. New technologies, automatic instruments and robots are processing data efficiently. In addition, outsourcing routine tasks and globalization will increase the need for data-analysis. All these changes are moving researchers work away from laboratories into an office. Hence, the office environment require equally radical change, in order to meet the demands of creative knowledge work. In addition, laboratory space itself is turning into technical space, sized according to instrumentation need and less support on human user demands.

3   APPROACH

3.1 Data collection and analysis

The method for studying the subject was chosen as an inductive qualitative research using grounded theory (Glaser & Strauss 1967) approach as a research philosophy. The research is a qualitative case study research, where the data is collected via interviews (n=10) with open-ended questions and reflecting on interviewees answers. The study observes the shared use of research laboratories through user experiences. Interviewees represent following groups of stakeholders: leaders of the unit or a research group, post-doc researchers, technical staff of the laboratory and an architect (head designer) of the new laboratory building. Because the research focuses on to describe the phenomena of shared use of laboratories, the conventional content analysis is used as method to analyse interview data. In addition, the existing theory and research literature on a subject is limited. Hence, conventional content analysis can be seen as an appropriate method of analysis (Hsieh & Shannon 2005).

The interviews are transcribed in exact written form, word by word. After this, the text is read, and key ideas and thoughts are grouped into meaningful clusters. The aim is to find out answers to our research questions, by interpreting the interview data. Hsieh and Shannon (2005) describe one of the advantages of the conventional content analysis is that knowledge is based on participants' unique perspectives and grounded in the actual data. This is also the aim of the content analysis of our research: the categories, into which the interview data has placed, derive from the data itself. However, we acknowledge that it may be impossible to analyse data without presumptions, because previous knowledge about the subject will affect on the analysis. In addition, this type of approach may be insufficient in order to describe the phenomena completely, if the key categories are inadequate. Credibility of this data analysis is partly validated and confirmed by literature sources. However, in order to receive full understanding of the context, further studies are needed. (Hsieh & Shannon 2005)

4   RESULTS

4.1 Shared use practices

In the field of biomedical research, shared resources are coordinated in different scales: nationally, locally, campus and building based. According to interviewees, the aim of the national coordination is to provide a researcher a network of state-of-the-art services: each core facility would offer a unique special know-how assistance, from which a researcher can choose the best ones for him. The national network is still under construction. In addition to this, core facilities are being developed also locally. Smaller, local scale core facilities can serve the biomedical research within a city or a smaller neighborhood.

In order to understand the current situation in this particular biomedical case study laboratory, one must first understand the background of the biomedical research in Finland. The field of biomedical research and so called Life Sciences begun to develop strongly in the middle of the 90's in Finland. In the beginning of the 21st century, in 2007, was established the Biocenter Finland, which is a distributed national research infrastructure. Biocenter Finland provides research services to Finnish research community, and to some extent also abroad. Altogether six universities, including seven biocenters, are participating in this infrastructure network, which enhances state-of-the-art research and national coordination of life sciences and biomedicine in Finland. (Biocenter Finland Website).

According to the case interviews the starting point and the history of the case organization may have influenced to the collaborative working culture and values people are facing today. When the case organization was founded the most important thought in researchers mind was "science first." To start from "almost zero" with very limited resources forced people to find cost effective laboratory solutions. One of the interviewed founders told that "it was also a home city project."

4.1.1 Core facilities

All biocenters in Finland have similar ways to organize and operate their laboratories. Biocenter Finland coordinates, among other things, the development of core facilities in Finland. According to the definition of Faber et al. (2009) "A core facility is a centralized, shared resource that provides scientific investigators with access to instruments; technologies; services; cellular, animal or human study support; and expert consultation." Core facilities include typically expensive and occasionally used instruments that are relevant to conduct state-of-the-art research in biomedical laboratories. For example, clean room space is a typical core facility, because the high-standard space requirement.

According to interviewees, researcher are initiatively established the core laboratories of the case study biocenter. Core facility can be established when several researchers are interested in similar areas of research, or there is a need for a new equipment and a person, who knows how to use it. In many cases, researchers and technical staff of the biocenter develop a core facility step by step.

Different variations of core facilities

Interviewees stated that there are different levels of core facilities: Some core facilities may include only a single instrument that is shared by the researchers and technical staff from different research groups of the biocenter. More advanced form of the core facility, is that there is an instrument or a group of instruments and an administrator, who supervises the core. This administrator can be a researcher or technical staff, and he teaches other people to use the instrument, but the users carry out the actual analysis with the instrument by themselves. The most advanced variation of a core facility is that the administrator also carries out the analysis for the researchers – in other words, the core facility is a full service. Furthermore, this service can be sold outside the biocenter to other universities or even companies.

Outsourcing

According to interviewees, major part of the work in a scientific research laboratory is pioneering; Researchers are, for the most part, investigators, who strive to discover something new. Hence, most of the experiments in laboratory are handwork, and also foredoomed to failure. When discussing outsourcing the research, which means that the laboratory experiments would be bought from somewhere else, the interviewees have an agreement: only routine tasks are possible to outsource. Researcher must first conduct the experiments and test methods himself. After that the actual analysis of samples, which is a routine task, can be conducted elsewhere. Of course, this may apply only to biomedical research and there could be fields of study, which cannot be outsourced. Generally speaking, outsourcing is suitable for tasks that require large number of the repeating actions, or there are numerous samples that need to be analysed with a same method.

Core facility as a service

In addition to outsourcing, research laboratory can offer core services outside the research unit or a university. The biggest core facilities are services, which are used also by researchers from another university as well as companies. In this case study biocenter collaboration with companies is not yet common, but in the future this area is expected to grow. Smaller cores do not systematically offer services outsiders, but depending on a core, occasionally there can be customers from another unit.

4.1.2 Centralized versus decentralized

Current facilities of the case study biocenter are decentralized and distributed among several buildings. However, new centralized facilities for this biocenter are already under construction and the expected completion of the building will be at spring 2016. It came out in interviews that the biggest weakness of the current facilities is the decentralized spatial structure. Interviewees were unanimous that the facilities would work altogether better, if they were centralized. The distance between the actual laboratory space and the office were considered important in many ways; The characteristic feature of a daily laboratory work in biomedical laboratory is that the researcher must walk from a laboratory into an office several times a day, and in addition, possibly between different laboratories. Hence, centralized organisation of the spaces would support the effective laboratory work.

Nevertheless, the results of the interviews are somewhat in contradiction: Altogether all interviewees considered centralized spatial structure the best solution. However, interviewees posses different opinions on how the laboratories and offices should be organized within the centralized building. Mainly the interviewed researchers considered that laboratories and offices should be separated in different parts of a building, or even in different floors: all laboratories should be grouped together, likewise offices. On the contrary, part of the interviewed technical staff stated that offices should be located in the immediate vicinity of general laboratories. Core facilities, however, could be grouped together and placed in different part of a building.

According to the architect, who is in charge of the design of the new centralized laboratory building, grouping both general laboratories and core facilities together would obviously result cost effective building structure, since the functions could be organized by technical and logistic needs of a building. In addition, the reason to separate laboratories and offices is psychological: people will consider shared laboratories more easily as collective facilities, if their own offices are separated from them. Figure 1 presents different variation for centralized facilities.

4.1.3 Research groups are situated based on the method of study

The upcoming centralized building will have deeper framework and separated laboratory-office concept. Furthermore, research groups from different units will share also general laboratories: different groups are situated based on the method of study, regardless of the unit they actually belong to. This is a radical change in scientific research work pattern, where each research group traditionally have their own general laboratories. In addition, core facilities are located near general laboratories in the same part of the building, while offices will occupy another wing.
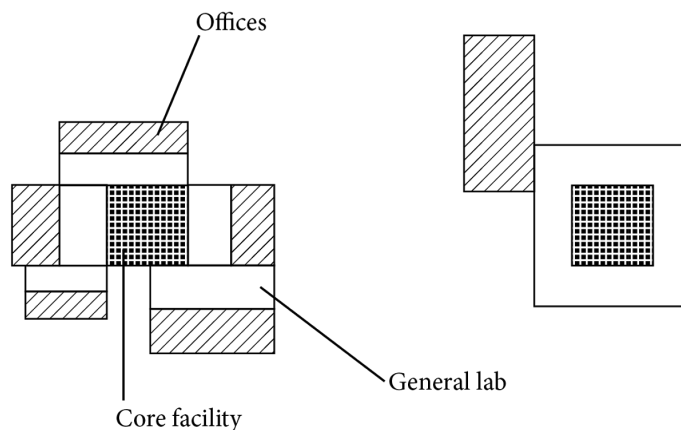
Figure 1 Different options how centralized facilities can be arranged.

4.1.4 Own versus shared

Interviewees state clearly that biomedical research laboratories require both general laboratory and core facilities, as well as offices. The key element of the successful shared resources is the relationship between own laboratory space, i.e. general laboratory, and core facilities. The nature of the laboratory work requires own bench space, which a researcher or technician

can organize their own individual way, and where they can keep their own equipment and liquids. However, these benches can be located within the shared laboratory room. One of the interviewed researcher even stated that sharing a general laboratory room with other researchers from different groups could enhance the collaboration and interaction between different people. Figure 2 illustrates situation with the shared laboratory room and individual benches.

According to interviewees, more important than all-encompassing laboratory layout solution, is the flexibility of spaces; In the field of biomedical research, technologies are evolving rapid pace. However, building design and spatial solutions are not so quick to transform. Therefore, spaces should be originally built as flexible as possible.

Figure 2 Separated laboratory rooms versus shared room.

Offices

Current facilities of the case biocenter are mainly traditional office rooms, occupied by one or two persons per room, and the rooms are located along a long corridor. According to the interviewed architect, new centralized facilities will include multi-space offices combined with silent "phone booths" and large multi-functional conference rooms. In the new building, technical laboratory staff will not have own office desks, instead they can use several mobile workplaces near actual laboratory rooms. However, teaching staff and researchers have dedicated office desks, which are separated from laboratories.

Other facilities

According to interviewees, researchers spend a major part of their day in campus and therefore an attractive environment was considered as an important element of the academic workplace; Campus should offer possibilities for exercise during a workday, as well as adequate social facilities for shower after the workout. In addition, outdoor environment should offer places for social interaction and relaxation. All interviewees considered that shared facilities offer settings for serendipitous encounters, which increases interaction and may lead even interdisciplinary collaboration. Moreover, the spaces between laboratory and office, such as corridors, cafes and restaurants, were considered natural places for social interaction.

4.1.5 Technology changing ways of working

Interview data implies that in the future automated instruments and even robots may conduct part the routine tasks in a laboratory. Already now there are some automated instruments that can independently conduct simple tasks; Researcher must only come around in a laboratory to place the samples into an instrument and the machine does the rest. This relieves researcher to focus on other, more demanding tasks.

According to interviewees, automation is seen only as a positive thing, which eases the routine tasks and repeating mechanical work, such as pipette work. In addition, this kind of repeating routine work may cause health risks for people. Hence, automated solutions are welcome. Even technical staff consider automation and robotics as a good thing, and according to interviewees, there is no risk that robots would replace technical staff within laboratories. Furthermore, automation enhances the utilization rate of spaces, because automated instruments can operate also during night as well as weekends.

4.2 Prerequisites of shared resources

One of the interviewed managers of the case organization said that "she did not want to allocate resources only to a single group." The same resource allocation ideology can be find also from other managers interviews. The shared managerial vision of "having things together" has been part of the case organizations shared laboratories implementation. However it was difficult to the laboratory users to say how strong influence the management has had for the collaborative culture they can feel every day in their workplace.

Interview data implies that all shared laboratory environments have one key prerequisite: consistent ways of working. All researchers and technical staff, who operate in a shared laboratory, need to be aware of the operational protocols of the facility, in order to be able to work there and sustain the functionality of that shared resource. Breaking the protocol of a shared laboratory may result untidy environment and infected instruments, and increased work for the next user of the laboratory. In the worst case scenario, the experiments of the next user will be ruined. However, the consistent ways of working and clear training protocol to house rules for new employees will prevent mistakes in a shared laboratory environment.

4.3 Advantages

According to interviewees, there are several advantages to coordinate the core facilities in national level. All biocenters are not required to purchase rarely used, expensive instruments; Instead these instruments are allocated in different biocenters and shared with others. In addition, all biocenters share the costs of the expensive instruments. Therefore, all the researchers from different universities are able to use these shared resources and furthermore, have access to state-of-the-art technologies. According to a research leader, the aim is to profile each biocenter in Finland to focus on different core facilities. In addition, core facilities can be seen also recruitment asset, because the top researchers want to work nearby their often used instruments. Furthermore, a bigger research unit may attract researchers more than small ones, because bigger biocenter may offer more possibilities for interdisciplinary work and internationalization. Therefore, the allocation of the core facilities in national level is a strategic decision.

All the interviewees were highly satisfied on their shared laboratory resources: sharing of knowledge and working methods were considered one of the most important advantages of shared resources. Some of the interviewees even claimed that shared facilities will enhance the interaction between people from different units, and generate new interdisciplinary collaboration projects. The cost-effective use of instruments and facilities were obviously one of the assets of a shared laboratory.

In fully functioning core facility, with state-of-the-art instruments and skilful technical staff, a researcher can benefit the knowledge of the technical staff and concentrate more demanding tasks, when technical staff carries out the routine analysis for the researcher. In other words, researchers will have more time for actual research and they can fully focus on their core competency.

Cultural mix-up

Bigger, centralized facilities are often also multinational. However, cultural differences may cause misunderstandings or even problems. According to a technician of the case study biocenter, language barrier is the biggest reason for misunderstandings, especially between non-native English speakers. In addition, foreigners may experience Finnish people somewhat rude and monosyllabic. However, according to interviewed post-doc researcher, multinational working environment is nothing but a positive thing, and a language barrier was not considered as a problem. Altogether, if the daily basis communication is in order, the multinational working community is considered extremely enriching experience. At its best, interaction between different people may generate novel themes for research and interdisciplinary research projects. The exchange of knowledge were considered important benefit as well. In addition, good team spirit in a workplace may even generate free-time activities between co-workers.

5   DISCUSSION

5.1 Significance of the results

The research brings a new perspective to the usability of health care facilities: it presents different practices of shared use laboratories, and these practices are applicable e.g. in medical laboratories.

Nationally coordinated health care facilities are topical issue in Finland. Social welfare and public health care facilities may be rearranged in five regional areas in the foreseeable future. Therefore, novel solution for shared health care facilities may be needed. This research opens the discussion about shared use practices in research laboratory environment. Nationally coordinated shared facilities of the biomedical research laboratories demonstrates that expensive resources can be coordinated in national level. However, research indicates also that some facilities can be coordinated in national level, but others need to be coordinated locally. Therefore, according to the requirements of the case in question, institutions need to decide which functions can be coordinated nationally and which locally.

On a local scale, the results imply that laboratory facilities can be used cooperatively, as long as certain basic conditions, such as consistent ways of working, are in order. In addition, shared use of laboratories may offer significant benefits for users of the shared facilities, as well as the whole university: core facilities can be seen as a recruitment asset, which can attract the best researchers and students around the world to work within the university. Obviously, this result may benefit all universities in Finland.

The significance of office environment within the research laboratories will grow in the future. However, the interviewees did not take a stand on what kind of office spaces they prefer.

Furthermore, based on the literature review, the actual office space should be silence place for solo work. The interactions and socialization between different people will take place in shared laboratories, meeting rooms and informal social spaces, such as coffee rooms. Hence, researchers own office space should provide adequate privacy and offer a place for concentrated work. On the other hand the spatial solutions for concentrated work can be diverse. Multi-office spaces may offer silent rooms and project facilities that can deliver even better privacy and functionality than traditional single office rooms. Also the distributed office work settings empowered by ICT -tools may help researchers to find the best place for office work - and not only in campuses.

5.2 Research limitations

Positioning the research problem to observe one case study biocenter may produce narrow research results. Hence, generalization of the results may be limited. However, the results imply that all biocenters in Finland aim to operate similar ways. Therefore, the results of this research may benefit especially other biocenters in Finland and also extensively the whole field of biomedical research. However, in order to compose more comprehensive understanding about the shared use of research facilities, more research will be needed. Further studies may concern also a shared use of teaching laboratories, since these facilities are one of the largest single-use space groups within universities.

The research data is collected via interviews of different stakeholders of the case biocenter. Hence, obviously the results reflect on the viewpoints of interviewees, and former experiences of these stakeholders influence on the answers they gave during interviews. However, in order to investigate the shared use of laboratory facilities, interview as a research method is valid: users of the shared facilities have first-hand knowledge, which facilities are shared and how the shared use of facilities function in practise. Interviewees can provide inside information about the shared use practises and open up the prospects of shared use of facilities. In addition to the interview data, on-location observation could be used as a research method. Observations could complete and verify the results of the interviews, and perhaps provide additional information. Case study research can be conducted by using qualitative and quantitative methods. Quantitative method to identify shared use practises in biomedical research laboratories could have be, for example, a survey. In order to broaden the examination of this case biocenter and to gather more information about the shared use of research laboratories, research methods should be expanded.

5.3 Practical implications

In Scandinavia many healthcare research laboratories are built during 1960-80 ties. In addition, new investments for hospital premises are on the agenda. The user-based knowledge for sharing resources by shared use of laboratories can help implementing effective and efficient solutions when renovating and designing next generation health care campuses and laboratories. The main perspectives for contribution of this paper are the user-demand side (managerial and operative aspects) and supply-side (designing the campuses).

If the key actors of health care campus developers share a common vision and state-of -art knowledge related to shared resources the obstacles of co-creating an effective research environment may become smaller.

6   CONCLUSION

Based on the case study the model of shared use of research laboratories seems to be a potential solution when supporting the dynamics of the scientific work and the efficient use of laboratory resources. Main requirements for shared use of laboratories are innovative leadership, collaborative work culture, shared vision between different stakeholders, advanced operational practises and facilities that supports the targeted way of working.

For the built environment the future laboratory organizations and the way of working requires more flexible and efficient space solutions. The balance between laboratory and office space is changing. More office space is needed and the ways of working in the offices is moving towards distributed and mobile work via ICT development. The utilization rate of the laboratories and the offices has been in low level. Because of economic and sustainable reasons the effective use of laboratories is coming more strongly to agenda of research campus development.

Campus as an instrument and a workplace serves people using the campus. The environmental value in use -quality is possible to create only together with key stakeholders. The link between user demands and facilities supply must be bridged by proactive and collaborative design practises. The advanced knowledge of next generation ways of working in science should influence to both local ways of working and spatial solutions as an integrated holistic system. In the case study example the integration of laboratory development processes and the collaborative working culture supports redesigning the research laboratories concept in the field of biomedical technology. After moving to the new building further studies are needed to measure and analyze the impact of the new solutions and practise models. In that case other campus laboratory design processes can benefit by using the user-centered evidence based on this research path.

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ELDERLY CARE

INTERIOR DESIGN AND ITS IMPACT ON OLDER PEOPLE, ASSESSING CHANGES IN A RESIDENTIAL CARE HOME

Jonas E Andersson

School of Architecture, Royal Institute of Technology, KTH, Stockholm, Sweden
jonas.andersson@arch.kth.se

Magnus Rönn

Ass. Professor
School of Architecture, Royal Institute of Technology, KTH, Stockholm, Sweden
magnus.ronn@arch.kth.se

ABSTRACT

This study presents results from a practice-initiated intervention of the interior setting in a resi-dential care home, RCH, outside of Stockholm, Sweden. In the wake of the Swedish governmental initiative "Growing old, Living well" in 2012, the Administration for Social Welfare and Health, ASW, at the City of Stockholm received partial funding for an intervention project, implemented as changes of the interior design of a RCH unit for 25 residents. This unit was situated on the ground floor in a four storey building; a refurbished hospital building from the 1950s. The project revolved around two situations that older residents regularly meet in a RCH setting; Firstly, the meal situation, which takes place in the dining room and the adjacent area for coffee or tea; secondly, the leisure situation, which involves distraction and socializing activities. The development of a set of essential environmental changes involved representatives of the municipal administration along with the ones of the private eldercare entrepreneur, experts in interior design and lighting, and smaller group of users, i.e. the residents and their relatives. However, the project started without a baseline assessment of existing conditions, hence, complicating a direct evaluation of the impact of interior changes. In consequence, this evaluation had to be realized as a multivariate analysis, which compared previous conditions with the changed interior setting. Triangulating research methods were used: interviews, observations, mini-questionnaires along with the Therapeutic Environment Screening Scale for Nursing homes instrument, TESS-NH. The TESS-NH assessments involved a group of 10 evaluators. The qualitative and quantitative assessments of the interior changes suggested a positive effect, and most users, residents, relatives or members of the staff, appreciated the new setting. Due to the lack of a baseline assessment, these experiences are difficult to correlate with particular changes in the interior setting. However, two factors appear as decisive for the successful outcome of the project: firstly, the development of a preliminary set of changes in the indoor design, conceived by spatial experts, and, secondly, the involvement of user representatives in the evaluation of the suggested ideas before implementation.

Key words

Intervention in interior setting, residential care home, user participation, expert advice.

1   INTRODUCTION

In 2010, the Swedish government allocated some 50 Million SEK to national exploration of es-sential aspects for a comfortable and healthy ageing. It was the so-called Growing old, living well, GOLW initiative.[1] The coordinator of the project, the Swedish Institute for Assistive Tech-nology, SIAT,[2] distributed the bulk of the means to hands-on projects with municipal organizers (Wiklund & Melin, 2013), while some 6 Million SEK was invested in three architectural compe-titions that aimed for rethinking housing for either still able older people or frail older persons (Andersson & Rönn, 2014). The Administration for Social Welfare, ASW, [3]of the City of Stock-holm submitted an application for a project called "Space for health," SFH.[4] The SIAT assessed the project favourably, and the project received a sum of 100.000 SEK, which was destined to create a blog around the evolution of an intervention project at a local residential care home, RCH (Frunk-Lind, 2012).

The full budget for project equalled some 800.000 SEK, of which 100.000 SEK was consecrated to administrational expenses including expert advice on interior design and interior lighting (Olsson, 2011). The project envisioned changes in the interior setting of communal spaces at a unit in one convenient municipal residential care home, in the following RCH. The aim was to convert existing space into an aesthetical and pleasing environment that would introduce new opportunities for activities and social contacts in order to promote an improved sensation of well-being among residents, their relatives and members of the staff. Based on a holistic understand-ing of the human being, the ageing process and professional caregiving, the ASW forwarded a belief in an assumed relationship between art and artefacts, food, furniture, interior colouring, spatial features, textiles and an increased level of a self-perceived sensation of safety and well-being and an enticement to participate in various social activities (Olsson, 2011).

1.1   Framework for updating an existing RCH setting

The SFH project was headed by a project coordinator at the ASW, who defined the exact orientation of the interior changes that were to be implemented. In turn, a steering group with two executive directors of the administration supervised the coordinator. Finally, a special advisory board was formed at the RCH in focus for the initiative, which consisted of 2 residents, 1 relative and 3 members of the staff. This board had a final say on the exact execution of the envisioned interior changes. As a way of involving other persons outside of the targeted groups, the project coordinator also initiated a diary-like blog at the municipal website, which described the evolution of the project. However, this blog was met with a poor recognition by potentially interested persons, i.e. residents, relatives or members of the staff. Hence, few responses were posted.

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1   This is a translation of the Swedish name "Bo bra på äldre dar".
2   In Swedish Hjälpmedelsinstitutet.
3   In Swedish, Stöd & Omsorg, Stockholms Stad.
4   In Swedish Rum för hälsa.

Two external experts supplied advice on how to improve communal space for activities and the meal situation, an interior designer and a light designer at an architect's office in Stockholm. The full sum for their analytic work attained the sum of 50.000 SEK. In contrast, the sum for refur-bishing works, new furniture and other equipment corresponded to the sum of 700.000 SEK. Af-ter a discussion between the central level of the ASW and a local one, it was decided that the study would be situated at the RCH of Tallbackens Vård&Omsorgsboende, TVO, in Bromma, a lush suburb in the western outskirts of Stockholm. This RCH is integrated in a seven storey high building. The building was originally conceived in 1956 as a local hospital for long-term geriatric care, but gradually extended until 1972. In line with hospital planning of that time, the original floor configuration described a rectangular block with a central corridor, around which patient rooms for 4-6 bed-confined persons were organized. These blocks were interconnected via stairwells with elevators, so that a large building projected in a north-south axis with occasional extensions to the east in an angular position. Through this configuration, the patient rooms faced either the original pinewood forest to the east, or the open and sloping farmland to the west with access to the lake Malaren.

Over the period 2005 to 2006, the geriatric hospital was converted into a residential care home. The former patient rooms were combined in order to create condensed one room flats with indi-vidual kitchenettes and bathrooms. With this new configuration, each unit consists of 25 flats with two larger open areas for dining and socializing. All in all, the building has four units with a total of 100 flats. Originally, the caregiving operation was solely provided by the city of Stock-holm. Following the introduction of tendering procedure even for eldercare services, the City of Stockholm has opened up for private care entrepreneurs. Since 2010, the four RCHs are run by one private care entrepreneur, the private care entrepreneur Vardaga.[5]

Table 1 The objectives associated with the envisioned changes in the interior setting.

1. Increased sensation of comfort by the resident and members of the staff during the meal situation;	2. Increased sensation of joy and social exchange by the resident and members of the staff.
3. An affirmative and stimulating ambiance in communal spaces;	4. An ambiance in communal spaces that would promote social exchange and well-being;
5. A rethinking of the interior design of communal spaces in close collaboration with the residents, relatives, members of the staff and the care entrepreneur;	6. An ambiance in communal spaces that would be perceived as inspirational, pleasing, safe and supportive, so that the residents, primarily, but also members of the staff would be in reach of activities and distractions;
7. Changes in the interior design that would enhance the older person's capacity to maintain everyday activities and invent coping strategies for an independent use of communal spaces;	8. Changes in the interior design that could be assessed scientifically in view of a larger implementation in other RCHs run by the City of Stockholm.

5   At the time of the intervention project, the care entrepreneur had a different name. It was then called Sil-verhemmen, see link http://www.vardaga.se.

1.2   Objectives for interior changes

The fundament for the realization of the SFH project was an aesthetically oriented understanding of the relationship between human physiology and environmental input: The envisioned measures were assessed according to the idea that an adequate solution would be associated with a positive epiphany by the user of the particular space, in this case the project coordinator with advisory support if these could be. Hence, the objectives for the interior changes were eightfold, see figure 1. The objectives were to be realized in three defined areas of communal space: the entrance hall to the unit, an extension of the corridor with an adjacent minor space used for vari-ous activities and distractions, and a dining room with a smaller adjacent space for informal snacks in between the larger meals, lunch and dinner. This space was associated with a socializ-ing ambition to create new acquaintances between people, i.e. the residents, relatives, and mem-bers of the staff.

The concrete changes of the interior setting of the three defined areas were closely related with a distinct intention to influence behaviours and routines among residents and members of the staff during the meal situation and create a locus for weekly events, which would install a less formal relationship between care takers and care givers. The project was launched in the fall of 2011 with a screening study of the meal situation at several residential care homes in the City of Stockholm (Act 119-78/2011).

The observation-based study concluded that most spaces for dining were ill suited to the situation with few positive ambient factors. This served as the starting point for the refurbishing measures that were to be realized at Tallbacken. These were implemented during spring 2012.
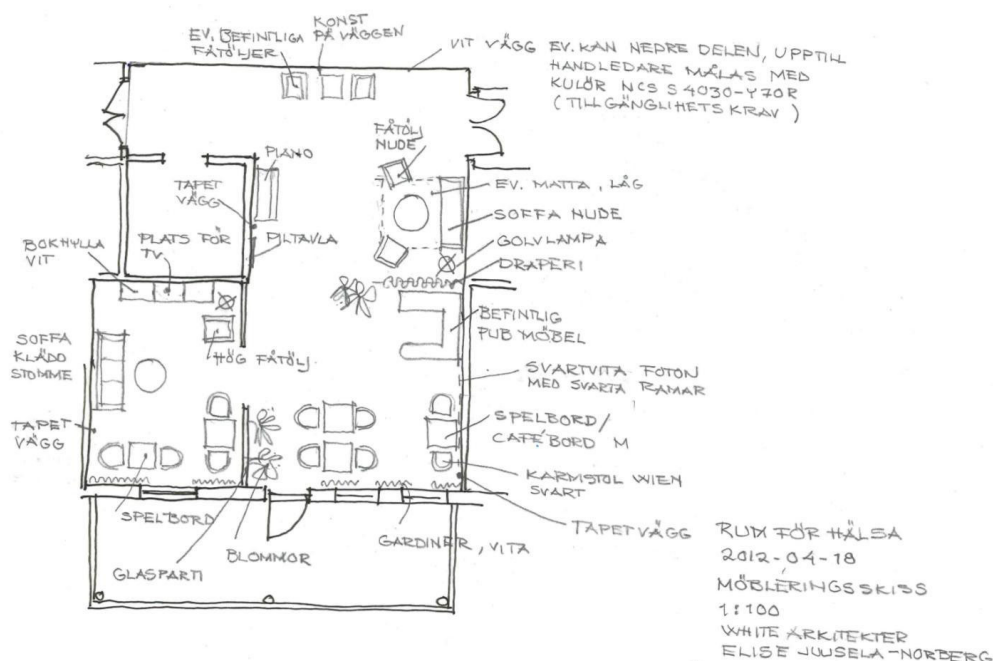
Figure 1 An analytic sketch of the area for main meals and adjacent space for minor snacks, with furniture arrangements and handwritten comments about changes in the interior setting.

In the fall of 2012, the full project had come to an end. The SFH project at the Tallbacken RCH started with a spatial analysis of the three areas that were intended to be changed. Two experts were commissioned, all in all 30 hours, one interior designer and one lighting designer. They assembled a design proposal with advices on how to proceed. Hence, it could be said that the project evolved with support of experts, see Figure 1.

1.3   Study design

Being part of the governmental initiative, an essential condition for the SIAT contribution to the SFH project was that it could be independently assessed after realization. This report was to ac-company the financial report. In consequence, the project coordinator contacted the authors of behind this paper, researchers affiliated with the School of Architecture at the Royal Institute of Technology (Andersson and Rönn) and the Danish Institute for Building Research, Copenhagen (Andersson). They were recommended by the SIAT, since, in a parallel track, they also evaluated the three architectural competitions, which were realized within the GOLW initiative. Their mis-sion was threefold, demonstrated by the three bullets:

- analyse the fundaments for the realized changes in the interior setting;
- assemble the residents' and relatives' experiences and usages of the realized changes;
- collect the staff members' experiences of the realized changes and their observa-tions from the SFH project.

The researchers implemented case study methodology with triangulating methods for accumulat-ing data from the project (Stake, 1995; Yin, 2003). Case studies are often seen as vital for the development of new thinking about a complex phenomena (Johansson, 2000, 2002), and for test-ing innovating existing theories (Flyvbjerg, 2004). In addition, case studies provide an alignment of practical experiences with theoretical knowledge, thus, creating a research material that is open for further analyses of a qualitative and quantitative nature.

2   STATE OF THE ART

In the context of RCHs, the physical environment has gained an increasingly larger recognition for being an essential factor in providing appropriate care for dependent and frail older people (Cutler, Kane, Degenholtz, Miller, & Grant, 2006; Day, Carreon, & Stump, 2000; Schwarz & Brent, 1999). Dementia touches core centres in the human brain that are involved in the percep-tion and understanding of space (Kolb & Whishaw, 2002). Hence, new findings on this relation-ship are important for the creation of appropriate housing for this group. The layout of the archi-tectural layout of the individual flat as well as the configuration of the communal space has for-warded the need of a fit between the older user and the architectural design, so that the physical environment will constitute a supportive environment (Barnes, 2006; Barnes et al., 2002; Day et al., 2000; Hoof, Kort, Duijnstee, Rutten, & Hensen, 2010; Küller, 1991; Torrington & Tregenza, 2007).

The alignment between the architectural design and the type of caregiving provided at the partic-ular RCH has been forward as an ephemeral but influential aspect for explaining differences be-tween care wards inside a RCH or in an comparative approach between RCHs

(Edvardsson, 2005a, 2005b; Edvardsson, Sandman, & Rasmussen, 2011). Appropriate work environmental conditions constitute another parameter to respect when conceiving new RCHs, especially, when this supposes a move of dependent and frail older people already living in an existing RCH under exemption conditions. The move for a flat in an ordinary flat creates the same problem: in this transitional situation, the individual strive to realize an new balance between the past and present existence by arranging artefacts, furniture, textiles and other interior decorations in a personalized order that forwards the personal identity (Gilroy & Kellett, 2006; Ratiu, 1997; Toyama, 1988). However, the fortunate outcome of this change of habitat depends ultimately on the older person's beliefs and trust in the organizer of the RCH that the move to the new environment will be an improvement of the original one (Devos, Spini, & Schwartz, 2002; Mirotznik & Kamp, 2000; Sverdlik & Oreg, 2009).

With reference to this appropriation process (Lefebvre, 1985), guidelines and recommendations have become common instruments to regularize architectural designs of RCH. These are mainly active on a comprehensive building level that structures the layout of the building and the distri-bution of space according to building performative requirements (Erhvervs & Byggestyrelsen, 2010; Svensson, 2008). However, the fit between realized buildings and human perception of space as affected by dementia or a long-term medical condition suggests a need for an improved feedback between practice and research in order to implement research findings (Steenwinkel, Baumers, & Heylighen, 2012). Transitional problems from an old RCH to a new one could be addressed by a decision-making and planning process that implements the same aesthetical and ethical principles for the new RCH as for the existing one. Such a process has an evaluative and participatory approach (Grant, 1997). This approach will involve the users of the building, i.e. residents, relatives and members of the care staff. This user involvement is often the key element for successful intervention projects (Schwarz, Chaudhury, & Tofle, 2004). The decision-making and planning process can also be programmed by an affordance-based approach that aims at con-ceptualizing disperse ideas and visions about the future RCH, referring both to architecture and eldercare, into a theory on the relationship between the future users of the building and the archi-tectural design (Maier & Fadel, 2009).

3   APPROACH

In the following, the use of the word of architecture implies a holistic view on the built space as an entity, which is equally depending on the architectural design, the interior setting with arte-facts and colours as well as the access to the outdoor environment. The research study was con-ditioned by the lack of a baseline evaluation of the unit in focus for the intervention project, hereafter called U1. In order to overcome this downside, the unit on the first floor, hereafter U2, with an almost identical configuration of space was included as a comparative case. In order to overcome this problem in assessing the realized interior changes, the study promoted a detailed research approach. The working hypothesis was to unravel possible key mechanisms in the inter-vention project and casual effects that could be connected to the changes in the interior setting.

3.1   Research methods

Consistent with case study methodology, all of the research methods had a triangulating charac-ter. In addition, they assumed a mixed approach in order to generate qualitative and quantitative data that would allow for mixed analyses. The research methods were:

1. Close reading of documentation that were generated by the intervention project (Brummett, 2010);

2. Evaluations of two similar units by use of the Therapeutic Environment Screening Scale Instrument for Nursing Homes, TESS-NH (Sloane et al., 2002);[6]

3. Interviews with key players who had been active in the intervention project;

4. Observations at the two units, accompanied by photo documentation of each visit;

5. Photograph-based interviews with the residents and relatives (Baptiste, Belisle, Pechenart, & Vacheret, 1991);

6. Questionnaires to the members of the project group along with members of the staff.

The interviews with the older respondents were transcribed into colloquial Swedish. Some poignant exclamations or phrases have been used in this text; however, these have been translated into an approximate type of colloquial English.

3.2   Spatial perimeters of the research study.

The four units of the Tallbacken RCH have each 24 flats per floor, which is approximately about twice as many residents per unit in comparison with other residential care homes. This was a di-rect consequence of the building being a former hospital. Hence, the research study demanded spatial perimeters. Thus, U1 and U2 served as comprehensive boundaries; U1 situated on the ground level and the U2 on the first floor. The entrance to the units is in a central location, at which two elevators are located. These elevators also link other higher units to the ground floor. The U1 is the access point for all units, since this unit has an entrance to the court yard. The ele-vators are intended both for residents, members of the staff, visiting relatives and various deliver-ies to the different units (groceries, care products and pre-cooked meals for lunch and dinner).

3.3   Execution of the research study

Observations were implemented during 3 field studies during October and November 2012, and in January 2013. They were realized as a walk through the communal spaces of the U1 and the U2 by the two researchers. Persons using and use of space was noted. These walks occurred in the morning, from 11 a.m. to 4 p.m., or in the afternoon, from 1 p.m.to 4 p.m. All visits were confirmed in advance with the head of the staff. Questionnaires were distributed to members of the project group and among staff as an attachment to an email, sent out prior to Christmas holi-day in 2012. Out of 7 respondents, 6 chose to respond. The photograph-based interviews were realized in January 2013. The staff recommended 5 residents, who they thought would take an interest in the research study. After a personal contact with each

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6   The TESS-NH instrument was developed during the 1990s as a special tool to assess environment adjusted to older persons with dementia, financed by the National Institute on Aging, NIA, in the US.

