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Preface by Editor-in-Chief

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Architectural research has its specific challenges but also opportunities, resulting from the interdisciplinary and varied nature of architecture itself. The journal of Architectural Research in Finland, as well as the yearly organized symposium that it originated from, is an attempt to bring together this variety, inviting us to consider what unites the work done is the three universities in Helsinki, Tampere and Oulu, as well as the international work connected to it. It is not a common set of research questions, common methodology or common literature. The scales and the corresponding architectural tasks are also very different, as this issue of ARF showcases: from urban and regional development to detailed design challenges, from typomorphology to lighting design.

The implicit connection, one might assume, is the practice itself. In our urbanizing world, buildings and cities are where everything happens and, correspondingly, where the problems and solutions concentrate. However, there is no commonly practiced ‘science’ of the built environment that we could all lean on. To the contrary, researchers who have found their topic of interest turn to their respective ways of doing research, together with the network of other scholars relevant to their pursuits. This may seem like fragmented scholarship, but it also implicitly refers to a common ambition: to do something that is relevant to architectural design and planning.

On the other hand, society at large presents us with challenges that cannot be addressed with mainstream tools and ideas. We also meet buzzwords such as smart cities, ubiquitous technologies, network society, co-design, strategic planning, and more. They all have to be reinterpreted, not only adopted by architects, and this requires critical and creative analysis of the social, economic and cultural contexts of the discipline. In the face of it, architectural research should not be seen as an additional element but a way of reflecting the identity of architecture itself. The articles collected in this issue demonstrate the multiplicity of perspectives to approach this task.

Editorial Introduction: Plan, Develop, Design. Making Smart Cities and Architecture

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The world is urbanizing and digitalizing, and cities, communities and buildings are being developed as smart environments. Smart cities are not only about ICT, energy and transport infrastructures. Smart cities are also about smart citizens, who participate in their city's governance, are concerned about the quality of life in their city, and about protecting their environment.

However, there used to be little synergy between smart cities initiatives and citizen science. To-date, our living spaces are expected to be enriching—inspired by art and culture meanwhile responding to needs beyond mere functionality—, sustainably in harmony with nature, the environment and our planet, as well as also inclusively encouraging a dialogue across cultures, disciplines, genders and ages.

This raises a variety of questions for architectural research that in line with the architectural discipline, has been addressing planning, developing and designing of our living and operational environments. Therefore, the main question in this number of *Architectural Research in Finland* is how to plan, develop and design smart cities and architecture.

In more detail, this number examines, what kind of integrative processes and methods could be used to connect diverse development actions in smart cities, communities, environments, architecture and construction. In this number, these ways of looking for solutions for the built environment, are addressed in multiple scales subject to deliberate, purposeful planning, development and design actions. Hence, we have called for papers from five standpoints elucidating planning, developing and designing smart cities and architecture: Emerging urban form, Smart building design and construction, and Smart lighting—cross-fertilized with aspects of Business models, Experience and participation.

Planning toolbox expanded

Looking back in the history, the need to understand the interaction between social life and physical space had first catalyzed studies on spatial syntaxes. Along with the growth of cities, coupled with advanced transport and communication technologies, diverse network theories and related topomorphological research were highlighted. What is next, as our cities are turning smart? As **Ari Hynynen** and **Jari Kolehmainen** put it, what kinds of methods are needed to analyze urban transformations? Should the morphological toolbox be expanded? Do we need new planning and design principles?

In this scope they themselves analyze the development of Finnish railway station areas as part of a wider continuum of knowledge urban development where both economic and innovation policies unify with urban planning. Case studies confirm their outlook of knowledge-based urban development transitioning to a new phase. This provides the prerequisites for interesting connections between railway station areas, the concept of a smart city and open innovation. Their article introduces new kinds of spatial planning principles, which can be placed in three categories: 1) smart profiling, 2) smart design and 3) smart innovation.

Frederik Vandyck and **Inge Bertels** on their part, provide a typomorphological analysis of patrimony of industrial activity in the urban fabric of a productive hotspot of the Brussels Capital Region. Despite the observed shrinkage in the amount of active urban industries, a GIS informed hotspot analysis revealed a concentration in the Jette-Koekelberg area. The presented work therefore provides a typomorphological study bridging the urban form and the architectural type.

In built-up areas there is a tendency to let the processes of urban change take place instead of top-down planning, **Tommy K. Lindgren** exemplifies. This change is therefore not managed, but piecemeal, resulting in a patchwork of ‘stamp’ plans directed by narrow private economic considerations. He further explains that the life-span of buildings varies according to their material composition – also the type of a building and its spatial configuration affect its vitality. These attributes and conditions play a part in how long a building can endure before confronting the need for radical changes and can be aggregated from open-source data and modeled using historical referents as benchmarks. This information forms a layer of probabilities in the city, revealing dormant locations facing imminent change.

By mapping the information of the material conditions on the topography of the city, we can identify potentials for development. Identifying these latent sites in the city and engaging proprietors and landowners would give new tools for the City to affect the change and renewal associated with turnover of the building stock.

Cities’ preconditions for development may vary: some areas are more attractive for infill development projects than others. Therefore, **Hanna Kosunen** and **Irina Atkova** scrutinize the alignment of urban regeneration approaches with the specifics of low growth or stagnated contexts, to sum up alternative approaches to urban regeneration and infill planning. Their analytical framework originates from organizational learning theory of action inquiry, to suggest how urban regeneration visions, strategies and actions are adjusted to low growth contexts.

Relatedly, **Mari Oline Giske Stendebakken** and **Nils O. E. Olsson** search for alternative approaches to investigate and conclude on the cost-efficiency of the option of new build or the rehabilitation of a cultural heritage site. Their findings indicate the complexity of such assessment and the relevance of time span in the evaluation of a future project.

Ranja Hautamäki scrutinizes another planning tool, meant for rapidly growing cities. She demonstrates that a ‘national urban park’ can be seen either as a model for sustainable urban planning or as a legislative cage for development. On the one hand the NUP is regarded as restricting development, emphasizing static preservation, bringing no real added value, transferring municipal decision-making to the Ministry and engaging primarily environmental and heritage stakeholders. On the other hand, it is considered to be a long-term tool of urban planning, safeguarding values, contributing to tourism and engaging a broad range of actors. The research shows that the NUP process reveals the current tensions between continuity and change, and nature and city, in rapidly growing cities.

EDITORIAL INTRODUCTION

As in planning, the importance of understanding the divergent views of different actors in the search for a shared vision of the future of the city, was just emphasized, planning was also set in charge to anticipate the demographic changes in housing design. **Ira Verma** explained that along with the Social welfare and health care reform in Finland, housing services, health promotion and wellbeing of residents will remain in charge of the local authorities. Environmental factors are important for independent coping of the elderly.

Individuality included

Correspondingly, design and construction of buildings and our nearby environment are developing towards smarter practices and solutions. **Henrika Pihlajaniemi** pointed that as technology and solutions are rapidly developing, there is a growing need for research about design factors, methods for implementations and the results of pilot projects. Common to the following articles is that they exemplify the focus on human experience in the design of the built environment.

Riikka Kuittinen, Eevamaria Juuti, Matti Lakkala and **Janne Pihlajaniemi** outline the essence of human-centered design in their paper *Individuality included,* by studying log house design processes and how users can participate to configuring their new homes. They conducted a consumer study and carried out interview for industry managers and found out that systematization of individual choices could benefit log house companies in terms of design resources.

In the end, in smart cities it is topical to ask, how smart development is changing our experience of the built environment. Perceptions of log and log buildings were examined by **Aale Luusua, Matti Lakkala** and **Janne Pihlajaniemi**. Log shows as a contemporary building material undergoing rapid technological changes expanding the repertoire available to architects when designing with log – with implications to ecology and occupant health that have been central objectives of smart development. However, in another paper by **Lakkala, Pihlajaniemi** and **Kuittinen,** it is argued that examples of architecturally viable industrial log are few meanwhile new opportunities are emerging.

With this same focus on human experience, smart lighting was seen to possess experiential value. As starting points, **Lucrezia Seghi, Sarunas Noskaitis, Spyridon Spanos, Mette Hvass** and **Ellen Kathrine Hansen** present diverse geographical positions and social and cultural contexts in different countries. According to them, these dedicated lighting cultures express distinctive relations of natural and artificial light.

In this setting, **Kjell Yngve Petersen** discusses ambient adaptive lighting that adjusts and reacts to the variations in the environmental conditions and user behavior. **Stine Louring Nielsen, Esben Oxholm** and **Ellen Kathrine Hansen** studied the user experience and patient satisfaction in the most sensitive context, interactive patient rooms of mothers just given birth. The authors found several areas that can be improved to meet the specific needs and thereby provide higher patient satisfaction.

Exploration of what might come

In this number, the ways of looking for solutions for the built environment, were addressed in multiple scales. Regarding action learning based smart city development, *exploration* has referred to the pursuit of what might come to be known through creativity, experimentation and learning. In sum of the above discussed articles, it can be concluded that planning, developing and designing smart cities and architecture, were foremost motivated by exploring of what might come through creativity, experimentation and learning. For sure, the extended toolbox can help us come up with new insights into both material and

immaterial city and reveal novel phenomena, be there heritage sites or pure potential.

Whereas *exploitation* has been viewed as the application of established competence to challenges, and as focusing on some efficiency-seeking routines. Most interestingly, there were also promising remarks of individual choices being systematized.

Smart Principles for Knowledge-based Urban Development

Case Finnish Railway Station Areas

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Abstract

Cities undergo continuous transformation processes, which have unique characteristic manifestations over time. The changes in many Finnish cities currently focus on the vicinity of railway station areas due to changes in regional structures and rail transport, as well as the densification of city centres. The enthusiasm for this kind of development is also increased by the special features of railway station areas, which seem to provide opportunities for new kinds of local economic and innovation policies. Railway station areas are also favourable locations for the application of various smart city technologies and services. In this article, we analyse the development of Finnish railway station areas as part of a wider continuum of urban development where both economic and innovation policies unify with urban planning. Case studies confirm our outlook of knowledge-based urban development transitioning to a new phase. This provides the prerequisites for interesting connections between railway station areas, the concept of a smart city and open innovation. One of the aims of our article is to bring together various themes that are brought up in smart city discussions and urban planning by introducing new kinds of spatial planning principles, which can be placed in three categories: 1) smart profiling, 2) smart design and 3) smart innovation.

Keywords: smart city, railway station, urban planning, urban development, innovation policy

In this article, we analyse the development of Finnish railway station areas as part of a wider continuum of urban development where both economic and innovation policies unify with urban planning.

Railway station areas, smart city and open innovation

In the last few years, rail yards, railway stations and station areas have become increasingly important in Finland as urban development sites. In development processes they are, however, approached from the relatively narrow standpoint of transportation (compare Meriläinen and Kunnas 2014). The starting point of our article is that railway station areas could have a wider role in urban development (see Hynynen and Kolehmainen 2016).

PEER-REVIEWED ARTICLE

The ongoing, extensive wave of development has been caused by numerous drivers of change which create pressure to regenerate railway station areas. These include, for example, changes in goods logistics, which have freed up rail yards' land for other uses (Hesse 2008, pp. 15-16), or the transformation of regional structures towards a more network-like format (YM et al. 2015), where railway station areas appear as transportation nodes of extended commuting areas and as the nodes of developing local centres (c.f. Bruinsma et al. 2008; Peters and Novy 2012a; 2012b).

Politics has also caused pressure for change since railway station areas have been raised to an important role in growth agreement procedures for Finnish cities (TEM 2016). The country's regional structures mainly take shape as growth corridors supported by efficient traffic infrastructures. The Helsinki-Seinäjoki axis, i.e. the so-called Growth Corridor Finland, forms a key corridor where the main railway operates as its backbone. The functional efficiency of the corridors requires the strengthening of public transport's modal split, but an important driver of change is also the low-carbon objectives, which states have committed to through international agreements.

At the same time, urban development organisations, which have a rather central role in the development of railway station areas, have identified the potential of these areas. The potentials typically involve the beneficial locations of the railway station areas at central nodes of transport networks, where good accessibility provides new types of operational opportunities for companies, services and housing. In addition, railway station areas are most often located in city centres, offering a variety of opportunities for economic value creation. Cities can easily see a number of regenerative opportunities in railway station areas, whether they are related to the urban image, business operations or any other attractiveness factor of the city.

The mutual interaction of land use and traffic culminates in railway station areas. Good public transport accessibility in railway station areas creates prerequisites for the placement of jobs and services as well as housing in the surrounding areas. The user flows of the stations create immediate demand for local services. On the other hand, local jobs, services and housing create demand for public transport services. Railway station areas are attractive housing areas, particularly for residents who value low-carbon development, good services and accessibility.