Communal space

Refurbished commu-
nal space

Space for informal venues
(Café, Pub or similar)

Adjacent space for informal
venues (Café, Pub, or
similar)

Not refurbished area: second
area for different meals during
the day, but intended for frailer
people with functional pro-
blems concerning eating,
drinking, and similar.

Refurbished wall with tapes-
try depicting a pinewood
forrest.

The dotted line describes the
area of communal space that
residents seem to use the
most, and included partly in
the intervention project.

Refurbished space for breakfast,
luncheon and dinner, associated
with ambition to improve the
meal situation for the residents
(both emotional and physical
changes).

At U-1 this space is converted
to an office space, while it is
an open space at U-2.

Refurbished space, and annexing
space to space for different
meals, and intended for after-
noon or morning coffee and tea,
often in combination with infor-
mal meeting (residents-residents,
staff-staff, residents-staff, or
residents-relatives).

Figure 2 Overview of the floor configuration of U1 at the ground floor: The pale grey colour indicates communal spaces of the unit, while the deeper grey tones delimit areas that were subjected to interior changes. These changes included a new interior colouring, new furniture, new textiles and other artefacts for interior decorating. The floor configuration of U2 is almost identical, and deviating spatial solutions are indicated (drawing withou scale).

resident, 4 residents and 1 relative chose to participate in an informal conversation with thematic questions about the changes in the interior setting. The questionnaires and the photograph-based interviews were handled confi-dentially, so that the respondents were anonymized and colloquial language was adjusted to cor-rect Swedish.

The TESS-NH instrument supposes a45-60 minute walk through the communal space of a unit. It gives a momentary assessment of the unit at the particular moment of the evaluation. The in-strument focuses on the physical environment's capacity to convey:

- Safety and security by assessing the number of entrances to the unit, the cleanli-ness, and the need of maintenance;
- Clues for spatial orientation from the residents' flats to communal space;
- Opportunities for privacy and access to indoor and outdoor environments
- Opportunities for participating in social activities;

All in all, the instrument includes 32 items to assess. A selection of 18 items has been validated. These form a sub-scale that allow for comparing one unit with others, or one residential care home with another one. In this study, the full instrument was converted to graphical data in order to compare U1 with U2. The evaluators used an earlier version of the instrument, dated in 2003 and used in previous studies by the authors (Andersson, 2005, 2011). The TESS-NH evaluations were realised by the two researchers behind this study on 4 October 2012. However, this prelim-inary assessment indicated a poor scientific value. Therefore, participants in a continuing educa-tion programme at the School of Architecture, KTH, were asked to participate.[7] This call resulted in 6 new evaluators, 5 women and 1 man. They took part in a 1.5 hour long introduction to the use of the instrument. The evaluators realized their assessments on 15 November 2013, in the afternoon, stretching from 1 pm to 4 pm. All visits for TESS-NH assessments were confirmed in advance with the head of the staff.

4   RESULTS

In the following section, results from the study will be presented in three sections. The opening section assumes the perspective of the project coordinator, the project group and the members of the staff, and focuses on the relationship between appropriate interior environments for depend-ent and frail residents. The second section forwards the residents' and their relatives' views on the previous setting and the subsequently realized changes. The third section is concentrated on the TESS-NH assessments.

4.1   The organisational perspective on the interior changes

The project opened with an internal meeting at the local office of the ASW in September 2011. The meeting concentrated on organisational matters like time frame for the project, meeting schedule, selection RCH, and idea of residents, who might participate. Later on, the time frame had to be adjusted, since the envisioned six month project developed into a one year-long pro-cess. It was the head of the local branch of the ASW, who proposed the

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7   This course was "Architecture for all, on accessibility, social inclusion, and usability" of 7.5 academic merits.

Tallbacken RCH as a suitable object for an intervention. The project was outlined as being a project for caregiving staff, with which experts in interior design were associated as advisors for a limited time. The second meeting occurred some weeks later. This meeting confirmed that the SFH project had been positively accepted by the staff of the Tallbacken RCH. By the end of September, an open-ing meeting was held at this RCH. During this session, the participants from the ASW and the members of the staff decided on which areas of the communal space at the U1 that was to be part of the project. From this date until the end of the project in October 2013, regular meetings were held, all of which concluded in minutes.

The project had a top-down approach, since the local head of the ASW requested means for the project by formally asking the head of the central ASW. The central ASW appointed the project coordinator. In turn, the head of the local ASW selected the RCH, while the members of the staff, who were to participate in the project, were nominated by the care entrepreneur Vardaga, in charge of the caregiving at the care home. The members of the staff selected the residents and their relatives, who were later involved in the project. The staff members presented various mo-tives for their involvement in the project, stretching from general concerns of improving the inte-rior setting in residential care homes, to a strong personal interest in interior design. They tended to use three referential models in order to motivate their focus of interest: firstly, the anthropo-sophically inspired interior setting of a residential care home in southern Sweden (the Vigs Ängar in Ystad (Husberg & Ovesen, 2007)), secondly, the great source of inspiration for 20th century Swedish interior design: the family home of the Swedish painters Karin and Carl Larsson, Sundborn, broadly presented in several publications during the first half of the 20th century (Larsson, 1899), and thirdly, the classical sets of furniture with corresponding textiles that en-hance the feeling of materiality, daylight penetration, indoor qualities versus views to the out-door, poignantly assembled by the Swedish designer Carl Malmsten in his work from the 1920s till the end of 1960s, a parallel track to the functionalist movement in architecture and interior design (Uitz, 2013).

Institution versus home

The interviews with the respondents in the staff demonstrated that the existing interior setting of U1 was collectively perceived as an institutional environment. Their hope was that the project would mitigate this appearance. This moderating effect on the interior setting was associated with their expectations: One respondent thought that the intervention would create "*a beautiful, pleasant and welcoming ambiance.*" Another respondent hoped that the entrance hall, associated with the first impression of the unit and the residential care home, should "*be inspirational and invigorating.*" Several respondents said that the new interior setting had to evoke a sensation of "*being at ease in a warm and friendly environment,*" or project a feeling of "*calmness and harmony,*" but in a modern and up-to-date style of interior design. The envisioned changes should create new opportunities for "socializing."

Inspirational models

The staff members' ideas for the intervention project forwarded the influence of generator imag-es for staging space for a communal use (Darke, 1984). The respondents' answers

demonstrated a lack of parallel inspirational models, rather an adaptation of fragments from previous spatial experiences, which the respondents described as a type of "neutral environment:"

-       *In my mind, you cannot turn public environments into homelike milieus, since, individually, we present personal motives and tastes when we think of home (…). We wanted to conceive a space that was open for everyone (…). Our intention was that the interior changes would be effective for a long period of time, since a new generation of senior citizens have started to experience an increased need of care and caregiving. They have completely different preferences than the group, who were born during the 1920s, had.*

The realized interior setting resembles either a type of home environment or a hotel environment. In the communal space, the homelike character relies on the presence of colourful potted plants, display cases with porcelain and pottery, decorative artefacts, embroideries, and small carpets in discreet place in order to avoid fall incidents. This orientation is also found in the interviews.

-       *For me, home is the way the residents have organized their flats. By transferring this character to the communal space, this area has become more welcoming, like a warm re-sort (…). There is no longer the sensation of being at a hotel, and, definitely, no longer an institution.*

The dining room conveys some similarities with a restaurant, while the recreational space for activities and special events picks up motifs that seem to derive from a Swedish adaptation of an English pub. This outcome is also reflected in the interviews:

-       *I envisioned a new environment similar to the one you can find in a hotel or a restaurant. It was a loose idea that converged into an interior design. We wanted the pub to be much darker, since our idea was centred on a traditional English pub with wooden details and different zones of bright and sombre lighting.*

Artefacts, new and old

One specific purpose of the project was to stimulate the residents' sense by inciting memories and generate recognition. However, this objective became stuck between a focus on old artefacts and new ones. This duality can be correlated with experience-based conclusions of the 1980s, when the National Board of Social Welfare and Health, NBSWH, started to promote a homelike environment for frail older people by use of traditional furniture and objects (NBSW, 1983). Two respondents said:

-       *I think that using glassware, porcelain and table linen inspired by Swedish design from the 1920s is an excellent way of enticing memories and recognition by our residents. By mixing these new artefacts with truly old ones, you will create a homelike environment accessible for everyone.*

-       *In my opinion, we shouldn't have anything that is old at the unit. Most things are recent and of modern design, although some objects are timeless (…). Chandeliers are something that most of our residents seem to have had in their former flats, and such features could entice presence and recognition. At the same time, most of our residents are very modern and have urban habits and tastes.*

Three other respondents suggested the opposite:

- *A modern interior setting with soothing colours, appropriate lighting and adequate sound insulation are the most essential aspects that must supersede the demand on an old-looking interior setting.*

- *I think that the homelike environment should be the individual flat. It is important that the older person has a say about this interior setting, but the communal space must be neutral, so that it can fit everyone's needs.*

- *I think that it is OK with displaying some old artefacts like memorabilia. This would evoke past decades, similar to the photographs of old movie stars that hang on the walls in the pub space. However, I do not believe that one should avoid the use of modern furniture and artefacts.*

The intervention project and user participation

The few residents and their relatives, who participated in the project, were selected by the staff members based on their assessment of the older person's interest and individual health status. Just, 4-5 residents and one of their relatives had been associated with the project. The intervention project demonstrated the weak position of this group of users in the decision-making behind the changes in the communal space. Two quotes from the interviews forwarded the difficulty that was related to realize expansive user participation:

- *I suppose that the residents and their relatives, who participated in the intervention project, were selected by the members of the staff, since they knew them the best. They could assess their potential to represent this group of users.*

- *The residents and the relatives have supplied their views on the changes in the interior setting and participated in our discussions. Sometimes, it was hard to really grasp what they actually thought about the suggestions for the changes. They responded with very short and neutral phrases like "it's OK" or "that will do nicely."*

The influence of the residents and their relatives on the changes of the interior setting was diffi-cult to pinpoint, however, there was one particular detail in the intervention works that offended them and made them to act forcefully. This refers to the intended design of the wall in the en-trance to the unit U1, but also leading to the other units on upper floor levels. This was the in-tended artwork - a spiralling wooden railing that would cover most of the white wall – which was incomprehensible for the residents and their relatives. Here, a clear difference could be de-tected among members of the project or the staff and residents and relatives. After several ideas, the project coordinator finally decided to solve the problem by suggesting wallpaper with a pho-tographic motif from an opening in a dense pinewood forest with sun penetrating from above, which pleased the residents very much.

The perceived effects of the intervention project

The interviews with the members of the staff suggested that this group believed that the changes, which had been made in the interior setting had created positive changes in the everyday life at the unit U1. The staff members thought that the new meal situation had had the envisioned ef-fect on the residents, and that they had become more attentive to which type of food, which was served. This created an expectation and made them communicate. In addition, they believed that the residents used the communal space more than before:

PHOTO A. This photo was referred to as a home environment twice and hotel once.	PHOTO B. This photo was referred to a home environment once.	PHOTO E. This photo was referred to a home environment once.

PHOTO F. This photo was referred to a home environment one time, a hotel one time, and an institutional place once.	PHOTO G. This photo was referred to a home environment once.	PHOTO H. This photo was referred to a home environment twice, and an institution twice.

Figure 3 The photographs of the RCH X with interior changes and their use by the interviewed residents.

- *The communal space is much more used than before by the residents, especially when the full intervention project was accomplished, and all the craftsmen had left the premises.*

- *Our residents have started to eat better, and much more than before, they even stay some more minutes after the meal and chat with each other.*

- *The meal situation has become much more pleasant with the new organisation of the din-ing space with three smaller tables and new pending lamps above each of them. The lamps give ampler and nicer light now.*

The area that was transformed into a pub-like space was regularly used on Friday afternoons. Then, beer, wine and whiskey were served. However, some critics had been raised against this new function, since it did not allow for other independent usages by the residents. Overall, this space did not generated more (during all of our visits to the Tallbacken RCH, the pub area was abandoned and the light turned off).

4.2   Older people's views on the interior changes

The residents at the unit U1 displayed a great variety of diagnoses, but they were mostly of a somatic nature, but some concerned dementia in an early phase. For most of the residents, the Tallbacken RCH would be the final step in their housing career. Based on randomized

statistics for the unit, made by the staff, approximately 17 persons out of the 24 older residents would pass away during the year. In some fortunate cases, the frail older person would recover partly and be able to move to another residential care home in the vicinity of a close relative (personal communication staff member 2013-01-10).

During the field studies at the U1 and U2, some 1-2 older persons were present in different areas of the communal space. Shortly before and soon after lunch, this number increased considerably, when the residents circulated the premises on their way back to the individual flat, either moving independently or being assisted by members of the staff. However, given the large units, the communal space, beside the area closest to the dining room, never gave the impression that the space was intensively used. The residents always were near their own flat, or close to the eleva-tors that serve the full building. It seemed as if they were in search for activities and events that were created by people entering or leaving the unit – relatives, visitors, members of the staff go-ing on or leaving a shift, or service staff delivering goods to the unit, or other upper units.

Institution versus home

The interviews with the residents and their relatives used actual photographs from the unit U1. These photographs displayed the areas included in the intervention project, but also untouched areas of the communal space. The respondents did not always recognize that the photographs were of their everyday environment. Their answer suggested rather that they believed the sur-rounding environment to be something in between the home environment and a temporary stay at some hotel.

- *Well, what do you find in a home? Obviously, there will be a sofa, a chair, a table and some armchairs (Photo J). And, a book shelf, of course, and a round carpet (Photo E).*

- *This looks nice, I think, really homelike! (Photo F).*

- *I chose these two photographs (Photos A and B) ... well, here you have the view of the lake, and we use to go down to the jetty, sometimes even board a boat so that we can circle the lake, or pass over to the other side.*

- *I like this one (Photo G), there you can the dart board.*

- *I think it looks rather nice (Photo H).*

Spontaneously, some of the older respondents suggested that they thought that the photographs showed either a type of hotel environment or that of an institution of some kind.

- *Well, this has something of being a hotel (Photo J).*

- *Such a door, you don't find at home, a hotel or an institution? (Photo K).*

- *Well, it could be a door to a theatre or something (Photo K).*

The respondents' choices of photographs described home, hotel or institution. These answers seemed to be correlated with the places that they used during the day, and that had been previ-ously observed from 11 am to 4.30 pm. The dining room was mostly associated with lunch, rather than dinner, the pub with what was happening on Friday afternoons. The collection opened up to a conversation about everyday life at unit U1:

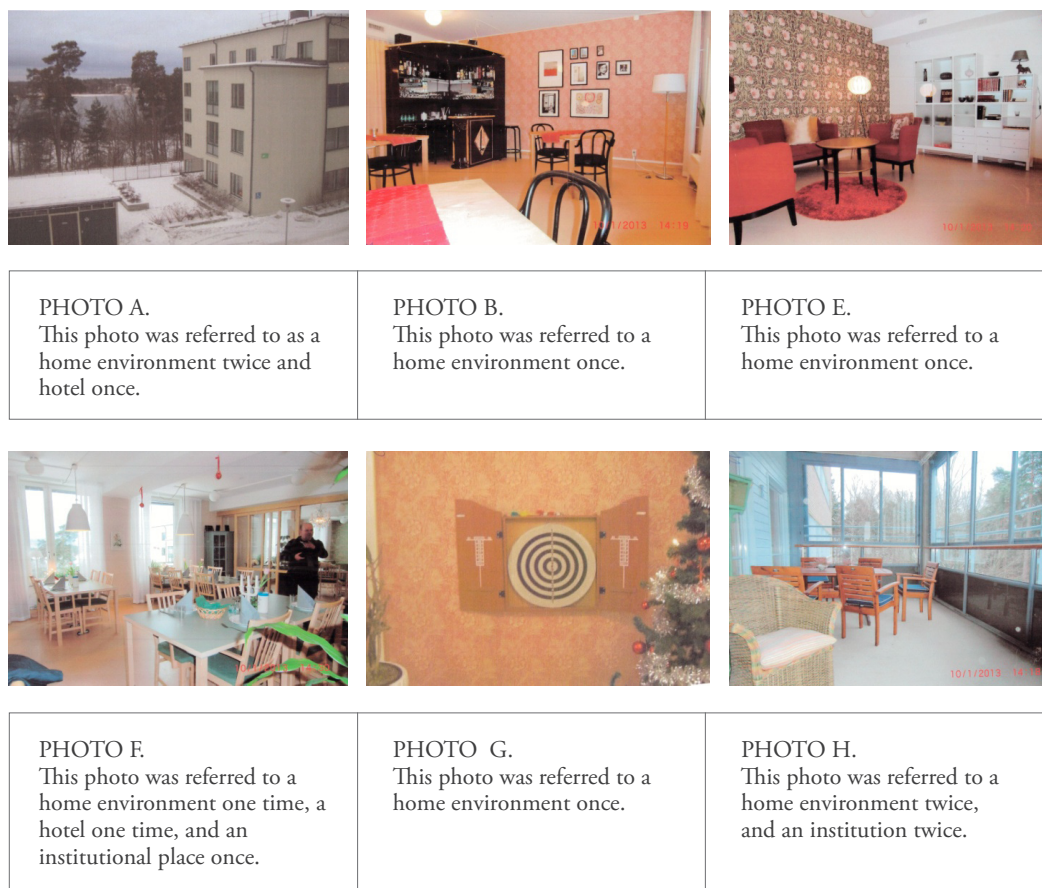| PHOTO J.	PHOTO K.
This photo was referred to as home twice and hotel once.	This photo was referred to as a hotel twice, and thrice as an institutional place.

Figure 4. The photographs of the RCH X with interior changes and their use by the interviewed residents.

- *This is nice, yesterday; there was a little girl who used the piano here.*

- *Well, my friend, you'll find us here often! We use this space because it is nice to sit here, we have a wonderful view of the lake, and it is sunny and open. It is so incredibly nice! And the members of the staff they bring flowers!*

Inspirational models

Most of the older respondents found the interview situation awkward or unfamiliar. Some had prepared for this meeting several days ahead, others had completely forgotten about it. In addi-tion, their individual diagnosis played tricks during the interview situation, and inspirational models could not be discussed at all. This line of questioning was too complex, and it led the re-spondents astray in their own personal memories before moving to Tallbacken RCH, or even when moving from a distant village in the Swedish province in search of work in the capital.

Artefacts, new and old

To some extent, the relationship between new and old artefacts was possible to discuss with the residents and their relatives. They were asked to date the artefact found on the different photo-graphs of the communal space after intervention project had ended. The photographs from the dining room, the pub and its adjacent space were considered to be from a time period that stretched from the 1940s until today.

- *Well, this must definitely be from the 1940s (about the pub);*

- *I think this can be from the 1960s, at least from the beginning of that decade (about the –balconies);*

- *Well, what time can it be? Let's say it is the 1980s, then, we are quite close to present time (about the adjacent spaces to the dining room and the pub area).*

User participation in the intervention project

Despite the fact that the interviewed residents had lived at the unit for 2 years or longer, they had vague recollections of how the dining room, the pub area with their adjacent spaces had looked like before the changes in the interior setting. They also had fade recollections from the realization of the interior changes: the repainting, the reorganization of furniture and the installation of new electric lighting and furniture.

- *Well, I had a peek now and then, just because I live quite close to the dining room. We noticed it also during lunches and dinners, but we didn't want to disturb the craftsmen;*

- *I noticed that something was going on, but I didn't pay much attention to details!*

The perceived effects of the intervention project

In general, the older respondents were happy with the changes of the dining room, the pub and adjacent spaces. Most of the older respondents were pleased with the interior changes in the communal space. Especially, they praised the colours and the choice of new wallpapers, even though the wallpaper in the adjacent space to the pub area generated some debate.

- *Oh, the new wallpapers in the pub area are splendid!*

- *I find it hard to like the wallpaper in this space, said two other respondents.*

- *I think it is nice, bright and clear, said another respondent.*

The respondents commented mainly on special aspects in the overall interior change like new paintings on the wall, new porcelain or the new lunch and dinner menus.

- *Well, you'll find several more paintings now than before. Some present more inspiring motifs than before. I think they have hung the original paintings here, and copies at the city hall!*

- *Oh, yes, the food, that's something new! But this change is due to several changes that are connected with new ways for the staff to prepare lunch or dinner: they set the table in a nicer way, and the food is positively different from what it used to be.*

- *Well, the meals have become much better; it is pleasant and tasty almost every day (…). Before, they had another meal deliverer. The new one is considerably better; so in my mind the change has dealt with even more than mere changes in the interior setting. It has not completely been a matter of new wallpapers – we were even involved in tasting different meals from presumptive new deliverers.*

- *Now, they also offer us two dishes, either fish or meat. Today, we could chose between poached salmon or lard-stripes, both served with stewed potatoes. Of course, a little des-sert in a glass with cream topping and something in it that is very pleasantly tasting. Cof-fee, on that of course.*

4.3   The observational perspective on the interior changes

The TESS-NH instrument offers the opportunity to transfer an observation-based and subjective assessment of the interaction between older persons, members of the staff, and the physical envi-ronment into a numerical value, but also the intra-relational dependency between these three components. The two evaluation visits resulted in 10 computable protocols, 8 from U1 and 4 from U2. Table 2 demonstrates that the instrument generated individual

assessments that were subject to personal background and previous experiences of similar space. Assessor A was con-sistently the most negative one, while assessor B appeared to be the most positive one. The me-dian scores for the two units suggested an even minor difference in rating than the overall in-strument: The median score for U1 was 88.0 points, while the corresponding one was 86.0 points. It is probable that the lesser number of computable protocols for U2 had an influence on the scor-ing, see table 2.

Table 2 Overview of highest and lowest scores along with median value and mid-values (between median and highest or lowest score) of 8 evaluators' (anonymized as A to H) scores in the full instrument concerning two key items, item 19 (homelike versus institutional appearance of the physical setting) and item 32 (overall assessment of the full unit in terms of pleasantness).

	Low score	Asse-ssor	1st quart.	Asse-ssor	Median value	Asse-ssor	3rd quart.	Asse-ssor	High score	Asse-ssor	Ave-rage
Full proto-col U1	83.50	A	87.00	C	88.00	H	93.00	F	93.50	B	89.0
Full proto-col U2	80.00	A	81.00	G	86.00	E	87.00	D	99.50	B	86.7
U1, item 19 and item 32											
Item 19	0,00	A	0.00	C	0.00	F	2.00	H	3.00	B	1.0
Item 32	4,50	A	7.50	B	8.00	H	10.00	C	10.00	F	8.0
U2, item 19 and item 32											
Item 19	0,00	A	0.00	E	0.00	G	2.00	D	2.00	B	0.8
Item 32	4,00	A	6.00	E	7.00	D	7.50	B	8.00	G	6.5

The full average score for U1 was 89.0 points, while the corresponding score for U2 was 86.0 points. This suggested that the evaluators were slightly more positive to the environment found at U1. The graphical overview of the scoring of the 32 items in the protocol demonstrated minor discrepancies between the assessments of the two units, however, not consistently more favoura-ble of U1 than of U2, see Table 3. The assessments suggested that the environment was more institutional than homelike, since the scoring of item 19 could attain as much as 3 points. This assessment is equal for both U1 and U2. In contrast, the overall assessment along a 10-graded scale of perceived pleasantness, item 32, moderated the institutional impression, since a score of 7 (U2) and 8 (U1) must be considered to be a high rating. Hence, the conclusion from the TESS-NH assessments of U1 and U2 was that these were institutional environments with some positive ambient factors. However, the ratings did not supply enough evidence for concluding that the changes in the interior setting of U1 had attributed the communal space with a better setting than the untouched unit of U2.

Table 3. A graphic rendering of the average scores for changes in the interior setting of the unit U1 and unit U2. Questions are listed in Swedish to the left, but the scores do not suggest a clear improve-ments of the care environment at the U1 (dotted line) compared to U2 (black line).
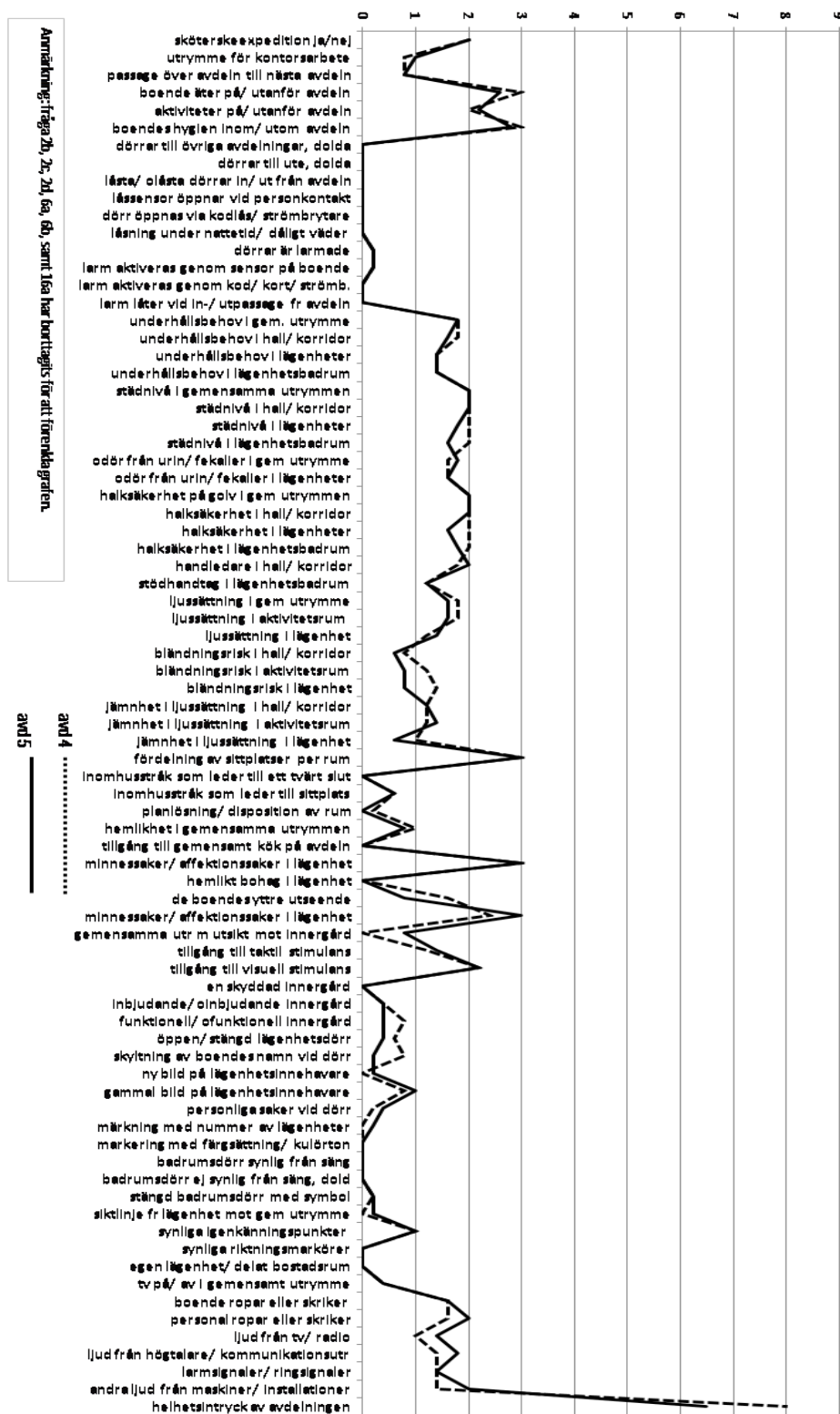
5   DISCUSSION

This study has focused on an intervention project, Space for Health, which was realized during 2012 in a particular unit at a residential care home in use, the Tallbacken RCH in Bromma, out-side Stockholm. Given the circumstance that no baseline assessment had been made prior to the intervention, the effects of interior additions or changes in some areas of the communal space were impossible to assert positively, or negatively, in a scientific way. Interviews with residents, their relatives and staff members suggested that both groups experienced a positive change with the new interior setting in comparison with the previous situation. The TESS-NH protocols sup-plied some support for claiming that this could be true, since 5 specially contracted assessors rat-ed the unit subjected to the intervention, slightly higher than the existing setting of another unit on the first floor. However, the data did not shed light on the type of environmental changes, single one or several ones, which had contributed to the positive acclaim among residents, rela-tives or staff members. It is likely that it is the full intervention, i.e. all the preparations prior to realization along with the concrete works that followed and were necessary for converting vi-sions into visible spatial changes, which has contributed to the almost euphoric feeling with which residents, relatives and staff members associate the undertaken changes. Such a reaction is consistent with other intervention projects with user involvements (Becker & Poe, 1980).

The lack of particular changes in the interior setting, which can be correlated with an increased positive sensation, is an evident limitation of this intervention project. Hence, the investment in experience-based environmental changes has not contributed to new knowledge on what type of changes in the interior setting that can be labelled as appropriate ones when rethinking other ex-isting RCHs in need of interior renovation. The study suggests that a top-down implemented in-tervention project may be liable for making members of the staff into becoming experts on knowing both the older residents' needs and the necessary environmental changes for this group of frail people. This turns interior design for older people into a shallow knowledge that never fully contemplates the complex problematics that age-related cognitive or functional disabilities may generate when using the physical environment. In the present study, this downside has been mitigated by the presence of two professional experts in interior design and interior lighting, who defined points of departure for the project. In addition, the study suggests that the inclusion of residents and their relatives was vital, since this influence stopped environmental changes that were based on an aesthetical idea rather than on knowledge on user preferences.

On a comprehensive level, the study suggests the need for a systematic approach when conceiv-ing changes in the interior setting in RCHs in use. Such a systematic approach involves organiza-tional aspects for the full project, i.e. who to appoint as project coordinator, how to document a mostly spoken exchange on aesthetics and personal preferences by minutes, how to convey the experts' intention for the environmental changes (sketches, views or full mock-ups) and how to involve residents, their relatives and members of the staff in an intervention project. In order to create a type of supportive architecture that will be active in the indoor space, the study supplies some ground for the need of harmonizing the use of space with the spatial experiences of the dif-ferent user groups.

6   CONCLUSION

The study lends support to the following preliminary conclusions on how to realize interior changes in the interior setting of a RCH in use. These are:

- Baseline assessments have to be made in order to sustain a correlation with environmental changes.
- The residents' and their relatives' use of different areas of the communal space is a source of knowledge for designing the threefold fit of activities-spatial layout-user;
- The residents' and their relatives' opinions have to be mapped prior to intervention, so that these can be integrated in the project;
- This group of people has to involved during the conceptualization and realization of the project, but also mandated to intervene if environmental changes appear as incomprehen-sible;
- Members of the staff have to be involved, so that environmental changes can be associat-ed with fundamental values for the particular type of caregiving;
- Expert involvement in the earliest phase of an intervention project will orient environ-mental changes in an overall aesthetical and pleasing design that will vouch for a subse-quent positive impact.
- Changes in the interior setting of a unit at a residential care home necessitate a systematic approach prior to realization so that these can be assessed accordingly when the full in-tervention has materialized.

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SRE-AIDAH: INTEGRATIVE WAYS OF RESIDING HEALTH AND QUALITY OF RESIDENCE.

A Concerted Trans-Disciplinary Research Effort - AIDAH '14-'18
Architectural Inventions for Dwelling, Ageing and Healthcare

Sten Gromark

Professor of Architecture, Dr; Director of Formas SRE-AIDAH
Chalmers University of Technology
sgromark@chalmers.se

Inga Malmqvist

Ass. Professor
Chalmers University of Technology
inga.malmqvist@chalmers.se

Peter Fröst

Adj. Professor
Chalmers University of Technology
peter.frost@chalmers.se

Ola Nylander

Chalmers University of Technology
nylander@chalmers.se

Helle Wijk

Ass. Professor
Gothenburg University
helle.wijk@fhs.gu.se

Marie Elf

Dalarna University
mel@du.se

Catharina Thörn

Gothenburg University
catharina.thorn@kultvet.gu.se

The original *AIDAH* environment intends to generate cross-disciplinary research and implementation projects for a sustainable built environment that confront three major challenges. (1) Increasingly diverse demands on the housing market call for flexibility and adaptability in resilient ways. (2) An ageing society requires new residential models that combine dignity and appropriate care but also provide good working environments for personnel. (3) Profound changes in technical conditions for caring and medical treatment necessitate rethinking traditional healthcare situations, developing new situations ranging from complex care in residence to intensive care units in hospital and patient hotels. Sustainability issues at stake in patterns of residential behaviour must be considered to have paramount importance in any strategy for a resilient urban future. The involved teams provide different and complementary perspectives focusing on the common notion of quality of residence considered in architectural, spatial and experiential properties of built environments for housing and healthcare contexts. The applied conceptual and theoretical framework focuses on architectural and caring innovations for reconfigured spatial situations that enhance sustainable caring, and improve health, welfare, and living quality. Our research effort will focus on identifying and characterizing strategies directed towards the integration of different ways of residing. The scientific integration in conceptual and methodological terms between architecture qualitative research, sociology of residence, and caring sciences is intended to bridge gaps and initiate cross disciplinary approaches. Objectives include identifying and articulating new resilient qualities in designs supporting care processes and healing environments, thereby providing new operational knowledge developed in close collaboration with diverse stakeholders. International exchanges will provide further strategic evidence-based design support for decision makers in planning, building and healthcare services. The cross-disciplinary teams of researchers from architectural design, social and caring sciences are based at the Centre for Healthcare Architecture and the CIB W069 Residential Studies, both hosted by Chalmers.

Keywords:

residential resilience, ways of residing, integration, quality of life, welfare, architecture humanities, projective architectural design practices, health and caring sciences, residential sociology, evidence-based design and qualitative research

Sten Gromark / Magnus Rönn / Peter Fröst / Ola Nylander / Helle Wijk / Marie Elf / Catharina Thörn

1   INTRODUCTION

This paper is intended as a presentation of a recently initiated concerted effort for a common future research approach within teams united around three interrelated research themes. This approach is building upon respective past achievements and experiences dedicated towards architectural inventions regarding the interrelated topics of dwelling, ageing and healthcare. The project has recently received support as a strong research environment from National Swedish Research Agency Formas within the general research and innovation frame of Sustainable Urban Development. It has just started and will be carried out from 2014 to 2018 even if teams have already been active formerly in their respective environments for a substantial time space. Our prime objective is to provide new operational knowledge supporting projections and ultimate realisations of new integrative ways of residing in a range of residential situations as healing environments of enhanced resilience.

The *AIDAH* research teams intend to generate cross-disciplinary and trans-disciplinary research to initiate implementation projects for a future sustainable built environment of improved health and enhanced quality of life confronting three major challenges by developing integrative ways of residing.

The diversification of demands on the housing market calls for flexibility and alterability that is adaptable to resilient ways of everyday life. An ageing society requires new ways of residing with dignity and appropriate healthcare providing also good working environments for personnel. Profound changes in technical conditions for medical treatment demands a rethinking towards new healthcare situations of advanced care in residence to intensive care in hospital and patient hotels.

The potential sustainable gains or losses at stake in these urban residential situations are crucial not only in economic and ecological terms but also for the realization of future qualities of life, of social sustainability, from an individual as well as from a societal point of view. We argue that residential conditions ultimately determine the fundamental prospects for citizens of reaching a higher quality of life at different phases in life as well as conditioning experienced qualities of urban environments on a general level.

The proposed research environment, *AIDAH*, focused on the key notion of i*ntegrative ways of residing*, makes a concerted effort to combine three established cooperating trans disciplinary research teams: 1. Emerging ways of residing focused on the general residential situation and integrative ways of living as residential resilience; 2. Architecture for an ageing society, focused on living conditions for elderly and when homes become a workplace for staff in care; 3. Healthcare architecture, with healthcare situations shifting between homes and institutions. The environment departs from the established national *Centre for Healthcare Architecture* and the CIB Commission W069 *Residential Studies*, along with the formerly active Nordic-Baltic researcher collaborative network Visurf, *Visions of residential futures*; all hosted by Chalmers. As related to these structures the intention is to establish also a similar Chalmers Centre for Residential Architecture.

The involved teams are from different perspectives all dedicated to the common notion of *quality of residence* considered in architectural, spatial and experiential properties of built environments for healthcare and housing. The common conceptual and theoretical framework is dedicated to architectural inventions for reconfigured spatial situations able to enhance sustainable health and qualities of living. Our joint research effort will particularly focus on unfolding strategies directed towards the integration of different ways of residing. The further scientific integration between architectural research and healthcare sciences intends to bridge the gap between care processes and the design of future built environments.

The programme will provide a common arena to discuss and develop enhanced frameworks for

- Common theoretical and methodological approaches for architecture problems,
- Unfolding analytical frameworks and re-conceptualizations,
- Conducting trans-disciplinary analysis on interconnections and synergies between respective fields of implementations,
- Initiating cross cultural comparisons of strategies on all actor levels,
- Exploring innovative and participatory processes and design projects in progress,
- Implementing and initiating Practice-based Research,
- Initiating and fostering processes of urban residential innovations,
- Disseminating research findings and results while teaching in Master classes studios,
- Taking active part in Master & PhD education as examiners and supervisors,
- Organising workshops, conferences and exhibitions,
- Publishing peer reviewed article and collaborative research text collection books.

2   STATE OF THE ART

The environment intends to initiate research focused on the crossing points between three interlinked societal challenges for a sustainable future related to residential situations in urban contexts.

We depart from a general perception of the societal challenge searching for appropriate market offers and solutions meeting the demands of an emerging new mosaic of diversified lifestyles within reasonable economical limits. Secondarily there is the paramount challenge of rising residential demands of quality and adequate services in response to an ageing society. In addition there is the challenge concerning how to respond to the accentuated necessity for new ways of providing advanced, relevant and resilient healthcare in residence as well as residential qualities while in a lasting or even a transient healthcare situation as healing environments. This is due to the double tendency with shortened as well as prolonged, but more care intensive, stays in hospital wards. Architectural projects for healthcare must provide relevant support for patient-focused and evidence-based care processes. Supplementing this approach we also regard as a vital issue the quality of residence from the perspective of staff involved in residential healthcare or elderly caretaking representing for these professionals a predominant working environment.

The intention is to provide relevant and operational new knowledge for architects and planners as well as for decision makers in healthcare within these interlinked fields based on the combination of scientific methodological approaches applied to residential situational contexts. These methods range in a spectrum from evidence-based design, EBD, to qualitative oriented socio-cultural constructivist interpretations of user aspirations to qualities of life. We intend to provide relevant new knowledge able to support the formulation and further implementation of policies, programmes and actions ultimately resulting in state of the art practical realizations of experienced residential and healthcare quality. Our joint efforts will provide valid contributions to the initiation of such potential innovative projects. We will initially situate these efforts towards an enriched context of visions of residential futures combined with empirical analyses of identified best projective practices already on the ground. Our main ambition is specifically to foster the discovery of valid new integrative residential solutions and the necessary paths to reach these ultimate objectives in experienced spatial and social reality.
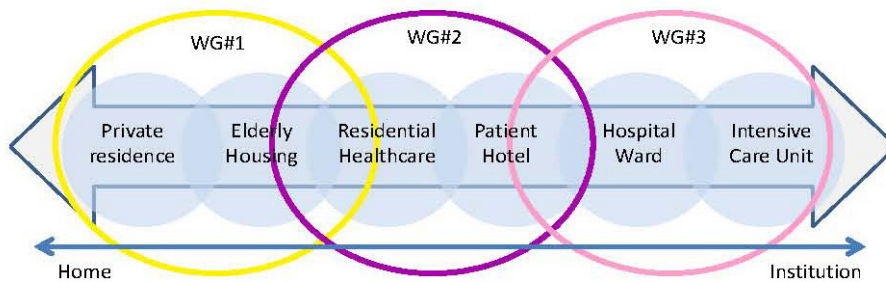
Fig 1 Integrative Ways of Residing – The Research Field as a continuum of residential typologies

Residential Situations – A Conceptual Frame

The current residential situation at large is, in many regards and according to many sources, characterised by processes of both accelerating individualisation and accentuated fragmentation of lifestyles. Our strategy is therefore primarily oriented towards residential solutions of integration. We are searching for integrative[1] ways of residing in renewed patterns of hybridisation, e.g. bringing different complementary user demands together in new synergetic urban residential contexts. A recent emblematic example is Casanova and Hernandez Architects with a typical integrative project in Groningen 2012 as a result of the Europan 6 competition. (Kort 2013) (Cf. also Ebner 2007) Recently articulated extended demands on housing encountered by providers and users alike have led to a number of experimental residential realisations at the very edge of radical invention. These are encompassing situations of healthcare, ageing and dwelling in new ways and surprising constellations of programmatic components. When these life spheres and life phases are brought together in urban residential situations, in different combinations, it becomes very clear in what way and to what extent

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1   Cf. integrative adj. 1. Of or relating to integration. 2. Tending or serving to integrate. 3. Relating to a multidisciplinary, holistic approach to medicine that combines conventional treatments with alternative therapies such as homeopathy or naturopathy. (Source: The American Heritage® Dictionary of the English Language, Fourth Edition)

they can potentially make a significant difference in sustainable terms. The virtually added value and decisive impact resulting from these integrative ambitions, in terms of resilient residential quality, becomes strikingly evident especially when supported by qualitative and innovative structural, architectural and aesthetical contributions of symbolic character. (Cf. Schittich 2007)

Impacts of changes in the residential sector at large—encompassing the spectrum from ordinary social housing to healthcare institutions and residences for the elderly—represent huge values at stake—losses or gains in social, economic or sustainable terms—for local communities and nations as well as for life opportunities of residents. Moreover, these changes and trends are to a large degree conditioning or delimiting future opportunities and everyday life prospects. The sustainable issues at stake in patterns of residential behaviour must be considered as of paramount importance in any strategy for a resilient urban future. At the same time, the importance of changing or advancing social and cultural behaviour patterns in everyday residential situations—taking care of the elderly or those temporarily or constantly in need of medical care or responding in more general terms to vague desires to materialize symbolically a specific new way of life—cannot be underestimated.

Research Environment Strategy

The research environment *AIDAH* responds to articulated societal priorities relating to qualities of life in the built environment in health residential aspects as well as in psycho-social terms. It intends to develop theories, concepts and methodologies for the articulation and deeper understanding of resilient integrative residential structures in its relation to the specifically focused challenges. It explores in particular the relations between quantitative and qualitative research methods in a variety of methodological approaches of EBD and architectural humanities research, in architectural design practice and education, and in research fields as healthcare sciences. Connecting researchers of high international standing the team is building a coordinated effort that will stimulate interdisciplinary as well as significant trans-disciplinary approaches while clarifying the singularity and contributions of architectural research within the fields of study.

A first initial step will be to bring the collaborating three working groups, WG's, further together in order to strengthen the mutual conceptual and methodological approach. In a first stage the intention is to develop and consolidate the respective profiles and identities. The second stage will focus on the main effort to bring these WG perspectives into one unified integrative research structure bridging between our efforts in scientific terms as well as in conceptual and methodological.

Project Deliverables

The deliverables will be identified as follows as our research strategy:

- Initial exchange bringing our conceptual and methodological approaches together,
- Start seminar with continued follow ups assembling key actors and stakeholders in the respective sectors to set the long term agenda autumn '14,

- Scientific articles and conference papers, active joint conference participation, about 5-9 dissertations estimated during project period 2014-18,

- Arranging conferences, workshops and seminars on specific topics bringing researchers and practitioners together (including PhD and Master students) across the three topics addressed,

- Three implementation projects will be carried out in collaboration with connected partners,

- Presence in international conferences building text collections with contributions from the three WG's,

- Exhibition presenting innovative projects, integrative ways of residing, as best projective practices in combination with Master class education innovative project explorations,

- A joint major anthology on 'Integrative Ways of Residing' with contributions from all the represented teams and members, bringing themes and projects together,

- Final international conference gathering researchers and practitioners,

- Common research project applications in international collaboration within EU H2020 and SSH or other funding schemes,

- The constitution of a reinforced and effective common research culture of excellence across the WG's united as one and becoming an active partner in relevant international collaborative research fields.

Environment Collaborative Context

The team involves primarily faculty from Architecture, supplemented by researchers from Cultural Studies, sociologist Catharina Thörn, and Care Science at Göteborg University, Helle Wijk, and Marie Elf from Högskolan Dalarna in the field of *Health, quality of life and well-being* and Svante Lifvergren, MD, Dir. CHI, Chalmers. Partnership is established with about ten public institutions, design practices and stakeholders of particular significance for the research field, also substantially co-financing the project. The *AIDAH* will host researchers on PhD, post-doc and senior level guest professors in projects with clearly defined scientific output and will offer regular seminar and workshop occasions and core activities in relation to these. Peer-review articles for international journals are considered essential as prime scientific output. Three new PhD-students have been recently recruited and are active from autumn 2014 in addition to the seven already active on different stages in the PhD process.

AIDAH has a strong trans-disciplinary profile with closely established relations to relevant stake- holders in society like providers of social services, hospital authorities and housing agencies and producers. Our Master level studios running each full year has the title *Future visions of housing, healthcare and work*. Student projects are oriented directly towards the addressed topics in experimental and innovative terms. For the team this represents a shared operational attitude towards research at the same time working on an extended inter-disciplinary basis primarily towards the healthcare sector but also towards cultural and social interpretative approaches.

3   METHODOLOGICAL APPROACHES – EBD & SOCIAL CONSTRUCTIVIST QUALITATIVE & CRITICAL INTERPRETATIONS

Researchers in the team apply a range of theories on socio-physical relationships and methodologies applied either in contemporary architectural research (Groat and Wang 2013) and qualitative research methods or within the relevant medical field of operation related to healthcare sciences and EBD, Evidence-Based Design. Our focus is in particular on the integration and crossover exchanges between these methodological and epistemological approaches.

Current research within the framework establishes the firm relation between the physical environment in healthcare architecture and nursing as well as medical outcomes for enhanced wellbeing and quality of life. New design principles has been developed, aimed at promoting healing environments that can contribute to patients' recovery, reduce infections and falls, help staff to cope better with stress and increasing patient's and relatives' involvement in the care process.[2] The present *AIDAH* team has actively contributed to and has established strong affiliations with the relevant international research context in particular represented by Guest Prof. Roger S Ulrich (Ulrich 2006; Ulrich 2012). This collaboration presents a unique position to advance research in the field on international level, fostering a critically oriented, socially engaged and responsible architectural research, linked with advanced education and projective, innovative practice. The situation calls in particular for research and education to renew its commitment towards socially responsive and reality based architectural design.

Another component is represented by qualitative interpretive perspectives and research methods. It is departing from a social constructivist epistemological approach oriented towards interpretations of experienced or projected experiential qualities applying biographical interview methods as well as visual interpretative aspects (Berger and Luckmann 1984 [1966]) (Rabinow and Sullivan 1987 [1979]; Patton 2002; Seale et al. 2004; Silverman 2011; Rose 2012; Emmison, Smith and Mayall 2013; Silverman 2013; Charmaz 2014) (Wertz et al. 2011). An important contribution to the field of research on particularly the key notion of ways of residing and to the respective current disciplinary context on residential situations is the ontological and epistemological; theoretical and methodological considerations established by affiliated Professor of Sociology Katrin Paadam based on early initial conceptualisations by sociologist Jim Kemeny (Kemeny 1992) (Paadam 2003) (Paadam and Gromark 2010; Paadam 2014) (Paadam, Gromark and Ojamäe 2011).

THREE WORKING GROUPS, WG'S

WG#1 Emerging New Ways of Residing & the Becoming of Residential Identities

The WG#1 focuses on advancing knowledge enabling explorations of new ways of actively implementing socially resilient and integrative residential solutions. While concerns about sustain- ability prevail at all levels of society and, in particular, in urban development, far

2   See for some illustrations of present discussions and projections in academia and media (Ulrich 2013; Hamilton 2014; Kimmelman 2014; Lubick 2014)

too little consideration is rendered the crucial impact of residential social relations along the changing patterns of cultural behaviour. Research will identify the nature and direction of significant changes in residential cultures through comparative case analysis focused on innovative and projective best practices. It will offer ideas and identify residential preferences on best possible housing quality for people with different socio-economic status. This will provide further knowledge on subsequent crucial implications of current trends for future quality of life opportunities among citizens and expressed demands on housing stakeholders and providers on the market. An important impact will be to indicate consistent avenues of approach and prospects for operational realizations, experiments and projective practices of various actors materializing future visions of social sustainability.

The team has been involved from the beginning in 2012 in the cross disciplinary development of the experimental residential project *Positive Footprint Housing*, brf Viva, initiated by Riksbyggen EF in Göteborg, a local and national cooperative housing provider, to be constructed at Chalmers campus around 2015/2016.[3] It has involved a related licentiate thesis project by Anna Braide and the consecutive involvement of the Master Studio *Housing Inventions* led by Ola Nylander, Anna Braide and Björn Gross. A main focused theme in this collaboration has been the notion of malleability as *alterability, adaptability* and *flexibility* as an aspect of residential long term resilience. (Schneider and Till 2007; Braide 2013) A typical example of this kind of radical innovation and projective practice on international level is represented by the Tila Apartment 'raw space' project in Helsinki 2011. (Böök 2011)

Another major theme in focus for the team is to foster innovation or invention in the residential sector—as a response to the evident *emerging new ways of residing*. There is an apparent mismatch in what the market can offer and the potential demand for a greater variety and diversity. This topic conceived as the relation between 'seriality and singularity' has been extensively addressed in a recent dissertation at Aalto University by Antti Pirinen demonstrating the domination of conventional market solutions over innovation, so often criticised by residents in the Finnish context. (Pirinen 2014) The potential loss in residential life quality resulting from this misfit could be as the author refers to as formulated in a study by Lapintie (2010) that has clearly noted the potential consequence as:

…the ultimately tragic nature of housing desires, bound to be unfulfilled amidst the inescapable realities of the housing market…' (Lapintie quoted in (Pirinen 2014: 27)

Another international research effort pointing in the same direction and corroborating this situation is French residential researcher Eleb that concludes after an extensive analysis of contemporary housing production in France, based as well on related historical and cultural residential evolution analysis that :

Confronted with all evident transformations of ways of residing, one simple notion comes up: multiply the offer, expand on diversity. Some inhabitants, even if not yet in majority, seem to be ready to adapt to residential spaces malleable in time, that are flexible and alterable, rather than in flats where all

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3   Cf.   http://www.johannebergsciencepark.com/sv/vad-vi-gor/plattformar-samverkan/projektplattform-open-arena/open-arena-urban-development/positive-

rooms are already strictly predesignated for specific purposes, something which brings forth a challenge, so often forgotten concerning responses to demands of residents' changing practices and usages. (Eleb and Simon 2013: 278)

The research team has, in international collaboration, recently very much focused on the critical interpretation of an internationally widely acknowledged refurbishment project of a social residential situation in Paris, *Tour Bois le Prêtre*, considered in the light of key conceptual concept of *symbolic transgression* and as empirical background for the discussion on *Rethinking the Social in Architecture*. The project alteration was finalised in 2012 and during 2013 the team has effectuated non-structured interviews in the building with eight residents. This material that is to be presented in forthcoming publications on the topic formulated as studies on the general subject of *The Becoming of Residential Identities*. (Gromark 2012a; Gromark and Paadam 2013b; Gromark 2013c) (Paadam 2013; Gromark et al. 2014 forthc.) A former study on the radical Fahle Maja renewal project 2006 in Tallinn has constituted the starting point in this interpretive approach. (Paadam, Gromark and Ojamäe 2011)

The main ambition of the WG is to establish a refreshed conceptual frame of reference addressing the current residential trends in order to grasp and to construct potential future innovations and strategies for action. The following objectives represent main foci:

- Identify and envision future residential innovations - within new construction, retrofitting, management and informed resident organisation,
- Develop further the theoretical and methodological basis for trans-disciplinary research,
- Strengthen increased cross cultural comparison - covering an extended geographical area,
- Create common arenas for academic research, teaching, and public and private stakeholders,
- Outline operational strategies for future practices and guidelines for urban residential policies.

The WG is led by Sten Gromark, also the coordinator of the *AIDAH* environment, with Ola Nylander, Anna Braide Eriksson PhD Cand.; Hanna Morichetto PhD Cand.; Catharina Thörn, Sociologist Dr, Cultural Studies, Göteborg University, is an external local member and Katrin Paadam, Prof. of Sociology, EE, Eli Støa Prof. of Housing, NO are the intended main affiliated international collaborators. (Paadam 2009; Nylander 2013; Gromark, Ilmonen, Paadam and Støa 2014 forthc.)

WG#1 will bring together Nordic, EU and international researchers from the CIB Commission W069 Residential Studies and the Visurf Nordic-Baltic team co-coordinated by Sten Gromark. This constellation of trans- and cross-disciplinary researcher profiles is devoted to inventions, to theoretical and historical analysis of residential social realities but also to sensual properties and basic qualities of residential architecture in a phenomenological meaning. Together with external partners this WG is to take responsibility for the general international overview of the current research and development in projective practices.

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Due to that Sten Gromark also upholds the role as vice director for the strong national strong research environment *SRE-Architecture in Effect* based in Stockholm and led by Professor Katja Grillner at KTH Architecture the team will be supported by activities devoted also to historical, theoretical and methodological issues related in particular to the relation between architecture and sociology in particular. Cf. (Gromark 2013d) He is also to be involved in a national cross-professional initiative from the Swedish Association of Architects to generate a new agenda for housing innovation for urban sustainability, initially supported by *Vinnova*; Sweden's Innovation Agency.

Swedish Residential Situation Today – Problems and Opportunities for Renewed Research Orientations

Family structures, ways of accommodation and housing provision have undergone major changes during the post-war period. The average household size has decreased sharply by an increasing proportion of ageing households without children, but also by young people living in one-person households longer periods now than before. Through changes in divorce law (1974), the traditional nuclear family with mother, father and biological children has decreased. Families with children can now be single-parent families with children and reconstituted families with children from past families. Shared custody of children of divorced parents is specifically required by children alternately living with either parent. (Boverket 2008) Increased immigration has meant that it has become more common with multigenerational families in particular during the first few years after immigration, but also by new immigrants settling with relatives already living in the country. Multigenerational families disappeared among the Swedish urban population in the context of urbanization periods from the end of 18th century onwards. (Thörnquist, Olsson and Claesson 2013)

There is a lack of knowledge on how different households actually use their homes. The population and housing censuses, as were made in 5-years intervals from 1960 until 1990, mapped the population's housing conditions and were an important basis for the planning of housing production. The surveys provided information on the composition of settlements of house types, standard, tenure and apartment sizes. This information should be linked with household demographic, social and socio-economic composition. (Nylander and Eriksson 2009)

While research and investigation activities regarding the residential situation have been dismantled, there have been major changes in the Swedish population. In 1990, when people and housing bills ceased, Sweden had 8 590 630 inhabitants. Today, the Swedish population is just over 9 million. Other differences in the period 1990 – 2009 are that the number of households increased from 3.9 million to more than 5.3 million. At the same time, the number of persons per household decreased from 2.2 to 1.7. The population has grown older while the numbers of single households have increased. Sweden has the highest number of single households in the EU. (Yearbook 2012)

In the early 1990s, the housing policy which formed the basis for housing construction from the 1940s was no longer on the foremost political agenda. With the disappearance of housing policies the financial support and subsidies for housing construction was also practically abandoned.

The non-profit housing company that so far had been the major residential providers was replaced largely by private builders. The focus was on small and medium-sized rental apartments were replaced by larger dwellings in the cooperative market segment. The former population and housing censuses were replaced by market surveys carried out by property developers such as Skanska, NCC and PEAB, JM. (Nylander 2013)

The knowledge about what has been built, and how the new housing works for the residents, during the period 1990-2009 is limited. Despite the investigations, in different forms by both public and private housing agencies, in the form of inquiries on how satisfied they are with their living accommodation, this kind of information is not available. Therefore there are so many pressing issues concerning new housing and family types that remains to be clarified. (Boverket 2011)

There are also a number of important factors behind imminent transformations. (Nylander and Eriksson 2009):

- Large cohorts of young people are now on the way out of the housing market.
- Elderly people, in many cases with no mortgage costs in their own home, are looking for new housing solutions with relevant level of healthcare services.
- Immigrant groups with difficulties to gain a foothold on the Swedish labour market.
- For the 'regular' kids family needs.
- Families where one or both of the parents are separated from other partners and individually or jointly have custody of their children. It may mean that the dwelling is alternately occupied by one person or by many people.
- For those families in which the parents together have children from previous relationships and may also have common children. Even where inhabited dwellings varied by different people. (Lind 2014)
- Through housing habit investigations new knowledge may be obtained on the current housing situation. Knowledge about how different groups in society relates to the offers available on the market.
- New knowledge is needed to inform new production of housing. Today's housing supply and floor planning design is still in many cases dependent on remnants from the guidelines and the conditions that were valid for Swedish households forty years ago.
- Most of the refugees who come here are rarely affected by market research for new construction projects in spite of their particular demands. They often take up residence in suburban areas and in many cases in one of Sweden's three metropolitan regions.
- In many neighborhoods, 90 per cent of inhabitants are 'new-Swedes'. The needs and demand among these groups is still an unexplored subject. (Nylander and Braide Eriksson 2011)

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WG#2 Residential Healthcare for Ageing

The background to this WG is the noticeable ageing societies unfolding in developed countries around the world. Valid residential solutions for care of old persons have to be developed if society in the future shall be able to handle the increasing proportions of elderly in the population. The evolving demographic situation underlines the urgent need for innovative thinking and research in housing for elderly both in assisted living services and in ordinary housing areas. Preconditions for layouts are influenced by the fact that private homes become workplaces for staff in care and healthcare.

This is a question about a resilient development creating a sustainable society in social and economic perspective. The focus on An Ageing Society was underlined in Chalmers research strategy in the Initiative-seminar *Technology & Housing for an Ageing Society* in 2008, assembling researchers from different fields in, and in collaboration with, other Chalmers departments.

The Swedish population is expected to increase from 9.3 million in 2009 to 10.9 million in 2060 and the elderly population, 65 years or older, represents a major part of this increase, both in numbers and as a part of the total population (Statistics... 2010). In Sweden approx. 94 per cent of persons over 65 years are living in ordinary housing, many with assistance from home-care (SKL 2009). For the majority of persons over 65 years that is also how they prefer to live. But along with an increasing life-span pensioners are a very diverse group. The third age is the age over 65 when you still can live an active life, while the fourth age is the age where most people become in need of help in their daily life (Agahi et al. 2005).

Most old persons live in ordinary housing, many with assistance from home-care. As a result, there is a need for research and innovations in housing areas promoting comfortable life in older age. (Äldreboende... 2008) Assisted Living (AL) qualities in design has been studied by several Swedish researchers (Paulsson 2008) while there is a lack of knowledge on ordinary housing for the elderly including the interface between buildings and urban scale.

Demographic trends places demands on health care in completely different ways than the traditional ones. Health care becomes more specialized and the intensity of technology is increasing. By this trend care in hospitals becomes more expensive, and as a result the number of days in hospital is decreasing. For the old patients there is often a gap in care chains, a situation that is now beginning to be addressed. The possibilities for home-healthcare are increasing for people of all ages, and they are able to perform many kinds of treatments, some of them in combination with the rapid development of the digital support of health care, now called E-health (Sandström 2009; Gund 2011).

The need for health care after surgery or treatments will increasingly be delivered out of the hospitals; in patient hotel, rehabilitation clinics and similar but also in private homes. With the demographic development of today, more patients will be frail and in need of longer time of care for recovery. The private home for the elderly is already, and will increasingly become, the workplace of staff in healthcare and home care. What happens to the older man's home when it becomes simultaneously workplace for others? Usually it is not only one, but several

staff persons in nursing and home care. The benefits of care within or adjacent to the homes of the people is of course obvious, including reduced medical travel, less anxiety in patients and reduce healthcare costs. However, for this combination of activities to work well, requires that both houses and neighbourhoods are designed also to care work.

Residential Healthcare

Home healthcare, or residential healthcare, concerns the increasing tendency of more healthcare activities to take place in private homes. It is increasing in two ways: First by the possibilities of today to perform qualified treatments. Even simple procedures with laparoscopic surgery (i.e. surgical operations carried out by means of telescopic instrument introduced into the body) can now be performed in private homes. Secondly the amount of care-activities is increasing. 87 % of the entire home care efforts are made to people over 85 years. This shows a great development, but the situation is not without its problems. Socialstyrelsen (National Board of Health) states in an evaluation in 2008 that home healthcare is suffering from a shortage of skilled personnel, it is divided into several principals and is also home healthcare assignments very unclear (Socialstyrelsen 2008). Care of the elderly cost about 70% of all social services costs of 126 billion SEK, already in 2001. About two thirds of the cost was for assisted living (AL) with 24 hours assistance, the form which thus contains only about 6% of the population over 65 years (Socialstyrelsen 2002). Internationally, one can roughly assume that 50% of the cost of medical care goes to people over 65 years (Taylor 2003). If you could see the cost of elderly care services in a larger perspective, it appears clear that society has much to gain from efforts for those who remain in their normal home, instead of many more older people have to move to assisted living.

The theoretical frame work for this study has two foci, namely the Design Theory and the Theory of human persons acting in an environment. As architectural research work it is based on the Design Theory as described by Donald Schön (Schön 1983). He identified the process where you reflect in action as well as over your actions. The analysis of architectural aspects in this study is taking place in the dialogue with the artefact. The other focus of this study was started in the Lawton's & Nahemow's so called *Ecological model*, where the relation between the individual the environment is fundamental (Scheidt and Norris-Baker 2004).

Aim and Research Questions

The general aim of this WG is to investigate obstacles and opportunities when care and healthcare are performed in home environments. Further research questions are: How and where can care facilities be designed to serve needs of an ageing population? How can apartments and common spaces be designed to fill the double purposes of housing and care? What kind of improvements can be done for delivering healthcare in existing housing-areas?

Projects

A new project of identifying risks for injuries in housing-environment indoor and outdoor started in May 2014. One identified risk-group is the elderly.

A planned participant-observation study accompanying staff working in home-healthcare and home care will focus not only on the elderly but also on the persons who are working in other person´s homes, personnel in home-care and in healthcare. The needs of the staff-persons in various residential health care jobs need to be investigated regarding the architecture of the apartments.

The next study aims to analyse, from a number of aspects, the empirical material of more than 60 different design-solutions of Housing for elderly, made by Master students. (Malmqvist 2012)

Expected outcome of the research projects presented in this WG is to enable better architectural programming as well as design in different kinds of building projects for the elderly; to facilitate eldercare programming, planning and implementation.

This WG team is led by Inga Malmqvist, Associate Professor PhD, together with Marie Elf and Helle Wijk Associate Professors PhD, with Morgan Andersson as affiliated member, Joel Msami and Charlotta Thodelius, PhD students.

Residential healthcare is a new research area concerned with a situation where more of healthcare activities take place in private homes (Malmqvist 2009). This is an increasing tendency connected to the demographic development. The WG develops the specific profile of residential healthcare analysed from an architectural standpoint. This research has dual perspectives in two dimensions: Dual User-perspectives in creating good every-day space for elderly in normal housing and at the same time good working conditions for care-staff; Dual Building-perspectives where we have to add new qualities in new buildings, while in existing buildings we often need to find simple solutions.

WG#3 Healthcare Architecture

The WG#3 will in a critical manner address the following questions:

> 1. What constitutes internationally the current domain of research evidence for the relation between architecture and different qualitative and clinical outcomes in healthcare?
>
> 2. Which parts of the domain are relevant to a Swedish context?
>
> 3. What impact has healthcare architecture on integrated care, quality of care, person centred care, adverse events and length of stay, from a patient, next-of-kin and staff perspective?
>
> 4. How do we sustain the development of new and more efficient care processes with supporting healthcare architecture?
>
> 5. How do we implement research knowledge together with other forms of knowledge in a specific situation (evidence-based design) in healthcare buildings (hospital wards)?

Sweden is today entering a period of major investment in new healthcare facilities with up to 15 billion SEK annually in the coming years (National Council of Property Managers within SKL). This is due to two different trends. Firstly, Swedish health care system is currently undergoing rapid and dramatic changes. Advanced technological and specialized medical interventions are concentrated to a limited number of large size university hospitals. Community health care matters are increasingly dealt with in smaller local hospitals and health care centres often on an out-patient basis. Secondly, in Sweden, a great proportion of the existing hospital building stock is out-dated and difficult to adapt to these new demands. Due to these tendencies, regulators, providers and commissioners in healthcare are forced to put high pressure on the quality of healthcare delivery. Healthcare architecture is today recognised as an important factor in reaching these goals (National Council of Property Managers within SKL). This wave of construction provides a great opportunity to create better buildings by using the growing research knowledge available.

The hospital ward, with its specific problems, raises high demands on research informed architectural design and makes its physical environment particularly important. The hospital ward/beds are in focus in many of these change processes. Since the 1980s many countries in Western Europe have tried to reduce their hospital capacity and to shift care to alternative settings. As hospital stays have become shorter and more intense, remaining inpatients tend to be more seriously ill, requiring more intensive care and high-dependency beds. These changes have resulted in a decrease in the number of acute hospital beds and a decreasing average length of stay. Sweden has consequently developed from having one of the highest numbers of hospital beds/100 000 inhabitants to one of the lowest. Today, the single patient room is becoming standard in new and refurbished facilities. This also puts new demands on staffing and organisation of healthcare as well as the design of the hospital ward and its support areas. Many more patients are passing through hospitals in much shorter periods of time. With the growth of chronic disease and many frail elderly people to be managed outside hospitals rather than in long-term hospital care, an increasing number of these admissions are patients who have many repeated admissions during the course of the year (EuHPN).

Research on future healthcare organisation identifies several new care logics that must be taken into account. (Christensen, Grossman and Hwang 2009) Solution workshops are designed to gather many experts around patients with complicated clinical problems; the experts draw on their shared competences and analysing abilities to—in a one-stop care design—diagnose the cause and propose a treatment plan. An entirely different logic is the value-adding process model, where the capacity to deliver care is embedded in iterative, controlled processes managing high volume, well defined medical disorders, e.g. hernia repair, angioplasty, cataract surgery to mention a few. Finally, the facilitated network logic models the care of chronic illness. The care of chronic illnesses relies heavily on modifications in patient behaviour. Thus, the intention of the model is to create learning networks among patients with similar diseases to facilitate learning and communication and ultimately, changed patient behaviour. However, the outcome of the different models is dependent on the design of the clinical microsystem—the most vital functional unit in the care system (Nelson et al. 2002). All this is crucial for de- signing the future hospital ward, whether for short or long time stays.

Sten Gromark / Magnus Rönn / Peter Fröst / Ola Nylander / Helle Wijk / Marie Elf / Catharina Thörn

The aim of the WG#3 is to:

> 1. Map and critically investigate the emerging field of international research concerning the relation between the physical environment and different health outcomes.
>
> 2. Research and develop a sustainable EBD process that can be used for healthcare facility organisations in its emerging investment wave. This has to take into account evidence on the relation between architecture and clinical outcome as well as new care processes and new ways of performing the planning and design process.
>
> 3. Establish an arena for collaboration and implementation with different stakeholders involved in the design of new healthcare architecture.

The theoretical approach for evidence-based design, EBD, will initially relate to the conceptual framework intended to capture the current domain of EBD in healthcare that is presented and discussed by Ulrich et al (Ulrich et al. 2010). In this framework, the built environment is represented by nine design variable categories. Furthermore, a series of matrices is presented that indicates knowledge gaps concerning the relationship between specific healthcare facility design variables. In EBD the focus has until now much been on the strength of the evidence, not so much on how research based knowledge can be implemented into the design process. Research findings have been translated into architectural recommendations and guidelines to improve the environment and subsequently be applied in to future constructions and rebuilding. This is not flexible enough in a time when healthcare is in such a rapid development. In Sweden, with its democratic and collaborative tradition in healthcare planning, new forms of interaction in multi professional design processes where customers, suppliers, users and experts are collaboratively active are needed. Innovation has to be supported in the front end of new projects. Therefore, there is also a great need for developing a more dynamic "evidence based design" planning process for healthcare architecture in Sweden. Theory and methods for implementation of EBD will be based on modern design theory and the science of design and is partly grounded in the Scandinavian tradition of participatory design (Fröst 2004), which places great emphasis on actively engaging multi-disciplinary teams of professionals in the design process.

4   EXPECTED RESULTS; DISCUSSION & CONCLUSION

As the *AIDAH* research environment, as presented in this paper, has just started its activities we can so far only point to results achieved in the former independent component teams as a valid platform and starting point for future expected achievements. But as a typical, desired and very recent result due to a doctoral thesis produced in the environment (Andersson 2013) a collaboration on national level has now started between the City of Gothenburg and researchers concerning the design and organization of Assisted Living for the elderly aiming for a new innovation frame programme.

This new cross over collaboration presents a unique opportunity to advance research in the field on international level, fostering a critically oriented, socially engaged and responsible humanist architectural research, intimately and actively related to education and practice as well as outreach activities. The situation of acknowledged urgent challenges ahead calls in particular for trans-disciplinary research and education in close cooperation with practice to renew its commitment towards a socially responsive and reality as well as evidence based explorative architectural design. We hope to contribute with this initiated programme to the constitution of a reinforced and effective common research culture across the three teams united as one and becoming an active partner in relevant international collaborative research fields.

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NEIGHBOURHOODS PROMOTING INDEPENDENT COPING - CASE STUDY

Ira Verma

architect, PhD student
Sotera-institute, Department of Architecture, Aalto University
ira.verma@aalto.fi

ABSTRACT

The changes in population structure are affecting urban planning in the local scale. It is important to find new ways to better integrate the aging population into the society. The living environments have to support more frail persons than earlier living in their own homes. At the same time social and health care structure is undergoing changes to meet the needs of the population. The share of home care is increasing and institutional care is targeted only for elderly persons in medical need. The solutions against feeling of insecurity and loneliness need to be implemented in the daily environment of elderly. The social environment and inclusion are as important as the physical environment for the wellbeing. Therefore, not only health services but all local services have to be easily reachable to support the frail residents. Accessible nearby services as well as perceived neighborhood quality are important environmental factors promoting independent coping and quality of life of elderly persons.

The aim of this multidisciplinary user study was to assess and promote an accessible network of private, public and third sector services in Lauttasaari area, Helsinki, Finland. The elderly have to be involved in the process of assessing and planning local environment. Therefore, user driven study methods, resident panel and walkthrough method, as well as an online questionnaire were applied to collect user experience of the quality of local environment and paths to services and to outdoor green areas. The study was done in collaboration with City of Helsinki. This sub research on physical environment focuses on assessment of accessibility and reachability of housing and services in the neighborhood from the point of view of growing elderly population.

To promote aging in place the communities would need to do neighborhood adaptations. Planning of housing, shopping, leisure services as well as public transportation may require modifications to meet the needs of the elderly. Accessible dwellings and services as well as stimulating public or semi-public spaces in the neighborhood enhance possibilities for social contacts and integration. Cross-sectoral collaboration inside municipal services including health and social services has to be developed. Furthermore, collaboration between public, private and third sector service providers enables tailor-made services for elderly consumers.

KEYWORDS

elderly, housing, neighbourhoods, service

1   INTRODUCTION

The impact of demographic change is a future challenge in all European countries. In Finland the demographic dependency ratio, (proportion of persons aged 0 -15 and 65 or over per 100 working age persons) was 54.3 in the end of year 2012 and according to population projections the limit of 70 dependents would be reached by 2028 (SVT 2012). This development will cut back the tax revenues of the municipalities, who are the main providers of health and social care services in Finland. The human and economic resources of municipalities are expected to diminish in the future. Therefore, the ability to take care of one self for as long as possible has become increasingly important. Reducing risks for premature loss of functional capacities and isolation of older people is essential for independent coping. Furthermore, the concept of intergenerational equity is a fundamental factor of urban sustainability. The active participation and inclusion of elderly persons is important both for the economy and for the quality of life.

Physical features of socially sustainable urban structure include among other things accessibility, walkability and local environmental quality. The characteristics of neighbourhood can encourage elderly people to maintain their functioning capacities. The built environment has an impact on the safety and mobility of elderly people. The living environment, apartment and immediate surroundings as well as local services have to support more frail persons than earlier living in their own homes independently.

The person-environment relation changes over the life span. The adaptation process may lead to home modifications or moving to a more suitable apartment. Home modifications and accessible dwellings are means to enable elderly persons to live independently. The home can become a prison, however, if the resident is not able to go out. Accessible nearby services as well as perceived neighbourhood quality are important environmental factors promoting independent coping and quality of life of elderly persons. The whole path from home to daily services has to be considered. All local services have to be easily reachable to support frail residents. It is important to find ways by urban planning to better integrate elderly population into the society. The built environments that promote social inclusion enhance the wellbeing of elderly.

2   AIM OF THE STUDY

Most elderly will live independently in their own homes. According to previous studies independence, inclusion and self-determination are main things that worry people about aging (Bowling 2005). Ability to perform daily tasks in the neighbourhood enhances the physical and social wellbeing of the elderly people. However, the current economic development challenges the municipal organization of elderly care. In Finland, the elderly care provided by municipalities has been for long based on institutional care in care homes and sheltered homes. Due to decreasing resources and new policies, the institutional care is targeted in the future only for elderly persons in medical need. People will live in their own home independently or with home care as long as possible. People are encouraged to self-care and to prepare for their old age. In a recent study the demand for informal care provided by

relatives is predicted to increase by over 50% between 2007 and 2032, while the supply of carers is growing only by 20% (Independent Age, 2030 Vision) It is important to strengthen the community relationships and recognise the dangers of isolation and loneliness of elderly people. At the local scale, weak social ties can be important, particularly in providing a variety of social opportunities. Furthermore, the weak social ties appear to be sensitive to environmental variables such as semiprivate space, spaciousness and structured open space. (Skjaeveland et al., 1997).