The role of railway station areas is important in making traffic flows more efficient. Several technology development organisations are preparing their development platforms in cooperation with cities, specifically for railway station areas. The majority of intermodal consolidation of trip chains and smooth everyday accessibility is solved at traffic nodes. Although ”Mobility as a Service” (MaaS) involves changing the entire mind-set of traffic (e.g. Litman 2013; Heikkilä 2014), many of its practical applications are best actualised at railway station areas.

The MaaS way of thinking represents the growing smart city trend at its purest. Ubiquitous digital technology is considered a solution for better meeting the supply and demand of mobility services, whether it concerns parking, compiling intermodal trip chains or hiring bicycles. Under closer inspection, the smart city discussions, which we will return to later in this article, cover wider themes than the utilisation of digital technology for making cities' activities more efficient - despite technology being at the core of a smart city. A wider smart city concept is needed simply because by the time projects begin to actualise, connections will be created to cities' business and innovation policies, physical urban design, traffic design, property development and many forms of urban life. In addition, the volume of ongoing railway station area development, as well as their roles in local innovation policies, give a reason to assume that we are now transitioning to a new phase. Although the need for change in innovation policy has already been identified, its connections with urban design and development

are only just being considered. Our key thesis is that not only does the implementation of innovation policy takes place in urban contexts, it also requires them.

Knowledge-based development and the creation of innovation environments have been key themes of Finnish urban development for the last few decades. It is often perceived as part of the activities of larger urban regions, but increasingly more small and medium-sized cities have joined this trend. It has also been thought that economic success and the creation of innovations require major “institutional thickness”, i.e. educational and research institutions, technology development and utilisation companies, and financial capital and other operators of the same chain (e.g. Amin and Thrift 1995; Keeble et al. 1999). During the last decade, discussions have also focused on the importance of skilled and creative individuals alongside institutional and structural factors. The main initiator of discussions has been Professor Richard Florida (e.g. 2002; 2005; see also 2017). This perspective has further emphasised the significance of the quality of cities: the city’s physical, social and symbolic features support the creation of innovations. Alongside Florida’s approach, the terminology of a local innovation environment has also brought up the importance of individuals and their mutual dynamics in innovation operations (Kolehmainen 2004; 2008; 2016). In sum, the common denominator between current urban development and innovation is openness; it is all about engaging different stakeholders to joint, open processes in order to create something new. However, the results of these processes are usually not permanent, but constantly evolving. All this could be described with the concept of “knowledge-based urban development”. The term was first coined in the 1990s (Knight 1995), but it is still valid despite the new aspects added to it.

The scope of this article

This article focuses on Finnish case studies and its aim is to consider how these two previously mentioned trends of urban development, i.e. the development of innovation environments and railway station areas, can connect with each other in the context of a smart city. A medium-sized city, Seinäjoki, is brought up as the main focus, where the trends mentioned in its development path are already clearly distinguishable and present, partly due to the small scale of the city. However, the story of Seinäjoki also has more general power of expression, since many other Finnish cities have travelled similar paths of development.

Seinäjoki has been strategically developed as a cluster of various micro-level innovation environments in both material and immaterial manners. The aim of the development work has been, and will continue to be, to both strengthen the urban region’s skill and innovation economy by developing it into a physical space, and also find new, more attractive urbanism from the city's new key sectors for urban design. In this relation, the railway station area that has become an important site of urban development during the past few years provides an entirely new kind of challenge. How can the opportunities it offers be utilised in a way that expresses the requirements of the future’s innovation activities in the best possible way?

This article is mainly based on two research and development projects, which were carried out in the 2010s. In the Unicreds project, which was funded by the Interreg IVC program, consideration was made as to how universities, businesses and the public sector could develop their co-operation. The Finnish part of the project was led by the University Consortium of Seinäjoki. The other participants were the Seinäjoki University of Applied Sciences, and development organisations and authorities from six different countries. In our own portion of the project, we analysed the mutual effects of innovation policy and urban planning from the 1990s to the 2010s using Seinäjoki as our “laboratory” (Hynynen and Kolehmainen 2011). No separate empirical data was collected in the project, but instead it referred to prior literature, reports and

analyses, and to the research and development work we have completed in Seinäjoki through several projects. The Unicreds project is, however, worth mentioning since the basic approach of this article was developed in connection with that project.

The aim of the Tekes-funded SmartStation project, coordinated by the City of Seinäjoki, was to create methods, which cities can use to design and prepare the implementation of their railway station areas as part of the wider development processes of urban core areas. The project also worked on a more general procurement model for the innovative design and implementation of developing urban areas. Seinäjoki was the target city in this project as well. (Hynynen et al. 2014).

The key operating forms of the SmartStation project were three workshops organised in 2013-2014. The main aims of the workshops were to envision the future development of Seinäjoki railway station area, as well as to engage the most important stakeholders, including landowners and the city's research and development officials. In addition to workshops, 13 interviews were conducted among representatives of organisations that are vital in terms of the development of the railway station area. The interviewees consisted of landowners, property developers, constructors, representatives of building companies and organisations operating in the railway station area. The aim of the interviews was to complement the visions created in the workshops with more realistic viewpoints related to the implementation of the area. Both the workshop and interview materials were analysed by means of typical content analysis (Hynynen and Kolehmainen 2016).

Alongside and in connection with the aforementioned projects, we participated as researchers in the development processes of railway station areas in other Finnish cities, such as in Kouvola, Lappeenranta and Lahti. These took the form of individual workshops and series of a few workshops. In the Helsinki metropolitan area, we participated in the "Elinvoimaa asemanseuduille! (ELIAS)" project, where new development and investment concepts were created for railway station areas. In addition to Finnish cases, small case studies were also carried out in Swedish (Göteborg, Malmö), Danish (Örestad), German (Bremen) and Dutch (Utrecht) railway station areas (Harvio et al. 2016).

We have also participated in seminar and workshop events related to railway station development organised by the national MAL-network (land use, housing and transportation) and Tekes (The Finnish Funding Agency for Innovation). Through these projects and co-operation processes, we have gained hands-on experience with the cities that carry out development work on their railway station areas. The projects, workshops and interviews have produced various outputs that have been analysed by multi-method triangulation principles. By combining conceptual frameworks of regional studies and urban planning, we do not assume that looking at an empirical object from more than one standpoint would provide us with indisputable facts, but instead, to create a dialogue for fruitful interpretative insights (Miller 1997; see also Eskola et al 2000, pp. 68-74 and Raunio 1999, pp. 340-342).

The aims of this article are to 1) offer a credible and justifiable description of innovation policy's and urban development's common evolution and its most recent phase, 2) consider the role of railway station areas in particular as part of the continuum of knowledge-based urban development, and 3) outline general planning principles for an innovation-driven smart city. Thus, the main research question can be shaped as follows: What prerequisites should be considered in supporting innovation policy spatially by means of urban development and planning in the context of a smart city?

Path to the smart railway station areas

Technology centres as embodiments of their era

The development of railway station areas as part of the development wave of smart cities is set, in our view, as one phase of a longer continuum of knowledge-based urban development. The progress of development has been divided into three phases, which are described by the urban spatial embodiments of innovation policy: technology centres, creative urban fallows and smart railway station areas. Concepts that describe the different phases have been collected into Table 1.

The development of competitiveness has been at the core of urban and regional development since the 1990s despite the fact that the concept of competitiveness in the regional context is very complex and somewhat problematic (e.g. Turok 2004, Bristow 2005). As the economy has become even more knowledge-intensive and global distribution of work has deepened, this has also led to the significance of knowledge, technology and skills in urban development. Cities of various sizes have made significant efforts to strengthen their own knowledge bases within the limits their own resources. The key operators of the first wave of knowledge-based urban development were universities and polytechnics, as well as technology centres.

The construction of a regional innovation system and the development of local innovation environments have incorporated as part of the development of regional competitiveness. From the perspective of a physical city, the importance of creating attractive campus areas has long ago been identified in the development of universities and polytechnics. As an international trend for the last few years, several campuses have aimed to further open up as part of the city and urban life by, for example, bringing services to the campus area which are aimed to the entire city, not just the academic community. Already before the interest to focus on campus areas, various technology centres were built in the vicinity of universities and polytechnics. The biggest construction boom in Finland took place in the 1980s and 1990s. At that time, the main starting points and objectives for technology centres were formed as follows: 1) the clustering of property management operations and various information intensive operations, 2) operational connections to universities and research institutions, and 3) the transfer of information and technology from the previously mentioned institutions to companies (see Mäki and Sinervo 2001, pp. 25; Chan and Lau 2005, pp. 1216: Kolehmainen 2005, 256).

	1990-	***2000-***	***2010-***
Urban space	*Technology centres*	*Creative urban fallows*	*Smart railway station areas*
Development policy	*Regional specialisation, industrial competitiveness, "exploitation"*	*Related variety, creative branches, "exploration"*	*Open innovation, digitalisation, "experimentation"*
Urban theory	*Networked de-centralisation (Network city, Netzstadt)*	*Qualitative transformation (Zwischenstadt, Metapolis)*	*Smart city, intelligent city*

Table 1. Common evolution of innovation policy and urban development since the 1990s. At the moment, the different phases progress in parallel.

The aim of technology centres is, therefore, to promote interaction between various operators. The aim of design has been to create spaces where random encounters between operators are possible, and which create prerequisites for multiform co-operation. However, from the perspective of urban planning, the implementations represent a familiar modernist tradition, which divides urban space into mono-functional zones and enclaves. Technology centres promote

their own internal interaction, but they are not lively, hybrid, urban spaces where completely different influences can intermingle. On the other hand, excellent transport connections, location at the outer fringes of the regional capital cities, as well as their feasibility of being expanded are often characteristic of them (Castells and Hall 1994, pp. 244-247). The phrase networked decentralisation describes the role of technology centres in strategic urban development, and their urban theoretical dimension, very well.

Urban fallows, resilience and self-renewal capacity

The current socio-economic situation emphasises the significance of the continuous reform of regions. In this respect, the concepts of regional economic resilience and self-renewal capacity are essential. According to Martin (2012, 12), regional economic resilience consists of a region's ability to resist recessionary shocks, its ability to recover, its ability to renew a growth path and its ability re-orientate. Similarly, Sotarauta et al. defines regional resilience as "adaptive capacity that endows regions with a capacity to change their destiny by adapting to changes and reshaping their own strategic capacity to act" (2012, pp. 275).

Both the concepts of resilience and self-renewal capacity are based on the idea that the development of urban regions is primarily through adaptation, which may be either unintentional or strategic. In any case, no urban region can fully change its operations or operating environment to make it the way it wants. Only part of a knowledge-oriented and innovation-oriented global economy strategy is planned (e.g. Boschma and Sotarauta 2007; Sotarauta and Srinivas 2006). Diversity is emphasised because we can never fully anticipate future development and/or take control of it with various development programs and systems or other conscious political operations. On one hand, diversity enables new and surprising development, and on the other hand, it ensures that at least some operators of an urban region are quickly capable of grasping new opportunities that open up to them.

Self-renewal capacity builds on classic distribution for seeking new, i.e. "exploration" and "exploitation", and their integration (e.g. March 1991). In the context of organisational learning, March (1991) defines exploitation as "refinement", "implementation" and "execution". Correspondingly, exploitation is characterised by him as "search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation" (ibid. 71). In a regional or urban sense, "exploration" involves the creation and search of new information and new resources and competences, which is actualised in the basic research of universities, the research and development operations of large knowledge-intensive companies, and other such operations where the future is sought for and created without clear questions (Sotarauta et al. 2007). From the perspective of economic structures, new companies, and particularly start-up companies, can be considered as "exploration agents"; they can use their operations to both utilise the markets and create them. When artistically creative and culturally oriented communities mix with various regional margin phenomena, a certain type of regional "exploration" takes place. This penetration into unknown thematic spheres may not become economically significant until later. For example, the roots of many growing and economically important creative sectors are in some type of regionally margin phenomena (Kainulainen 2005; Ruokolainen 2008; 2017).

Self-renewal and the capacity for it also have new counterparts in the physical side of urban development. Abandoned industrial areas, "urban fallows" (Oswald and Baccini 2003), in city centres are a good example of this. Small start-up companies and enthusiasts of cultural industry often seek these premises. Reasons for this include affordable rents, central locations and premises that are multi-functional and robust. There are plenty of voluntary operations in cities which gain their spatial expression when an opportunity for this arises. It is only recently that cities have begun to understand that part of these grass level operations may grow to be the anchor tenants of emerging

economic sectors (Baum 2010; Ylä-Anttila 2010). Research has also shown that the number of cultural operators in cities correlates with successful business (Markusen and King 2003).

Smart railway station areas for open innovation

The development of innovation systems and environments concerning the development of an urban region's competitiveness has been based on the promotion of systematic and interactive innovation processes. Thoughts concerning the strengthening of self-renewal capacity, on the other hand, strongly emphasise the significance of exploration, i.e. seeking completely new, surprising paths of development. A so-called paradigm of open and user-centred innovation and "democratising" thoughts concerning innovation bring a new level to this idea by increasing the interactivity of innovation in relation with various economic actors and society as a whole (von Hippel 2005).