The supply of housing solutions suitable for elderly persons as well as access to daily services and recreational areas are important for self-maintenance and independent coping of elderly. The access to services has to be considered in relation to the needs and characteristics of the population residing in the neighbourhood (Talen 2000). To meet the needs of elderly, the commercial services, green areas as well as health and cultural services have to be accessible by foot or by public transport. Increased possibilities for mobility may help elderly persons live independently in their own homes for longer (Metz, 2000). According to Dempsey, N. & al. (2009) residents' willingness to stay or to relocate can be related to the accessibility to services and facilities as well as the perceived quality and maintenance of the built environment. The walking is the main physical exercise of elderly that help to maintain the functional capacities. According to Wang ad Lee (2010) more there are destination in the walking distance and shorter paths from home, more people walk. So called third places like bus stops and benches in the park can be meaningful places for social interaction for residents (Rosenbaum 2006).

The municipality is developing new strategies for care at home. It is in their interest to connect local private service providers and third sector to meet the challenge together. This can increase the service offering locally and create new opportunities for the service providers. The active participation of citizens is encouraged to develop municipal services. Furthermore, municipality has to publicize for example planning information in the internet, in newspapers and in planning reviews. Those who are concerned can follow and influence the planning. The current participation tools are not accessible to all resident groups, however. The point of view of a person who is retired from work is not often heard, not involved in the formal planning and decision making process. However, the participation of elderly in the process of assessing and planning local environment is important as they represent soon over 25 per cent of the population (population projections in Finland predict 25.6 per cent of persons over 65 in 2030). The aim of this study was to assess the strengths and weaknesses in a chosen neighbourhood together with elderly persons living locally.

3   METHODS

This case study was based on both quantitative methods and qualitative user driven research methods. The living environment was analysed through planning documents, observation and a questionnaire on user experiences. The spatial analyses were conducted to assess the accessibility of the local public services (such as health care centre and library), recreational areas (such as parks and seaside) and the city centre of Helsinki. Open access geo referenced topographic maps were analysed, including urban functions, typologies of buildings, number

of floors and infrastructures (PaITuli[1]). The information on services and their locations was analysed using the Service Map provided by the City of Helsinki[2]. The open data on public transportation, route (Journey planner[3]) and travelling time (Matka-aikakartta[4]) are provided by the Helsinki Region Transport. Furthermore, in order to analyse the accessibility of the apartment blocks, the building register data about all buildings with or without lifts was collected (Statistics, City of Helsinki building (construction) register 6/2012).

The pilot study area was decided together with Helsinki City Services. The neighbourhood of total population of 20 000 inhabitants is situated in south-west of Helsinki. It was chosen because of relatively high percentage of residents over 65 (18.6 %) which is slightly higher than in average in Helsinki (16%) (Statistical Yearbook of Helsinki 2014). Furthermore, the number of people living alone and their socio-economic status of residents living in the area are high. The local residents were participating in the study through an online questionnaire, workshops and pre-designed walking tours. The participants, inhabitants over 65 years, were recruited through local newsletter (paper and internet) and flyers in local services. The satisfaction of residents regarding to access to the local facilities and green areas was discussed in workshops. Three workshops were organized, first one in the local library, second in a private service centre for elderly and third in the Town hall of Helsinki City. The discussions at workshops were recorded and transcribed for further analyses. The researchers were participating and observing two walking tours organized by the local association for elderly at the recreational areas. One walking tour was organized by the researcher to the daily services. The walking paths and walking speed were recorded with a mobile application.

The theme of the first workshop was the experienced quality of the living environment. Participants were persons over 65 living independently in the neighbourhood. A large amount of photos of the neighbourhood were used to discuss about the most appealing and unpleasant places in the neighbourhood. The daily paths from home to services were described by the participants and marked on a map. Second workshop was focused on local service provision and new collective housing models for elderly. The theme was introduced through an architectural master thesis on multigenerational apartment building[5] which was done part of the study. Participants in the second workshop were elderly persons living independently in their own home or in a senior home situated in the area. Third workshop was organized in the aim to gather public, private and third sector service providers to meet the elderly living in Lauttasaari. A board game that was developed in the project in collaboration with researcher on service design[6] was used in workshop to process the results of the study.

The online questionnaire was used to gather user experience on the living environment as well as on the use and accessibility of services.

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1   http://datakeskus.csc.fi/en/web/research/paltuli-spatial-data-service
2   http://www.hel.fi/palvelukartta/Default.aspx?language=en&city=91
3   http://www.reittiopas.fi/en/
4   http://mak.hsl.fi/
5   Nenonen, Laura
6   Hyvärinen, Jaana

4   RESULTS

More than 80 persons over 65 living in Lauttasaari were participating in this study. Total of 64 persons responded to our questionnaire, ten persons were participating in each of the two resident workshops and 32 persons were participating in the workshop at the Town hall. Some persons were participating both in the questionnaire and the workshops. The respondents to the questionnaire were between 64 and 95 years old. They were all living independently in their own apartment. Two of the respondents were careers of their spouse. Seven of respondents self-reported using walking aid (rollator or walking stick), 10 having hearing disability (6 were using hearing aid) and 11 problems with vision. Two respondents self-reported memory disorder.

Table 1 The respondents to the questionnaire (N=64).

	All respondents (N=64)	male	female
Mean age	73 years (between 64 -95)		
Gender		19%	81%
Living status			
• living independently alone	58 %	25%	65%
• living independently with spouse	40%	67%	35%
• other housing arrangement		8%	-

4.1   Housing

Lauttasaari is an urban area developed since the 1940's and 1950's. It is highly considered living area due to the maritime urban townscape and direct connections to city center. However, the population and the building stock are aging simultaneously. All persons who responded to our questionnaire were over 65 and had been living in the Lauttasaari area approximately for 27.5 years and in their current apartment for 16.8 years. The respondent over 85 had been living respectively 36 years in Lauttasaari and 33 years in their current apartment. According to OH (2003) length of residence has a direct and positive effect on residential satisfaction. Furthermore, the elderly who are strongly attached to their neighborhoods express a high level of residential satisfaction (OH, J. 2003). The persons participating in this study all wanted to grow old and stay in Lauttasaari. Many persons over 65 live, however, lived in the center of Lauttasaari in the old apartment houses that lack lifts and have problems in accessibility (see fig 1). Some retrofitted lifts have been built in the old houses, but most apartment houses also have steps at the entrance. The main accessibility problems in apartments built in that period are narrow doorways and small bathrooms (Verma & al. 2012).

There is a new housing and commercial development area in the south of the island where the former industrial area aside for housing. Most participants in our study who were living in these new accessible apartment houses had moved there from other parts of Helsinki. There are many elderly living in Lauttasaari who can't afford to change for a more suitable

home even if it is available due to high housing and real estate prices in the neighborhood. Furthermore, the persons who have been living in Lauttasaari for decades did not consider the new development area in the south belonging to their own neighborhood. According to Manzo, L. & Perkins, D. (2006) development projects can be perceived by some residents as a threat and raise concern because of the changes in the familiar neighborhood. The elderly residents criticized the new housing area to be too dense and not esthetically high level. Those how had visited the new apartments did agree they were more functional and accessible, however.

According to our questionnaire, the main qualities people over 65 appreciate in their apartment house were the views outside (81%) and balcony (70%) as well as distance to the sea (73%) and the services (56%). However, the order of precedence changes for people over 85. Because of long walking distance, the sea becomes inaccessible to some respondent over 85 and therefore is slightly less significant (60%) in their daily life. Therefore, the yard also becomes more important for persons over 85 (70%) than for all respondents over 65 (53%). When daily radius gets smaller due to loss of functioning capacities the places for outdoor activities and social interaction should be found in the immediate surroundings. The sheltered resting places and benches are missing in many urban yards.

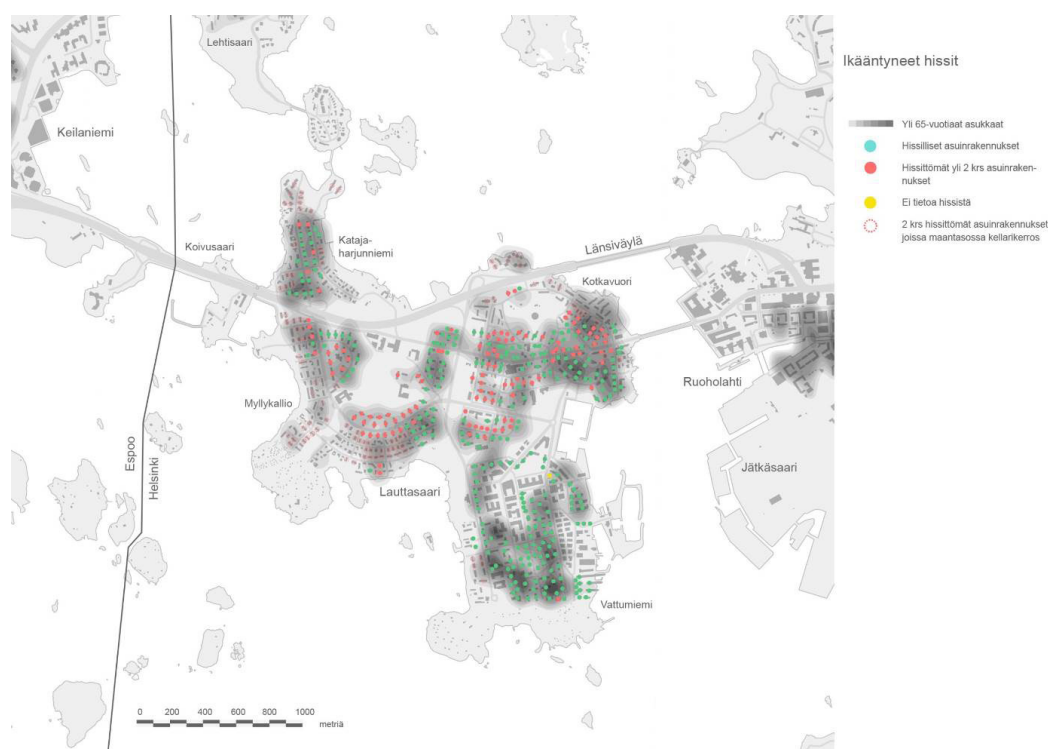Figure 1 Concentration of population over 65 (grey) and apartment houses with lifts (green) and without lifts (red)

4.2   Services

The main shopping areas in the area are situated along the main street in old part of Lauttasaari and in a new commercial area in the south of the island. The access to the groceries and small retail shops on the main street is challenging due to the topography of the island. Most elderly

use public transportation to access these shops or at least to return home with the heavy bags. The entrances to the retail shops are narrow and have steps. The narrow pavements witch pedestrians share with bicycles are also a cause of concern to persons walking slowly with a walking aid. The questionnaire to the retail shops reveals that also the shop keepers regard the access by public transportation the main advantage of the location of their premises. The discussion in the workshops reveals that even though the elderly want to promote the small retail shops in the old part of the island they do most of their shopping in the accessible premises in the south of the island. The retail shops in the old part are used occasionally for specific services (hairdresser, Wine store etc.). As 90% of the respondents are going alone for groceries, even at a very old age, safe walking paths and resting places become important for feeling of security.
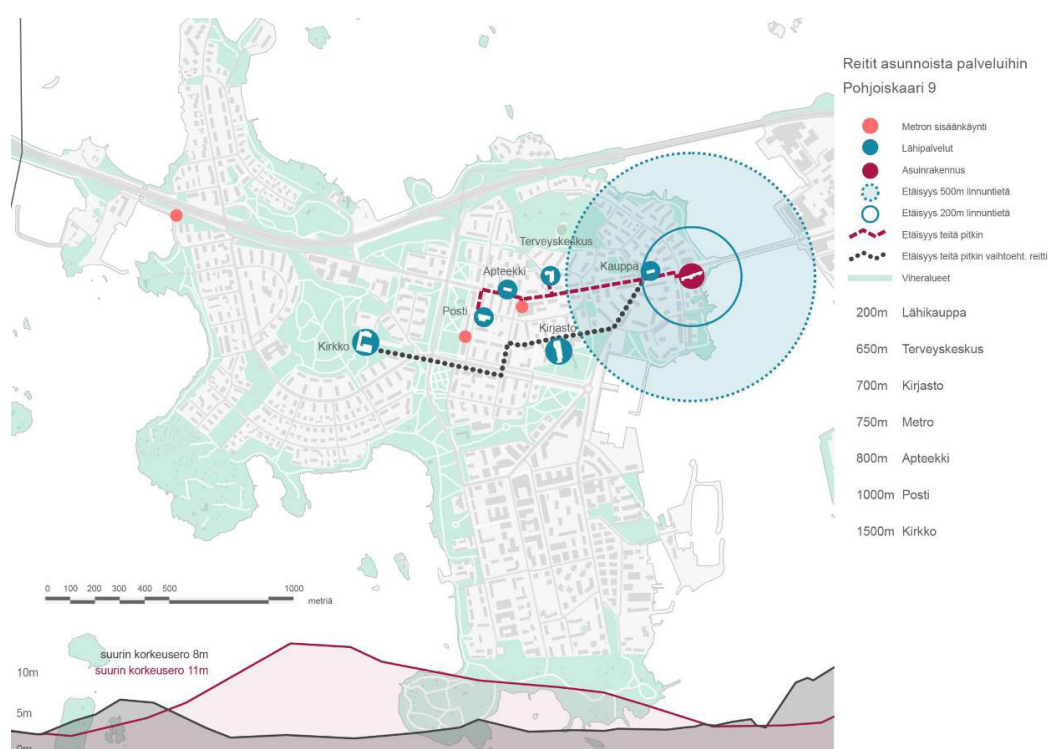
Figure 2 Paths and distances to the daily services by foot (200 m radius in green). The maximum difference of level along the path is 11 m.

According to our study, the persons over 65 choose to use the commercial area in the south because it is easily accessible by foot or by public transportation. The premises are also built according to new building regulations that take the accessibility issues into consideration. The results of our questionnaire confirm results from previous studies that local services that are important for the residents include groceries shop, public transport stop, pharmacy and health care center. Somewhat surprisingly the proximity of a hair dresser was important for 80% of the respondents over 85, whereas the public transport stop or health center for 70% of theme. The result might be partly explained by the social and personal aspect of the service. However, the result would need further study to be confirmed.

Other services, like the local health center as well as the parish is both situated on a hill top. The premises are used for many activities for elderly but are not easily accessible. The slope is too deep for people with mobility impairment and there is no direct bus from all parts of the island. The local library is used by the elderly. It is situated near a park, easy to access by foot but relatively far from the nearest bus stop.

4.3   Mobility

Wang and Lee (2010) found that the presence of many neighborhood walking destinations is positively related to both the frequency and duration of walking. Results of previous studies suggest that elderly persons perceive some environmental features like steps and hills to be more challenging to mobility than other persons. Svensson (2009) found that for the mobility impaired, sensitivity towards long distances and steep slopes seems to be more restricting to accessibility than specific details in the physical environment. The results of our study indicate, however, that characteristics of the walking surface and uneven footpaths are a cause of insecurity and fear of falling. The main self-reported hindrance for walking outside was the fear of falling (50%) and sensation of pain (36%) when walking. Shumway-Cook & al. (2003) found that elderly with disabilities are more likely to avoid features within an environment that posed a challenge to mobility. This inclination to avoid environmental challenges can lead to reduce the mobility and to further deterioration in physical status and social interactions (Shumway-Cook & al. 2003). Furthermore, Proffitt (2006) suggests that hills appear steeper when people are tired or in poor physical condition or elderly in declining health than to people who are in better condition. The lack of benches (25%) was reported as an obstacle for walking. The residents found difficulties to move on narrow pavements with cross-fall, especially when slippery. The winter maintenance of pavements, pedestrian crossings and buss-stops is significant for mobility of the elderly.

Figure 3 Narrow pavements with cross-fall and entrance steps are felt unsafe.

Figure 4 Winter conditions are challenging for the mobility of elderly persons.

According to our study the elderly persons tend to choose, if possible, quiet and pleasant walking paths through parks and narrow lanes rather than busy streets with heavy traffic. According to Svensson (2009) residential areas, where pedestrian and car traffic is separated provide the most favorable environment for those with mobility impairments. Furthermore,

the participants in the workshops reported that parks to be important for their daily paths. They were found safe and accessible. The maintenance was important, however, especially in the winter. The elderly considered walking in the park easier than on narrow pavement with piled snow. According to previous studies good access to attractive and large public open spaces is associated with higher levels of walking (Giles-Corti &al 2005).

The researcher participated in two walking tours at the seashore organized by the local association for seniors. According to Harris-Kojetin & al. (2005) social environments and the availability of informal social support such as resident groups and walking groups, may provide a supportive environment for walking. The participants were in good physical condition and the walks were two and two and a half kilometer long. Both walks were organized at summer time in good weather. The walking speed for longer walk, with 11 participants, was approximately 3 km/h and for shorter a little slower, 4 km/h (5 participants) in average. The walking speed was influenced by the temperature (colder in the shorter walk) as well as the lively conversation and contemplation of the views at the sea. However, in-depth analyses show that uneven walking surface and even gentle slopes affected the walking speed. During the observation on the walks we noticed that the accessibility, the auditory and visual quality of the environment as well as the temperature and wind were detected. The social aspect seemed to be as important as the physical aspect of the walk, as the seniors participating on the walk knew each other and the walk ended in a coffee shop at the beach.

In Lauttasaari, 90 % of all the respondents reported the use of public transportation. However, only 50% of respondents over 85 reported the use of public transportation. The participants complained that the bus service plan has been designed for young and healthy persons and there is no direct bus service to places that are meaningful for elderly. In our study the access by bus to the nearest elderly center was assessed by travel time maps. The analyses show that the projected changes in transport services in the near future will be unfavorable to elderly living in Lauttasaari. The opening of the new metro line will reduce direct connections to the city center and the elderly center and most resident would need to change from one vehicle to another. This will affect the accessibility as well as the travel time (see fig 4). The public transportation connections are vital for mobility of elderly.

Figure 5 Travel time estimations to the nearest elderly centre (in blue).
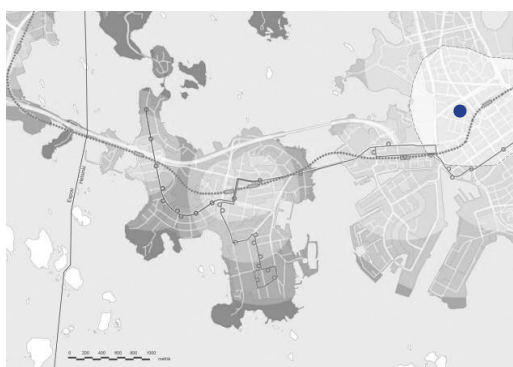
Figure 6 Estimated travel times after projected changes in public transportation.

From lightest grey color 0 to 9 min, to darkest grey color 40 to 49 min.

5   DISCUSSION

To promote aging in place the planning of housing and services as well as public transportation may require modifications to meet the needs of the elderly. Accessible dwellings and services enhance also possibilities for social contacts and integration. Therefore, the densification of existing housing areas has to be sensitive to local population structure. New affordable housing development projects should be targeted to areas with old building stock and high density of elderly population. This would allow elderly to find a more suitable apartment in the local environment and also attract younger generations in the area. Mixed land use and multigenerational population structure will help to maintain the local services. The familiar environment enhances the feeling of safety and help to maintain the social connections, which can become important for elderly living alone.

Special attention has to put in the integral planning of housing, local service structure (public and private) and public transportation. New means of connecting people and the services they require are needed. This brings out need for close collaboration within the city services as well as collaboration with other stakeholders acting locally. The mobility is vital for maintaining functional and social capacities of the older population. As Talen (2003) phrases, the priority has to be given to increase access between humans and the services they require.

Therefore, access to services and recreational areas has to be considered also from the point of view elderly residents. That means assessing the reachability of services by foot and by public transportation. The qualitative data about accessibility is not available; therefore more user study methods are needed.

6   CONCLUSION

The population structure is going to change and the number of people of working age is to decrease. In Finland in 2030 over one fourth of the population will be over 65. People want to live independent life and demand to be included in the society. Many of these persons will be providers of help to older friends and relatives. To support the mobility of the elderly and to manage the daily life at home as long as possible new planning strategies have to be adapted. The local scale becomes important and we need to increase the understanding and knowledge of elderly people's needs through empirical analysis, workshops and semi-structured interviews. The participation of the elderly in the local planning process might help to make better decisions and plan successfully for elderly people. The planning in neighbourhood scale

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TOOLS FOR HEALTH CARE PLANNING AND CARE

A COGNITIVE GYM FOR SENIORS

Christina Lassfolk

Health Factory/Department of Electrical Engineering and Automation, Aalto University
christina.lassfolk@aalto.fi

Matti Linnavuo

Health Factory/Department of Electrical Engineering and Automation, Aalto University
matti.linnavuo@aalto.fi

Sanna Talvitie

ORTON Foundation / ORTON Rehabilitation Ltd
sanna.talvitie@orton.fi

Marja Hietanen

Department of Neurology, Helsinki University Central Hospital
marja.hietanen@hus.fi

Raimo Sepponen

Health Factory/Department of Electrical Engineering and Automation, Aalto University
raimo.sepponen@aalto.fi

ABSTRACT

Purpose This paper presents features of an environment for combined cognitive and light motor training for seniors. It aims at identifying factors that potentially influence the architecture of a cognitive gym for seniors.

State of the Art Demographic forecasts predict increased longevity. However, this does not automatically ensure a good quality of life. This paper surveys factors influencing senior exercising. Hence, we review reports describing cognitive training interventions, relationship between aerobic fitness and cognitive performance, motivation, virtual realities, exergames, interaction with technology, and gerontechnology. Learning occurs at all stages of life, and appropriately supported it results in a good quality of life.

Approach Based on our own experience from constructing a stroke rehabilitation environment as well as on data reported by previous research we list features that we believe necessitate attention when planning a cognitive training facility for seniors.

Results The present report highlights four categories of issues: the tasks, the equipment, the room, and general considerations. Each feature represents a different view on the thematics.

Discussion We hope the presented list of features serves as an opener for a fruitful dialogue with experts in the area of architecture and construction. The advantages are overwhelming: to offer seniors the opportunity to affect and improve their quality of life and for society to potentially spend less on health-care costs.

Keywords

Training environment, cognitive training, cognitive gym, seniors.

1   INTRODUCTION

Demographic forecasts suggest that in 2050 the world population will for the first time consist of more people over the age of 65 than under the age of 15. Of the total population 4.2% will be over 80 years old. In Europe the support ratio will decrease to two persons in the working age to one in pension. At the same time the traditional family support system for the elderly breaks down. Generally, disabilities accompany the 8-11 last years of life. These challenges demand actions to improve the quality of life (QOL) and independence of the elderly and to decrease health costs. Measures to promote healthy aging should include: a safe environment, a healthy lifestyle, exercise, non-smoking, no drug or alcohol abuse, social interaction, prevention of frailty and disability, medical healthcare and control of chronic illness. (Lunenfeld, 2008)

In a concurrent publication (Lassfolk et al., 2015) we conduct a minireview of rehabilitation approaches mainly in the area of cognitive stroke rehabilitation. The proposition to reuse rehabilitation tasks on healthy seniors to preserve their skills spurred us to perform that study. In the present paper we summarise those findings and elaborate further on the ideas especially into emerging architectural requirements. We expand the literature review in order to better understand factors influencing the motivation of seniors as well as ergonomic and design requirements for seniors. Based on the accumulated information we consider what implications this could have on the architectural planning of the site. We strive to describe a generic training environment so as to enable a fruitful dialog with architects and health-care facility planners. This article aims at identifying factors that potentially influence the architecture of a cognitive gym for seniors.

2   STATE OF THE ART

This chapter reviews related research and sets the scene for topics relevant to the planning of a cognitive training environment for seniors. We look into the areas of cognitive training, aerobic fitness, motivation and quality of life, virtual reality, exergames, interaction with technology, and gerontechnology.

2.1   Cognitive training

Defining the most advantageous cognitive training for seniors requires consideration. To this end retention of everyday life activities stays at the centre. These consist of a variety of small practical tasks that need different kinds of cognitive skills such as memory, attention, or reasoning. Generally, the so called executive functions, such as planning, scheduling, inhibition, and working memory, constitute the ones which decline with increasing age and which give a sign of functional decline. Estimating how well an intervention transfers to practical abilities poses challenges. Further, skills such as functioning senses and motor skills also matter in the mastery of the everyday tasks.

Willis et al. (2006) report the findings of a five-year follow-up study on the long-term effects of cognitive training on everyday functional outcomes in elderly. Their study consisted of three types of cognitive practices: reasoning, memory, and speed training. Of these only the

reasoning training showed a significant result in the everyday functionality reported by the participants. However, all practices showed direct improvement effects in the specific area they targeted, i.e., memory training improved the memory function, but it did not transfer to the perceived everyday functionality. In the reported experiment the evidence of transfer came quite late only after five years. (Willis et al., 2006)

Roenker et al. (2003) investigate ways of improving the driving performance of older adults so that these can maintain their mobility and avoid crashes. They experimented with a pure cognitive speed-of-processing training and driving simulator training. The participants did not believe that the speed-of-processing training would have any effect on their driving performance. The so called useful field of view reliably measures crashing proneness. This field of view can be expanded by training. The simulator training improved the skills practiced, but these skills did not generalize and they seemed to disappear after 1.5 years. However, the speed-of-processing training resulted in fewer dangerous manoeuvres and faster reaction times. This may be due to faster attention switching. This improvement also seemed to be quite persistent. A regular booster practice could be effective for skills that tend to disappear. Elderly people make decisions slower in traffic situations, which may cause their higher risk of crashing. This experiment suggests that the speed-of-processing training improved their decision making and thus decreased their crashing risk. The experiment dealt with driving, but other everyday activities such as walking could also improve with the same type of intervention. (Roenker et al., 2003)

Fernández-Prado et al. (2012) examine the effect of cognitive training on the QOL perceived by elderly. QOL attributes divided into four categories: health, social integration, functional abilities, and activities and entertainment. Of these health and social integration correlated with the cognitive improvement and perceived QOL found. The authors conclude that their study shows that cognitive stimulation improves the general cognitive capacity of elderly people. (Fernández-Prado et al., 2012)

2.2   Aerobic fitness

Cardiovascular fitness presumably preserves brain fitness. Current research focuses on which parts of the brain and which functions can benefit from aerobic fitness training.

Colcombe et al. (2003) refer to an earlier research which shows that a well-preserved brain adapts to change in a more plastic manner. According to their experiment aerobic fitness training diminishes age-related tissue density decline. Thus, cardiovascular fitness seems to protect and enhance cognitive function in older adults. They refer to earlier research about the potential of improving brain health in older adults by means of a threefold mechanism: cardiovascular fitness, cognitive training and dietary improvements. The dietary component could according to them consist of antioxidant supplementation which has indicated beneficial effects in animal tests. (Colcombe et al., 2003)

Kramer et al. (1999) show that aerobic training substantially improves performance in tasks requiring executive control. Already a small increase in the aerobic exercise through, e.g., walking suffices, but this enhancement improves brain functionality selectively. (Kramer et al., 1999)

Kramer and Willis (2002) survey age related cognitive decline in older adults and methods of enhancing cognitive vitality. They mention research showing a linear decrease in cognitive skills throughout adulthood, the starting point and rate varies individually, but this decrease accelerates in the late 70s. However, they also note that this decline can be moderated through experience, cognitive training, and fitness training. They allude to a general observation that knowledge-based abilities last longer than process-based skills. The former skills can even improve throughout the life span, whereas the latter decrease with age. Well-learned skills can last until the late 70s, but general perceptual, cognitive, and motor processes do not survive as well. Different skillsets deteriorate to different degrees in different individuals, but targeted training can retard the decline or help compensatory skills to evolve. Older adults commonly experience difficulties to switch priorities of tasks. This exemplifies a specific skill that can be trained. However, each individual should receive training in those areas where the personal skills have experienced the greatest deterioration. This implies that the performance of the individual should be measured at regular intervals during the aging process. An observation of a drop in some functionality should then trigger a targeted training effort in that area. The learning rate of old and young adults as such does not differ. Older adults that start from a lower level can even improve their reaction times more than young people. Thus, training equalizes differences in performance. (Kramer and Willis, 2002)

2.3   Motivation and quality of life

The motivation of elderly to perform muscle or fitness exercise can be assumed to predict how they would relate to a cognitive training facility. Hence, we review two papers on motivation of older adults to exercise. Further, we look into factors affecting the perceived QOL.

Lübcke et al. (2012) investigates older adults' perception of exercising at a gym. They note that the motivation to exercise changed with time. When people started exercising they did it in order to take control of their life, but later it represented a health investment and a social activity. Seniors appreciate the possibility to exercise at their own pace, the opportunity to socialize and find peers, the availability of competent staff, and the accessibility of exercising machines. They prefer training in a gym dedicated to seniors, as they experience the atmosphere as less competitive and stressful. The gym has to be perceived as safe and open to personal requirements and adjustments. Recommendations claim that seniors should perform muscle strengthening exercises at least twice a week. In order to preserve physical and mental health the exercise must be regular. Resistance training has been proven to increase muscle strength, bone density, well-being, and memory function. Participants reported increased physical capacity as a result of the gym training. They felt that their strength increased, that they had less pain, that the joint stiffness decreased, that they experienced improvements in performing their everyday tasks, and that they felt more active, younger, and in control. They felt that the training had increased their confidence, that it had revitalized them, that they had achieved something, and that they belonged somewhere. Group activities seem to suite older adults extremely well. (Lübcke et al., 2012)

Philips et al. (2004) analyse motivational factors of elderly exercisers. Many of the current elderly have never exercised before, not even as young, as exercise represents a fairly new custom. They exercise less than younger persons and yet their health would benefit more

than that of the younger. Especially women remain more sedentary than men. Exercise should not only be recommended orally to them by clinicians, but it should be prescribed in writing, as they tend to better obey written prescriptions. Health decays with age, but total physical activity and mortality act into opposite directions. Consequently, motivating elderly to exercise constitutes the best possible health promotion. Motivation represents a variable property of the human mind which can be affected. Phillips et al. decompose motivation into the following components: perceived chance of success, perceived importance of the goal, perceived cost, and inclination to remain sedentary. Perceived chance of success consists of self-efficacy, perceived control over one's health, comorbidities, and behavioural factors. Perceived importance of goal in turn incorporates: beliefs and education, importance of health, and definition of health. Perceived cost consists of: perceived barriers, access, and demographics. Inclination to remain sedentary includes: habits and prior experiences, psychological issues, and environment. Thus, the authors suggest that elderly can be motivated a) by educating them about the benefits of exercise, b) by promoting goal-oriented, gradual, activity progression, c) by addressing their cost fear, d) by addressing safety, e) by adapting activities and equipment to their needs, f) by treating concurrent morbidities, g) by involving the seniors in the planning of their own exercise program, h) by giving them exercise prescriptions in writing, i) by focusing on accessibility and affordability, j) by promoting the social community benefits of exercising together with other peers, and k) by providing physical and occupational therapy. (Phillips et al., 2004)

White et al. (2009) examine the relationship between physical activity and QOL in elderly. The authors hypothesize that physical activity influences QOL through self-efficacy and health-status as mediating contributors. Self-efficacy can be influenced by health interventions such as provision of successful experience, supportive feedback, and credible role models. Previous research has shown that physical activity reduces the risk of disease, and enhances QOL. The authors found that being more active correlated with being more efficacious, with having fewer disability limitations, with higher physical self-worth, and with being more satisfied with one's life. (White et al., 2009)

2.4   Virtual reality

Lassfolk et al. (2014) review rehabilitation solutions. Rehabilitation systems rest on virtual realities (VRs) that immerse the person into a simulated world that appears as very realistic. As a result, the person experiences presence in the VR and learned skills presumably transfer to reality. Optimal learning occurs when the system adapts to the personal needs. Serious games have developed from entertainment videogames, in that they try to adopt the engagement and reward from gaming, but unlike these they work towards a pedagogical objective. Many rehabilitation tasks aim at improving everyday life activities. Home-based rehabilitation solutions often represent means of intensifying the rehabilitation, i.e., to save travelling time and to enable therapists to attend to more patients. In an optimally planned rehabilitation environment the person can sense competence, creativity, satisfaction with life, pleasure, and flow. (Lassfolk et al., 2015)

2.5   Exergames

The next two paragraphs summarize the major aspects of exergames (from exercise and game) from an article reporting science panel discussions at the Power of Play: Innovations in getting active summit 2011 (Lieberman et al., 2011). After that we review an article describing an exergame development project and finally we survey a multiplayer game.

Lieberman et al. (2011) survey features of exergames. These games require physical exertion, whilst making the physical activity more appealing and engaging through the gaming experience. When successful the game plot completely absorbs the player so that he forgets the discomfort of performing the exercise, he perceives the exertion as milder, and he works harder and perseveres longer than he otherwise would. The games include assessment, feedback, and coaching and they affect motor ability, balance, agility and core strength. Exergames can take a variety of forms such as sports challenges, dance contests, adventure games, or treasure hunts. The game design defines its cognitive, emotional, social, and physical impact. Presumably these games influence health-related skills, self-esteem, and self-efficacy, and in addition they advance social support. They may also serve as a gateway experience to increased physical activity in the real world. Potentially exergames manage to proselytize elderly suffering from the most common reasons for not exercising regularly, namely cost, physical limitations, lack of interest, and time constraints. Hence, these games may be able to influence the sedentary lifestyle of seniors and to affect cognitive function. These games frequently utilize accessories such as accelerometers, global positioning system (GPS) units, balance boards, dance pads, gym equipment, cameras, remote controls, heart rate monitors, smart phones, activity and sleep meters, brain wave monitors, blood sugar monitors, emotional and attitudinal gauges, and pedometers. They can measure physiological variables such as oxygen consumption, vertical jump distance, systolic and diastolic blood pressure, heart rate, respiratory rate, endothelial function, energy expenditure, reductions of body weight, and fat stores. (Lieberman et al., 2011)

Lieberman et al. (2011) hypothesize that seniors could play exergames in senior centres, fitness centres, or optionally at home. The games can adapt to special user needs such as disabilities, rehabilitation regimes or age-related limitations. Some games require one player whilst others require multiple competing or collaborative players. The latter alternative suites well the desire for social interaction amongst seniors. Research recommends games that require moderate-to-vigorous physical exertion. Therefore, some more demanding games employ both upper- and lower-limbs. Games can implement a preventive purpose to improve the skills of healthy people, e.g., to prevent falls, or they can serve as a rehabilitative tool for disabled or patients. Exergames may improve motor ability, balance, agility, core strength, reaction time, eye-hand coordination, feeling of success, overall physical activity levels, and social involvement of elderly exercisers. Gaming seniors may also benefit from psychosocial elements such as strong bonding, group socializing, higher self-esteem, mutual support, and intergenerational socializing. If the games record personal data the privacy of the stored data needs to be ensured. (Lieberman et al., 2011)

Väätänen and Leikas (2008) describe the design process of an exergame called Fitness Adventure. They applied a human-centred design (HCD) approach to create a game that

would encourage late middle age people to do active physical exercise. Since previous research indicates that maintaining a good walking ability prevents mobility-related disability, they decided to build a game that would make people visit new surroundings and tourist attractions whilst simultaneously becoming physically active. Already in the conceptualizing phase parallel attention has to be paid to technology as well as the cultural background and the needs of the future users. During the iterative HCD process they worked together with end users to generate a common understanding of user backgrounds, needs, tasks, and usage environments. They based their prototype on wireless sensor technology and mobile devices. They created in total 14 different plots, which they analysed and refined. Based on the refined plots they selected the ideas to implement. During end user evaluations the location based exergame prototype received mixed feedback such as "highly motivating and fun" and "nice to try once". In the evaluations the adventure content of the game showed insufficient richness. Further, men would have added a report of the distance travelled and success in finding the right routes, whereas women would have added social walks with friends. In conclusion, the authors list important design characteristics of exergames: ease of use, intuitiveness of interaction, support for motivating and joyful exercising, playful content, and optional statistics. The game must find a balance between competition and social networking. The design process must identify values, habits, assumptions, and expectations of the target group. Further, gender preferences differ, men seem to like sports performance whilst women prefer cultural themes. (Väätänen and Leikas, 2008)

Strömberg et al. (2002) report about a game called Nautilus which represents the cooperation multiplayer game segment. Originally, the game design targeted a science park with children and families as visitors. The gaming takes place in a virtual space, but otherwise the players do not need to wear any special items. The players interact with the game by producing natural body movements such as moving their arms, stamping their feet or crouching down in their attempt to rescue a dolphin. Their success depends on how well they act as a team (3-5 people). The game design aims at reducing the boundaries between the surrounding physical space (5x5 m) and the virtual space by utilizing a large wall screen as well as creating an immersive underwater lighting and audio environment. Users experienced the game as a mixture of a theme park attraction, an interactive movie, and a team sport. They felt being part of the game rather than controlling it. (Strömberg et al., 2002)

2.6   Interaction with technology

Seniors experience difficulties when interacting with technology and smart devices. The personal previous familiarity with similar devices and interactions forms the basis for new encounters. Accordingly, seniors frequently run into problems when trying to utilize solutions intended to make their life easier. We review four articles presenting such experience.

Culén et al. (Culén et al., 2013) studied difficulties encountered by elderly when they go to a smart gym to train. As these users lack previous experience with computers they encounter problems at every step of the process from registering to the gym to adjusting the exercise machines. These challenges originate in both cognitive and physical properties. They have not acquainted themselves with items such as touch technology, screen iconography and its interpretations, screen navigation and interaction, exercise settings, or physical interaction

with the exercise machines. All these forms of smart technology also enter their homes in an effort to support their independence and everyday living. However, the elderly need to understand how they can master their tasks and goals in order to benefit from this smart help. (Culén et al., 2013)

Alvseike and Bronnick (2012) investigate the ability of elderly to use an iPad as a control device for a smart home. In a test where the elderly were requested to control the lighting and temperature with a touchscreen tablet computer, approximately 40% managed to do so after having had the opportunity to practice the technology for 4-5 month. The authors notice an issue in that those elderly that would benefit most from the smart house technology often suffer from a cognitively impairment and face greater difficulties than average to employ smart technology. In the reported study age or gender did not seem to affect the ability to exploit technology. The authors note that self-efficacy can be raised by favourable peer role models which manage technology, but on the other hand own failures lower it. (Alvseike and Bronnick, 2012)

Culén and Brattesteig (2013) report preliminary observations of elderly handling touchscreens. Touch interfaces are regarded as intuitive, natural and easy to use, but many elderly experience them for the first time. Elderly experience difficulties to read a small touchscreen, they come across difficulties to touch and push correctly, and their abilities change over time. They noticed that elderly hit a much larger target area on a touch screen than younger users. In addition people with tremors run into difficulties to hit the correct spot on a touchscreen. In some of the experiments they detected that elderly users deploy only a minimal part of the available functionality (e.g. on a mobile phone or a TV remote control). Projects designing products and services for elderly should involve elderly users, they should listen to these users, and they should refrain from just pushing smart solutions, which elderly do not desire. However, elderly people form a non-homogenous group with diverse impairments such as reduced vision, reduced hearing, or dementia. Therefore, the researchers expect that touchscreens may serve elderly, but they have to build around a general solution that can easily be customized and personalized to suite individual needs and habits. To conclude, the authors note firstly, that in the future elderly may well live in technology rich homes which assist their living in many ways, however, technology can only replace lost skills, but it must not replace human care. Secondly, they state that for the social and emotional wellbeing of the elderly they have to be allowed to master their own lives, i.e., they have to be able to control the technology that surrounds them. (Culén and Brattesteig, 2013)

Callar et al. (2012) investigate how elderly utilize cognitive and physical training devices. They encountered a polarized test group consisting of both people who have exercised and continue to exercise and on the other hand people who have never exercised. As a generalization of each group they created short descriptions that depict a typical person of that kind. They also generated textual scenarios that describe typical behaviours of these persons. This method led them to the conclusion that a user-friendly device perception correlates with a motivation to use it. This can even cause overuse with health risks as a consequence. On the other hand those who encountered difficulties in the interaction tended to disparage the usefulness of the exercises and declined further training opportunities. Seniors like to use devices if they regard

them as user-friendly, and if they believe that these improve their health and safety. They appreciate systems tailored for them and training programs that fit into their daily routine. The authors conjecture that cost may strongly impact decisions to acquire the equipment needed. Thus, they believe more in shared facilities where people can meet. They also recommend free installations for trial use, free-of-charge devices for trainings prescribed by doctors, and better integration of usability for seniors. They conclude, that the predominant technology driven approach should be replaced by a user-centred design in order to meet the expectations of the customer. (Callari et al., 2012)

2.7   Gerontechnology

Bouma et al. (2009) review the state of gerontechnology (from gerontology and technology). It strives to preserve QOL of the elderly and to delay loss of functionality. Hence, it embodies preventive measures acting on the daily environment in which people live, age and gradually change. It has to respond with innovative solutions to the demands of the elderly so that they can proceed living their lives as they wish, so that they can choose and enjoy, and so that they can continue as active members of the society. Gerontechnology faces interdisciplinary research challenges in its search for complementing or replacing solutions for deteriorating motor or cognitive abilities. This necessitates attention, because a good health enables the realization of everyday life ambitions which in turn boost the self-esteem. Disease and decay should not dominate the life of the elderly. Instead, they should be motivated to take up other activities such as games or communication. The elderly should be involved in designing solutions for them. However, they do not represent a homogenous group and diversity increases with age. In addition, each individual stores a personal technology track which represents his previous experience with technology, and accordingly forms the basis for his future technology adoption. Gerontechnology combines solutions from areas such as chemistry, architecture, information technology, robotics, design, or business management. The individual solutions range from recommendations for healthy nutrition, to lifting supports, to alarms, to telecare, to garden robots, to cochlear implants, to an ever-growing category of aids. Gerontechnology strives to increase awareness about the needs of the elderly and to foster the generation of solutions that meet those needs. (Bouma et al., 2009)

3   APPROACH

The authors of the present paper have cooperated in a stroke rehabilitation project conducted by Aalto University and the Helsinki University Central Hospital. The idea of reusability has emerged during this project, i.e., the prospect of offering cognitive stroke rehabilitation functionality to healthy people of senior age or other patient groups. This report strives to investigate the former group, i.e., providing cognitive training to healthy, elderly persons. Consequently, we performed a literature review to see, firstly, if other research showed similar indications and, secondly, to identify reported features and requirements for senior training. The results thus collected partly reiterate ideas reported in the literature, partly present new ideas generated as analogies, associations or extrapolations from results presented elsewhere. The degree of inserted creativity varies, anyhow, the proposal rests on the general insight compiled by the authors so far. We have taken the freedom to combine and innovate based on what we have learnt so far. The current material aims at spurring a discussion around the concept. We have listed our findings in the next chapter.

Google Scholar (GS) was utilized for all scientific article searches. As the search was conducted by a representative of the Aalto University only open access material or series subscribed by this university were directly accessible. Of necessity, material that was not directly accessible was disregarded. Usually only the first few screenfulls of GS provide useful input. Among the articles extracted by GS a subjective screening based on attributes such as respectable publishing channel, usefulness, review, and recentness of the article were applied. When starting to investigate a previously unknown area one of the challenges lies in finding fruitful search terms or keywords. This article describes one such learning curve.

First, we generated the term "cognitive gym" ourselves. However, a quick search proved that it had, indeed, been coined before. It had been employed in brain training contexts directed towards, e.g., military or self-development, but it also seemed to appear in published books. Anyhow, a search on phrases "cognitive gym" and "senior" did not bring us forward. Instead, we extended our search and have selectively used separate keywords such as: cognitive, training, stroke, rehabilitation, senior, and gym. As a further source of input the reference lists of the articles read have been examined. Among the abundance of information available the authors have studied a subset of articles selected according to the criteria described above. Available time represented the main limiting factor for the article at hand. This search and study operation resulted in the references presented in chapters 1, 2 and 4 of this article. The remaining material originates from experience recorded during the development activities conducted by the collaborative team represented by the authors of this article.

4   RESULTS

This section describes features which may affect the architectural planning of a cognitive gym for seniors. The system envisioned should assist and promote preservation of everyday functionality in order for seniors to maintain autonomy and QOL. We envision the outcome as a multipurpose playground for varying sorts of games and tasks that require cognitive as well as motor abilities.

4.1   Tasks

A wide variety of cognitive and motor tasks can be envisaged. The exerciser may sit on a chair, stand or move around. A personal trainer may occasionally accompany the trainer, at times he exercises alone and sometimes he performs a group task encompassing up to five persons. (Lassfolk et al., 2015) The room must be flexible enough in order to be able to host a varying amount of tasks that may change from time to time.

4.1.1   Extrapersonal space

Traditional paper-and-pencil and computerized rehabilitation tasks seat the rehabilitee in front of a table or a computer display. This kind of context located within an arm's length of the person resides in the peripersonal space, whereas a task that primarily involves the person's own body takes place in the personal space. However, more recent research approaches frequently incorporate a broader set of human functionality in the extrapersonal space, i.e., in the area outside the arm's reach. This includes acting in a virtual or augmented reality or moving in front of a wide-screen display in a situation that more closely resembles everyday

life activities (Cameirão et al., 2010; Gamito et al., 2011; Naveh et al., 2000). In these three spaces (personal, peripersonal, and extrapersonal) stimuli should be generated evenly across the whole area, i.e., from left to right and from top to bottom. This widens the person's awareness of the surrounding and can potentially reveal hazardous and unconscious gaps in perception. From a room planning point of view this implies that a sufficiently broad assortment of activities should be feasible in the scope of the training environment. The dimensions of personal and peripersonal exercises could be approximated by those of the extent taken up by a single exercise machine in a gym. While distinct tasks in the extrapersonal space can roughly be conceived of as using the space of a small gym consisting of 10-15 exercise machines.

4.1.2   Several modalities

The exercises preferably encompass both cognitive and motor components, and as many as possible senses. At least the system generates visual and auditory stimuli and expects responses in the form of motor or oral reactions. Motor responses include a whole spectrum of movements from moving one finger to running, jumping or crouching around the space. This may influence the selection of floor materials, the dimensioning of protrusions in the room and the sizing of the room.

4.1.3   Number of players

The tasks may include both single-player games and multiplayer games. Single-player games may better improve distinct cognitive functions, whereas multiplayer games could be more fun and develop group-interaction skills. In order to set an order of magnitude we estimate that there will be maximally five simultaneous players in the room.

4.1.4   Playground of characters

In an immersive scene the actor plays distinct roles which differ from his true self. The entertainment industry has spawned game agents, so called avatars, which represent the player in the game context. In order to fight back boredom a playful setting could inspire the senior to enter into a fantasy world in order to get his daily exercise done. Potentially some background scenery, scents, special effects or imaginative props from the theatre world could add to the salutary illusion. (Simmons et al., 2013; Strömberg et al., 2002)

4.2   Equipment and mounting

The tasks will be controlled by a computer. Additional equipment used varies but may include devices such as a mouse, a normal display, a large display, a projector, a keyboard, a joystick, headphones, loudspeakers, spot lights, a gesture detection camera, or a balance board. (Lassfolk et al., 2015) Some virtual environments also utilize head-mounted displays, sensing floors (Leikas et al., 2003) or data gloves. However, these may constrain the user or be expensive. The architecture should not restrict which equipment can be used or which criteria a specific facility may follow. If some of the equipment on the person needs to be wired up when the person also has to ambulate a flexible solution for cabling from the ceiling must be provided. A projector may be mounted to the ceiling, below the floor or behind a wall. Spot lights and loudspeakers may be fixed to the ceiling or walls. The computer and its peripherals

may need a table. The large display would be mounted on a wall or it could hang from the ceiling. The gesture detection camera should be located in front of the person so that the person stays in view all the time. Some of the equipment weigh much and must be well fixed, and some need protection against vibrations.

4.2.1 Truss or other construction aids

The equipment items that need to be solidly mounted could, e.g., be attached to a truss structure or similar construction aid enabling easy and reliable fastening of relatively heavy devices. Not bolting the equipment directly to the walls, ceiling or floor furthers easy movability of the entire training equipment. Trusses also provide generic scaffolding that enables reconfiguration of the equipment and addition of new equipment when needed.

4.2.2 Background light control

The lighting of the room should take into account both the needs of the exercises and the requirements of the other room usages. In some of the tasks all lights may be switched off, in some tasks part of the lights will be left on, and in some tasks the lights may be dimmed. In applications where a part of the lights remain off the configurability of the lighting constitutes an essential point. Ideally each light should be switchable and dimmable separately. Inflexible fixed group switching can lead to problems.

4.2.3 Background music

In addition to audio stimuli being used in some of the tasks the exercisers could also be offered the opportunity to listen to music while training. Ordinary gyms often offer music, radio or TV. With cognitive tasks this may pose challenges depending on the task. On the other hand, the trainer must experience the gym as pleasant in order to return regularly to perform the workout. If the person prefers to train in silence this must also be possible. Architecturally this could have an impact on the amount of echo produced in the room and on material selection. The room needs not be a hi-fi studio, but a pleasant place to be in.

4.2.4 Portability

A portable equipment setup takes precedence over a fixed installation. First, by virtue of organisations relocating and facilities moving also the training equipment should be portable. Second, the same space can serve distinct purposes in a time allotted manner, i.e., at a certain time of the day the room serves as a meeting room and at some other time as an exercise playground. Third, several institutions can share the cost generated by a single, portable system. The different uses should preferably not distract each other. A multipurpose sharing of facilities can save a lot of money and improve the economy of facility usage. However, this connects to how equipment should be mounted and fixed in order to minimize scratches.

4.3 Room

The physical dimensions of a training environment should at minimum measure 3 x 3 m on the floor and 2 x 2 m on the display wall. Ideally, however, the space should be larger than this in order to offer more options for various tasks and more motor training. A free floor space of

5 x 5 m (Strömberg et al., 2002) would enable many more applications of the space and even larger areas could easily be used for variation and more realistic tasks.

4.3.1   Protection of equipment

Some of the equipment risks being kicked or moved unintentionally by the people using the room. Its placement needs to be carefully planned. Sufficient equipment cooling necessitates planning. In general, a balance between security, protection and cooling needs to be found.

4.3.2   What the room should not have

Noise coming from other parts of the building, from adjacent spaces or from other activities going on simultaneously should preferably be blocked out. Uncontrolled disturbing noise can lead to irritation and misinterpretations of task performance. The room should not have any windows or they should be covered completely. The space should be separable with walls from other adjacent activities. This gives the exerciser peace and quiet to concentrate on the training. No steps, stairs or loose carpets can be allowed in the training space. The person must be able to move in all directions without stumbling over bumps in the floor. The walls should not contain any protruding objects which could hurt the exerciser. No extra items should hang from the ceiling and come in the way of the person moving around.

Extra furniture that resides in the room for other purposes must be mounted on wheels or otherwise be easy for one senior person to stow away. During the exercise no excess furniture should be in the training area. As bounds cannot easily be demarcated on the floor, all free space between the walls of the room should in practice be evacuated every time a training session starts. In case the extra furniture can be screened off behind extra wall segments it may reside in the same space. The exerciser must not unintentionally hit any unexpected items while moving around in a hectic game. A training session must not cause damage to the person, any equipment or furniture.

4.3.3   Multipurpose room

The same room can act as a training environment, as a meeting room, or as a canteen, to name a few. Smart scheduling allows efficient space utilization. However, the combined requirements from all the different activities have to match, and the reconfiguration from one purpose to another necessitates thorough planning. In the worst case scenario the multipurpose room does not suit any activity and the modification demands too much effort.

Preferably, all training equipment remains unobtrusive when the room serves for other purposes. Nevertheless, starting a training session should not cause inconvenience. If the room alternately serves varying purposes, switching from training to non-training or vice versa necessitates a well-designed solution. This may need some architectural innovativeness to solve.

The training tasks differ although many of them probably utilize the same basic equipment. The physical environment shall support the transformation required by different tasks. Thus, props and furniture (e.g. table, chair) used during one training session should be readily

available but at the same time easy to put aside. A cupboard for the extra items could be planned into one of the walls.

4.3.4   A mixed gym

The cognitive gym could alternatively be envisioned to evolve as an extension to existing ordinary gyms especially specialised senior gyms. These could add a few cognitive exercise machines to their repertoire in order to better cater for both the motor and cognitive wellbeing of their customers. Seniors prefer to exercise in a social setting with peers. This paradigm could be extended to also include the cognitive exercise. This would imply that the facility would host both traditional exercise machines as well as cognitive workout stations. Hence, the architecture should observe requirements for both traditional gyms and cognitive gyms. As an example requirements for air conditioning and temperature control may be stricter for places incorporating aerobic activities.

4.4   General

4.4.1   Safety

Planning the safety of using the system requires attention. Safety must not be compromised by any other features. The training environment must provide a safe opportunity to exercise weak skills. If the target customer group does not trust the environment it does not meet the expectations. The exercisers will come to the environment to challenge their skills and in many cases train tasks that would be too dangerous to practise in the real world. Examples of such skills include crossing a street (Naveh et al., 2000) or driving a car (Roenker et al., 2003). (Lassfolk et al., 2015)

4.4.2   Low cost

Cost strongly influences the investment in a training facility. Neither private nor public budgets permit excesses costs. At least it should be possible to start small and enrich the environment little by little as the benefits of it emerge.

4.4.3   Availability and accessibility

The site should be conveniently and centrally located so that people can travel there easily with public transport or by own car. Inside a senior housing block the facility should be accessible by all inhabitants, also those depending on a walker or a wheel chair. As people's daily activity rhythms may differ a simple solution would be to allow access to the facility 24/7, i.e., all around the clock every day of the week. This can be achieved with programmable access cards that could then also encompass other functions such as reservations, follow-up of exercise activity, and charging.

4.4.4   Telerehabilitation

Remote direction and supervision of the training may be offered as an option. This probably requires an internet connection and some kind of conference call functionality on the computer.

5   DISCUSSION

In this paper we collect a list of features representative of a cognitive gym for seniors. In addition, we provide preliminary remarks on possible implications to architecture. We hope this could open a fruitful dialogue with experts in architecture and construction.

The findings reported in the present paper represent a starting point and requirements for designing a cognitive gym for seniors rather than a ready solution. The observations presented should be conferred and improved throughout the design process. The current list of features and requirements is based on a short literature review and a limited experience in the domain we are embarking on. Thus, it sets forth a vision of what a cognitive gym for seniors could embody. The refinement process should include seniors as experts on their needs. It should further incorporate specialists on architecture, gerontechnology, and elderly care. Probably many more competences which we are not even able to name now will be needed. A broader literature review should be conducted in order to find out about similar or analogue endeavours and learn from the experience of other researchers. Potentially other research teams have invented the same concept, but call it differently which has caused us to miss it in our literature survey. The current concept reflects our background and approach to this interdisciplinary field. Probably, persons representing another intersecting discipline would approach the topic in a completely divergent manner, generate an entirely different set of requirements and features, and call the system something else. Finding such alternative approaches does not pose a risk but a source of richer input and improvement. However, the present study rests on the data which we are currently aware of and it should not be interpreted as anything more than a blueprint of a practicable cognitive gym for seniors. It presents work in progress waiting for further refinements. The next step on the road towards implementing a cognitive gym for seniors include creating a broad enough network of interdisciplinary expertise, dialoguing, analysing the advantages and disadvantages of distinct proposals, constructing a prototype, and iterating towards a functioning solution together with the users and specialists.

The need for a concept that we call a cognitive gym for seniors seems well motivated. A clear need for improved quality of life for seniors exists. Previous research shows that the physical as well as the cognitive condition can be influenced by training even at advanced age. Providing such a facility and motivating the seniors to benefit from it is subject to further research. Anyway, the endeavour to strive to construct such a facility appears justified. The advantages are overwhelming: to offer seniors the opportunity to affect and improve their quality of life and for society to potentially spend less on health-care costs.

6   CONCLUSION

Learning occurs at all stages of life, and appropriately supported it results in good quality of life. A cognitive gym for seniors could provide a tool for seniors to control and advance their well-being and for society to master the demographic challenge while maintaining budgetary control.

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USING SIMULATION IN VARIOUS STAGES OF HOSPITAL PLANNING

Vesa S. Paju

Director, Consulting Services, M.Sc.
Delfoi Oy
vesa.paju@delfoi.com

Eeva Ketola

Medical Director, MD, PhD, eMBA
City of Järvenpää
eeva.ketola@jarvenpaa.fi

Kristiina Kariniemi-Örmälä

Director of Health Promotion, RN, M.Sc.
City of Järvenpää
kristiina.kariniemi-ormala@jarvenpaa.fi

Juha Halonen

Process Development Consultant, M.Sc.
Delfoi Oy
juha.halonen@delfoi.com

Rashmi Werning

Process Development Consultant, M.Sc.
Delfoi Oy
rashmi.werning@delfoi.com

ABSTRACT

The Finnish public healthcare sector faces great challenges due to increasing cost mainly due to increasing old-age dependency ratio. That is why buildings and processes need to be planned to support Lean processes and working practices. There is a large amount of research on how discrete-event simulation can be used in health care. However, literature does not offer a comprehensive theory or guidance how process design and simulation should be used when planning and designing a whole new social and healthcare center or hospital. In this paper, it is demonstrated how process planning and simulation has been used in social and health care center planning to improve the working process and productivity of the service provider in the new building. In addition to the costs saving opportunities, this paper also demonstrates that with the help of detailed process planning and simulation, the functioning of the process from patient perspective can be improved. We depict a case study (Järvenpää's new social and health care center) where the method of the framework was used with successful results. Process changes lead to significant monetary savings and better availability of care. With simulation also the impacts of the changing environment can be tested and plans adjusted accordingly. We propose that with the use of user-centric building planning method and simulation based process planning method, social and healthcare buildings can be planned more efficiently and the building itself will be much better for the users than with traditional methods.

Keywords

Vesa S. Paju / Eeva Ketola / Kristiina Kariniemi-Örmälä / Juha Halonen / Rashmi Werning

1   INTRODUCTION

The public healthcare sector faces great challenges due to increasing cost. There is a huge challenge to increase productivity while Finland's old-age **dependency ratio** (the **ratio** of people over 65) is increasing. The full impact of the ageing of the population on the development of the economic dependency ratio will be felt in the 2010s and 2020s. The proportion of persons older than 65 years in the Finnish population is expected to increase from 17% at present to 27% by 2040 and to 29% by 2060 (Official Statistics of Finland, 2011). This means, that the need of care increases while people get older. At the same time the care possibilities and treatment practices improve and even more difficult diseases and older patients can be treated successfully. All this happens in the operational environment, where the municipalities have to arrange many new services according to the new laws. At the same time the municipalities are struggling with the economic depression and money has to be saved and working processes made more effective.

When designing new social and health care buildings or renovating existing buildings and processes, it is very important, that planners and decision makers take into account these challenges. There are advanced methods and software for designing and modelling buildings, for example the lighting and energy consumption of the building can be modelled in a very detailed level. However, in health care merely 3-11% of the life cycle cost comes from the building and its features. Instead, 60-90% of the costs is personnel costs and other costs related to the building use and the quality of care depends of the high quality of treatment practices leaning on evidence based health care, fluent patient flows and leaned processes (ratios from city of Järvenpää's financial statement for year 2012) The importance of customer service design (Mager et al., 2011) and working patterns are related to each and also to the planned building.

The user-driven design approach, used in this planning process at city of Järvenpää, requires commitment from the personnel and patients who are accompanying. The new way of working together with the planners and deciders, as an equal partner, has proven to be very productive and rewarding; the building and process designs have been developed by means of users feed-back. The purpose of the new social and health care center is to produce health and well-being to the citizens of the city of Järvenpää. The user-driven design approach has been a possibility to strengthen patient processes and to plan totally new ones, tailored to the new operational environment. Approximately 100 of users all together; personnel (doctors, nurses, social workers, physiotherapeutics, cleaners etc.) and patients have taken part in to this user-driven planning process.

Delfoi addresses this problem through Lean thinking (Womack et al., 1990) and the use of simulation in various stages of hospital planning and use. In this paper, Delfoi demonstrates how process planning and simulation has been used in social and health care center planning to improve the cost effectiveness of the new hospital. In addition to the costs saving opportunities, this paper also demonstrates that with the help of detailed process planning and simulation, the functioning of the process from patient perspective can be improved. Improvements in the process can lead to shorter sick leaves and better availability of care. Also

in this paper, it is demonstrated, how simulation and process design help architects and other design disciplines (e.g. structural engineering, HVAC-, electrical- and ICT-planners) in the timely execution of a hospital planning project.

When designing new hospitals an important aspect is not to bring the old way of operating as it is to the new building. New hospitals should not be seen as just buildings but as functional entities incorporating healthcare processes, resources and patients. The buildings should allow functional changes and improvements during life span. When the functional changes are ambitious and substantial the effects can be hard to estimate through static calculations or other present means of operations. Simulation is a dynamic tool that allows testing different scenarios in volume and ways of working before large, and sometimes out of scale, investments have been made.

The research questions are following:

- How can simulation be useful in different phases of hospital planning to

    1. Improve the patient process and availability of service?

    2. Assist architects and other design disciplines in designing a functioning and cost-efficient building?

2   STATE OF THE ART

During the past years process thinking has become popular and interest towards using methods of industrial engineering in health care has increased (Dahlgaard et al, 2011). It has become widely accepted that there are processes in health care. Research on the health care processes has mainly focused on how the operations of a unit or the treatment of certain type of patients should be organized. There is also a large amount of research on how discrete-event simulation can be used in health care (e.g. Jun et al., 1999). However, literature does not offer a comprehensive theory or guidance how process design and simulation should be used when planning and designing a whole new hospital or social and health care center.

Lean was first introduced to manufacturing industry, but is today widely used also in health care. Lean (Womack et al., 1990) is a methodology and a management philosophy focusing on adding more value to the customers with fewer resources. Key principles of Lean include removing waste from each stage of the process and improving the flow of products through the manufacturing process and minimising work-in-process inventory. Also designing and using cost-effective value streams, standardising work practices, and using pull type scheduling techniques instead of push-type, are key principles of Lean (Womack et al., 1990).

Delfoi's uses Lean thinking in its health care projects to identify possible improvement areas and simulation to verify the effect of the changes in the process. The use of Lean in health-care can, for example, include that possible capacity bottle-necks inside hospital are identified and eliminated with the help of simulation. This way, the flow of patients is ensured.

Another typical example of how Delfoi uses Lean in health-care is the redesigning of value-streams. For example, the detailed work process of one out-patient appointment or treatment visit can include several phases before, during and after the appointment, and different mix of employees, materials, equipment, spaces and software are needed in each of the phases. Some of the phases might be non-value-added (i.e. waste), and when re-designing value-streams, some non-value-added work can be eliminated. In addition, there are many cases, where the content of the phase can be changed and the phase can be transferred to another employee category. Some work can be transferred from physicians to nurses and some work from nurses to secretaries. All these changes need to considered, when planning new facilities.

A more comprehensive review of how Lean is used in health care can be found in literature (Lawal et.al, 2014).

We present a framework in which simulation is a part of the whole hospital planning process. Framework in designed for this paper and reflects Delfoi's observations on hospital planning and design projects. In the framework architect design and other design disciplines are in constant interaction with the process design along the hospital planning and design process. Framework is presented in figure 1.
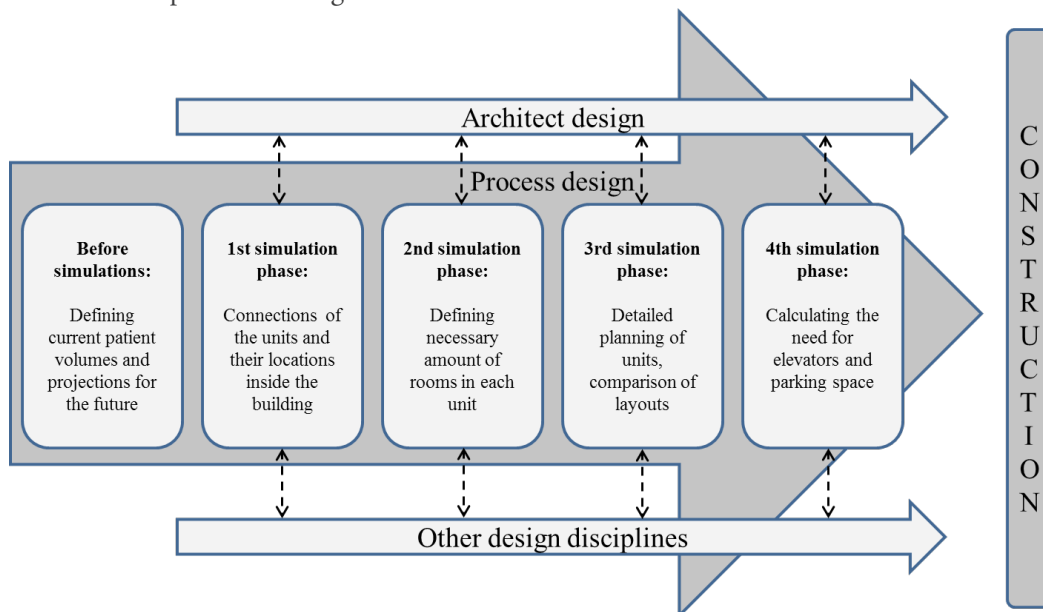
Figure 1 Framework of using process design and simulation in different phases of hospital planning and design process

Before the simulations can be started it is important to define the patient volumes. Volume estimates can be based for example on current volumes, which are scaled up or down to a specific year far enough in the future (e.g. year 2030). Scaling factors can vary between patient types or units. There can also be more than one general volume estimate used in the simulations along the design process (e.g. minimum, probable and maximum volumes). In simulation volumes can easily be changed and different scenarios compared. Early phase detection of bottlenecks in work flows, resources and local epidemiologic data on patient service behaviour depending on diagnoses and treatment is important. In the future the

service efficiency makes the forecasting even more important. Some of the bottle-necks in patient processes were well-known before the simulation, but not all. The simulation of the processes is a possibility to test and analyse patient processes in a totally new way.

The first simulation phase if done either in the beginning of the design process, or even before the architect design starts. The goal is to determine the connections between different functional units into a schematic layout. In the layout, it is stated which units should be close to each other so that the patient and employee processes are fluent. For example, if the patient utilizes services from both sample collection site and medical imaging during the same visit, these units should be close to each other. Also, there should be an easy access to units with the largest volume of patients. Also the movement of employees should be taken into account. For example, if specialists of one unit offer a lot of consultation (requiring physical presence) to another unit, these two units should be close each other to minimize unnecessary movement. In order to do the simulations the processes of each unit should be determined. In this simulation phase the current processes have to be documented detailed enough in order to estimate the required changes to achieve future, target state processes.

In the second simulation phase the focus is on individual units. When moving to a new building the ways of working can be changed radically, since the spatial limitations of the current offices are removed. The focus of the process documentation for the simulation should be on how the patient and employee processes should be in the future, rather than on the documentation of the current processes as they are. In this phase, the required amount of rooms and how many employees are needed with the future processes and volumes, is determined. This phase of the process design is where major guidelines and requirements for the building's design are drawn. Changes in the process can drastically improve the patient care by shortening the lead times and improving the availability of service. These measures can be improved for example by increasing the number of patients per doctor (or nurse) per day or by offering new services (e.g. electronic reception, platform for self-treatment). Simulation helps in defining the number of rooms, which could be either too low or too large if the estimates are done based on current processes.

The focus of the third phase simulations is the movement of the patients and employees inside the unit. When designing a functioning building the unnecessary movement from one place to another should be minimized. Simulation can be used to compare different layouts drawn by the architects. For example, the locations of the storages and patient office as well as the form of the building can influence a great deal the distance walked.

In the fourth phase the simulation is used to count the capacity of certain logistic areas and equipment. For example based on simulation the need for parking space or bicycle racks can be counted as a function of time. Also, the capacity and required amount of elevators can be estimated through simulation. The advantages of simulation in comparison to static calculation are in this phase unquestionable. People stay in the building different times and arrive in different arrival distributions depending on the unit and the type of the reception. Simulation can also take into account possible queues and delays in the process. The large number of parameters makes it almost impossible to get accurate information through other means than simulation.

Even though the general framework is presented as flow from phase one to phase four, it is acceptable and even recommendable, that the simulation proceeds through iterations. In first iteration, all the process development activities are typically not understood in detail or accepted by the user. Through iterations, additional information is presented to the users and users can suggest alternative development activities, which are then modelled with simulation and the results are presented during the next iteration. Users' feedback is gathered through conversations in the workshops, where the simulation results are presented. Another means of collecting feedback is using web-based surveys. Based on the improvement ideas collected the simulation scenarios are updated. Ideally, there should be at least three to five iterations in each phase, depending on the scope of the process changes and possible resistance towards the changes.

3   APPROACH

This paper illustrates the benefits of simulation through a case where discrete-event simulation (process simulation) has been used to support the planning and design along the design process of Järvenpää's social services and health care center. Delfoi was the process consultant and did the simulations in the project. The research method in this paper is single case design (Yin, 2009). There are several justifications for using single case design. In this paper the justification is that Järvenpää offers a representative and typical case of social services and health care center planning. Same general features and problems are present in all hospital and health care building planning and design projects, not just in Järvenpää. Data of a case study can be either qualitative or quantitative, or both (Eisenhardt, 1989). In this paper the qualitative data is collected through empirical findings during the Järvenpää design project. Quantitative data is gathered from the simulations done during the project.

3.1 Case Description

Järvenpää is a municipality in Southern Finland with population of little above 40,000. Eleven units from different areas of health care and social welfare will move to the same building in year 2016. The building is designed based on future, year 2030 customer volumes. The units moving to the new building are community health care (emergency room and sub-acute reception), dental health care, instrument care and maintenance, occupational health care, rehabilitation, sample collection site, medical imaging, ward, home hospital services and social services.

The planning of the building is conducted by an alliance, which incorporates three legal entities: the user (Järvenpää's social and health care service organization), the buyer (real estate company owned by Järvenpää municipality) and the main planning consortium (consisting of 5 companies) which was selected through a bidding competition. Process planning and simulation was acquired through a separate bidding competition by the buyer.

The need for alliance comes from the present need to use more intensively the users' voice in the planning. The history of building projects -not so good- might cause frustration and lots of extra use of money for reconstructing or corrections. The need to build a house for the future processes is evident, not vice versa.

4 RESULTS

Delfoi's simulations in Järvenpää were done together with the people, who are going to be working in the new building. Information about each unit was collected through interviews. Each unit was interviewed separately. In most cases there were present several people from the unit, both managers and subordinates. It is important to involve many people to the design so that a wide variety of opinions and improvement ideas is gathered, and results are valid. This also reduces the opposition towards changes. The simulation process consisted of several iterations, where simulations were followed by presentation of the results and again new simulations based on the comments. The loop continued until the results were approved by everyone in the design team.

The results are divided into two sections. First section depicts improvements in the patient process and in availability of service that where accomplished in the planning and design process. Second section addresses the use of simulation when striving towards a functional and cost-efficient hospital.

4.1 Improving the patient process and availability of service

The patient centric approach is crucial in future working processes of social and health care. Lean processes with fluent patient flow in the same building will diminish waste. Both end customers and professionals are happier in a building where they can feel that it is planned according their needs. After the experience on user-driven planning process, it is impossible to return back to the earlier way of hospital planning.

A large decision towards improving in the availability of service was made when the location of the social services and health care center was decided. The new building is located in the center of the city, whereas all the units are currently spread across the city area. Especially the emergency room, ward, rehabilitation, medical imaging and sample collection site are far from the city center. Also, many units plan to have longer opening hours as they move into the new building making it easier for people working office hours to utilize the services. Easier access to services had to be taken into account when making the patient volume estimates for the future.

One of the greatest advantages of the new building is that all eleven units are under the same roof. Consultations are easy across unit borders, and knowledge between employees can easily be transferred, as long as the facilities enable it. For the customers, it is beneficial that they can combine their visits, for example go to the sample collection site right after they have gotten a referral from the doctor. The new building also helps to organize multiprofessional teams for patients with needs across the health care and social services sector. These teams gather to discuss a patient's progress without the patient once a month. This kind of multiprofessional team work is expected to get the customers of social services to use more health care services, so that their quality of life is better. These measures will lower the costs to society, since although the costs of primary health care can increase, the costs of e.g. special health care, wards, detoxification and rehabilitation are estimated to drop more significantly.

During the project (2. phase simulations in fig. 1) a detailed analysis on the components of the work day were done to each employee group in each unit. This analysis served partly as initial data for the simulations to define the amount of rooms. The second purpose of the analysis was to point out targets for development. These targets included for example large number of meetings, paper work and slack between receptions. Targets varied from one unit to another. By focusing on and fixing these targets a doctor, nurse or other professional can meet more patients or customers per day and focus on the work they are educated. Based on qualitative interviews and cross-sectional study of working schedules the improvement opportunities in operations management were discovered. After that, simulation was used to test the planned changes in operations management, and a new plan was accepted after some iterations. The implementation of the new processes lasts at least two years and the new processes are planned to be in full use when the building is ready.