The concept of open innovation has become mainstream since 2003 (Chesbrough 2003a; 2003b), although the principles of open innovation have been more or less in use in companies already before then. The basic idea of open innovation is twofold: on one hand, companies seek information, knowledge and technology required by innovation processes among third parties rather than focusing solely on their own research and development work. On the other hand, companies also actively seek new, external commersialisation opportunities for internally developed ideas, concepts and technologies (for example licensing, sale of IP rights, spin-offs) (e.g. Chesbrough 2003a; 2003b; Gassmann 2006; Diener and Piller 2010).

Open innovation is not, however, a case of mere information exchange and various transactions between organisations. A significant resource for innovation is individuals: users, consumers and citizens. So-called user-centred innovation is one of the most interesting phenomena related to open innovation. In simple terms, it means that users of a product participate significantly in the development process of the product, service or technology, in which case the innovation or product development effort of development subject's actual process owner remains rather low in comparison with the closed innovation model (von Hippel 1986; Diener and Piller 2010).

The increase in open and user-centred innovation in particular, has created an increasingly mentioned new concept: the quadruple helix of innovation. In this case, a new operator group, i.e. users, has been added to the traditional triple helix, in other words, the interactions among the public sector, companies and universities. Living labs are the physical manifestations of such innovation operations. One of the most important characteristics of living labs is that the development of innovations takes place with genuine users in a genuine environment, and not in a laboratory (Arnkil et al. 2010). In addition to user-driven constellations, the living labs can be conceptualised as networks characterised by utiliser-driven, enabler-driven or provider-driven innovation (Leminen et al. 2012).

The quadruple helix has also been given a wider significance as a "people's community" or as a (local) citizen society (Kolehmainen et al. 2015). The interpretations of the quadruple helix that expand the concept, reflect the open nature of innovation operations and emphasise the fact that quadruple helix cooperation is a case of objective cooperation between actors in the creation and implementation of new knowledge and new innovations. It is also worth noting that open innovation and quadruple helix models aim towards a variety of innovations; they can be technological, social, product and service innovations, either commercial or public.

In sum, the concept of open innovation has been a great success and has had a tremendous impact both on innovation practices and on innovation studies. The concept has evolved over time and become more and more nuanced. It has also given impetus to other innovation concepts and practices following the

basic idea of openness and intense collaboration. The concept itself is still evolving and there are new levels of analysis ranging from individuals to ecosystems, regions and even national innovation systems (cf. West et al. 2014). Accordingly, it is only natural that the linkage between cities and open innovation has already been discovered. This is the case especially in the smart city context. It is not far-fetched to state that, in some sense, entire cities can be considered as “living labs” or “ecosystems” or, in other words, platforms for real-time tests, development and co-creation of new products and services, other innovations and smart technologies (see e.g. Paskaleva 2011, Lappalainen et al. 2015, Raunio et al. 2016).

Open innovation is difficult to pinpoint to a certain location or certain area of a city, but on the other hand, such a platform may be most intensive in the railway station areas of cities. There are good reasons for this, since railway station areas belong to all residents of a city without the exclusion of anyone or any group. Through the flow of people that the station convenes, visitors to the city are also participants of the area. Thanks to these flows, railway station areas are extremely dynamic places with potential for various competences and scales to encounter. In addition, the large number of visitors creates a platform for diverse services.

The mix of various functions and scales is thought to enable creative collisions which, as a result, produce new kinds of combinations. Openness and user-centricity of innovation are all-embracing objectives which aim for self-guiding and smartness in the production and use of an urban space and services related to it. All this is aimed to be implemented, for example, by means of digital technology and various cloud services. In all three phases, urban space is both the result of innovation and its venue. It can, however, be questioned as to what extent the processes of railway station areas’ planning, implementation and development (in their current form) manifest the significance of these areas as open innovation platforms of a smart city.

Spatial potentials and preconditions for a smart railway station area

Developing “smart” railway station areas requires a more comprehensive approach than just technological development. The relatively simplified technology-centricity of a smart city, such as the overall non-specificity of the term, has been brought up in international research literature (for example, the Journal of Urban Technology, 2015 vol. 22:1 and Intelligent Buildings International 2011 vol. 3:3). Albino et al. (2015) in particular have reviewed a large number of international studies and official documents in their article which clearly indicate that the “smart city” concept, in fact, involves humane, communal and technological aspects. Smart transportation, efficiency, ecology and innovation are repeated in debates as features that are common among various smart city concepts.

In literature, there are efforts to create comprehensive indexes for evaluating the smartness of cities, but according to authors, universal assessment systems are not possible due to the diversity of cities and situations. Assessments should take into account the diverse visions and priorities of cities in such a way that “hard” and “soft” components of smartness are processed in an integrated manner (Albino et al. 2015).

This is the starting point in our article as well. For example, it is relatively common for open innovation to be understood as a part of economic policies and other kinds of development that are characteristic to a smart city, but it is seldom realised that open innovation also needs more open and flexible urban space to support it. Due to the technological emphasis of a smart city, it is deceptively easy to assume that the virtual infrastructure alone provides sufficient support. A virtual space is a ubiquitous and flexible structure that

regenerates our spatial practices and thus also gradually transforms the physical space. However, our study shows that the requirements of physical urban structures and space, and their potentials cannot be implemented without changes in the urban planning approach and related active planning interventions.

The conceptual framework of a smart city should, on this basis, be developed in such a way that it also includes spatial planning principles. Relatively recent research literature shows attempts in this direction. For example, Komninos (2011) uses the concept of "spatial intelligence", and his aim is to expand the smart city concept towards a city's actual development context. Case studies are carried out in three cities: Bletchley Park in North London, Cyberport in Hong Kong, and Amsterdam Smart City. However, the spatial forms of intelligence that Komninos has found represent the previously mentioned "soft" components of a smart city: organisations, networks and governance. Progress must be made towards a city's "hard" spatiality, where intelligence could be operationalised into such planning principles that could also guide the physical planning of a city. Based on these ideas, we have divided the planning principles of smart city into three groups: smart profiling, smart design and smart innovation.

Smart profiling

When it is a question of railway station areas and strengthening MaaS methodology, mobility and accessibility in particular are raised to the centre of attention. These criteria are also valid when considering smart city on a more general level. Railway stations are both the nodes of a transportation network, but also places which have evolved over time by local development. A central location in a transportation network creates the prerequisites for development but, on the other hand, a place, which consists of various resources, is worth supplying with efficient connections to a wider transportation network. From the standpoint of urban planning, dynamics that aim towards a balance of network (or node) potential and place potential, creates key prerequisites for development. The mutual relationship between network and place potentials also creates a fundamental development profile for the site and this concerns both the qualitative and quantitative features. Bertolini and Spit (1998) have developed a so-called Node-Place model (c.f. Figure 1) particularly for the analysis of railway station areas. The model can be utilised as either a quantitative analysis method, like Bertolini and Spit have done, or as a more qualitative evaluation framework, such as we have done in our own study. The universally applicable nature of the Node-Place model enables it to be applied to other kinds of locations than just railway station areas.

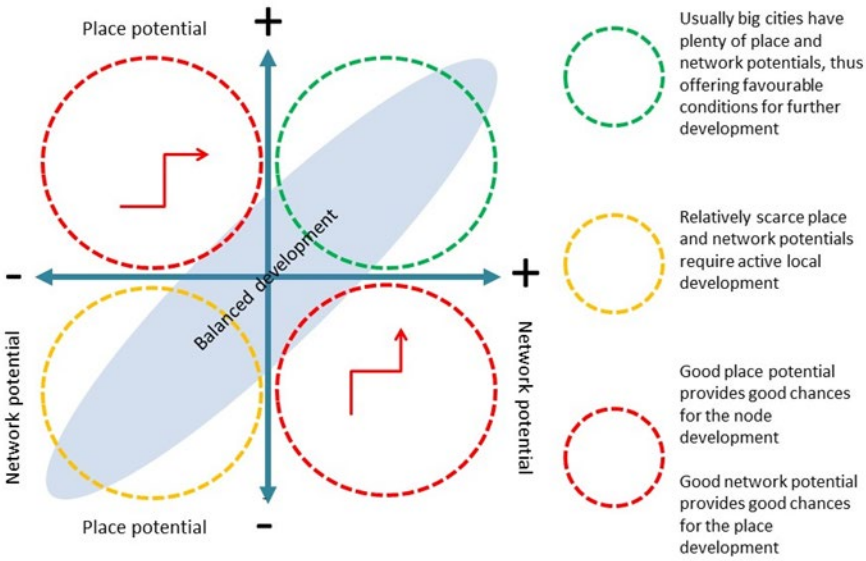

Figure 1 - Application of the Node-Place Model (c.f. Bertolini and Spit 1998)

Smart design

As for the local scale, it can be stated that new construction most often takes place within existing urban structures. The aim of design is to, in this case, “knit” together the splintered urban structures, both fabric and networks, in order to make them functionally more efficient. The knitting can take place at different scales, as more strategic integral design, or merely reaction to a current problem. Regardless of the scale, integration belongs to the basic toolbox of today’s planner, and it can be divided into four aspects: 1) connectivity, 2) compression, 3) conversion and 4) multiscalar interface (Hynynen 2016; see Ellin 2006; see Ylä-Anttila 2010). These four concepts describe various urban design situations, which are particularly common in railway station areas. This is due to the fact that the main generator of disintegration is the growth of the scale of transport networks (Graham and Marvin 2001). The aspects of integral design are specified below:

Connectivity

In most railway station projects the primary aim is to make public rail transport more efficient and increase its share in the modal split. Synchronising various networks by developing transportation technology and services is a key method towards reaching this objective. Connectivity is not just about the node-dimension of the railway station area, it also has an important role when developing the place-dimension. As previously brought up, railway station areas, together with their railyards, easily form barrier effects in city centres, and various urban design methods are utilised to eliminate them: tunnels, bridges and bridge-like structures.

Compression

Connective constructions are often very expensive, so much so that public funds alone are not sufficient. Railway station areas must be planned in such a way that the projects provide an opportunity to create economic value. One strategy is to grow the density of the urban structure by increasing floor space and number of functions. High-rise buildings and a diversity of services are potential solution models to put in practice. The construction of a large event venue in a railway station area also increases the activity of an area and promotes economic value creation.

Conversion

Most of the railway station areas under development already exist, and they may have a long history. The functional mix of the premises may have changed several times. It is worth noting that, for example, old brick buildings of the 1800s are still in use. They are robust structures, able to withstand major changes without needing to be demolished. There is a lot here for modern day designers to learn with regard to energy and material efficiency, since railway station areas are dynamic places, often subject to strong needs for change. On the other hand, applying the principles of circular economy (e.g. Bocken et al 2016) opens future prospects to build for dis-assembling, in which case the components can be utilised or re-assembled in a different location (e.g. Jensen and Sommer 2016).

Multi-scalar interface

Connectivity requires detailed planning of technical systems and related services. The special feature of railway station areas is, however, that they are the hottest points where traffic flows accumulate and connections from one network to another must operate smoothly. However, planning of the networks and systems alone is not enough. Spatial design is also needed, so that the traffic flows can be organised in a commonly shared space. Further, it is not just a case of “flow", but also “slow” waiting, which is an essential part of travelling. As the railway-station areas in the near future will be integrated more tightly into urban cores, the more they will need to have urban qualities.

Smart innovation

The key features of future, as well as some ongoing smart city development are openness, a certain democracy and continuous regeneration. During this development phase, innovations can widely emerge from different forms of urban life. Referring to Huizingh’s (2011) typology of open innovations, it is

interesting to think that urban environment would be open to be shaped by its users, even after the actual implementation has been completed (Table 2). However, this should be recognised already during the planning phase. The openness of built urban space is enabled to the extent the users can participate in planning, since the preconditions of management and use of the space will be established from the very beginning of the process. In places where technical infrastructures and land ownership set conditions for future changes, if openness and flexibility is desired, the limits for "openness" must be specified and planned in cooperation with the participants. It is, of course, possible to also develop the area in a more designer-centred manner so that it is open for self-organising development afterwards. In this case, the nature of openness will be defined differently (Hynynen and Kolehmainen 2016).

Table 2 - Railway station areas as innovation platforms (cf. Huizingh 2011; Hynynen and Kolehmainen 2016)

Development process	***Result of development work***	
	Closed, "complete"	***Open, continuously developing***
Initial situation has been defined, traditional planning process	*Designer-centred "complete" railway station area* *Innovation platforms defined by experts, designers or companies*	*A railway station area that has been designed in a designer-centred manner, but left open for further development* *The providers and users of innovation platforms are not able to influence the basic structure of the area*
More open initial situation, open planning process	*A railway station area that has been planned and implemented in an open and participating manner* *Innovation platforms become more important along the development of the area; providers and users can influence the plans* *The "complete" physical structure and function create limits for the innovation platforms as the area develops*	*A railway station area that has been planned in an open and participating manner, and is open for further development* *Open innovation platforms will born (and die) depending on the needs; various actors define the needs* *The area's physical structure is continuously changing and completing, it enables social and technical experiments*

On this basis, railway station areas can be considered certain innovation platforms. They could be key tools for local economical and innovation policies, aiming to intertwine various objectives, actors and networks through concrete co-operation. In many cases, railway station areas are at the core of urban development, and cities have the opportunity to regenerate themselves through the development of their railway station areas, if they able to realise the potentials included in them. Railway station areas offer a unique opportunity to develop and pilot new technologies, businesses and services (for example, MaaS).

Case-studies

Below we aim to demonstrate how the introduced planning principles manifest for smart railway station areas in Seinäjoki, Tampere and Espoo. Some examples have been shown in the Table 3.

Seinäjoki

In Seinäjoki, the railway station area became a key site for urban development when decisions to significantly increase housing in the city centre were made by the city council. Reasons that led to this include, for example, the rapid increase of the city's population, with growth rates of 1,5 percent per year (Seinäjoen kaupunki 2014).

Seinäjoki's urban strategy stems from knowledge-based development (Seinäjoen kaupunki 2013). This is particularly well fleshed-out in the objectives set for the railway station area. According to them, the railway station area will form a third physical innovation environment alongside Frami technology centre (which includes University Consortium and SeAMK) and the district of Itikanmäki (Foodwest and Rytmikorjaamo). The difference between these two is that the railway station area encompasses the entire city centre.

Seinäjoki has developed its own knowledge capital in a networked manner, reflecting the idea of quadruple helix co-operation (Kolehmainen et al. 2015). However, the networked method means that the researchers and experts travel from their main campuses that locate in other cities. Also, audiences for events come mainly from outside the city. However, the railway station area does not actively seize on opportunity, but only handles its essential functions in a rather dull and backyard-like milieu.

In the workshops of the development process of the station area, new content was envisioned for the four main functions of the area - travel, leisure, housing and work. The experience of rail travel was brought up in discussions in such a way that railway station areas could be developed into interesting destinations together with their events and services. The area's leisure functions would serve both long-distance travellers and local residents. Any dining facilities created in the area could, at best, operate as shop windows for the "food province", the spearhead economic branch of the region. Housing, on the other hand, would keep the area lively during different hours of the day as well as seasons, albeit this would require a rather heterogenic demographic structure. Therefore, residential possibilities should be versatile in terms of space, price and ownership. Mixed city principles would be essential in order to avoid the birth of a sleepy neighbourhood, and for the new district to become a vital, continuously regenerating source of innovation.

In the workshop, the future of work and work-life was discussed in terms of continuous change. The station area should be able to respond to these changes with adaptability and flexibility of spaces and infrastructures. It was seen that the area should host even small-scale production, which could be located in office buildings. Various hub-like arrangements should also be enabled, as well as apartment and office hotels for mobile work and for a new type of knowledge-intensive work. Functional mix, diversity, spatial flexibility and versatile connectivity, both within and outside a city, became the key terms for further development of the area. These features are in line with the requirements of open innovation.

In 2015, the station area was the target site for the *Europan13* architectural competition. Based on the winning proposal, a planning process was initiated in the spring of 2016. At present, the process is in the master planning phase. For promoting new business in the area, a project called *RESPA* (Recreating spaces) was launched with the aim to create a new type of development and innovation platform based on the functions and qualities of the station area. A competition called *Fiksu assa* (Smart station) was organised within the

framework of the project, which aimed to seek products, services and ideas to be trialled in the railway station area of Seinäjoki.

Tampere

The railway station area is one of the most important urban development projects in Tampere. It consists of the central station area, the railyard crossing deck in the Sori area, as well as a multipurpose arena. The starting point of the project has been a vision of a well-functioning node for all transport modes, which is also an attractive cluster of business, workplaces, services and housing with high-quality urban architecture.

An international architecture competition was organised in the area in 2014. According to the winning proposal *Reconnecting Tampere*, the eastern and western parts of the city will be connected with an urban deck that crosses the railyard. The current station square will be extended into a north-south oriented railway station park. A travel centre will connect all transport modes and travel chains. Implementation begins with the construction of the deck and the multipurpose arena, continuing with the tower buildings on the northern side of Sori bridge. After this, the construction moves towards the north. The railway station area will form the city's most important concentration of offices. A new type of shopping and service centre will also be built on the site.

Interest among property investors has been sought by commissioning designs from world-famous architect Daniel Libeskind, as well as by organising an international competition concerning the central station area. In both cases, the tactics of compression have been applied for enhancing urban mobility and regeneration, but also for creating economical values for funding the public projects. Other projects that try to solve the railyard's disintegration problems include tunnels below the railyard, which clearly apply connecting tactics by improving the integration of the pedestrian and cycling network. On the other hand, the tunnels have been partly provided with commercial functions so, to some extent, it is also a case of compression.

Espoo, Kera

Kera is a railway station for commuter trains in the industrial area of Karamalmi in Espoo, between the stations of Kilo and Kaunianen, approximately 15 kilometres from the central railway station of Helsinki. Several companies in the area have utilised rail transport, so there has also been goods transport in Kera. However, goods transport reduced in the 1990s and finally ended in the summer of 2009. AGA Oy's factory area, which was built at the beginning of the 1960s and emptied in the 1990s, as well as Inex Partners' logistics centre, which moved its functions to Sipoo by the end of 2018, are located in the vicinity of Kera station. The Kera railway station was named after former Kera Oy's ceramics factory. The factory's production ended in 1958 and new industrial operations and jobs began to form in the area. The majority of the current industrial area was constructed between 1960 and 1990.

The master plan for the area was approved by the Municipal Council of Espoo at the beginning of 2017. Kera will be a climate-friendly and lively district that attracts new business operations to the vicinity of competitive transportation connections. According to the plan, the former commercial and industrial area will become a versatile residential and commercial area between Kauniainen and Leppävaara.

Because Kera is a dense area, the service centre can be reached from the residential blocks by foot in less than 20 minutes. Leppävaara, Kauniainen, Tapiola and the Espoo centre can be reached by bicycle in the same time. In the near future, Kera could be an attractive growth node of the metropolitan area, where the light rail connection called *Raide-Jokeri* efficiently connects to the national public transportation network. The objective of 14,000 residents and 10,000 jobs enables the development of the railway station area as a new kind of city centre.

Table 3 - Smart planning principles applied to the case areas

	Seinäjoki	***Tampere***	***Kera***
Smart profiling	*A growing regional centre located along the main railway line; a northern terminal of the "Growth Corridor Finland"*	*The country's second city, a key node along the main railway line, located in the middle of the "Growth Corridor Finland"*	*Location in the metropolitan area creates a lot of development potential*
Smart design – connectivity	*Tunnel connecting the CBD and the district of Pohja; integration of the railway station area as a part of the city centre*	*Re-Integration of the city centre; railyard crossing deck, tunnels below the railyard*	*Railway connects Kera to the important centres of the metropolitan area*
Smart design - compression	*Housing, services, events and jobs in the railway station area; shop window for the "food province"*	*Concentration of high level construction, multipurpose arena, casino, versatile services*	*Lots of new floor space*
Smart design - conversion	*Utilisation of old roundhouses as culture and leisure facilities*	*Old roundhouses as hotel's lobby, restaurant and conference facilities*	*The large shut down industrial premises located in the vicinity of the station offer low-threshold opportunities for flexible spatial use*
Smart design - multi-scalar interface	*Integration of various transport modes with high-quality transport planning and architectural design*	*Integration of various transport modes with high-quality transport planning and architectural design*	*Integration of various transport modes with high-quality transport planning and architectural design*
Smart innovation	*Business trials were sought for the area with the RESPA project; the area has the opportunity for a more open and flexible spatial solutions*	*A digital company-led MaaS platform for various digital mobility services; a test site for indoor and outdoor positioning and location-based services*	*Theoretical opportunity for a more open and flexible spatial solution to be shaped continuously*

Because the detail planning of the area is still in the drafting phase, the starting point for development is open, which also creates opportunities for open processes. Participants and stakeholders can be defined freely. The area is

also open in terms of its qualitative objectives. The railway station area could be a continuously developing and transforming, flexible area, which could also provide open innovation platforms for various developers. Large number of residents, jobs and commuters create opportunities for a diverse, mixed railway station area, which has a diverse service structure. In this way, the innovation platform can also be diverse.

In 2015-2016, an idea competition on the development of the area of Kera was arranged. The winner, *Co-Op City* emphasised circular economy and sense of community. The logistics centre of S-ryhmä will move from Kera to Sipoo in phases. In the Co-Op City plan, the life cycle of the old logistics centre will be prolonged by new functions, evolving in accordance with the area's development stages. As soon as the logistics functions move away, the area could be used for arranging events and sports activities.

Some reflections on the cases

Although these three cases are mutually quite different with regard to the size of their surrounding urban regions, their location in regional structures and national rail network, they all have clearly positive future prospects on the growth of rail transportation, and they all are located in growing urban regions. These structural starting points lead easily to very dynamic development profile. The rest depends on local development will and activity. However, in order to avoid the simplified "business-as-usual" mode, it is important that the toolbox of decision-makers and developers include smart planning principles. *Smart innovation* is an especially demanding principle to implement, and so it requires support from the *smart design* principles.

It is worth noting that only in Tampere have plans started to be implemented. The descriptions in *Table 3* therefore are mostly publicly expressed objectives for development and planning, and partly potentials brought up in our study. On this basis, our aim is to inform the ongoing debates with future possibilities now, as the development projects are flexible enough to stand remodelling.

Unfortunately, we were forced to exclude railway station areas with less dynamic development profiles. If the case is located outside of Growth Corridor Finland, a lot more development activity is needed, as well as recognising and deploying diverse development resources. Even the main national rail transportation actors like VR (the Finnish state railway company) and LiVi (the Finnish Transport Agency) are not very keen to give their support to development processes. In these cases, it is important to consider, for example, the potentials of MaaS, its smaller and subtler scale, where the traffic flows and multi-scalar interfaces are weaker, very creatively. The same type of downscaling should be applied to the other smart principles.

Conclusions

Technology centres continue to implement the principle of "exploitation" or, in other words, they aim to produce new knowledge and technology for the benefit of business. On the other hand, the aim of the "creative fallows" is to focus more on "exploration" by offering low-threshold premises for new enterprises, among which there may be future success stories. With this same continuum, the role of railway station areas could be "experimentation", which is created in the encounter of various functions, scales and competences in a smart and open urban context. It is important to notice that this classification describes different emphases more than sharply-defined operational models. It does, however, seem as though innovation needs urban context.

In this respect, open innovation should also be defined with openness in terms of urban space, not just opening innovation processes for users or competitors. This notion is well-aligned with the recent findings of the open innovation research. It also sets apart Finnish railway station areas from the previous stages of evolution, i.e. creative fallows and technology centres in particular,

because railway station areas are only just stepping into the arena of knowledge-based urban development.

Innovation and its processes cannot be directly managed or planned, but the innovation environment can be. If we could understand the spatial pre-conditions of innovation processes, it would be possible to support them indirectly. At the moment, many railway station areas are going through their initial re-creation phases, so there is a crucial turning point under way. There is a good reason to question whether we have the patience to develop innovative railway station areas for regenerating our long-term urban economies, as the pressures for short-term development projects clearly exist. Railway station areas are special urban areas which must also be developed in a special way. At this very moment, there is a clear momentum.

Railway station areas have true potential to be the couriers of smart city development. As previously stated, this will not occur by itself, and definitely not by means of conventional mind-sets and practices. The first critical step to bypass the “business-as-usual” practices is to identify the smart potential of railway station areas. Secondly, political willingness to realise this potential must be found. It is a benefit for the smart, future-oriented development of railway station areas if we are able to formulate appropriate and clear urban planning principles for these. They will help designers and decision-makers identify the actual development requirements of the area and conceive possible development profiles. Place and network (node) potentials create different pre-conditions which exclude certain options but which, on the other hand, support other ones. In addition to this, planning principles should provide design-based models which can be used to create user values as well as financial and symbolic values. The significance of the latter two in particular is emphasised, if a new type of urban environment is sought, where the path of implementation can be more complicated and longer than normal.

If the aim is to seriously produce urban space that enables open innovation and user experimentation, the whole process of space production must be seen in a new way. There must be a transition from a product-oriented methodology to a demand and user-centred production of space. This could mean, in practice, affordable, flexible, multi-purpose and, possibly, dismountable spaces. These do not belong to the typical objectives of current urban development. However, it is good to realise that there exist approved models for this kind of sustainable constructions if we think, for example, the robust factory buildings of 1800s and 1900s which still continue to be in use, albeit converted to other purposes. There are also indications that the rising circular economy will bring along interesting, smart solutions to our buildings and cities.