4.2   Functioning and cost-efficient building

Simulation and process design can be used in several stages of the hospital planning process. In this section we give three examples from Järvenpää of issues where they were extremely useful in terms of operational costs and functionality. Examples are dental health care, ward and people logistic simulations. All three examples depict how the combination of simulation and Lean thinking can help when designing new processes in to a new building.
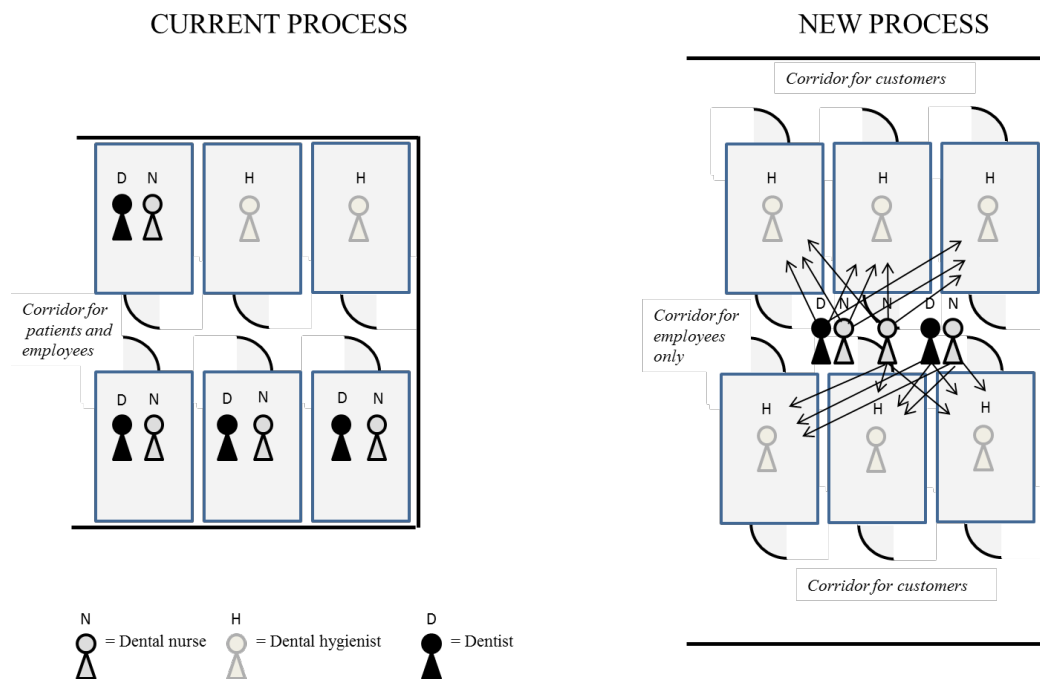

Figure 2 Current and new processes in oral health care

Example 1: Dental health care

If individual units are considered, the most significant process changes in Järvenpää were made in dental health care. Currently dental care has two offices in Järvenpää in old facilities. Most of the patients see a dentist who is assisted by a dental nurse. Currently there are only a

few dental hygienists who work autonomously. In the future the care is organized into teams. For example in adult health care, where volumes are the biggest, the team work is re-organized so that dental hygienists take over a large part of the reception, previously done buy dentists. The shift in the ways of working is presented in figure 2.

In the current process dentist-dental nurse pares treat a majority of patient. Simpler patients are treated by dental hygienists. In the new process a vast majority (90 %) of patients are treated in teams. A team consists of 3 dental hygienists, 1 dentist and 1.5 dental nurses. Several teams can work simultaneously and utilize partly same employees (2 teams in fig. 2). Only 10 % of the patients are treated solely by a working pair of one dentist and one dental nurse. This segment includes those cases, where the treatment can not be completed during the team reception.

In both processes (current and new) a reception lasts for 60 minutes, so the amount of patients per hour is the same. What has changed is the number of patients per dentist per hour. The team reception is organized so that dental hygienists stay in their rooms for the whole 60 minutes. They make procedures that do not require a dentist for the first 40 minutes. During the last 20 minutes, a dentist is also present and can finish the treatment together with the dental hygienist. The receptions are scheduled so that they begin in a 20 minute interval. One dentist has time to visit three dental hygienist's rooms in one hour. Dental nurses assist dental hygienists and dentists in the procedures. With simulation the required number of rooms for the new process could be determined. Delfoi did the simulations using Delmia Quest simulation software, which also has 3d-user interface. Through the 3d-interface, the functioning of the new process and use of rooms was presented to the users, and they could see minute-by-minute, patient-by-patient how the workflow is proceeding from 7:00 am to 9:00 pm inside the building.

The new working process serves as a recruiting advantage for Järvenpää when working in full scale. The meaningfulness of job content of both dentists and dental hygienists is higher in the new process. Dental hygienists can treat more demanding patients and their consultation possibilities are better, dentist can focus on work that measures up to their education. Advantage of the new process from the patients' point of view is that unnecessary re-visits are unusual since more patients can be treated during one visit.

These changes in the process lead to significant savings in the personnel costs. Even though the combined number of employees grows, the number of doctors is lower. And, since dentists are far more expensive workers for the municipality than dental hygienists costs are lower in the new process. In Järvenpää's case, the costs of adult dental health care are going to be as much as 30 % lower with the new process than with the old processes, if the calculations are done using the expected volumes in 2030. This equals over 0.5 MEUR savings (calculated at price level of 2012) per year. This type of transformation could not have been possible in the old offices.

The new process has already been implemented and tested in real-life in some part of the existing dental care units. Further changes towards the new process are hindered by the

current facilities, so full scale implementation starts when the new building is ready in 2016. Design of a similar type of transformation has also been started to Järvenpää's sub-acute community health care reception. Delfoi simulated also the vision 2030 in the community health care. With process changes, such as reinforcing patients towards self-treatment and the use of electronic channels, and shifting sub-acute patients from emergence room to sub-acute receptions, the costs savings can be substantial. The operational costs of community health care in year 2030 can be even lower than in year 2012, if all the desired changes take place.

Example 2: Ward

In the beginning of the project the architects designed several possible layouts for the building. Based on qualitative analysis and ranking of the design parties involved, e.g. Järvenpää's employees and Delfoi, layout alternatives were cut down to three. One of the biggest differences between these alternatives was how the operations of the ward could be organized. There were qualitative factors involved, but these layouts were also compared quantitatively in simulation.

Simulations were designed so that the operations inside the ward consisted of daily routines and tasks related to arrival and discharge of the patients. These routines and tasks were different for each employee group. All important rooms, or nodal points, were placed to each of the layouts based on the drawings of the architects. These rooms included for example patient rooms, storages, utility rooms, medication room, nursing stations and the dining area for patients. Simulations reported the distances walked by all the employee groups.

Significant differences between the three layouts could be reported. Especially one of the layouts proved to be worse than the other two, when measured by the walking distances. This layout was discarded mainly due the simulation results, as the distance walked in the worst layout was 33 percent higher than in the best one. If that layout had been chosen, the ward of 65 patients should have needed at least one extra person to manage all the tasks. Simulation was also used to determine the effects decentralized storages in comparison to centralized storages. With decentralized storages the walking distances were 1 to 5 percent lower. Simulation was of great help to design a ward where the walking is minimized and the nursing staff can focus on essential, which is taking care of the patients. The lean processes with no extra walking, no waste of time searching for equipment, improved process for different material flows were simulated so that the decision making was clearer.

Example 3: People logistics

People logistic simulations were done throughout the project in Järvenpää. As the process and other designs become more and more accurate, the simulation was run again and results updated. One of great advantages of using simulation is that changes can be made, and their effects seen faster and easier than in other means of design. As described in the framework (4th phase simulations in fig. 1) there are a large amount of parameters related to people logistics. These include (1) arrival distributions that vary between hours, days and weeks for each unit and patient type, (2) routines of the employees, such as house calls and consultations and (3) the means of transportation, which can vary large from unit to another, just to name a few.

One result from the people logistics simulations can be seen in figure 3. Figure presents during an example week how many people are inside the building as a function of time and divided into patients/customers, staff and ward visitors. This particular information was used when a specialist building planning consultant determined guidelines for the design in terms of fire safety. Similar graphs were formed to determine the right number of parking spaces and bicycle racks. Especially the parking building is a major investment so the amount of parking spaces should be estimated carefully. If there are too few parking spaces, the level of customer service diminishes especially in a municipality such as Järvenpää where many people use their own cars as a form of transportation. In the early phases of the project (1st phase simulations in fig. 1) people logistics simulations helped not only to determine the places of the individual units in comparison to the entrances and each other, but also which routes have the largest volumes inside the building and must be designed to be easy to travel.
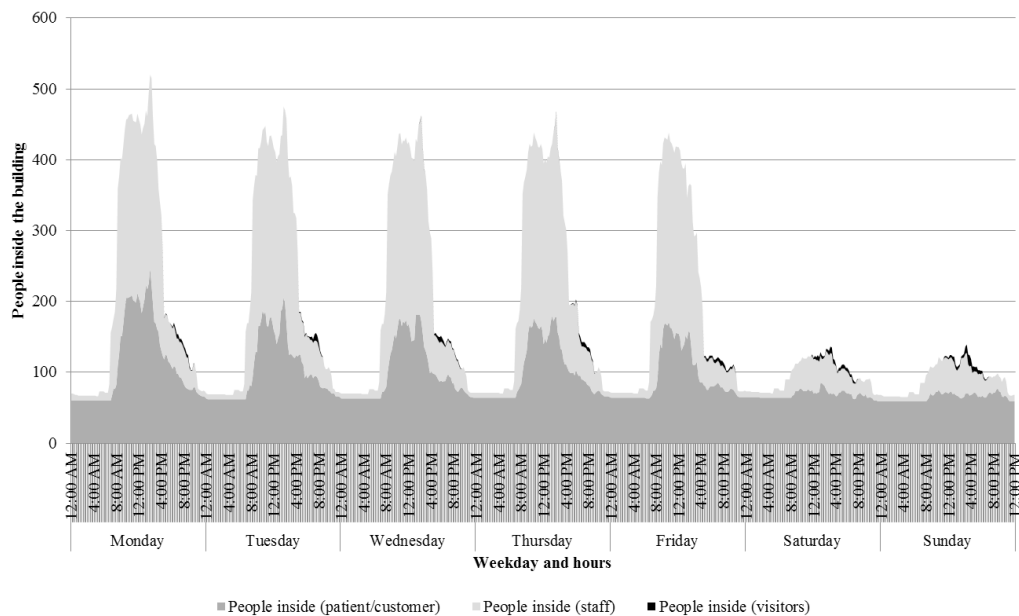
Figure 3 The amount of people in the building a function time (an example week from the simulation)

5 DISCUSSION

With simulation, the correct number of rooms and personnel was calculated, and based on the simulation also the operating costs of the whole unit were modelled. The results were used in decision making, when comparing different alternatives. The cost-calculation model included both the building-related and user-operation-related costs, so that sub-optimisation of only other cost component was not possible.

The architects and other designers were able to get quickly correct information about the exact room numbers and possible other process-related requirements for the rooms. Typically the number of rooms is subject to many changes even during the late design phases, and this causes changes to building plans. When these changes occur in late phases of the planning

project, modifying the detailed plans requires that all the design disciplines check and modify their plans, and this takes time. The late changes can even cause delays and budget-overruns for the whole project. Process simulation can prevent those late changes, since the capacity of the facilities is thoroughly analyzed in the early design phases. Alternative demand and process scenarios can be analyzed to see, how much a certain change in requirements changes the use of the building. When this is known beforehand by architects and other designers, they can incorporate new elements of flexibility to the building design beforehand.

In Järvenpää's case, for example, a possible change in the requirements came up in March 2014, when the Finnish government decided that a big part of the social benefit application and payment responsibilities would be transferred from municipalities to a government agency (Kela, the Social Insurance Institution of Finland) from 2017 onwards. This change was quickly simulated, and with the architect, the location of the unit inside the building was changed, so that the space can be maximally utilized even after 2017. If the simulation would not have been done, there was a risk, that some users would require a design change during or after the bidding negotiations with contractors. With simulation, this risk was proactively handled.

The use of simulation in the project went along with the framework presented (see fig. 1). The first simulations in Järvenpää were done to determine the connections between units and their locations inside the building. For example, (1) the sample collection site was placed to the ground floor because it has the largest number of customers, (2) instrument care and maintenance, and oral health were placed next to other and (3) the emergency unit was located so that there is no other traffic through the unit. In the second phase of the project, the right number of rooms inside the units was determined based on simulation results. For the ward, an even more detailed simulation (3rd phase in fig. 1) was done to determine where e.g. nursing stations, storages and utility rooms should be situated to minimize unnecessary movement inside the ward and to compare different layout alternatives that the project architect had designed. Simulation was also used to determine the right number of elevators for customers and materials, and the need for parking space was also simulated (4th phase in fig. 1).

When presenting results of a single case study it is important to be cautious in making generalizations (Siggelkow, 2007). The purpose of the paper was not to introduce an extensive new theory on principles of hospital design, but to show that simulation is a useful tool in the design. Eisenhardt and Graebner (2007) state that in formulation of new theory, results are better when several case studies from the same field are observed. Delfoi has experience of using simulation in more than 1,000 design and development projects in industry and health care. The conclusion from this experience is that simulation often offers facts to support the decision making in complex situations. Theoretical contributions could be greater, if a study was conducted where several hospital were compared, others where simulation and process design was used, others where it was not. However, this paper offers an example of a practical framework of using simulation and process design in hospital planning. This framework can be tested and extended by academic researchers to form a comprehensive new theory.

If we consider how the simulation and process design could have been utilized better in Järvenpää, it would have been beneficial if Delfoi's work would have started earlier. When Delfoi started the work in Järvenpää, the architect had already started to draw the building based on partially imperfect information. If the patient volumes had been estimated and Delfoi had done the 1st phase simulations, and even the 2nd phase simulation before the architects work started, the architects' work would have been easier.

6   CONCLUSION

The main finding for architects and social and welfare organizations from this study is that process simulation is a valuable tool, when planning new facilities, and it should be done iteratively and in separate phases before and during the building design process. It should be used at least to verify resource plans for rooms, personnel, elevators, parking spaces and other resources that could become process bottle-necks if not planned properly. Especially, when the social and health care macro level process and detailed working processes inside the units are to be changed during the building planning project, simulation should be used - in a great detail – to analyze different system alternatives and model the benefits for patient and productivity. When there are multiple user units (or wards), dynamic input parameters and complex working processes, the need for simulation is evident, since other analysis methods cannot incorporate all the required characteristics of the process. When simulation is used, architects and other planners can have better input data and fewer late changes in their design process. And 3d-simulation is also useful when presenting the new processes to employees and other users of the building.

The use of process simulation and Lean thinking to support the architects' work will enable the building to be efficient in three ways. Firstly, the work inside the building is done efficiently while unnecessary movement is minimized and working phases that do not add value are removed, both in the patient care as well as in the logistic processes. Secondly, the built space is in efficient use, since unnecessary rooms are removed already in the design phase. Thirdly, the level of service customers perceive is higher due to functioning process. All in all, process simulation helps to cut down and prevent costs along the life cycle of the building.

Examples mentioned in this paper were from the single case. Many of the problems or aspects to consider are same in all hospital planning and design processes. It can be stated based on the findings in this paper that the use of simulation and process design helps architects and other design disciplines in designing a functioning and cost-efficient hospital, which also incorporates a better patient process and increases the availability of service.

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A SYSTEM FOR ROOM-SCALE CONTACTLESS MONITORING OF VITAL SIGNALS

Jussi Kuutti

Department of Electrical Engineering and Automation,
Aalto University School of Electrical Engineering
jussi.kuutti@aalto.fi

Mikko Paukkunen

Department of Electrical Engineering and Automation,
Aalto University School of Electrical Engineering
mikko.paukkunen@aalto.fi

Pekka Eskelinen

Department of Electrical Engineering and Automation,
Aalto University School of Electrical Engineering
pekka.eskelinen@aalto.fi

Raimo E. Sepponen

Department of Electrical Engineering and Automation,
Aalto University School of Electrical Engineering
raimo.sepponen@aalto.fi

ABSTRACT

Contactless detection of vital signs is needed when attachment of physical sensors on the subject is not possible. This is the case in health monitoring of elderly people in care homes or intoxicated people in police custody. Doppler radar sensors have been previously tested with promising results in, for example, searching casualties under earthquake rubble. The radar signal that is reflected from the subject is phase modulated by their heartbeat and breathing. However, the arbitrary position and movement of the subject decreases the detection accuracy. A previous study suggests that a metal shielding around the monitored person can be used to intensify the received modulated signal. This study presents an advanced 34-GHz low-power radar-based method for room-scale detection of respiration and heartbeat of a human subject. The functioning of the system is demonstrated in a test shed with aluminum coated surfaces strongly reflecting the radar signal. To further enhance the field of view and reflections of the signal, the radar sensor is placed in the shed's upper corner in a tilted position. In the system demonstration, one test subject lay in supine, prone and both side positions in the test shed, both breathing normally and holding his breath. Simultaneous electrocardiography, seismocardiography and respiration data were collected as reference. The results suggest that even with simple filtering of the radar signal, the vital signs could be satisfactorily detected in every subject position. However, to reveal the subject's heartbeat also during normal respiration, a more sophisticated analysis method should be applied on the data. Additionally, to generally confirm the system's operation, more tests with multiple test subjects of different sizes and in different positions should be carried out. The metal coating that improves the radar signal reflections and prevents the crosstalk of the signals originating from adjacent rooms can be rather easily installed at small spaces like cells. However, in residential facilities this may be complicated. Also furniture and other people in the same monitored room, set challenges to the vital signs detection.

Keywords

Contactless monitoring of vital signs, Doppler radar sensor, elderly care, cell death, smart environment

1   INTRODUCTION

Reliable contactless monitoring of vital signs is needed in many healthcare and medical surveillance applications. Radar-based detection can be utilized in emergency situations in search of people got buried under crashed buildings (Bimpas et al., 2004) or earthquake rubble (Matsui et al., 2004), or when searching hiding people in law enforcement and military operations (Bugaev et al., 2004). Sometimes contactless monitoring of vital signs is also necessary if the patient has severe burns and attachment of e.g. electrocardiography (ECG) electrodes is not possible (Birsan and Munteanu, 2012) or when it is necessary to protect medical personnel from a physical contact with a patient that has been exposed to toxic materials (Matsui et al., 2005).

The life expectancy in developed countries is increasing and their population is ageing (Christensen et al., 2009). Elongated lifetimes are probably also accompanied by physical and mental disabilities, and in the future there can be increased need for care home facilities with full-time assistance of the nursing staff (Kagawa et al., 2012; Matsui et al., 2013). A contactless radar-based detection system can provide a cost effective and versatile method to monitor the vital signs of the sleeping elderly (Matsui et al., 2013). Additionally, the system could be used to alert the nursing personnel if the resident falls on the floor and cannot get up on their own, or if a patient with memory disorders gets up in the night and is potentially leaving the room. A contactless radar-based system would thus improve the safety and wellbeing of the residents, especially in the night time when there usually are less nursing personnel present. Compared to video-based monitoring, a radar-based system would also better maintain the privacy of the care home residents.

In the last ten years, the National Police of Finland has annually reported 8-27 deaths of people in police custody. Compared to the number of drunk and disorderly arrests each year (89 000 on average) the number is small, but every cell death is nevertheless a tragedy and causes distress and procedural burden to the police department in question (Police University College, Statistical Service, 2014; Tiainen-Broms, 2012). Extremely intoxicated people are inspected by a physician prior to taking to the police station. However, it is not always clear what substances the arrested person has been taking and their condition can deteriorate while in custody (Hietanen, 2012). Currently the condition of the people in custody is monitored only visually and aurally through a peephole in the cell door—usually at only two-hour intervals—and sometimes additionally with video cameras (Eteläpää, 2010). Some cell deaths could have probably been prevented given the vital functions of the arrested person could have been reliably monitored. In this case, however, attaching physical sensors on the subject is not practical, and radar-based detection could be a feasible solution. The radar sensor can also be secured against possible violent attacks by hiding it behind a sheet that is transparent to the radar signal.

This study presents an advanced contactless Doppler radar-based system for detecting the respiration and heartbeat of a human subject. The radar sensor is installed in the upper corner of an aluminum-coated test shed in a tilted position, enabling good signal reflections and a comprehensive room-scale field of view with few or no blind spots. The configuration of the test setup is described, and a demonstration of the functioning of the system with one test subject in different lying positions inside the shed is performed.

2   STATE OF THE ART

Radar-based detection of vital signs has been previously comprehensively studied with promising results. Chen et al. (1986) described a 10 GHz radar-based life detection system that could be used to detect the heartbeat and respiration of people that lay on the ground at a distance of 30 m, or even further, and sitting behind a cinder block at a distance of about 3 m. In both cases the subject's body was perpendicular to the radar beam (Chen et al., 1986). Li et al. (2006) tested a Ka-band heartbeat detector with different transmitting powers and different distances perpendicular to four sides of a seated test subject. The best accuracy was achieved when measuring from the back of the body. The spectral analysis performed to the collected data revealed that the reason for this was the fact that the interference of the radar signal's harmonics was minimized when the measurement was performed in this subject position (Li et al., 2006). Li et al. (2009) also presented an application case study about utilizing a Doppler radar sensor (5.8 GHz) in infant vital signs monitoring. The system could be used to monitor the wellbeing of babies to prevent sudden infant death syndrome and detect possible breathing problems. The system was found out be able to accurately detect the respiration at distance of 1.15 m despite the subject's position, being thus suitable to be used with standard-sized cribs (Li et al., 2009).

Obeid et al. (2012) studied a radar system for heartbeat detection from a distance of 1 m. A test subject that was holding their breath was measured for 15 s with a 16-GHz operating frequency and several transmitting power levels between 0 and -25 dBm. The tests were performed both using a single antenna and separate transmission and receiving antennas. An ECG signal was acquired as a reference. Both antenna schemes showed promising results for detecting heart rate (HR) and heart rate variability (HRV). At lower power levels, however, the HRV could not be detected with a single antenna setup (Obeid et al., 2012). In a review by Li et al. (2013), it is suggested that a 228-GHz radar can be suitable for detecting vital signs even at a range of 50 m. Measuring respiration and heartbeat simultaneously with a very high frequency is, however, challenging. In addition to Doppler radars, some other promising radar technologies are also described. Ultra-wideband (UWB) radar's detection range can be controlled and the interference caused by multi-path reflections and reflections from other objects can thus be eliminated. Compared to a continuous wave Doppler radar the UWB radar is however more complex and has higher power consumption. Frequency-modulated continuous-wave (FM-CW) radar can be used to localize objects from a far distance. Thus, the technology can be practical in cases where subjects are very mobile, like in smart houses and care home facilities (Li et al., 2013).

Kagawa et al. (2012) developed a non-contact system for HR monitoring of elderly people. The system exploited two 24 GHz radars which were placed under a bed mattress. As an improvement to conventional radar-based methods, an automatic gain control was applied to reduce the influence of body motions. To maintain the detection accuracy despite the body position of the subject, the best radar output channel out of four was in real-time automatically selected. The research work by Kagawa et al. (2012) was continued by Matsui et al. (2013). Their study suggested that the system was a potential solution for constant monitoring of the HRV of bedridden elderly people. Alterations in HRV can be used, for

example, as an index of severity in sepsis, and predicting septic patients with a risk of multiple organ dysfunction syndromes (Matsui et al., 2013). Exploiting a capacitive sensor mat for fall detection of elderly people (Rimminen et al., 2010) and cardiac monitoring of people that lay on the mat (Rimminen et al., 2009) has also been studied with promising results. However, as installing the sensor mat under existing floor material can be burdensome and expensive, the system seems to be most suitable for apartments under construction or renovation.

3 APPROACH

3.1 Radar Sensor

For evaluation of the proposed vital signs monitoring system, a continuous wave microwave Doppler radar sensor was assembled (Figure 1). The Doppler radar signal reflected from the monitored subject is phase modulated due to the subject's respiration and heartbeat (Li et al., 2013). The test radar was implemented using wave guide technology. Wave guides are a practical and time-saving way for prototyping of radio-frequency devices compared to development work needed for the more compact monolithic microwave integrated circuits (MMIC). The operation principle of the radar follows the principles of basic police radar used for speed control of vehicles. A difference is that the test radar's movement detection starts from 0 Hz (DC voltages), rather than some fixed nonzero frequency corresponding the selected minimum velocity.
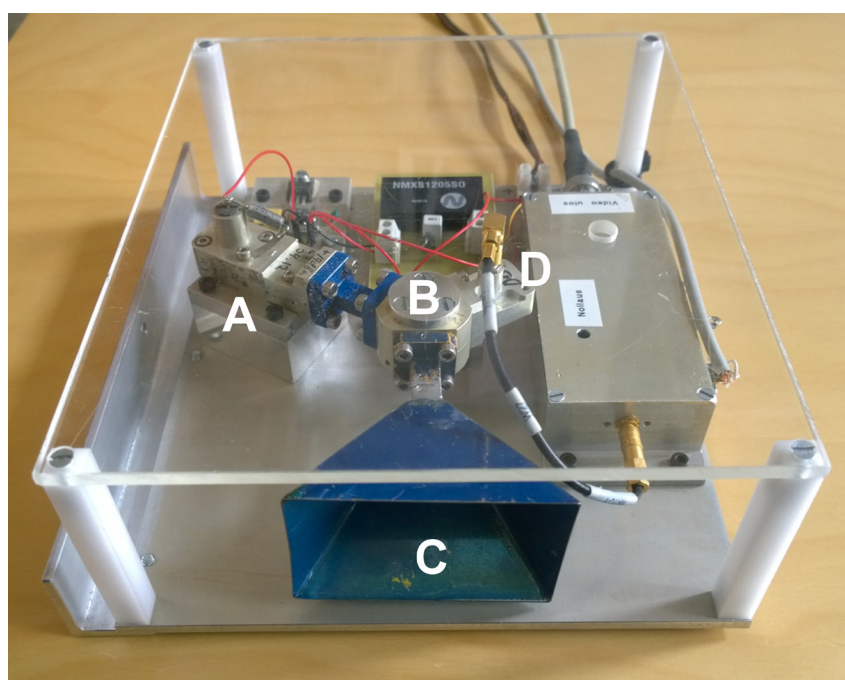

Figure 1 Test radar sensor: (A) transmitter, (B) circulator, (C) horn antenna and, (D) receiver and amplifier.

On the transmitter side of the radar, an M/A-COM 4000-series Gunn diode oscillator with a single frequency of 34 GHz is used. The maximum power of the radar is 100 mW but in the

test setup it is operated at 10 mW. The selected oscillator is not most optimally temperature compensated but has a simple structure and low price, thus being suitable for prototyping. The radar signal's wavelength, λ, is about 9 mm, which is of the same order with the chest deviation by respiration (4–12 mm) and not too large for heartbeat (0.2–0.5 mm) (Obeid et al., 2012). The millimeter-level wavelength also enables use of a relatively small-sized antenna. In the test radar, a horn antenna was used for its good directivity. As the radar features no frequency sweep, only the movement of the monitored subject can be discovered. The power density of the radar is far lower than the recommended safety limits (Finlex, 1991). Low power consumption of the radar also enables battery operation. This feature may be needed in applications were safety issues prevent the use of regular AC line current.

The receiver of the radar sensor employs one-diode phase detection to find out the Doppler frequency of the reflected signal. The transmitter and antenna are connected to the receiver through a ferromagnetic wave guide circulator. The circulator leaks the transmitted signal also to the receiver, where it is mixed with the reflected signal. The difference of these two signals is then phase detected. The difference signal should be ideally zero if no movement in the test shed is registered. Due to the Gunn diode's temperature dependence, however, there is always some noise and drift present. Thus, the radar has to be regularly tuned using a multiturn potentiometer.

The radar is powered with 12 V DC from a dual output AC/DC power supply (GPC-3030, Good Will Instrument, Bayan Lepas, Malaysia) and the radar output signal is fed to the data acquisition system via a coaxial cable using a BNC connector at the radar's end and a mono-micro plug at the other end.

3.2   Test Shed

Utilizing a metallic wire mesh chamber for radar-based vital signs monitoring has been previously tested by Chen et al. (1986). The chamber (2.5 m × 1 m × 0.3 m) could fit one person rather tightly. The radar (100 μW, 10 GHz) was connected via an open-ended waveguide to the chamber's wall. The cardiac activity and respiration signals of a test subject could be clearly detected in the supine and side positions. The radar could be operated with very low power as the metallic chamber limited the radiation's access to the environment and also kept the external noise out (Chen et al., 1986).

For this study, a test shed with dimensions of 120 cm × 205 cm × 195 cm (length × width × height) was constructed of 30 mm (walls and door) and 50 mm (floor and ceiling) thick polyurethane insulation boards with a 0.2-mm aluminum coating on both-sides (Figure 2, left). The shed was designed to comfortably fit one person in different positions and at same time to be room-like. The aluminum foil-coated insulation boards enabled a light-weighted and easily realizable structure of the test shed. Studwork of the shed was made of wood and the floor was covered with an additional 7-mm laminate panel enabling movement inside the shed. The test shed door was made of the same insulation board having a dimension of 60 cm × 186 cm. The inlets needed for measurement equipment cabling were pierced in the wall. The radar sensor was placed on a shelf in the corner near the ceiling of the shed (Figure 2, right). The radar's antenna is at height of about 173 cm from the test shed floor and it is

directed downwards vertically in 33º angle and horizontally in 45º angles to the walls.

Aluminum reduces the absorption of the radar signal in the building materials. Along with the tilted installation of the radar sensor, the aluminum coating was used to facilitate the best possible radar signal reflections and coverage in the test shed. In some applications, monitoring people located in adjacent rooms each equipped with a radar sensor might be needed. In these cases a reflective aluminum coating on the room surfaces will also prevent the crosstalk between separate radar signals.

Figure 2 External (left) and internal (right) view of the test shed: (A) test shed entrance, (B) feeding and (C) exhaust air fans of the ventilation, (D) data acquisition equipment, and (E) radar sensor.

The skin depth of an electro-magnetic wave on aluminum decreases with increasing frequency. Already at 1 GHz, the skin depth is about 0.003 mm. The featured coating (0.2 mm, 66 times the skin depth) can thus be considered as a thick shield, and multiple reflections inside the aluminum foil can be neglected. Additionally, as the dimensions of the test shed are far larger than the radar wavelength divided by 2π ($>> \lambda / 2\pi$), signal reflections in a far field can be expected and the radar signal can be handled as a plane wave (Ott, 1988). If a plane wave arrives at normal incident to the aluminum surface, the fraction of electromagnetic power that is reflected back from the surface, the reflection loss R, can be calculated as follows (Ott, 1988; equation 6-23b, p. 172):

$$R = 168 + 10 \log \frac{\sigma_r}{\mu_r f} \, dB$$

Using the radar's operation frequency f = 34 GHz, the relative conductivity (σ_r = 0.61) and the relative permeability (μr = 1) of aluminum, the Equation (1) gives a value R ≈ 61 dB. This means that less than 1 ppm (parts per million) of the energy gets into the aluminum coating and all other is reflected back to the test shed. Furthermore, the reflection loss of a plane wave increases with the angle of incidence (Ott, 1988). The wooden studwork, floor laminate and small gaps between the insulation boards, however, slightly decrease the reflections.

To promote the test subject comfort, the shed is equipped with a 25 W lamp attached to the wall. Ventilation of the test shed is realized with two 11-cm computer casing fans at its both ends. The feeding air fan was installed at the floor level and the exhaust air fan at the ceiling level of the test shed. The air exchange fans are powered with 5 V DC from the same dual output AC/DC power supply as the radar sensor. To further improve the test subject's comfort, a camping mattress made of 190T polyester with polyurethane foam and air filling and size of 183 cm × 51 cm × 2.5 cm is placed in the middle of the test shed.

3.3   Reference Measurements and Data Acquisition

Reference measurements were performed to obtain direct information about respiration and the mechanical and electrical functioning of the heart. Previous reports about radar-based vital signs detection have used only ECG (e.g. Obeid et al., 2012) or a fingertip pulse sensor (e.g. Li et al., 2006) as reference measurements for cardiac functioning of the test subjects. The present implementation couples ECG together with seismocardiography (SCG) to create a robust electro-mechanical reference data set against which to compare the radar measurements.

The mechanical functioning of the heart was measured with an SCG signal detection equipment based on the system described by Paukkunen et al. (2012). The SCG signal was captured with three orthogonally mounted 1-D acceleration sensors. For antialiasing, each acceleration signal was DC coupled to an 8th-order Bessel filter with rated -3dB cutoff frequency at 100 Hz. In contrast to the original implementation (Paukkunen et al., 2012), the SCG system in this study used DC coupling and a gain of 0 dB for the SCG signals to better detect the low-frequency respiratory movements of the chest.

The SCG sensor was mounted on the test subject's sternum about two centimeters above the xiphoid process using double-sided adhesive tape. The sensor wire was further secured just above the sensor and on the upper chest near the clavicle with single-sided adhesive tape. The ECG electrodes were attached on the medial side of the wrists and on the left ankle of the test subject. From this electrode configuration, the bipolar limb lead II (right wrist – left ankle) was detected. The respiration belt was placed on the abdomen without interfering with the SCG sensor. Placement of the electrodes and sensors is presented in Figure 3.

All signals were recorded with commercial data acquisition hardware and PC software (MP150 and AcqKnowledge 4.3, BIOPAC Systems, Goleta, CA, USA). The signals were digitized using a sampling rate of 1000 samples/second. Both the radar signal and the SCG signals were coupled to the data acquisition system through a universal interface module (UIM100C, BIOPAC Systems, Goleta, CA, USA). The ECG and respiration signals were

detected using wireless transmitters and receivers (BioNomadix BN-ECG2 and BN-RESP-XDCR, BIOPAC Systems, Goleta, CA, USA).
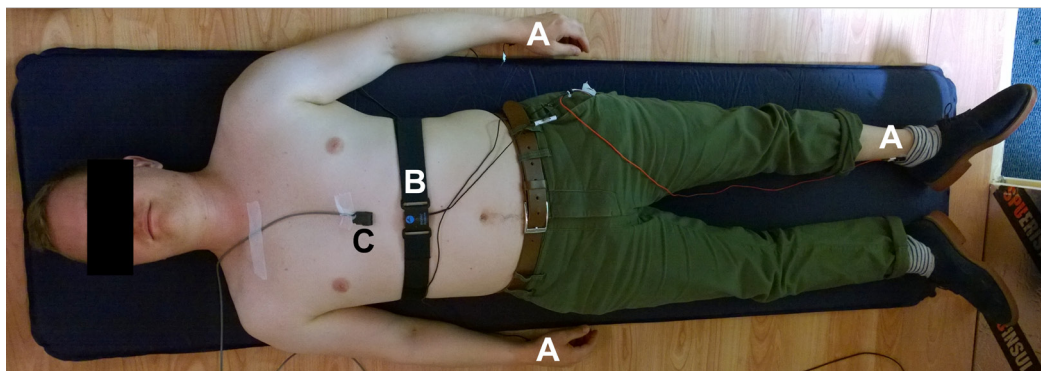

Figure 3. Placement of the ECG electrodes (A), respiration belt (B), and SCG sensor (C).

3.4   System Evaluation

Measurement data of a single test subject (36 years, male, 172 cm, 73 kg) was acquired in four different lying positions: supine (lying on back), prone (lying on abdomen), right side position and left side position. The test subject lay on a mattress with his head facing the test shed rear wall. In the supine and prone positions the legs and arms of the test subject were straight and aligned in parallel. In the side positions, the lower arm was placed under the head and the legs were slightly bent to add physical stability and comfort.

In each position, measurement data was first acquired for two minutes with the test subject breathing normally. After this, the test subject was instructed to take a deep breath and hold his breath as long as he felt comfortable. Simultaneously, the measurement data was acquired. Empty test shed was also measured with the radar sensor for two minutes as a reference. The test shed door was closed during all measurements.