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Urban Industries and the Production of Urban Form

A Typomorphological Analysis of Urban Productive Spaces in the Jette-Koekelberg Area in Brussels Capital Region

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Abstract

The proposed paper aspires to provide a typomorphological analysis of patrimony of industrial activity in the urban fabric of a productive hotspot of the Brussels Capital Region. The research fits within a larger PhD-track on the sustainable retrofit of such productive activities in this region.

Due to zoning policies and increasing real estate pressure on urban land, a major part of the space-extensive productive activities has disappeared from Brussels' urban areas, taking jobs and artisanal knowledge towards monotonous enclaves in the outskirts. Whereas European cities were rich in productive activities, they now mostly host consumption. This is problematic. Urbanists, architects and policy makers plead for the inversion of this process by reintegrating industrial enterprises in the urban fabric.

Despite the observed shrinkage in the amount of active urban industries, a GIS informed hotspot analysis revealed a concentration in the Jette-Koekelberg area. The presented work therefore provides a typomorphological study of the patrimony of these remaining structures. In this light, the analysis is performed at different scales in order to bridge between the urban form and the architectural type. The studied area is therefore decomposed into the analysis of its urban fragments, building blocks and parcels.

Informed by the logical classification of these productive urban artefacts at different scales, this paper aspires to obtain insights on their typomorphological setup. Deploying this approach which is mainly focused on the residential use, to a mixed-use area, unveils strongholds and alterations on basic types in the urban fabric. In doing so, this investigation attempts to inform the ongoing planning debate on productive cities and mixed-use development by looking specifically at the existing built environment: urban form and building types. Despite the large interest in productive cities, this has not yet been treated systematically.

Keywords: urban industries, typomorphology, Brussels, productive city

PEER-REVIEWED ARTICLE

Brussels: a productive metropolis

In planning debates on sustainable urban development (European Environment Agency, 2006; Hillman, 1996), compact city strategies that promote the intensification of micro-central areas, are encouraged for their reduced consumption of energy and land. Such existing urban cores are to be densified and diversified with activities and building types. However, a gap between planning theory and practice exists, as zoning policies remain the corner stone of spatial planning in many cities (Crysler et al., 2012). Problematic is the contradiction that arises when considering the need for space-extensive, industrial urban land in highly desired urban cores, like former port areas. Exemplary are the high rates of redevelopment of industrial land with more profitable programs, after relocating their activities towards monotonous, suburban enclaves or third world countries. London can be considered the paragon for this phenomenon. Brearley (2016), argues: “What used to be the place of production is now solely hosting consumption: the city has eaten itself”. Jobs in Brussels’ industrial sector have disappeared since the 1980’s by 4,1% on a yearly basis, compared to a notified increase in suburban areas. This, next to a general decrease of jobs in the sector, has caused 30,9% of the low-educated workers in BCR to be unemployed (De Salle, 2013). The separation of work-production and workers-consumption promoted the unsustainable transportation of people and goods via roads, proven by an increase of 70,0% between 1991 and 2001 (Ryckewaert, 2011; Verhetsel et al., 2009). In 2014, Brussels was ranked second on Europe’s most traffic congested cities list (INRIX, 2015). In reaction to the previously elaborated numbers and inspired by the international planning context, the Brussels urban development agenda has been oriented towards the preservation and qualitative retrofit of production in the BCR (Brearley et al., 2016; De Boeck et al., 2017; Ryckewaert et al., 2012; Vandermotten, 2013).

Concretely, two planning policy tools, ‘ZEUS’ and ‘OGSO’, have been introduced in 2014 to promote the co-habitation of productive activities with the existing urban environment in well-chosen urban areas. Firstly, ZEUS (Du. Zone voor Economische Uitbouw in de Stad, En. Zone for Economic Expansion in the City) provides tax benefits for Small and Medium Enterprises (SMEs) that employ locals in residential areas with high unemployment rates. Secondly, OGSO (Du. Ondernemingsgebied in Stedelijk Weefsel, En. Entrepreneural Zone in the Urban Environment) allows the upzoning of former urban, industrial land to mixed-use programs on the condition that 90% of the initial industrial floor surface is reintegrated in the new (Cassiers et al., 2012; De Boeck et al., 2017). Nonetheless, both policy measures contradict each other, as the upzoning of OGSO increases land prices, making residential activities more interesting than industrial or productive ones.

Despite these promising intentions, a gap between this planning theory and practice is notified in piloting projects that have been developed by Citydev Brussels (Vermeersch, 2016). The encountered problematics embody multiple scales, from societal to building technical. Moreover are designers reluctant towards this undiscovered field, where the need for typological research is repeatedly unveiled (Brearley et al., 2016; Vermeersch, 2016).

Theoretical framework: typomorphology

In order to explore this undiscovered field of the typology and urban form of industrial activities, a systemic methodology is found in Caniggia’s typomorphological approach. It is, next to Conzen’s urban morphology, Bill Hillier’s Space Syntax and Henri Lefebvre’s philosophical theory, specified on bridging between the urban form and its main constituting element: the building (Sima and Zhang, 2009). The relevance of this approach is due to the gaping lack of knowledge on compatible and mixed-use types in order to qualitatively retrofit production in the city. By studying the urban form of Brussels’ 19th century expansion, it can be concluded that its growth was highly characterized

by the presence of small-scale, industrial activity. Despite the notified escape of industry's activity from urban areas, their patrimony remains present. Today's mixed urban fabric, in other words, can be studied as a container of answers to previously encountered problematic. The city is in its history (Rossi, 1966) and is therefore here taken to be the point of departure for constructing systemic knowledge on the typomorphological setup and compatibility of urban, industrial activity.

Typomorphological methodology

Caniggia's typomorphological methodology is characterized by a specific point of view on both the temporal, as well as the spatial dimension of urban form. Namely, it is fundamentally based on the understanding of a city fabric through the analysis of its historical process of formation on the one hand and introduces the concept of hierarchy of space on the other (Comert, 2013; Sima and Zhang, 2009). Moreover, it is particular in the sense that it applies to the building (typo) as well as the urban (morphological) scale.

Type can be defined as the inner structure of form, a principle that leads to infinite formal variations. In other words, the type is the ensemble of inherent similarities that are abstracted over a large set of buildings (Argan, 1963; Caniggia and Maffei, 1979; Grassi, 1967a; Moneo, 1978). Caniggia proposed the typomorphological method as being extensive classifications of urban spaces (Caniggia and Maffei, 1979; Moneo, 1978). This taxonomic conception stems from the idea that building typology is the basic premise for the analysis of an urban form: morphology. The decomposition of complex urban fragments into elements, structures and organisms, enables to reveal their specificities and interrelationships and bring order to the knowledge of the built environment (Moudon, 1994). The elemental objects to be found are lots (parcels), streets, built forms and public spaces (Levy, 1999). It is the deductive character of these analytical studies of past and present urban artefacts that enable the logical construction of architectural knowledge (Grassi, 1967a).

The derivation of constitutive types in the urban environment can reveal strongholds of political, economic, social and cultural influences that are imprinted in the built form (Argan, 1963; Grassi, 1967b; Moneo, 1978; Rossi, 1966). Grassi argues that the forms of realized architectures are entirely attributed to mankind and influenced by their societal context in the time they were conceived that the logical classification of these forms will unveil important insights on base types and modifications of it.

Procedural typology

The hypothesis that urban form is the ultimate readable sediment of human culture, is conceptualized by Caniggia and Rossi in the notion of consciousness. The dialectic relationship between human interpretation, or action, and urban form can either be spontaneous or critical consciousness (Caniggia and Maffei, 1979; Moudon, 1994; Rossi, 1966). Spontaneous consciousness is not mere imitation, nor reproduction, but the "critical understanding of what it takes to make a building"(Moudon, 1994). The, by Caniggia repetitively used, examples are the Florence row houses that are constructed by builders without critically reflecting upon its design: there was only one way to build that row house in a certain time and place (Moneo, 1978). Such 'common-sense' can be attributed to the notion of (base) types. On the other hand, critical consciousness represents the "critical self-conscious thought process guiding the building activity which may not refer to its cultural context" (Moudon, 1994, p. 293). These highly specialized structures are often interpreted as monuments, places of symbolic function (Rossi, 1966). Rossi's theory of permanence in the city fabric analogously divides two concepts: types (dwelling) and primary elements (monuments). These persistent primary elements structure the mental map of the city and are of monumental value in the way they condition the collective memory of the city. It is not their actual function, but rather their form and locus which attributes to this memory.

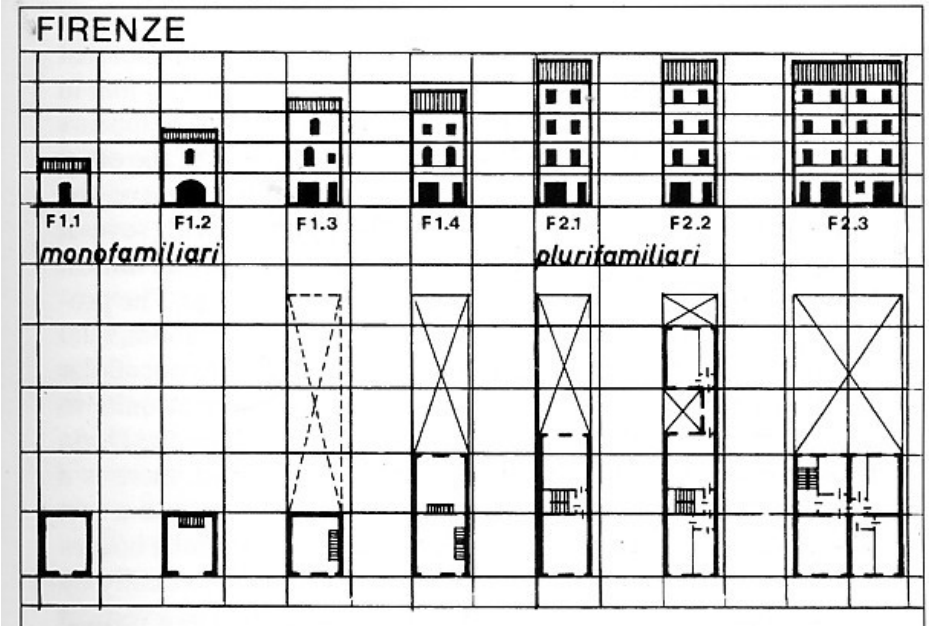

Figure 1 - Florence row houses, (Caniggia and Maffei, 1979, p. 87).

Type-mixity

In contrast to the stated objective of this paper, most studies have so far been particularly interested in functionally determined types (Moudon, 1994). The classification to function therefore presupposes that all existing forms are created to serve a particular function, neglecting its dynamic capacity or ability to host more than one (Rossi, 1966). This last is particularly valid for the critically conscious works of architecture. Whereas the spontaneous are residential and derived from categorization, the latter are independent of their function and stand alone. According to Rossi, such monuments hold an ability to host multiple functions over time. Therefore, the form of the primary elements is independent of their functions. He even argues that we tend to appreciate urban artefacts that have altered their function over time (Rossi, 1966).

Case study: Brussels Capital Region

The typomorphological method is, as earlier described, characterized by the hierarchy of analysis that is similar on two different scales: buildings and towns, architecture and urbanism (Caniggia and Maffei, 1979; Moudon, 1994). The hierarchal order therefore distinguishes between elements, structures of elements, systems of structures and organisms of systems to delineate the studied object in scale and enable the decomposition of the complex urban environment (Comert, 2013; Sima and Zhang, 2009). Concretely, if buildings were defined to be the elements, then building blocks can be regarded the structures, the area will be the system and a town can be considered the organism. This pyramid structure is equally valid for what bricks are to walls, walls to rooms and rooms to buildings. Caniggia's emphasis thus lies on the interplay between scales in the urban fabric, what Rossi (1966) denoted to be the architecture of the city. This synthetic methodology therefore enables to understand this relationship through the analysis and categorization of all elemental objects.

In order to grasp the typomorphological setup of these elemental objects in the Brussels Capital Region, raw sources of data are to be ordered and brought together. This has been established by the means of a registered company database (0) which is spatially interpreted through GIS-mapping (1), historical and actual aerial images (2), archival research (3) and on-site investigations (4) that respectively enable the following studies:

0. The categorization and listing of active productive activities (FOD Economie, 2016).
1. Geographical interpretation (mapping, clustering and hotspot analysis) of the earlier listed active industries (CIRB-CIBG, 2017a)
2. Diachronic reconstruction and qualitative interpretation of the studied environment (CIRB-CIBG, 2015).
3. The in-depth study of Brussels' industrial patrimony that has been listed in the visual inventory of industrial patrimony, published in 1981 by the Archives d' Architecture Moderne in Brussels (CIVA, 1981). The inventory holds graphic information, such as plans, elevations and pictures, as well as a listing of the building's most important features: date of construction, original function, architect, actual (in 1981) function, etc. Its major drawback, however, is the visual, in situ method that did not always allow to reach the inner yards of the building blocks. This space, as will be later revealed, appears to be the most frequently chosen location for industrial activities in residential areas. The building permits of industrial buildings that are not listed in this visual inventory are, however, found in other municipal archives.
4. On site investigations logically allow for the check-up of the temporal relevance of the previously elaborated data.

This paper will, following the typomorphological method, first define a productive cluster through the hotspot analysis of the entire region that will then be decomposed into aggregates of building (block) types.

Brussels Capital Region (BCR)

In order to locate and grasp the actual productive activities in the BCR, a geo-referenced database has been set up for which the raw input data is obtained from the national register of subscribed enterprises in Belgium (FOD Economie, 2016). All records of the database include a NACE (Fr: Nomenclature statistique des Activités économiques dans la Communauté Européenne, En: statistical nomenclature of economic activities in the European Community) code that indicates the nature of the company's activity and can therefore be used to make a selection of the existing productive activities in the BCR.

Due to the availability of address information in the databank, a link with the cadastral data of the Brussels Capital Region was established and allowed for the study of the geographical distribution and extent of these industrial activities. By the use of GIS-software the distribution, density and hotspot analysis maps are generated and respectively shown in the upper row of Figure 2. The hotspot-clustering analysis is carried out by means of the getis-ord gi method and represents places with high concentrations of industrial activity. Theoretically it is calculated to be a cluster of delineated areas (blocks, municipalities, monitoring districts etc.) with a high concentration of features (here industrial activities) and which are surrounded by other delineated areas with high concentrations (Manepalli et al., 2011). The features that were put in, are the address points of the companies, calculated on the delineated area that is chosen to be the building blocks. In order to be clear, it should be mentioned that the address point has therefore been calculated as a singular entity, not considering economical or physical statistics of the studied companies. Small, medium and large enterprises in terms of employment or production, are thus equally calculated as one feature. This allows to maintain the entire range of building structures for industrial activities.

Analogue to these spatial statistics of productive activities anno 2016, the method is repeated to visualize the sprawl and distribution of the industrial patrimony that was listed in the earlier elaborated, visual inventory (CIVA, 1981). After being manually corrected, the inconsistent set of address points was geocoded using Google Maps API. Therefore, the inventory became comparable, as shown below, to the actual database of productive activities.

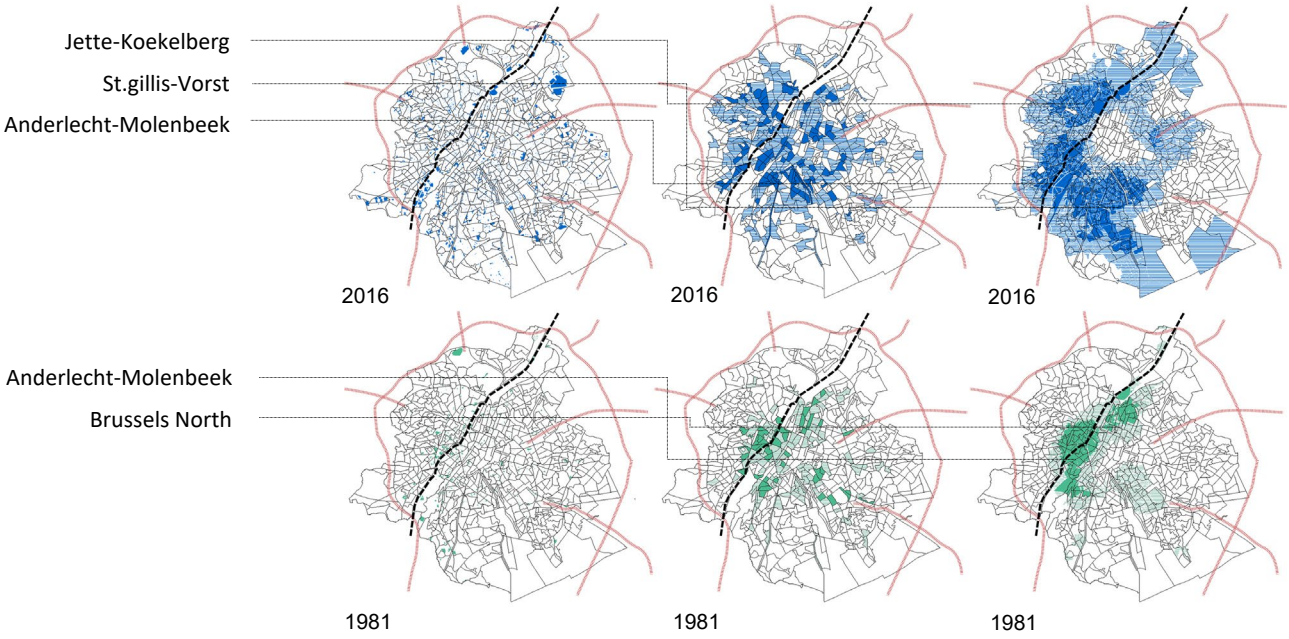

Figure 2. Distribution map (left), density map (middle) and hotspot analysis of productive activities (as defined above) in the Brussels Capital Region. Whereas the upper row is created by the use of the Databank of Registered Companies in Belgium (FOD Economie, 2016), the lower is generated for the visual inventory (CIVA, 1981). All maps are created by the author with the use of ArcGIS software.Figure 1 - Florence row houses, (Caniggia and Maffei, 1979, p. 87).

The above shown graphs unveil three major concentrations of actual productive clusters in the Brussels Capital Region, being Jette-Koekelberg in the north, Anderlecht-Molenbeek in the west and St. Gillis-Vorst in the south. The productive clusters that are based on the visual inventory from 1981, however, reveal a somewhat different pattern, with hotspots in Molenbeek and the Brussels North area. Whereas the first is still recognizable in today's analysis, the latter is now mainly replaced by office blocks. In general, some preliminary observations can be made.

1. The radius of centrality, defined as the distance from the hotspot to the city center has significantly elongated over the course of time.
2. The imprint, and therefore importance, of the Canal Brussels-Charleroi is clearly depicted by the location of industries in 1981's density map and hotspot analysis. The current-day situation has altered.
3. The mobility context of the current St.Gillis-Vorst hotspot seems to be problematic as it is located in the midst of the Ring Road's (R0) missing link.

Due to its smaller, compared to the two others, grain size of parcels and blocks, it here is chosen to focus on the Jette-Koekelberg cluster. The hypothesis is based on the idea that the chances to discover qualitative co-existence in space of industries, residential use and other, are higher in residential areas with significant concentrations of industrial activities. By doing so, we attempt to avoid the mono-functional (industrial) enclaves that are in parts of the Canal Zone.

Jette-Koekelberg - Organism

The hotspot that is subject to research, as shown in Figure 3b, is delineated by the scale of the Monitoring District map (du. Wijkmonitor, fr. Monitoring des Quartiers) in order to increase the statistical comparability of the generated data as it is the most commonly used denominator (CIRB-CIBG, 2017b). In reality, the researched area is bordered by the following linear elements: railroad Jette-Brussels North on the north side of the area, the Canal Brussels-Charleroi on

the east side of the area, Avenue Leopold II (and tunnel) on the south and the Avenue de Laeken on the west. The productive activities (in red) appear to be of sprawling nature.

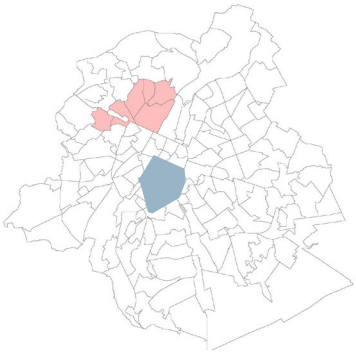

Figure 3a. Delineation of Jette Koekelberg cluster on monitoring district map. Image produced by author.

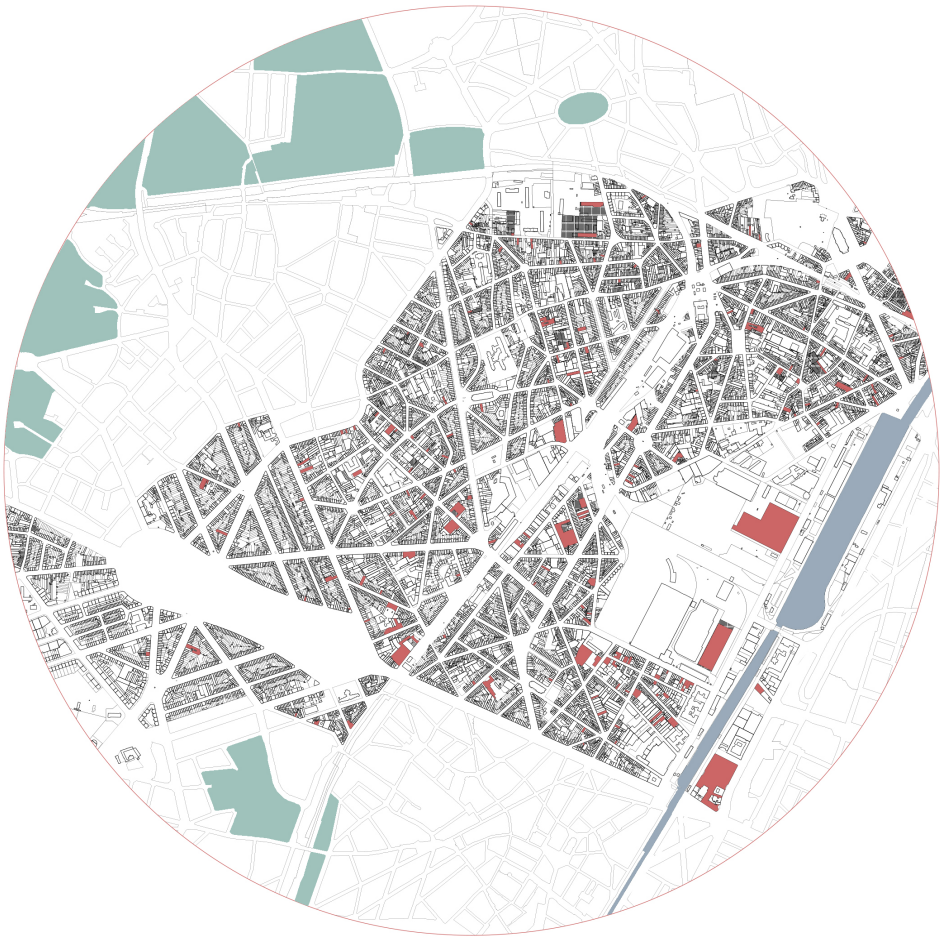

Figure 3b. Figure ground map of the area of interest, showing the productive activities in red, the canal in grey and greenery. Data retrieved from cadastral maps, edited by author (CIRB-CIBG, 2017a).

Concise Historical Overview

The first expansion of Brussels city center out of its pentagonal shape, happened shortly after the establishment of the Belgian kingdom in 1831 and along its main axes of entry from the hinterland: Chaussée de Gand, Chaussée de Jette, Route de Ninove, etc. The villages that surrounded Brussels in a first belt took shape around these important (cross)roads and generally accommodated housing and agricultural activities. This rural character persisted for a long period as the first industrial activities were grafted on agriculture: breweries, leather workshops, etc. (Bauwelinckx et al., 2011). The Jette-Koekelberg area was rich of Small and Medium Enterprises (SMEs) that were located along these important historical axes. The Sunday market, for example, hosted their stands of local SMEs on a weekly basis (Bauwelinckx et al., 2011). The presence of their ateliers, workshops and farms is firstly depicted in the in 1836 established Dubois map.

Certain consecutive developments testify of a quick industrial development of the region on a larger scale. Exemplary is the construction of the canal Brussels-Charleroi in 1827-1832 and the first European railroad connecting Brussels with Mechelen in 1844. The first cartographic material from that period (Dubois, 1836) reveals the design proposals for the ‘quarters of work’ and ‘industrial arsenal of Brussels’ area at the west bank of the canal. Years later, in 1843, these structures seem to be significantly enlarged with docks and a

covered market at the location of the current Tour & Taxis complex, as notified in Vanderstraeten's map (1843).