In order to make the vital signs more visible the captured radar signal was filtered. A band-pass filter (BPF) with a pass-band of 0.2 – 0.5 Hz and a high-pass filter (HPF) with a cutoff frequency of 0.5 Hz was used for the normal breathing measurement and the breath-holding maneuver, respectively. Both filters were of finite impulse response (FIR) type with a -92-dB Blackman window. The selection of the cutoff frequencies was based on common frequencies of these vital signs (Bugaev et al., 2004). The reference signals were not filtered.
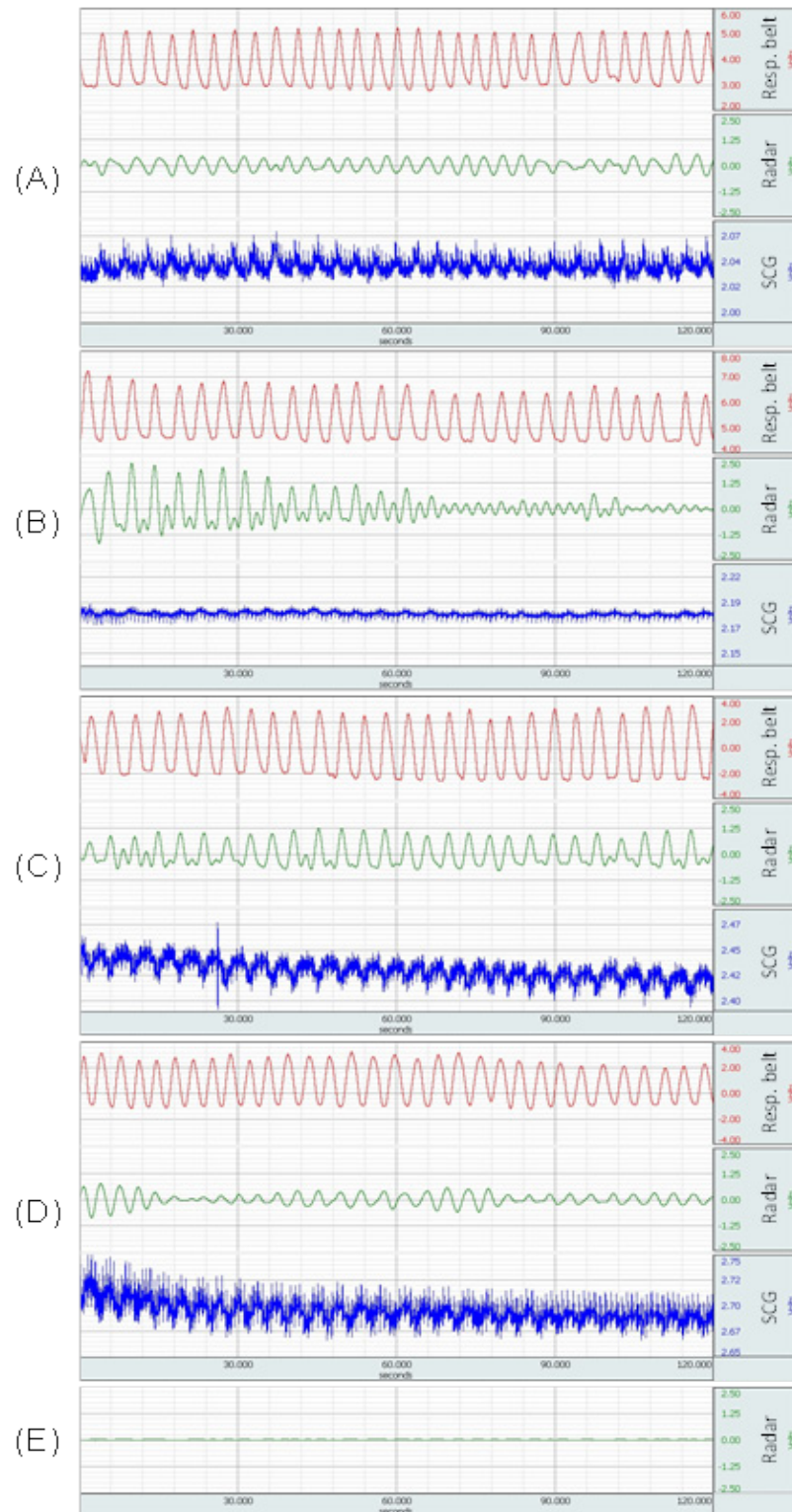
Figure 4 Recorded respiration belt, SCG (foot-to-head) and radar signals (BPF 0.2 – 0.5 Hz) during normal breathing periods: the test subject in supine (A), prone (B), left side (C), and right side positions (D). Additionally the radar signal of the empty test shed is shown (E).
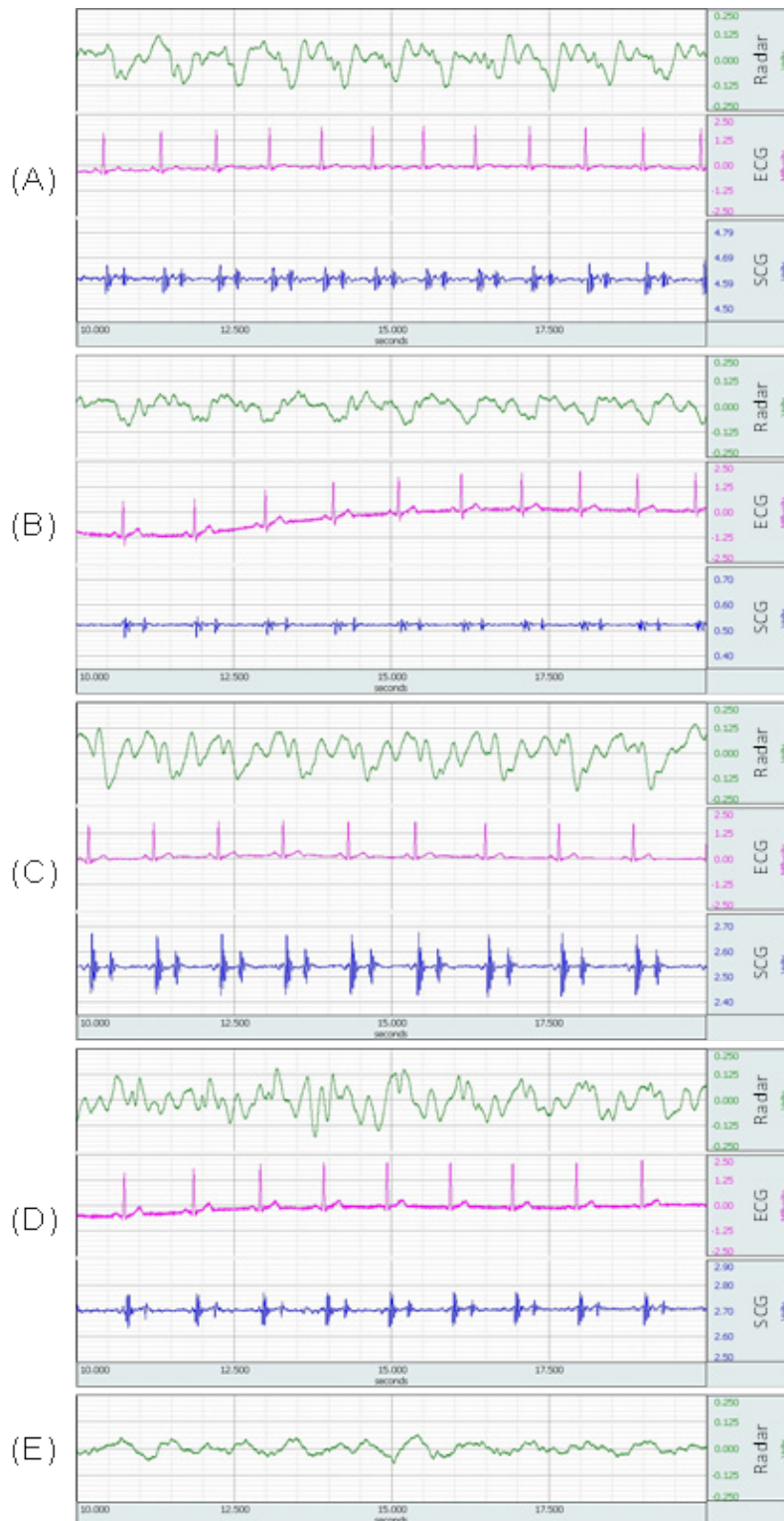
Figure 5 Recorded ECG (bipolar limb lead II), SCG (back-to-chest) and radar sensor signals (HPF 0.5 Hz) during the breath-hold periods: the test subject in supine (A), prone (B), left side (C), and right side positions (D). Additionally the radar signal of the empty test shed is shown (E).

4   RESULTS

One of the three possible SCG sensor signals giving the clearest visualization of the vital sign under consideration was selected. The respiration belt signal, foot-to-head SCG signal and the corresponding filtered radar signal for the whole normal breathing periods in different test positions are plotted in Figure 4. The detected bipolar limb lead II ECG signal, back-to-chest SCG signal and corresponding filtered radar signal for ten-second clips of the breath-hold periods are plotted in Figure 5. Similarly filtered radar signal of the empty test shed is additionally shown in both figures.

Correlation coefficients between the respiration belt and radar signals were in different test subject positions as follows: supine -0.814, prone 0.704, left side 0.843 and right side -0.334. Depending on the radar signal reflections, the respiration belt and radar sensor signals can be in same or opposite phases. Here, the negative sign implicates the latter.

5   DISCUSSION

The respiration of the test subject could be revealed from the acquired radar signal in each test subject position, and the radar signal frequencies were in agreement with the reference signals (Figure 4). In the supine and left side positions, respiration can be clearly distinguished from the radar signal but in the case of the prone position, there is strong variation in the signal amplitude. The correlations between the respiration belt and radar signals are relatively strong in all other than in the right side position. The poor correlation in this case is probably due the fact that during the data acquisition, the radar signal goes first to opposite phase compared to the respiration belt signal, and then rephrases again. During breath-hold periods, the heartbeats could be extracted from the radar signal in every subject position (Figure 5). Also in this case the frequencies of the radar-captured signals were in agreement with the reference signals. In the beginning of the right side position measurement, the radar signal seemed to be distracted by some noise, possibly caused by a motion artefact. Compared to the radar signal during normal respiration, the amplitude of the signal acquired from the empty test shed is infinitesimal. In the breath-hold case, the empty shed's signal is almost half of the magnitude of the heartbeat signal captured by the radar-sensor, but weak and arbitrary enough not to be interpreted as heartbeat.

The results here suggest that the vital signs could be extracted from the radar signal even with simple filtering. However, as respiration and heartbeat partly occupy the same frequency bands, more sophisticated analysis should be applied on the radar signal in order to extract the heartbeat also during normal respiration. It should also be noted that in some cases filtering alone may not be enough for extracting the vital signs from the radar signal. This may be the case if, for example, there is much environmental noise present or if the monitored subject is breathing very superficially or irregularly. Presence of random body artefacts or multiple subjects in the same room may also require advanced signal processing methods (Li et al., 2013).

The system evaluated in this study featured a test shed with aluminum foil-coated surfaces. Taking the low transmission power of the featured radar sensor into account, the reflective metal foil lamination seemed to well strengthen the radar field inside the test shed as was also indicated by previous research (Chen et al., 1986). Usually metal coating can be afterwards easily installed only to small-sized unfurnished spaces such as cells. In order to study the applicability of the presented monitoring method for example in nightly health and security monitoring of care-home residents, evaluation tests should also be carried out in regularly furnished rooms with casual surface materials.

Further evaluation with a bigger test subject group should be performed in order to find out the system's applicability in monitoring people with different weight, body size and strength of vital signs. Selection of the test subject positions should also be supplemented with different sitting and even arbitrary positions. Repeatability of the measurements should also be studied. With proper signal processing the SCG signal can be used to provide information about both the heartbeat and respiration (Tavakolian et al., 2008; Pandia et al., 2012). This can also be seen in Figure 4 and Figure 5. Thus, in future evaluations of the system, the reference instrumentation could potentially be limited to SCG measurements only.

While monitoring intoxicated people in police custody, exact information about their respiration and heartbeat may not be the most practical way to keep the monitoring personnel updated. Instead, the system could be set to give an alarm if the trends in vital signs indicate that the condition of the subject is in danger to deteriorate. Although strong motion artefacts prevent reliable detection of the vital signs, these body movements usually suggest that the subject is just changing position. In the case of very harsh motion artefact, in turn, the subject may have had a sudden seizure or is just in need of reassurance. In the case of nightly monitoring of health and movements of elderly people, the approach could in many cases be similar. If a strong motion artefact is suddenly registered, the resident is possibly rolling over or getting up. If no movement or vital signs information is after this registered, the person may be in need of medical attention or other help.

The monitoring devices used in homes or home-like care facilities must be non-obtrusive and acceptable to the residents (Chan et al. 2009). Generally assisting and monitoring technologies with low obtrusiveness are taken as most acceptable, and older people are more interested in applications which they feel they personally need (Daniel et al., 2009). The felt need and gained benefits in safety and autonomy can also override the privacy preferences (Courtney et al., 2008, Townsend et al. 2011), and the perceptions about assisting technologies are also often influenced by the healthcare providers (Courtney et al., 2008). Video-based monitoring is not likely accepted by older adults if a less obtrusive sensor is sufficient (Townsend et al. 2011). The radar-based detection system could be used to provide a less intrusive health and safety monitoring method, and the technology could also be used to support the ability of the elderly to remain independent in their own private homes as long as possible (Daniel et al., 2009). However, in case of any kind of technically assisted monitoring, its purpose and the used methods must be beforehand explained to the residents or their trustees, and consent from them received.

6   CONCLUSION

In this study, a test setup of a 34-GHz Doppler radar-based contactless vital signs detection system was presented. The test setup featured a test shed with aluminum-coated surfaces and an option for ECG, SCG, and respiration measurements. A demonstration of the system's functioning was performed with one test subject. The subject lay in four different positions in the test shed both breathing normally and holding his breath. The results suggested that even with simple filtering of the radar signal, the respiration and heartbeat could be satisfactorily detected in every subject position. The reflective metal coating on the test shed surfaces seemed to be a practical way to enable the use of low, and thus safe transmission power of the radar sensor. The presented system seems to be a potential option for contactless monitoring of vital signs. In the health and security monitoring of elderly people in care home facilities a clear advantage is the less intrusive detection method of the system. Any kind of monitoring in home-like facilities, however, must be beforehand accepted by the residents.

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EVALUATING DESIGN QUALITY IN OLDER PEOPLE'S RESIDENTIAL CARE FACILITIES

Linguistic challenges when adapting assessment instrument for use in Sweden

Susanna Nordin

Dalarna University
snr@du.se

Kevin MacKee

Dalarna University
kmc@du.aw

Marie Elf

Dalarna University
mel@du.se

Helle Wijk

Gothenburg University
helle.wijk@gu.se

ABSTRACT

Purpose The aim of the present study was to translate, adapt, and further develop the SCEAM instrument for use in Sweden.

Background There is increasing interest in how the physical environment can support health and well-being in residential care facilities (RCF) for older people. A recent review showed a lack of instruments for evaluating design quality in RCF. The SCEAM was identified as an instrument appropriate for Swedish RCF. SCEAM is a British instrument, developed to evaluate building design of RCF. The instrument is person-centered and uses the needs of frail older people as the basis for understanding how well the residential care facility is designed.

Method The translation involved two stages: for-ward and back-ward translation.

Results In this paper we focus on the linguistic challenges in translation of an instrument developed to evaluate the quality of the physical environment of RCF. A lengthy process of translation of the Sheffield Care Environments Assessment Matrix (SCEAM) has produced an instrument that fill a need of an instrument with a strong focus on the importance of the physical environment of RCF in the society.

Discussion To ensure quality in terms of conceptual and semantic equivalence between the original and the translated instrument, a forward-backward translation was followed in the current study. The translated instrument has a potential for use when planning new environments, during intervention and follow up as for quality assessment.

Keywords

Residential Care Facility, Elderly, Staff, Design Quality, Instruments, Linguistic challenges

Susanna Nordin / Kevin MacKee / Marie Elf / Helle Wijk

1   INTRODUCTION

There is a lack of valid and reliable instruments with a potential of evaluating the design quality of residential care facilities (RCF) for older people. This is crucial, given the importance of the physical environment in promoting positive healthcare outcomes. This was shown by Ulrich et al. (2008) in a research review where it was found evidence for that well-designed health care settings can promote healing for patients and provide good working environments for staff. Additionally, studies have shown that environmental design is linked to improved well-being and a decrease in psychiatric disturbance among persons with dementia (Cohen-Mansfield, 2004). So the impact of the physical environment on health and wellbeing is well established, for example the World Health Organization (1998) conceptualised the physical environment as one of four components of quality of life (Parker et al. 2004).

Evidence-based instruments for the assessment of the RCF´ strengths and weaknesses could both be

- imperative in improving the environment to better adapt to the elderly´s and staff needs,
- inform on how the design of the RCF effects outcomes such as health and well-being,
- support an evidence-based design (EBD) approach in the planning, design and construction of RCF´s and
- giving opportunities for comparisons between facilities.

As part of this process, reliable and valid instruments are required for the detailed assessment of healthcare environments. This paper describes the linguistic challenges when adapting an English instrument that assess design quality of RCF (the SCEAM) for use in Sweden (the S-SCEAM). It is a part of a wider study comprising the development of the Swedish version of the Sheffield Care Environment Assessment Matrix (S-SCEAM) (Nordin et al. 2015).

2   STATE OF THE ART

One way to construct attachment in residential care is to create a place that mimics the idea of one's old home, and subsequently parts of one's old self-identity (Wiles et al., 2009). RCFs are therefor also often represented and promoted as homes rather than healthcare environments. The approach has a strong agreement in the literature claiming a reciprocal relationship between the well-being of older people and the place and space in which they dwell, most obviously manifest through a strong sense of attachment (Wiles et al., 2009). If our understanding of the complex processes between the design and atmosphere of the building, its inhabitants and staff is to be enhanced, reliable and valid instruments for assessing the physical environment in RCFs are required. However, such instruments are lacking, especially instruments that encompass environmental features related to building legislations, health and safety issues, and those related to person-centred care.

The Sheffield Care Environment Assessment Matrix, SCEAM provides a comprehensive assessment of the physical environment of RCFs (McKee et al. 2002). It can be used to: guide the process of designing new RCFs; assess the potential of a building to be used as a RCF; assess the quality of an RCF in current use; collect data for research purposes. SCEAM consists of 370 items, each relating to a specific building feature. These are organised within a series of location categories (i.e., dining area, circulation space).

When evaluating a building using SCEAM, the assessor walks through the RCF and scores each SCEAM item as present (1) or absent (0) on a checklist. The RCF's scores is calculated as the proportion of items scored as present, and scores broken down by domain and building location give a profile that can be considered against standards of interest to the assessor or against other buildings. There is a SCEAM manual with guidelines for use and scoring checklists, and a glossary providing definitions of words and concepts. SCEAM was shown to possess some construct validity, but to date test-retest and inter-rater reliability have not been investigated, and the internal consistency of the instrument's user need domains remain unreported.

While SCEAM seems an appropriate instrument for assessing RCFs in the United Kingdom (U.K.) where the instrument was developed, the present study considered its suitability for use in Swedish RCFs. While British and Swedish RCFs share many features, there are also many differences. Such differences reflect how the two countries diverge on, for example, the specifics of design requirements and contemporary legislation on care for older people; and also more broadly in terms of architectural traditions and the cultural norms governing how older people are perceived and cared for. While adapting an instrument designed for one culture so it is fit for use in a different culture is not a simple process (Polit & Beck, 2012), there is still more work required in developing an entirely new instrument. Given the lack of instruments for assessing the physical environment in Swedish RCFs, the present study present experiences and results from the linguistic translation process of developing SCEAM to make it available for use in Sweden.

3   APPROACH

The translation phase was conducted in two stages and involved: 1) forward translation and 2) backward-translation. This procedure was iterative and cyclic with repeated rounds of adjustments performed by the research group. The study was conducted during 2011-2012, and was a part of a larger project, approved by the Central Ethical Review Board in Uppsala (Ref. No 2011/323). Participants and materials are described below as they relate to the two phases.

Stage 1: Forward translation

Three members of the research group had Swedish as mother tongue (SN, ME, HW), and one was a native English speaker who had been involved in the development of SCEAM (KM). Initially, KM explained and clarified the concepts and meanings of the items to reduce the risk of misinterpretation (29). The original SCEAM was translated from English to Swedish by the first author (SN), with focus on preserving the meaning of each item. The translation

was reviewed and discussed in the research group frequently before reaching consensus on the most appropriate translation of concepts and wording.

Stage 2: Backward translation

The Swedish version of SCEAM was translated back to English by a bilingual professional translator with English as mother tongue. The translator had no access to the original version. The meaning of the back-translated items and the original items were compared and discussed by the research group and the professional translator before reaching satisfactory equivalence between the versions.

4   RESULTS

The results follow the sequential order in which the translation was performed. Some items in the original SCEAM instrument were found to be difficult to translate. For example, the English word "culture" can be interpreted on several levels and cannot be directly translated to Swedish without the risk of changing the intent of the item. Further, some items in the original version contained words that do not convey the same meaning to Swedes or words that does not exist at all in the Swedish language. For instance, the word pastiche is not commonly used in the Swedish language and its meaning was therefore not clear. Furthermore, the phrase double banked corridor was not possible to translate since there is no counterpart in the Swedish language. These issues are elaborated via exemplar items in Table 1

Table 1. Example of forward translation

Original version	Forward translation
Do the lounges reflect the culture of residents?	Do the lounges generate a feeling of familiarity among the residents?
Is there any pastiche?	Are there any imitations?
Are there mainly double-banked corridors? (rooms on both sides, no windows)	Are there mainly corridors with rooms on both sides, not any windows?

Overall, there was a high degree of consistency between the backward translation and the original version. However, some alterations were revealed between the two versions which led to further investigation of some words and concepts before reaching consensus. Words of similar meaning were discussed such as the English words "safety" and "security". In the backward translation the word security was used instead of safety and this issue was discussed with the professional translator, where consideration was given to how similar terms can diverge in their suitability for describing a physical state in comparison to describing how a person feels about a physical state. These issues are elaborated via exemplar items in Table 2.

Table 2. Example of backward translation

Original version	Backward translation
Are there safety lighting indicating paths, ramps, steps?	Is there security lighting to show paths, ramps, steps?

Many items from the original SCEAM were found to be irrelevant in Sweden mainly due to cultural differences between the residential care systems. Some environmental features do not exist within Swedish RCFs. For example, one item asked whether the personal room or apartment could be monitored by glazed panel, spy-hole or surveillance camera. Such monitoring is not used in Swedish RCFs and is strictly regulated by law. On the other hand, some environmental features are universal in Sweden, but not in the UK. For instance, in the original instrument there are several items on personal belongings in the private apartment. That older persons in Swedish RCFs have their own apartments is regulated by the law which means that they can equip the apartment as they wish.

This highlights a problem with the original SCEAM, which was developed for use both as a design guide and for post-occupancy evaluation. For use as a design guide, it is important to have building regulations embedded in the instrument as items. However, when the same instrument is used for post-occupancy evaluation, if the RCFs assessed have been constructed according to building regulations as would be anticipated, such items will always return a positive response, creating bias in the instrument's scoring range, and providing little descriptive information.

The analysis also showed that several items in the original SCEAM were focused on how the building was used, and not on built-in design. Items related to building orientation, for example asking if lounges or private rooms are facing south in order to get daylight, were also considered to pose difficulties since it is questionable whether it is desirable for all rooms to face the same direction.

Several items were subjective estimations on the level of comfort within the physical environment, e.g the level of cleanliness. In addition, items sometimes included more than one sub-query which made the scoring problematic. Some items were perceived to be similar to each other, and some items contributed their respective scores to more than one user-need domain, problematic due to the inflation of inter-domain correlations that results. Consequently, words and concepts were changed and clarified. Overlapping items in which the content was similar or closely related were combined, and items with two or more scoring components were simplified. In cases where a single item scored on multiple domains, the item was revised or partitioned into two items to ensure its score contributed to only one domain.

Table 3. Example of revision of items

Original version	Translated version
Is there a view of the outside from the corridors? (include internal courtyard)	Are there external views from different parts of the circulation space? (including internal courtyard)
Are there external views from different parts of the circulation space?	

A number of items had to be allocated to new location categories, as some of the RCF location categories in the original SCEAM had no or little relevance for Swedish RCFs. New items were also added to the target language instrument. Several items relating to building standards and legislation for Swedish RCFs were added and included in the sections Overall Building Layout, Living Room, Kitchen and Private Apartment. For example, accommodations for persons with disabilities are recommended to be free from elevated thresholds in order to improve access in the indoor environment and minimize the risk of falling.

5   DISCUSSION

The procedure of translating SCEAM from English into Swedish produced an instrument called S-SCEAM.   However, the comprehensive changes of the original instrument raises the issue of whether or not we have produced an adaptation of an existing instrument, or rather a new instrument entirely. Yet, the basic structure of the original instrument remains, as do a high proportion of original items. An argument can be made that subtracting or adding items to an instrument is only changing one level of that instrument: the original SCEAM instrument was not merely a series of items assessing some abstract idea of a 'good' care environment for older people, but rather a tool for examining the role of the physical environment in the quality of life of its residents, and for enhancing the positive influence of that environment.

According to the limited amount of instruments for assessing the physical environment, SCEAM was identified as having considerable promise. The fact that the instrument had been developed in a British health care context suggested it might be readily adapted to Sweden since the two countries share a European sensibility and European legislation, and have long histories of welfare provision in supporting disadvantage citizens such as old people. Nevertheless, while the citizens of the U.K. and Sweden might have the same basic needs and share some core values and aspirations, the two countries could be argued to be quite distinct in terms of their approach to the care of older people. Care facilities for older people in the two countries might thus be anticipated to be distinct, with the realization of such facilities not only informed by care practices but also differing planning procedures and building legislations, differences in the materials used in the respective construction industries, and different principles relating to exterior and interior design.

This distinctiveness of Swedish and British RCFs emerged quite clearly in this study. Core differences between Swedish and British RCFs – such as the requirement for individual private apartments in the former, informed by Swedish legislation identifying care facilities as 'home' for their residents - had the effect that many items in the original SCEAM were judged to have little or no relevance for the Swedish context. The passage of time itself can also influence the validity of an instrument. Although SCEAM was developed only a decade ago, ten years is a substantial duration in which developments and changes in care practices and legislation can occur, as well as in technology relevant to both care practice and care environments. Adapting an instrument from one language and culture into another is,

therefore, not only about ensuring cultural relevance and applicability: the adaptation process provides an opportunity to look carefully at the original instrument and to improve upon the original in terms of reliability and validity, general robustness and 'user-friendliness', and suitability for use.

Study strengths and weaknesses

Due to the breadth of the original SCEAM instrument, the translation work was quite time consuming and demanding. However, it was crucial that the process was comprehensive, and the iterative approach adopted provided opportunities for periods of reflection, adaptation and revision. Eldh et al (2013) stresses the necessity of forward- and backward translation of an instrument followed by testing the translated instrument in the target culture, in order to achieve a better understanding of important aspects of both the original and translated version. It was valuable in this respect to have one of the members of the group that developed the original SCEAM as part of the current research group; and the input of a range of individuals representing different perspectives and different expertise was essential.

To ensure quality in terms of conceptual and semantic equivalence between the original and the translated instrument, a forward-backward translation recommended by Polit and Beck (2012) was followed in the current study. However, standard guidelines for instrument translation are lacking, and there is yet no accepted optimal method.

6   CONCLUSION

There are relatively few instruments that reliably and validly assess the physical environment of RCFs, yet there is a great need for such instruments. There is clear evidence for the important role of the physical environment in the quality of life of individuals, and as an individual's frailty increases so does the significance of the physical environment for life quality. Of course, physical environments, once constructed, are not so easily changed. Yet the cost of intervention at a physical level is not an argument against so intervening, and the retention of a poor environment can be a serious barrier to the success of interventions other than environmental: if the environment works against the provision of good quality care, the impact of change in care practice will be minimised.

S-SCEAM is as a comprehensive instrument for the assessment of Swedish RCFS. Psychometric testing of the instrument as well as the development of guidelines for the appropriate use in Swedish context are also yet to be developed. Nevertheless, S-SCEAM in its current form has considerable promise as an instrument that can be used in the assessment of the physical environment of Swedish RCFs. S-SCEAM can contribute to the evidence-based design of RCFs through use when planning new facilities, assessing existing facilities, renovating facilities, or when conducting research into the relationship between the environment of RCFs and the quality of life of residents. While S-SCEAM clearly has its greatest application within Swedish RCFs, we would suggest that S-SCEAM represents an improvement on the original SCEAM, and can be better used as a foundation for future developments of the SCEAM as

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HOSPITAL CONCEPT AND HOSPITAL PROGRAMMING - PARTS OF THE PLANNING PROCESS

Reijo Kekäläinen

Dosent (Emer) Aalto University
Faculty of Architecture

KEYWORDS

Concept of the hospital

It is necessary to group the hospital functions to main groups such as operational area, elective area, patient ward area and technical support services, patients and staff services. The concept is the basis for programming and planning.

Functional medical volumes

The medical volumes are based on hospital district population. The hospital shall take care of the needs of the population. The volumes shall be calculated for various specialities by using reliable statistics.

Planning figures

All medical specialty functions have an individual figure for production volumes. They are mostly presented in a form of how much volume for 1000 inhabitants. For instance 0.7 visits for consultation/1000 inhabitants/year or 8 % of the population will be operated/year.

Programming

For programming a reliable production volume must be determined. It concerns all functional activities both medical and non-medical.

The volumes are transferred to square meters by using general figures such as 700 operations/theatre/year and 2500 consultations/consultation room/year.

INTRODUCTION

When looking at the situation in Finnish Central hospitals today it is astonishing how poor has been the competence in programming and planning. Extensions with important medical functions have been clued to the main building where ever there is free site for construction. The hospitals seldom have not had any functional concept or the site a master plan to follow.

When you plan a new hospital or renovation you must have a functional concept and a reliable realistic room program. In Finland there exists several serious modernization projects for hospitals. Some have already lay-out sketches under preparing. The projects do not have proper functional concepts for medical activities, neither do they have proper realistic room programs.

The principles how to construct a realistic room program are unknown. The only source for information for the program is the present staff. The main principle is to maintain the present way of working. For the future the volumes are increased just to be sure.

Very often the statistics is unreliable or they are not used and very often misunderstood and have unreliable interpretation. The change in volumes, increase or development is not updated.

Most of the planners are unexperienced simply because we have not made big hospitals in Finland during the last thirty five years. The planners are completely dependent on the hospital personnel. It is very dangerous because there are no tools to control the aims and competence of the staff.

In planning and design of a sizy central hospital the planners need a clear medical concept. Also they need a realistic departmental- and room program. The program is based on the population of the hospital district and constructed by using correct volumes for functions as well as domestic and international planning figures.

The leadership of hospitals shall understand that there must be a functional medical concept and a updated master-plan at all times. Hospitals are changing, growing and developing continuously. There are new functions and methods which must be adapted. There must be guidelines and information how to carry out new demands.

The rules how to design a hospital have not been touched in the previous seminars or conferences, not at least enough. The main interest has been put on architecture and hospital administration and organizations. The lecturers have been taking about healing environments not clearly presented what it really means.

I will handle the hospital concept and the procedure for constructing a realistic program for the hospital in my presentation.

1   SETTING THE PROBLEMS

The first task of this study is to find or form a medical concept for the hospital. It means that all departments and units must be analyzed in order to find out their place and tasks in the hospital entity.

It is necessary to study the patients, personnel, material and general logistics of the unit. This way you find out the characteristics of each department. Next step is to combine departments and functions with similar nature to larger entities. When you have formed the medical elements you have to add non-medical parts.

Second task is to work out the means to construct a reliable and realistic room program. The key facts are the functional volumes of each specialty and medical performance. These volumes are based on the population. It is obvious that similar population in various hospital districts need equal functions and volumes. If the population is only a half the volumes are also half.

These medical needs and services what the population demands or needs can be examined statistically. Through this examining the essential planning figures can be found. They are for instance in consultation visits/1000 inh./year, operations/inh./year and so on. This way figures for emergency, on call units, open-care departments and others can be discovered.

By using the planning figures a functional medical program can be constructed with realistic volumes. This program is the basic for creating the room program for the hospital.

When the hospital concept and the departmental program or room program are available the following step in planning is to start to form the building and to put it on site and start to think about the external traffic solution.

2   APPROACH TO THE PROBLEM

The background for this study and presentation is an over forty years professional experience in hospital design. It   includes office work, research work for doctoral degree and teaching period in Aalto University faculty of architecture.

The research work in Aalto University, Sotera Institute with lots of excursions to the latest modern hospitals in Europe during the last ten years has formed a reliable view of the direction where the hospital design is moving.

By examining modern hospitals, discussing with the right persons and studying the motives for changes and solutions it is possible to pick up one thing from there, another from here and combine a theoretical ideal model or hospital concept. Some solutions have been made from an economical point of view and some from medical point of view. The difficult part is to separate one from another.

Research works on this field are rare to be found. The only way practically is to study modern new hospital and to discuss with people involved.

3 PROBLEMS AND RESULTS

3.1. Background

When starting a new hospital project or major renovation of an old hospital one of the key problems is to find out size and dimensions of the new hospital. It is very common that a standard general/central hospital in Europe is based on a 300-200.000 population. This population is big enough to demand various medical specialities in volumes which enable to have a separate department in the hospital. Concerning big hospitals there are also other factors affecting to the dimensioning. They are for instance:

- Teaching
- Research
- Cooperation with other hospitals

Population is the key to the medical volumes needed for the hospital functions to serve the society on different medical needs and problems.

By using statistics certain characteristic figures for the needed functional volumes can be found. This gives the possibility to count and find out what kind of medical services are needed and what the essential volumes are. It is astonishing that the same population in Central Europe and in Central Finland has the same demands and equal volumes in special care hospital services, for instance operations, deliveries, doctor 's consultation, need of patient wards etc.

There are some statistic figures you have to use when forming the programs. Most important are the following:

- How many patient visits per year for the elective consultation and how many visits/year/cons. room.
- How many patient visits per year for emergency and 24/7 consultation
- How many operations per year/population and how they are divided for:
    - Elective operations
    - Day surgery
    - Endoscopies
    - Sections
    - Eye surgery
    - 24/7 on-call surgery
- How many operations/op.theatre/year
- How many beds for the wards per 1000 inhabitants and how they are divided for the specialities
- How many examinations per inhabitant yearly for imaging how many examinations in one x-ray laboratory yearly in average
- How many laboratory tests for the population yearly and how many test results for one worker and how much gross m^2 per one worker

Some important areas or functions are dominating when forming the medical entity of the hospital. They are:

- Emergency and 24/7 consultation
- Elective consultation
- Open care units
- Operation and treatment
- Wards, hospital beds
- Delivery
- Imaging and laboratory services
- Supporting services

These functional volumes give 95 % of the hospital entity. They can be transferred to facilities and rooms and also to the number of personnel needed. In order to find out how many functional rooms are needed you have to determine and agree the yearly volume of the main functions, for instance:

- The number of operations/year/theatre
- The number of consultations/year/cons. room
- The number of deliveries/year/delivery room
- The number of treatments/yearly/in various tr. room

You also need the number of the beds for intensive care unit, neonatal ICU, observation unit in emergency, infection unit and so on. The numbers are related to other functional volumes of the hospital. Lots of discussions have occurred lately concerning the number of hospital beds needed in the hospital for certain population. The numbers vary between 2.5- 1.6/1000 inh. The discussion has risen because the conservative wards which work 24/7 are expensive.

Some solutions exist to the subject. Many hospitals have formed day hospitals. Also wards for critical patients have been established. These wards take care of 24/7 patients.

By using above mentioned methods and essential characteristic figures we can find out the sizes and dimensions for various functions in the hospital as well as the medical needs. This information can be transformed to departmental premises and to room programs.

3.2. Hospital concepts

Every hospital needs a medical functional concept. It is the guideline for future development and overall mastering and controlling the entity. It is comparable to the Master-Plan which shows way for future land use and building renovations and enlargements.

The concept "core hospital" first came out in connection of an architectural competition "Future hospital 2004". The hospital was to be placed in the middle of Rotterdam City. There was not place enough for all functions of the program (100 000 m2). The winner picked up the most essential functions of the medical performance and called it "Core hospital". Today we call it "Hot hospital" and it is the most demanding part of the hospital in modern programming and design.

In this study full attention is also put on the functions which were left out in the "Future hospital" when forming the Core hospital. In this study the whole hospital will be examined.

After finding out the medical and none-medical functions and volumes of the hospital we can analyze the result with several characteristics:

- Functions of the unit
- Working hours
- Elective or 24/7 function
- Medical and non-medical
- Volume of patients
- Nature of patients
- Need of own entrance
- Special needs for dimensioning (room height, construction etc)

By studying the criteria the hospital departments can be grouped into larger entities. It occurred that there are five or six entities which are studied in the following pages.

Few facts have to be mentioned which are essential in forming the hospital concept. It is assumed that multipurpose rooms are used in:

- Doctor `s consultation (with some exceptions)
- Wards
- 24/7 consultation

Latest hospital concept used in the planning is the following:

3.2.1. Hot hospital

This essential part of hospital functions quite much follows the "core hospital" idea. Differences are that today it is part of the whole hospital entity. It contains all 24/7 departments and functions.

In this study also the rest of the hospital will be analyzed not only the "Hot hospital". Other hospital functions will also be part of the hospital concept.

This part consists of all 24/7 medical activities in the hospital. The units are:

- Emergency, 24/7 consultations
- Operation
- Delivery
- Intensive care units, monitoring units
- Infection unit
- Part of imaging and laboratory for emergency
- Ward for critical patients

It should have two entrances one for 24/7 consulting and one for emergency and trauma. Very often delivery unit also have an own entrance.

The planners were discussing of "hot floor" in the hospital but today the hot area is so large that it has to be solved to be in several floors. Otherwise the distances will be too long. The hot area is about 15-18 % of the building volume.

This part is the living core or heart in the hospital. It is constructed with stainless steel, tiling and special floor materials. It has a heavy mechanical service and has a typical hospital atmosphere.

The reasons for the hot hospital entity are the following:

- 24/7 working hours
- Heavy mechanical services
- All individual units are part of the patient processes
- No disturbance to the rest of the hospital

3.2.2. Elective hospital

This part of the hospital is normally working eight (8) hours five days a week. It's function can be described so that it works like an office or a supermarket. Patients are elective patients with reference to the doctors` consultation or treatment.

This part of the hospital consists of following units:

- Doctors` consultation
- Day hospital
- Procedure center, treatment unit
- Open care functions, rehabilitation, psychiatry, dialyses, oncology therapy unit
- Sample taking
- Center for health promotion

The patients use main entrance and have a referral from health center, gp or similar. Some patients come from the wards. The main aspect of this part is that the work is planned and thus easy to direct and control.

The role of day hospital is developing. Some hospitals use it for as reception for patients to operation. All preparations for operations take place here. The location is in this case near operation unit.

3.2.3. Diagnostic service units

The departments of this unit have special functions. They are examining patients or samples taken from patients. They can have patient visits and the patients come mainly from the doctor `s consultation and from the wards. The units of this part are:

- Imaging diagnostics
- Central laboratory with
- Microbiology
- Clinical chemistry
- Hematology
- Microbiology
- Pathology
- Radioisotopes
- Clinical physiology
- Neurophysiology

It is often recommended that these units shall be located to the same part of the hospital. Individual unit location depends on patient traffic. Work in these departments is mainly planned before it is predictable.

Emergency and 24/7 consultation mostly have own imaging possibilities and also on-call laboratory services so these patients do not disturb the main units. Working hours are eight (8) hours per week five days. Mechanical and electrical services are semi heavy as well as building technics and materials.

3.2.4. The hospital wards

In some European countries the planners have started to use one patient rooms on hospital wards with individual bathroom. The solutions have an approach which has a hotel reminding touch. In personnel several hospitals use more so called hotel staff to take care of non-medical works. The relation in personnel between nurses and assisting staff has changed.

The patient ward organization or system in a modern hospital can be the following:

- **Wards** hotel part, it has appr. 80-85 % of the hospital beds. It works practically eight (8) hours with full staff. All patients who need 24/7 observation will be transferred to the critical patient ward which is open 24/7 and is situated in hot hospital premises.

- **Critical patient ward** is located in hot hospital area. It has about six to eight (6-8) % of the main ward beds.

- **Monitoring ward** is also in hot hospital area. It is a step –down unit from intensive care unit (ICU) and does not have or need as much personnel as ICU.

- **Observation ward** is part of the emergency and 24/7 consultation. The unit belongs to the emergency patient process when searching for the diagnostics and care and treatment.

- **Intensive care unit** is part of the emergency and operation processes 24/7 and situated close to the emergency and operation unit.

- **Day hospital** belongs to the elective hospital area. Patients come in the morning and during the day by appointment and referrals. It works in close connection with

consultation, open care unit and wards. According to the statistics the day-hospital can lighten the work pressure on the wards remarkably.

The hospital ward has always formed an own almost separate part of the hospital building. What has happened lately is that the number of beds in hospitals has decreased dramatically. The work load on patient ward is lower than before.

It has been a long way from 20-40 bed ward halls towards one bed patient room comparable to a hotel room. However the structure of the personnel has not followed the change.

We have got used to dimension the hospitals according to the number of beds also the cost of running a hospital have been related to the number of beds.

Today we try to make hospitals with less beds than earlier the patient stay on the ward is shorter and actually we can take care of more patients with only half of the beds compared for instance to 70ies.

Day hospital plays an important role developing the hospital for the future. Today the unit has many tasks in different hospitals. The functions are not the same in various hospitals. The main functions are:

- Oncology
- Preparation for operation
- Second recovery
- Children`s psychiatry
- Hematology
- Care for int. medicine

In some hospitals they will try to find rooms for day hospital in Hot hospital premises. It has been noticed that it helps so much the wards and many other units that this location and more working hours can be a good alternative to examine.

Counting the running cost of a hospital must be based on other production than the number of beds in the hospital.

Same problem exists when we have used to count the square meters (m2) related to the number of beds. It is not necessarily relevant today.

3.2.5. Technical support services

The units and functions in this part are serving the medical performance. They take care of material supply, catering, cleaning, repairs and building maintenance. In this part are also security and control systems as well as ICT services. This part consists of following functions:

- Central storages, logistic center
- Sterilization

- Pharmacy
- Catering
- Building and equipment maintenance
- ICT services

These departments are normally gathered around or to the nearness of a service yard in order to get materials directly to the units. Material supply logistics in a hospital is one of the most important logistic systems. It also contains the routes for waste and used textiles. Lots of various technical transport equipment have been installed to hospitals to take care of these logistics.

It is natural to group these departments together. They have many similar demand for external and internal traffic connections, same kind of building demands in materials and dimensioning. Sterilization has one individual demand. It has to be able to serve operational functions correctly.

3.2.6. Patient and personnel services

The functions in this part are assisting the personnel to do their work in the hospital. In this part also belong services for the patients during their visit in the hospital. These services here are non-medical in nature.

This part consists of following functions:

- Administration
- Staff changing rooms
- Catering for staff
- Education and teaching
- Patient services
- Restaurants, café`s etc

These functions have a common task but they do not necessarily form a separate or individual block in the building. These facilities are located in different parts of the hospital. Some of them are in dark basement area, some have to be located to parts with good natural light, some functions can have own separate entrances and so on.

Most of the patient services (non-medical) are naturally located in connection or near the entrance or main hall. This is the area where the patients, outpatients or inpatients and also visitors have their shops, café s, restaurants, hair salons etc.

3.3. Conclusion of the concept

The various functional hospital concepts are made to form guidelines for a hospital how to run it. It also gives instructions and limits for an individual development. Reasons to make the concepts are many. Researches and planners have made a closer look to the functions of the hospitals and they have tried to organize the functions and building so that it is more:

- Effective
- Productive
- Economical
- Appropriate
- Friendly to the patient
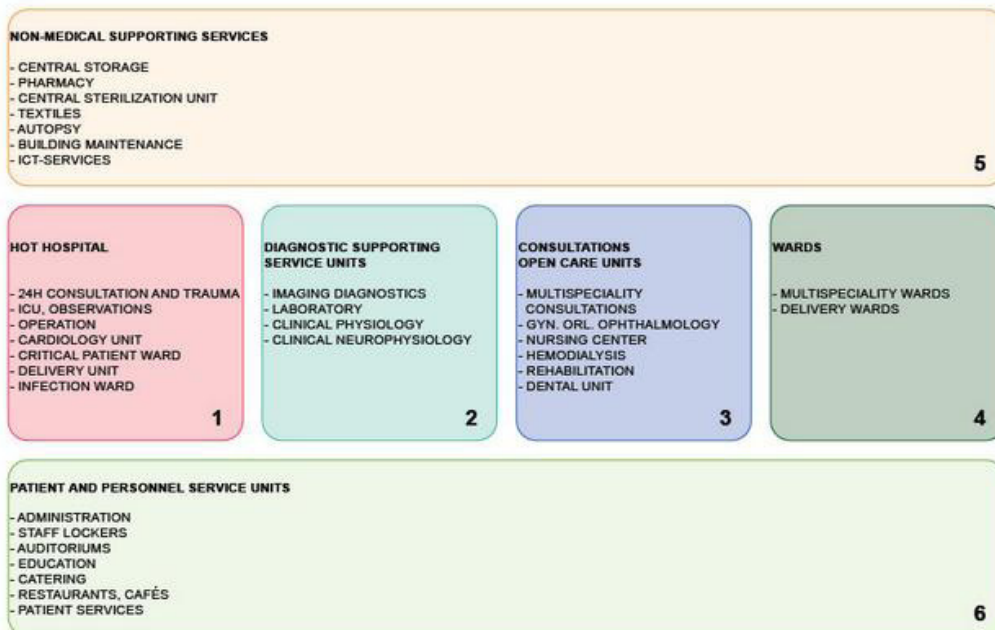- Organized, compared to old hospitals thirty or forty years back.

The hospital world is very conservative and it does not change or develop itself very easily. The persons who have a good overall touch at a hospital are few and they are very seldom doctors or nurses. In a group with several educations and backgrounds it is often difficult to find a common language. If a reasonable medical concept can be reached it is a big step for the hospital.

The aim of this concept has been to find a scheme which gives freedom to the hospital planners and designers. It means that you are not any more bind to conservative building forms and traditional solutions. The planners have five different building elements to play with. Each of them has individual functions and dimensioning.
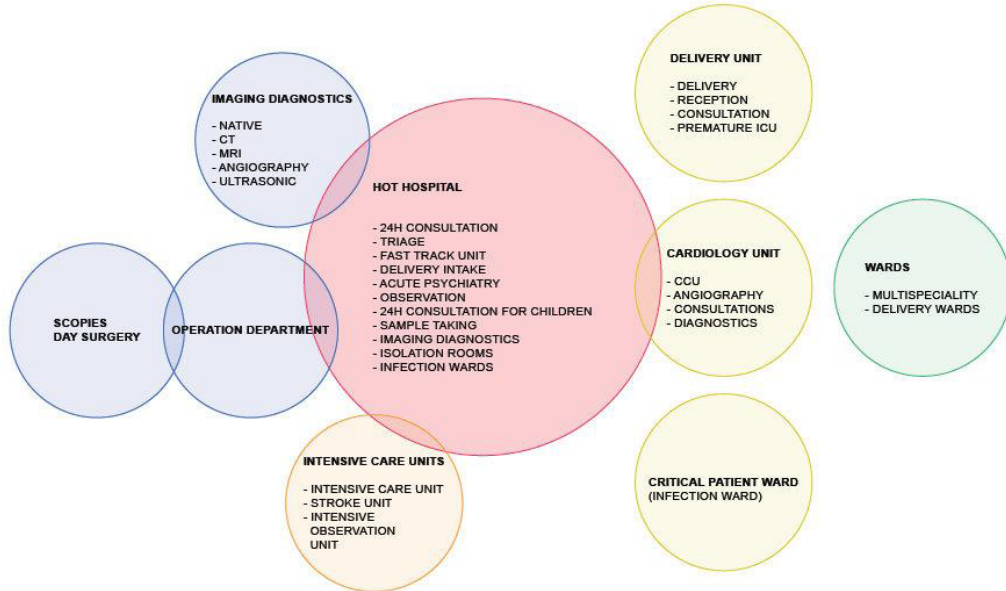
The main blocks can be divided to smaller parts or they can be combined in many ways presuming that the planners are acquainted with hospital functions.

From the overall logistics it means that the patients and the staff mainly stays in the same part of the building in different cases as well as the visitors. The patient processes should be put to the hospital building so that people do not have to move around the hospital too much. Same kind of patients stays in the same area.

GENERAL HOSPITAL CONCEPT
MAIN GROUPING OF FUNCTIONS

NON-MEDICAL SUPPORTING SERVICES

- CENTRAL STORAGE
- PHARMACY
- CENTRAL STERILIZATION UNIT
- TEXTILES
- AUTOPSY
- BUILDING MAINTENANCE
- ICT-SERVICES

5

HOT HOSPITAL	DIAGNOSTIC SUPPORTING SERVICE UNITS	CONSULTATIONS OPEN CARE UNITS	WARDS
- 24H CONSULTATION AND TRAUMA - ICU, OBSERVATIONS - OPERATION - CARDIOLOGY UNIT - CRITICAL PATIENT WARD - DELIVERY UNIT - INFECTION WARD	- IMAGING DIAGNOSTICS - LABORATORY - CLINICAL PHYSIOLOGY - CLINICAL NEUROPHYSIOLOGY	- MULTISPECIALITY CONSULTATIONS - GYN. ORL. OPHTHALMOLOGY - NURSING CENTER - HEMODIALYSIS - REHABILITATION - DENTAL UNIT	- MULTISPECIALITY WARDS - DELIVERY WARDS
1	2	3	4

PATIENT AND PERSONNEL SERVICE UNITS

- ADMINISTRATION
- STAFF LOCKERS
- AUDITORIUMS
- EDUCATION
- CATERING
- RESTAURANTS, CAFÉS
- PATIENT SERVICES

6

GENERAL HOSPITAL CONCEPT
HOT HOSPITAL

IMAGING DIAGNOSTICS

- NATIVE
- CT
- MRI
- ANGIOGRAPHY
- ULTRASONIC

DELIVERY UNIT

- DELIVERY
- RECEPTION
- CONSULTATION
- PREMATURE ICU

HOT HOSPITAL

- 24H CONSULTATION
- TRIAGE
- FAST TRACK UNIT
- DELIVERY INTAKE
- ACUTE PSYCHIATRY
- OBSERVATION
- 24H CONSULTATION FOR CHILDREN
- SAMPLE TAKING
- IMAGING DIAGNOSTICS
- ISOLATION ROOMS
- INFECTION WARDS

CARDIOLOGY UNIT

- CCU
- ANGIOGRAPHY
- CONSULTATIONS
- DIAGNOSTICS

WARDS

- MULTISPECIALITY
- DELIVERY WARDS

**SCOPIES
DAY SURGERY**

OPERATION DEPARTMENT

INTENSIVE CARE UNITS

- INTENSIVE CARE UNIT
- STROKE UNIT
- INTENSIVE
  OBSERVATION
  UNIT

CRITICAL PATIENT WARD
(INFECTION WARD)

GENERAL HOSPITAL CONCEPT
CONSULTATIONS
OPEN CARE UNITS

IMAGING DIAGNOSTICS

TREATMENT UNIT

CONSULTATIONS

- MULTISPECIALITY CONSULTATION
- OPHTHALMOLOGY, ORL, GYNECOLOGY

OPEN CARE UNITS

- HEMODIALYSIS
- REHABILITATION
- MEDICATION
- DAY HOSPITAL

**CLINICAL
PHYSIOLOGY**

**CLINICAL
NEUROPHYSIOLOGY**

NURSING UNIT

SAMPLE TAKING

DENTAL UNIT
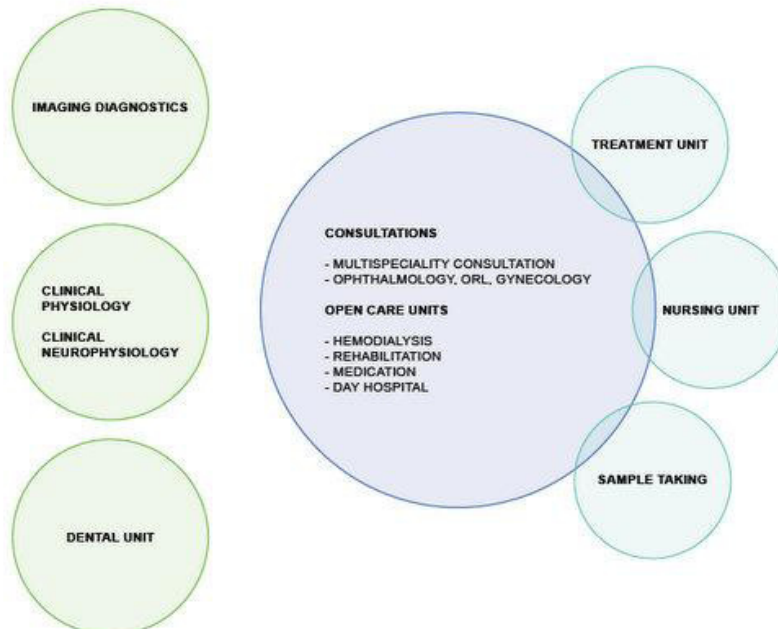
GENERAL HOSPITAL CONCEPT
DIAGNOSTIC SUPPORTING SERVICES

ELECTIVE PATIENTS

HOT HOSPITAL

DIAGNOSTIC SUPPORTING SERVICES

- IMAGING DIAGNOSTICS
- CENTRAL LABORATORY
- CLINICAL PHYSIOLOGY
- CLINICAL NEUROPHYSIOLOGY

CONSULTATIONS

WARDS

GENERAL HOSPITAL CONCEPT
WARDS

**IMAGING DIAGNOSTICS
CLINICAL PHYSIOLOGY
CLINICAL NEUROPHYSIOLOGY
REHABILITATION**

CONNECTIONS TO
TREATMENT UNITS

CRITICAL PATIENT WARD

WARDS

- MULTISPECIALITY WARDS
- DELIVERY WARD

VISITORS
ENTRANCE

**OPERATION
DELIVERY**
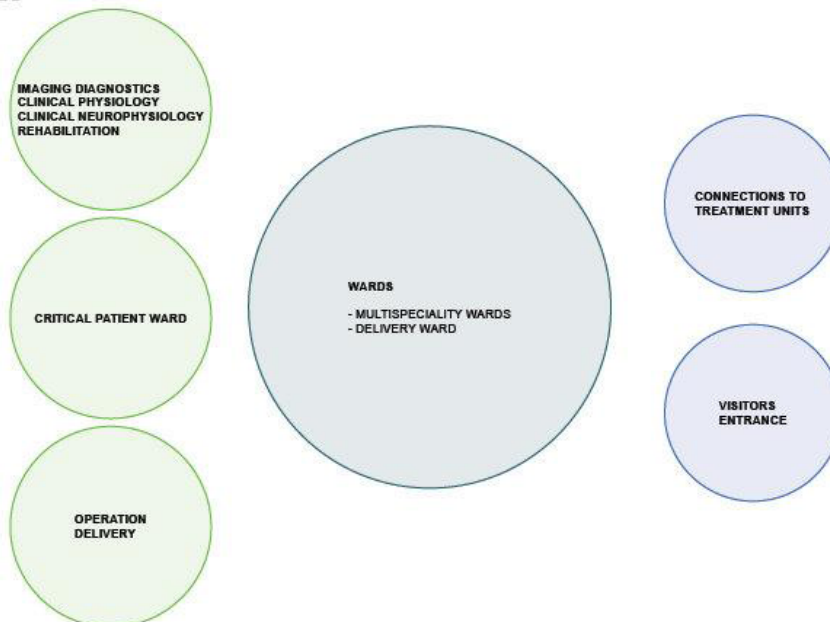
4   PATIENT PROCESSES

The concept gives guidelines for the four medical department groups and to the two technical and staff service groups. In forming the concepts logistic patient processes have been used to help in approaching the hospital entity.

When you look and examine closely the hospital processes there exist about fifteen (15) essential patient processes, five technical support processes and a few individual special processes, for instance visitors ` routes. These processes determine the locations of the individual units inside the department group. Most important processes are the ones for emergency and 24/7 consulting patients.

4.1. Emergency

Emergency processes start from the entrance and lead through first aid, sample taking, imaging diagnostics and treatment into the observation ward, intensive care unit or maybe back home. Patients to delivery start their process from the 24/7 entrance (generally) and it leads through consulting examination, delivery room, maybe operation and to the ward. New born intensive care unit is part of this process road and it is located near delivery rooms and operation.

Most of the 24/7 patients only need the doctor or nurse consultation. They get care, medicine and go home or to the elective consultation or procedures in near future.

Some 8-10 % of the emergency patients here follow the more difficult processes.

Often there is rush and pressure in the emergency unit and therefor the patient processes have to lead effectively through the unit. It means that you avoid unnecessary waiting patients in the premises.
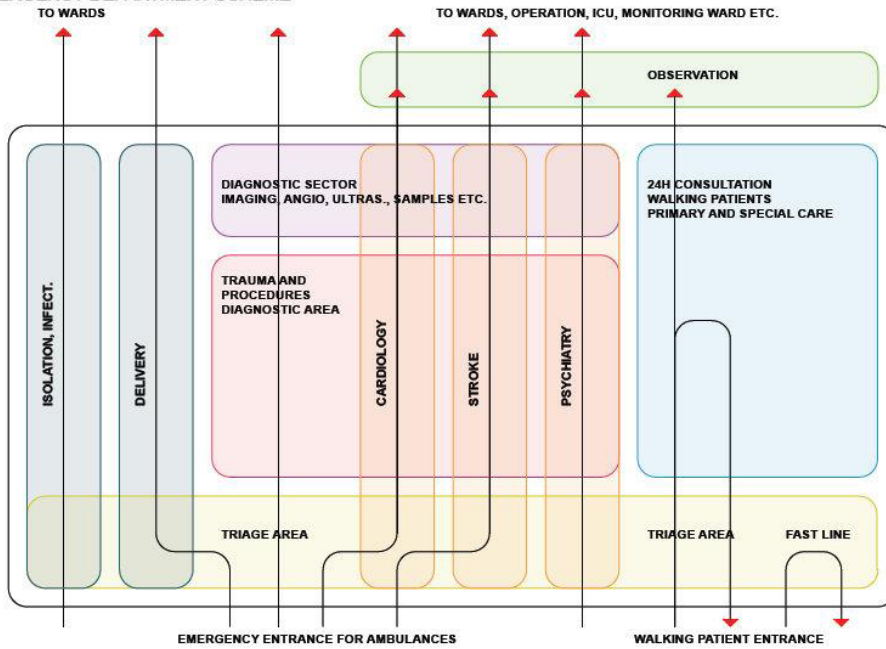
4.2. Elective hospital

Elective hospital processes mostly start from the main entrance. Patients go to their unit for registration. It can be doctor `s consultation or open care unit. Patients visit sample taking unit, imaging diagnostics unit and hospital physiology.
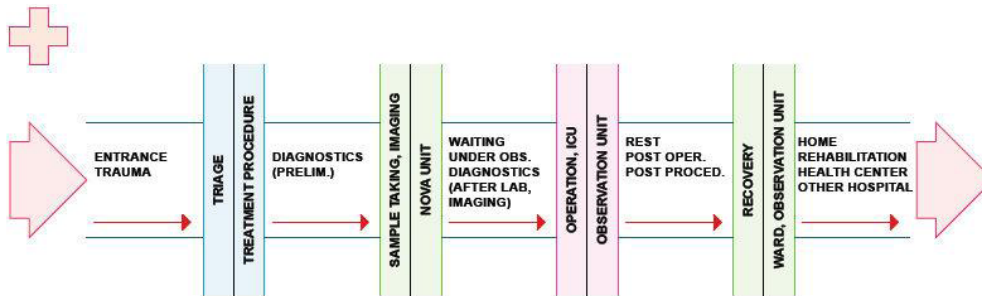
Patients' service units are located along these routes such as café s, restaurants, small shops etc. Elective hospital part is the one which mostly resembles a shopping center. There are some individual units where you get the services and along the main hall you have the non-medical services. The patient reserves the next visit if necessary and goes home.

The idea to make an effective elective hospital part is to give the patients the needed services in a limited area. The patients do not have to move too much around the whole hospital building.
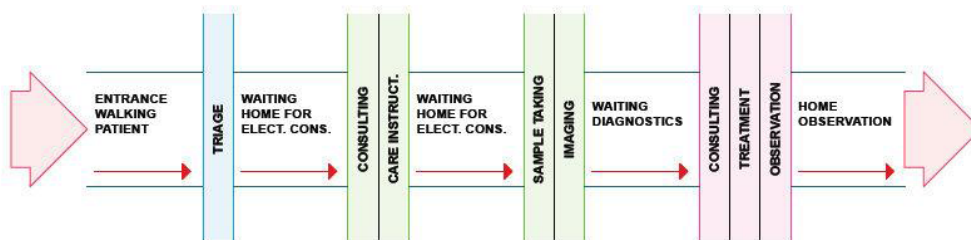
GENERAL HOSPITAL CONCEPT
24/7 CONSULTATION
EMERGENCY DEPARTMENT SCHEME

TO WARDS

TO WARDS, OPERATION, ICU, MONITORING WARD ETC.

OBSERVATION

DIAGNOSTIC SECTOR
IMAGING, ANGIO, ULTRAS., SAMPLES ETC.

24H CONSULTATION
WALKING PATIENTS
PRIMARY AND SPECIAL CARE

ISOLATION, INFECT.

DELIVERY

TRAUMA AND
PROCEDURES
DIAGNOSTIC AREA

CARDIOLOGY

STROKE

PSYCHIATRY

TRIAGE AREA

TRIAGE AREA

FAST LINE

EMERGENCY ENTRANCE FOR AMBULANCES

WALKING PATIENT ENTRANCE

GENERAL HOSPITAL CONCEPT
24/7 CONSULTATION
EMERGENCY PROCESSES / TRAUMA PATIENT

ENTRANCE
TRAUMA

TRIAGE

TREATMENT PROCEDURE

DIAGNOSTICS
(PRELIM.)

SAMPLE TAKING, IMAGING

NOVA UNIT

WAITING
UNDER OBS.
DIAGNOSTICS
(AFTER LAB,
IMAGING)

OPERATION, ICU

OBSERVATION UNIT

REST
POST OPER.
POST PROCED.

RECOVERY

WARD, OBSERVATION UNIT

HOME
REHABILITATION
HEALTH CENTER
OTHER HOSPITAL

GENERAL HOSPITAL CONCEPT
24/7 CONSULTATION
EMERGENCY PROCESSES / WALKING PATIENT

ENTRANCE
WALKING
PATIENT

TRIAGE

WAITING
HOME FOR
ELECT. CONS.

CONSULTING

CARE INSTRUCT.

WAITING
HOME FOR
ELECT. CONS.

SAMPLE TAKING

IMAGING

WAITING
DIAGNOSTICS

CONSULTING

TREATMENT

OBSERVATION

HOME
OBSERVATION

4.3. Wards

Ward processes start in 70 % of cases from emergency and 24/7 consultation and end to the wards. Ward patients visit imaging diagnostics and clinical physiology,   physiotherapy unit and oncology therapy unit.

Laboratory sends sample takers to the wards. Some traffic connection from and to the ward is to operation, intensive care unit, ward for critical patients or just to the main hall area for the services or to meet relatives and friends. Visitor traffic must be considered. It can be large and disturbing so the routes and meeting areas should be well designed and located.

4.4. Technical support

Technical support processes are general logistic processes which lead to the departments or respective logistic areas and back from there.

Special attention should be put on catering, sterilization and pharmacy logistics.

Each hospital shall have a plan for technical support logistics. It is a process which starts from the logistic center and leads to every unit. A huge variety of technical equipment solutions are offered to the hospital to solve the problem.

Hospital shall make decisions for several facts before they start to solve the logistics. For instance:

- The form of material delivery to hospital
- What services are outsourced?
- What kind of storage system is in units?
- Automatic or manual transport to the unit
- Timetable for logistics

4.5. Conclusion of processes

The main processes give guidelines for the locations of different departments in the five major blocks and also main instructions how to combine the main blocks to each other. Main processes are medical and should be negotiated with the hospital medical experts.

5   EXTERNAL LOGISTICS AND ENTRANCES

It is necessary to examine the external traffic and necessary entrances to the main hospital, because it affects to the forming the main blocks. Each of the five blocks have external connections and logistic needs.

5.1. Patient entrance

Most of the patients use the main entrance. These groups are patients to doctor`s consultation to open care units and patients with referral to diagnostic service departments.

Emergency area has two entrances, one for the ambulances trauma patients and other serious cases. The second entrance is for the "walking" patients to the 24/7 consultation. Also delivery patients can use this entrance.

There should be parking areas near every entrance. They can be for patients, escorts or visitor and meant for short time stay.

Visitors to the wards use mostly main entrance are guided to the ward or they meet patients in the entrance area, main hall, café or else.

5.2. Personnel traffic

In planning the hospital you must put attention to the personnel traffic while entering and leaving the hospital. There is heavy traffic in the morning and again in late afternoon. Personnel is entering the hospital through several entrances, first to the clocker room and then to the working place.

Normally there are one or two parking areas for the staff. In a hospital for 250 000 population work more than 2500 employees. Out of which about 1800 use the locker rooms and others go straight to the department.

Together with the patient traffic a very good possibility is to organize the public traffic so that it can take care most of needs.

5.3. Material supply logistics

Most of this traffic can be directed to the hospital through a service yard with entrances to respective reception areas. The different nature of traffic is the following:

- General materials to logistic center
- Central kitchen, catering
- Textiles
- Sterilization
- Pharmacy
- Waste and dirty linen

All this can be arranged in the service yard. There are special needs which should be separate and in peaceful areas.

The traffic to obduction premises is a special one. There are relatives and other escorts who come to take care of the past. In this connection there is needed a small parking place and a loading area.
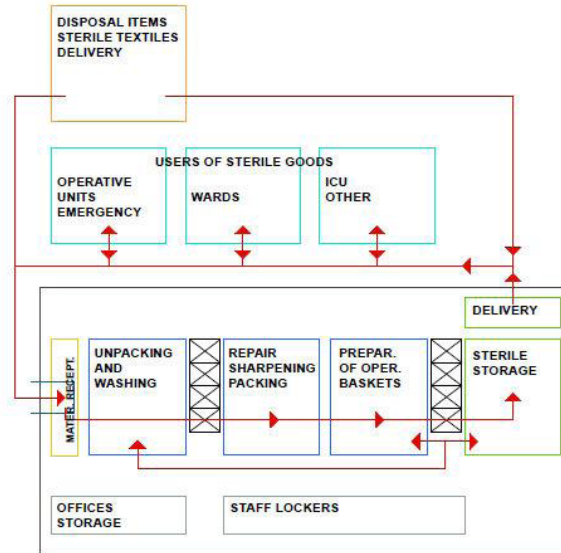
GENERAL HOSPITAL CONCEPT
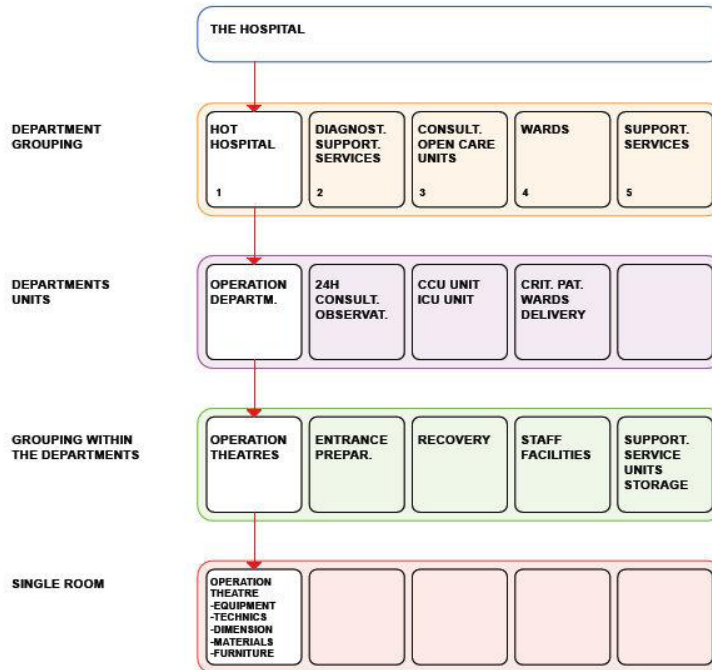INTENSIVE CARE UNIT
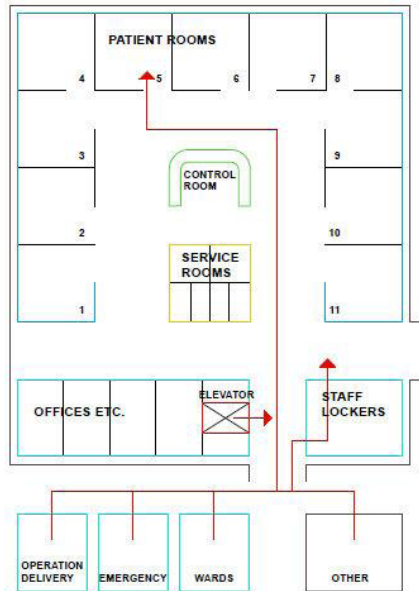
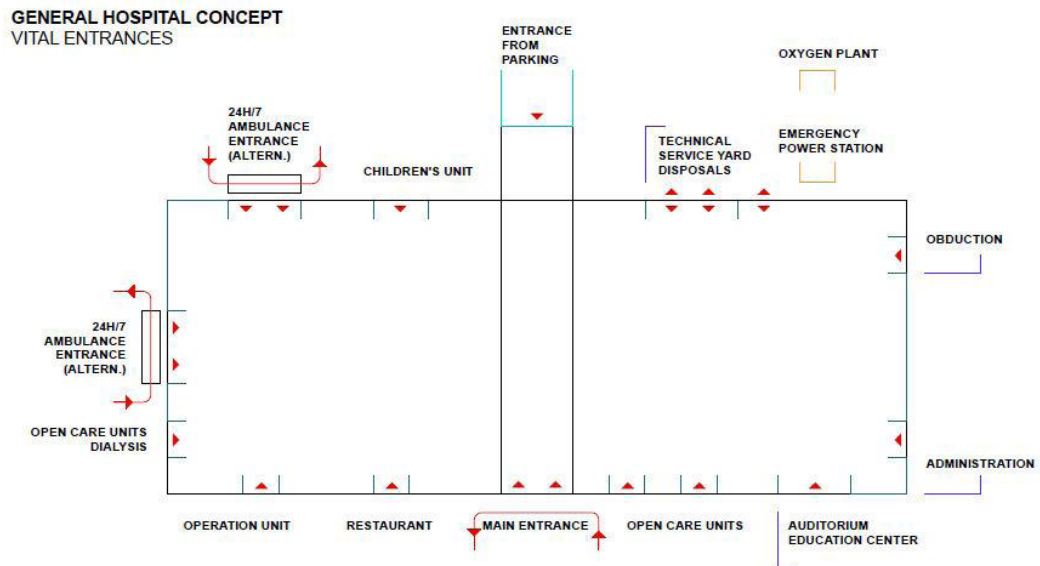**GENERAL HOSPITAL CONCEPT**
CENTRAL LABORATORY
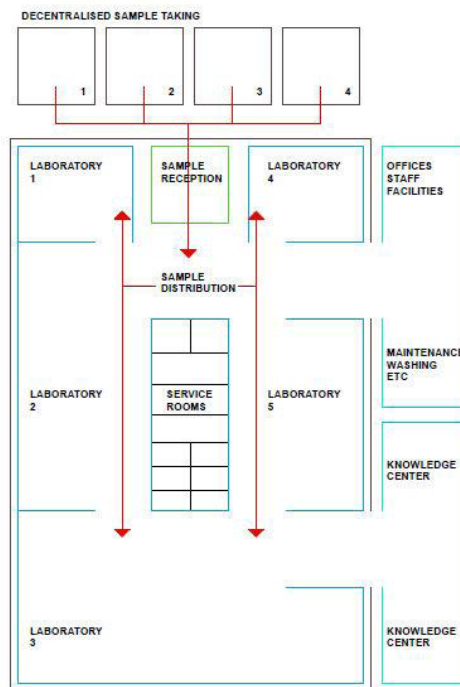
GENERAL HOSPITAL CONCEPT
CENTRAL STERILIZATION UNIT

GENERAL HOSPITAL CONCEPT
CONSTRUCTION OF THE ROOM PROGRAM

GENERAL HOSPITAL CONCEPT
VITAL ENTRANCES

6   DISCUSSION

The hospital planning process is a two sided task. First you have to plan a complicated big building so that it fulfils all medical functional demands and takes care of the needs of the population. Secondly you have to plan a building with high architectural value. The goals should be so ambitious that it will give some new innovations to the field.

Historically hospital architecture has produced results which have been in the first row when architecture has developed.

There are also periods with lower quality and results. The reasons can be the following:

- Fast medical development
- Changes in the community
- The growth of the towns and cities
- Democratic development, care and cure for everybody

Today hospital architecture can present marvellous examples of good architecture. The buildings are not any more gigantic concrete monsters. Some attention should however be put on the medical function ability and the concepts of the hospitals.

It is necessary to pay attention to the most important aspects in planning which is that the hospital will serve faultlessly the society. This is the reason for planning a hospital.

Some of the means how to achieve this goal is presented in this study. The way/process from medical volumes to programs is very interesting. The planners shall consider the medical processes, overall logistics, service and supply and feasibility in making comfortable working areas for the hospital personnel.

The division of responsibilities should be clear, the planners and designers are planning and taking care of large entities and the future users are giving comments to the plans.

The planners should plan the hospital for normal standard performance and not to be too much fascinated in special cases or rare emergency cases.

The concept is developing. For instance there is discussing going on concerning the role of physiotherapy and psychiatry as part of the general hospital.

The effect of the modern examples in Europe can be noticed in present planning for instance in Finland. The financing system can be different but the goal or target is the same, to keep the services and the costs in balance.

7   CONCLUSION

In this presentation some of the elemental parts of the planning process have been touched. They are maybe the most difficult parts to handle and to get a common understanding. These elements are:

- Medical functional concepts
- The medical processes
- Guidelines for constructing the program
- The hospital ward system

In the future more attention should be put to the whole planning process, who is doing who is making decisions and who is taking responsibility of the planning process.

In many conferences and seminars lots of attention has been in administrative and organizational models but not so much in hospitals and its functions.

This presentation is based on personal experience during decades in various hospital planning areas. I have also been fortunate having been able to visit several new modern hospitals. Also the discussions with persons involved in hospital planning development and running the hospital have been most valuable. It has been essential during the last ten, fifteen years to become acquainted with the problems and situation and wishes of nine hospital districts in Finland.

LITERATURE:

Interdepartmental connection. Requirements in a general hospital building. Kekäläinen, 1982.

Future health interreg III C. New concepts and new environments. Claes G Johanson et others, 2006.

Tunnuslukuja terveydenhuollon alueellista suunnittelua varten. P.Kinnula et others, 2013.

International Conference ARCH 14 on research on Health Care Architecture

The amount and quality of research on Healthcare Architecture has grown rapidly in recent years. However, there are still many questions remaining. The commission, therefore, is to share the existing research knowledge and latest results and to carry out research projects focusing more specifically on the health care situation in a variety of contexts. The ARCH14 conference was the third conference in the series of ARCH conferences on Research on Health Care Architecture initiated by Chalmers University. It was realized in collaboration with the Nordic Research Network for Healthcare Architecture. It was a joint event between Aalto University, Finnish Institute of Occupational Health (FIOH) and National Institute of Health and Welfare (THL International).The conference gathered together more than 70 researchers and practitioners from across disciplines and countries to discuss the current themes

BUSINESS + ECONOMY

ART +
DESIGN +
ARCHITECTURE

SCIENCE + TECHNOLOGY

CROSSOVER

DOCTORAL DISSERTATIONS