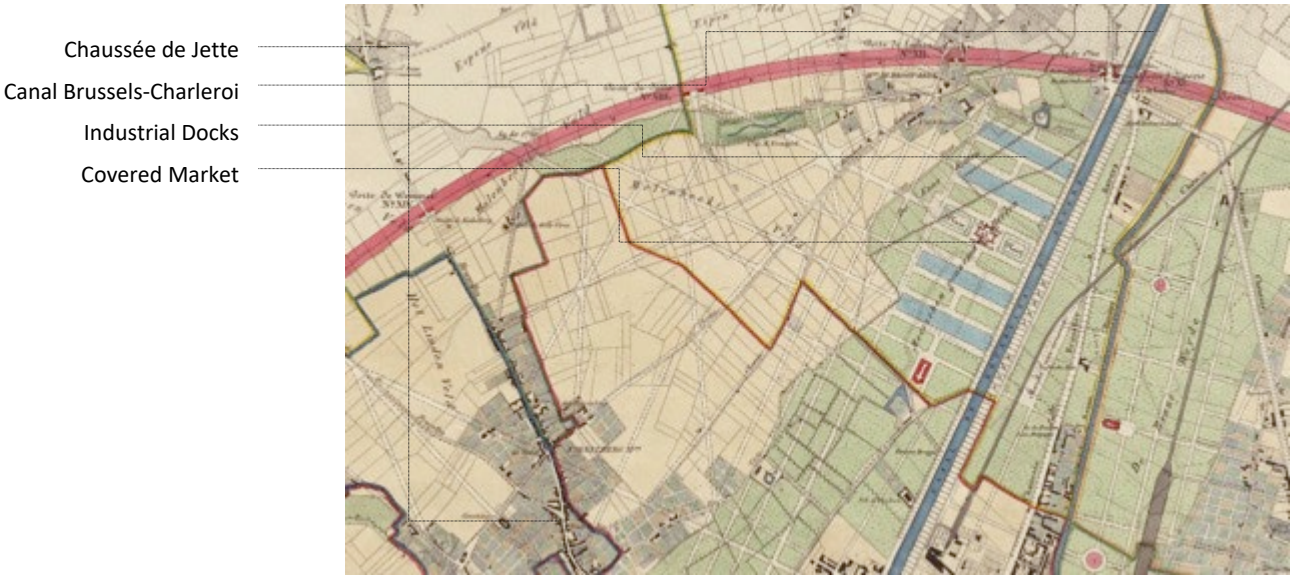

Figure 4. Depiction of studied area anno 1843, revealing the importance of the Chaussée de Jette, of the canal Brussels-Charleroi and the proposed design of industrial docks with a covered market (Vanderstraeten, 1843).

Unlike what the upper left map (1873) in Figure 5 suggests, is the street grid already studied and projected on the landscape in 1843, however, only introduced partly by the end of the 19th century. What is already present in the urban fabric though, is the railroad connection between Brussels South and North station that happened to form a surrounding belt around the historic Brussels Pentagon. This historical border still exists today in the form of the earlier elaborated metro line 2 ("Map Belgium in 1873," 2015).

The 1904 map depicts the established connection between the historic center and the newly introduced Elisabeth Park in the west of the area, in the form of the Leopold II Lane. This wide avenue in Hausmannian grandeur forms the structuring backbone of the newly introduced street pattern. In 1900, this same Leopold II also inaugurated the port of Brussels (now: Vergotedok) and thereby caused a wave of construction of prestigious industrial buildings in this maritime area (Valente, 1999). Later, in 1939, we can see the first signs of the Tour & Taxis complex that was constructed by, and named after the family that started the Belgian Postal service: Von Thurn und Tassis (Tour & Taxis, 2014). They used the marshland next to the port as pastures for their postal horses and constructed a public warehouse, a goods station and buildings for the customs near the water (Valente, 1999). Apart from the continuous densification of the outlined street pattern in the area, no significant changes are notified in the consecutive maps. Statistics unveil that 74% of the area's built fabric stems from before 1961 (FOD Economie, 2001). However, after Tour & Taxis' heydays in the 1960's, its use as logistical hub diminished and gradually lost importance up until the point where it was put for sale in 2000. After a tumultuous planning decennium, the site is being redeveloped into a mixed-use neighborhood (BRAL, 2015).

It can be concluded that the Jette-Koekelberg cluster has taken advantage of its excellent positioning in terms of mobility (road, rail and water) of goods and workers. This has enabled the area to change from an agricultural character to accommodate a high variety of industrial activities (CIVA, 1981). Moreover, due to the strict outline of the parceling grid with a residential grain size, a high diversity of industrial activities can be found: from small ateliers with the size of a house to larger annexed building complexes (CIVA, 1981).

Figure 5. Historical growth patterns from 1873 until today (2017) of the Jette-Koekelberg region. (NGI, 2015)

Urban Morphology

Based on the industrial and morphological outlook of the Jette-Koekelberg area, it can be divided into two major study zones: a monotonous residential part in close proximity of the Elisabeth Park and a more productive eastern area.

Moreover, the following morphological and spatial notifications can be summarized:

1. The location of Tour & Taxis (and intrinsically the canal) has attracted a diverse gamut of industries to settle in their proximity and the presence of this productive patrimony diminishes with the radial distance from this focal point.
2. The built area of the productive activities does not seem to be inversely proportional to their distance from the city center as could be expected in the context of real estate value.

As mentioned above, todays overall morphological outlook of the region has not been drastically altered since the 1930's due to its profound planological street pattern. Namely, the radical introduction of the street axes has caused that all building blocks, except for those facing barriers like metro lines or a railway station, appear to have regular shapes: triangular, rhomboid or rectangular. Consequently, it enables to unveil strongholds in the formation of mixed-use building blocks, through the morphological categorization of typical blocks.

Productive Blocks – System

The shapes of the studied building blocks (defined as the smallest enclosed space by three or more streets) can be divided between rectangular and triangular structures. These recurrent urban patterns reveal underlying logics when displaying the industrial buildings in red:

1. In triangular, regularly shaped blocks, productive activities are mainly located in the midst of a street. As such building blocks are usually divided with plots that lay orthogonal to the street, the deepest parcels can logically be found in the middle and appear to be a favourable location for industries to settle.
2. On the basis of the figure ground maps, three categories of industrial sites can be divided in those that a. follow surrounding plot dimensions (1-4, 11-12), b. are constructed over multiple plots (5-7, 13-18) and c. reveal a continuous and chaotic annexation of land for the expansion of their activities (7-10).

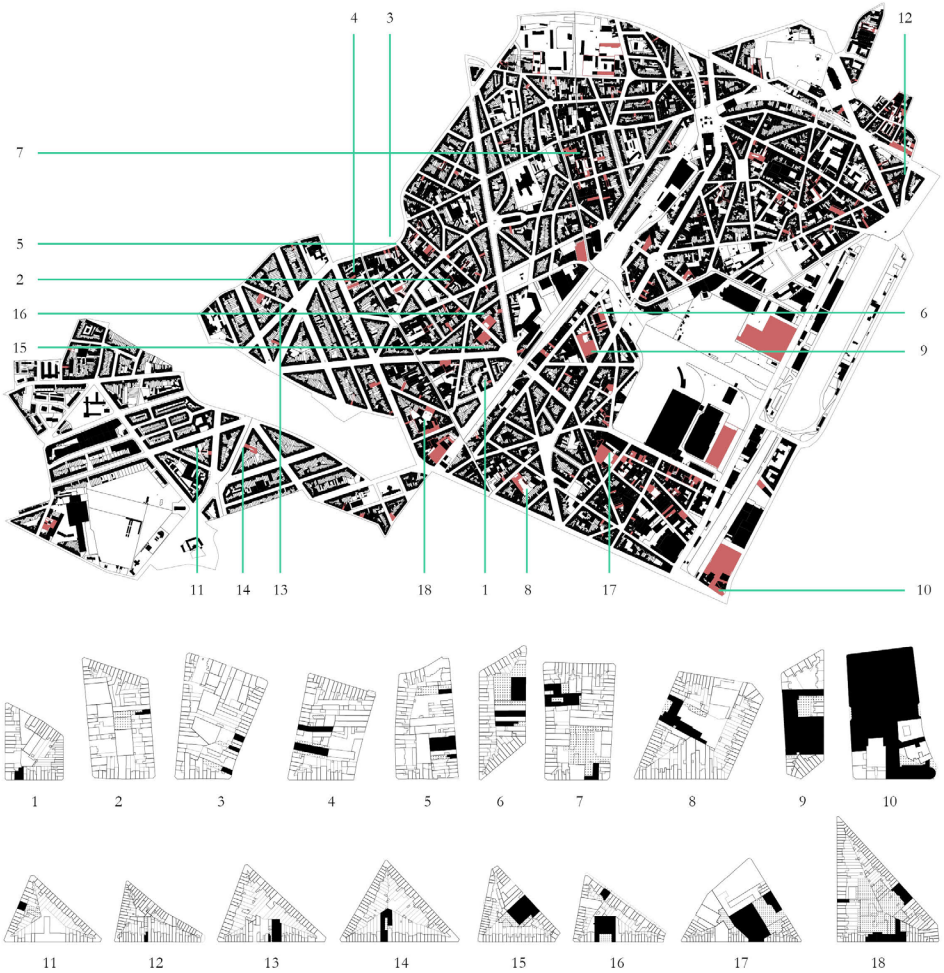

Figure 6. Morphological analysis of mixed-use (residential, industrial, other) building blocks in the Jette-Koekelberg hotspot. Industrial buildings are depicted in black, their parcels in dots. Image produced by author.

Chaussée de Jette – Structure

In order to further study these outcomes in regard to their context (spatial and temporal dimension), it is chosen to focus on the area around the Chaussée de Jette. Its historical importance in terms of mobility and industrial activity, as well as it being a spatial cross-section of the larger study region 'Jette-Koekelberg', argument for the proposed zoom. Despite the few domiciled productive companies in this region, the actual morphological outlook certifies a richer industrial history, taken over by other, more compatible functions.

Historical analysis

Available historic maps (Dépôt de la Guerre, 1969; Institut Cartographique Militaire, 1891; Vander Maelen et al., 1858) and (CIRB-CIBG, 2015) geo-referenced aerial views that date from 1858, 1869, 1891, 1930, 1971 and 2015 enabled to reconstruct the chronology of all buildings in the studied area. However, it should be noted that renovations with small impacts on the surrounding urban form were neglected. The result is depicted in Figure 7 and can be summarized by the following notifications:

1. Most large-scale complexes stem from before 1930 and persisted despite the development pressure and zoning policies.
2. Buildings and building blocks that are constructed after 1971 are small-scale projects that either infill the vacant land or redevelop former industrial structures.

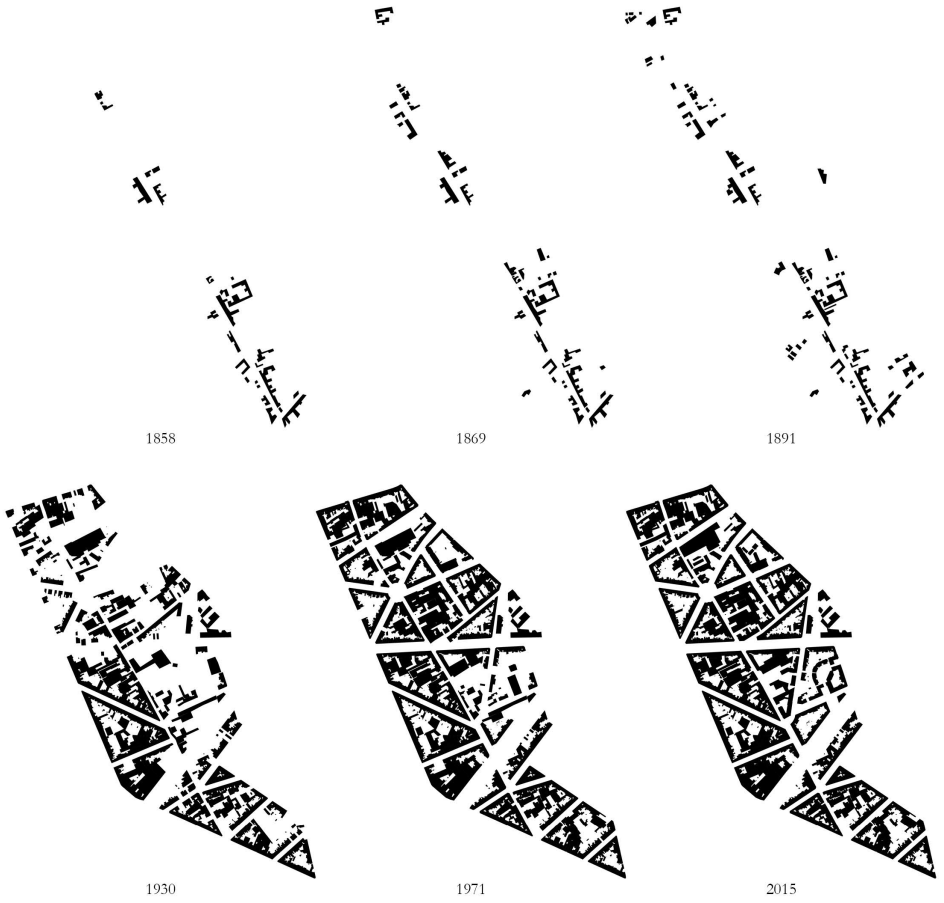

Figure 7. Date of origin of actual built environment. Produced by the author by the use of historical maps (CIRB-CIBG, 2015).

Morphological analysis

Figure 7 would suggest that the Chaussée de Jette had lost importance around 1900 due to the introduction of the Hausmannian street pattern that surrounds it. However, it was only after the construction of the Brussels Ring road (R0) in the 1960's and its connection to the city that the passing traffic was redirected via the Jetselaan and Leopold II Lane. However, as mentioned before, the morphological outlook of the area did not alter significantly.

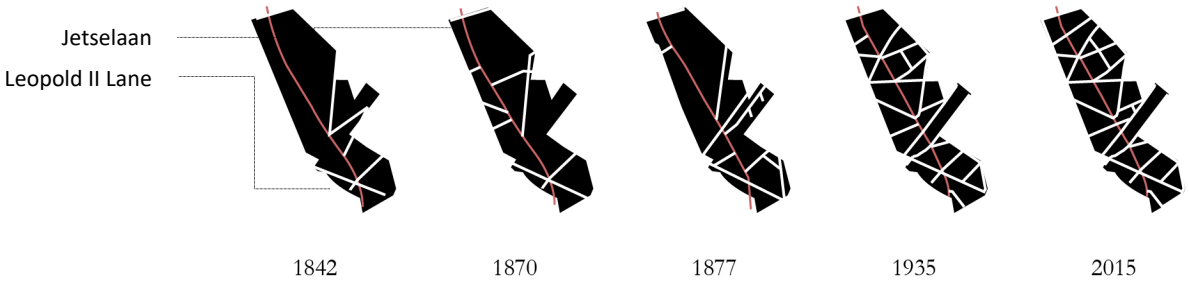

Figure 8. Historical overview of street pattern around the Chaussée de Jette. Schemes produced by author.

Whether or not in productive use today, the area is rich of industrial buildings that face the Chaussée de Jette. Table 1 highlights the average parcel surface at each street side of the building blocks (see Table 1) [1]. From the table can be

[1] The averages (Av.) are calculated as the sum of the plot areas (Total) that have access to a particular street, with the exception of the corner plots, and

concluded that at all the block sides that face the Chaussée de Jette hold the largest and deepest parcels by far. This is graphically represented in Figure 9a. The importance of the historical road is similarly revealed in the average plot depths (represented on the horizontal axes) over five cross-sections of the studied area and shown in Figure 9b.

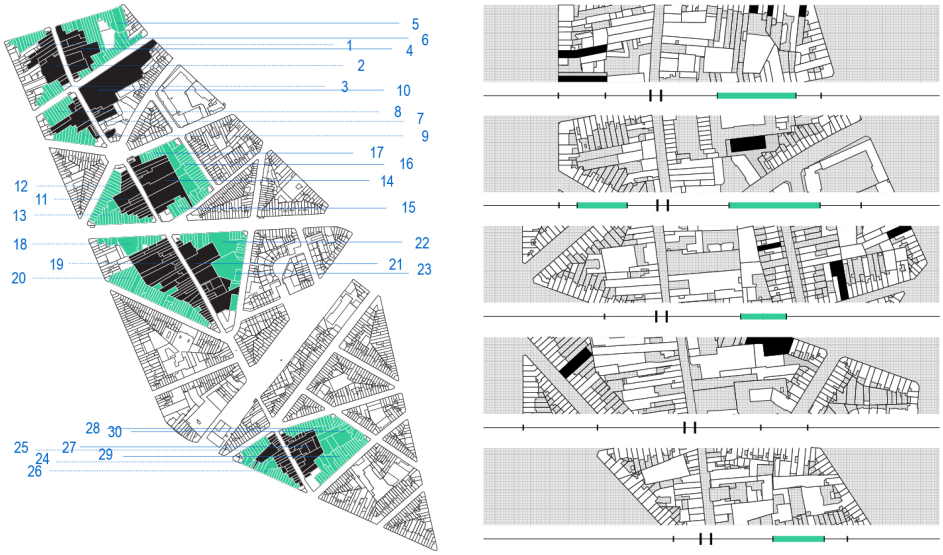

Figure 9. a) Average plot area per side of the building block with highest values depicted in black. b) Average plot depth in cross-sections over de studied area. Drawings made by Author.

Table 1. Calculation of average plot area according to sides of a building block.

	No.	Total	#	Av.	
	1	*1295*	*14*	93	*m²*
x	2	*5427*	*11*	493	*m²*
	3	*1718*	*10*	172	*m²*
x	4	*6038*	*9*	671	*m²*
	5	*7147*	*21*	340	*m²*
	6	*3745*	*21*	178	*m²*
x	7	*3268*	*7*	467	*m²*
	8	*2396*	*12*	200	*m²*
	9	*2706*	*14*	193	*m²*
x	10	*11710*	*7*	1673	*m²*
x	11	*4871*	*14*	348	*m²*
	12	*2879*	*19*	152	*m²*
	13	*2895*	*16*	181	*m²*
x	14	*9049*	*9*	1005	*m²*
	15	*3698*	*17*	218	*m²*
	16	*3543*	*17*	208	*m²*
	17	*2456*	*13*	189	*m²*
	18	*3242*	*14*	232	*m²*
x	19	*13303*	*37*	360	*m²*
	20	*7512*	*44*	171	*m²*

Industrial types – Building scale

The previously elaborated studies and categorization of building blocks have revealed certain strongholds in the patrimony of the area's industrial activities. The industrial importance of the Chaussée de Jette is argued by its persistence through time. The constituting role of these constants in the development of the surrounding urban fabric will in this final section, be further analyzed on the scale of the parcel. The following is an attempt to discover the basic (industrial) types and their alterations due to various influences over time, in accordance to Caniggia's procedural typology. Of all 18 active industrial buildings that are nowadays located in the delineated area around the Chaussée de Jette, the following 12 are capable to represent the typological diversity of the entire gamut, as depicted below in Figure 10. Through the categorization of these structures over their plot dimensions, the following persistent phenomena can be discovered:

1. The first row contains of industrial buildings that follow the outlined plot dimensions of the residential grain size and therefore easily blend in the larger structure. This type can mainly

are divided by the number of parcels (#) that are summed. The parcels that are orthogonal to the Chaussée de Jette, are marked with a cross (x).

be found in the triangular shaped blocks as their plot distribution is rather static.

2. The buildings in the second row are typified for their chronological annexation of land in order to accommodate their growing industrial activity. These structures are, in a first phase, annexing the neighboring plots or parts of it. It results in chaotic structures that are connected by cut-out passages. Seen the original, or basic, structure is a residential row house, this type again fits within its context in the street.
3. The earlier elaborated phenomenon of the 'residential crown' in rhomboid or rectangular building blocks around an industrial activity, is depicted in row 3. Whereas one front house from this belt solely enables accessibility to the pit, the significantly larger floor surface of the industry hosts all activities. This heart of a mixed-use building block, , however, forms the edging wall for neighboring backyards, often covered by a small garden houses for micro-scale productivity.
4. In the fourth category, the large-scale industrial activities are listed. Among it is the well-known Godiva Chocolate factory in the Wapenstilstandstraat. Characteristic for these monumental structures is their incapacity to grow further. This 'final stage' is often represented by buildings of grandeur, replacing old and inefficient structures that were annexed.

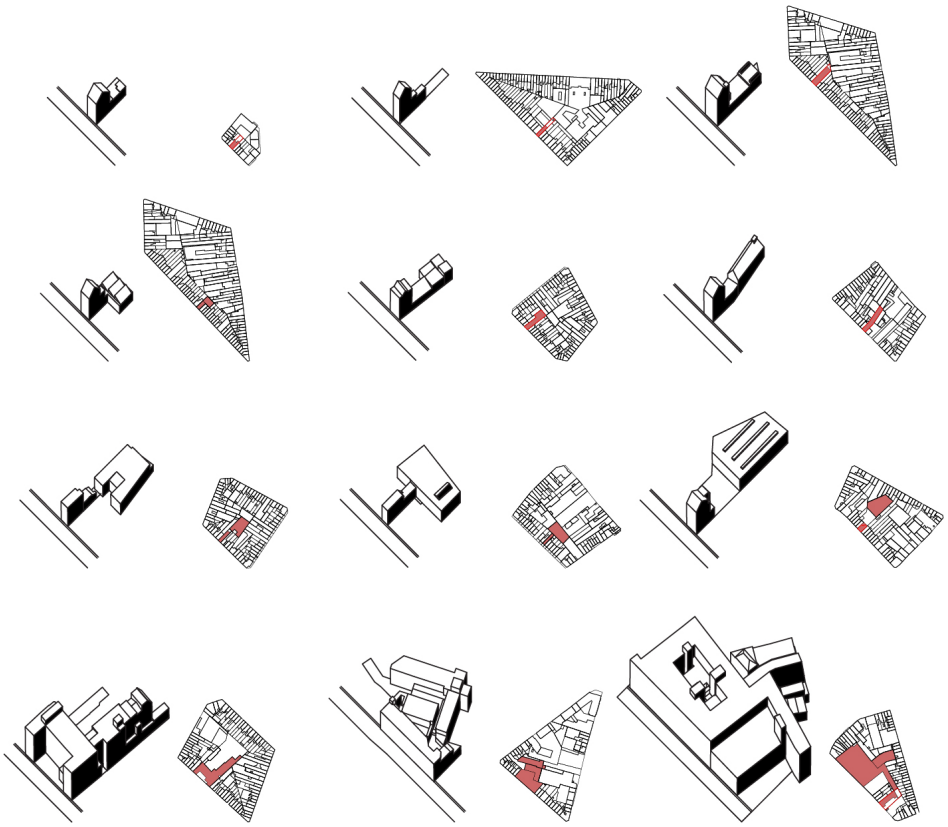

Figure 10. Typological overview of industrial buildings in delineated area around the historically important Chaussée de Jette. Façade images (Google Maps, 2016), drawings produced by author.

Conclusion

The categorization of the industrial buildings to their plot dimensions has intrinsically caused to unveil insights on the basic type as the term was defined by Caniggia, earlier in this work. Row 2 and 3 for example, hold such elemental traces in the current forms, which are established through the continuous

annexation of land. The persistent nature of those elements in the time frame and urban fabric, plea for their spatial importance and compatibility. It can be concluded that, contrarily to row 4, the structures shown in rows 1-3 can be subscribed to the concept of spontaneous consciousness that results in more or less similar types which can be traced back to their root / basic type: here the (residential) row house. Opposed to that are the monumental industrial buildings that reveal the critical consciousness about their built environment that is lacking among the spontaneous. As Rossi argues, these monumental artefacts help constitute the mental map of a city and have often altered in use (Rossi, 1966). This latter is particularly true when comparing the industrial outlook of the Chaussée de Jette strip with the amount of actual industrial activity.

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The Material City

Potential for Urban Development in Mapping Material Processes, Erosion and Obsolescence in Helsinki

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Abstract

Urban development hinges on the availability of free space. The planned growth of Helsinki as reflected in the General plan of 2016 relies on identifying areas for infill in the urban fabric. In built-up areas there is a tendency to let the processes of urban change take place instead of top-down planning. This change is therefore not managed, but piecemeal, resulting in a patchwork of 'stamp' plans directed by narrow private economic considerations.

The life -span of buildings varies according to their material composition – also the type of a building and its spatial configuration affect its vitality. These attributes and conditions play a part in how long a building can endure before confronting the need for radical changes, and can be aggregated from open-source data and modeled using historical referents as benchmarks. This information forms a layer of probabilities in the city, revealing dormant locations facing imminent change.

By mapping the information of the material conditions on the topography of the city, we can identify potentials for development. Identifying these latent sites in the city and engaging proprietors and landowners would give new tools for the City to affect the change and renewal associated with turnover of the building stock.

Keywords: Urban metabolism, Helsinki, Urban design, planning

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Introduction

To create a framework explaining urban change, especially in the context of Helsinki, that can also function as a basis for actionable knowledge for public and private actors, we need to identify all the different disciplines and regimes that have to be accounted for. Concerning urban transformations, we need to separate city planning and development into wide ranging and long term operations and more local and specific processes; then complicate and refine the definition of a building in the city and challenge the analytical models of 'Urban Metabolism' as satisfactory for understanding the changing city.

This paper aims at outlining the multidisciplinary nature of the challenge and propose methods to arrive at points of convergence, in the form of a mapping combining cadastral, material (building historic) and land use information – and placing these in the context of the city as a sociocultural environment. First, planning and development in Helsinki is described and defined, especially concerning planning-led and developer-led processes (section 1.), then the concept of Urban Metabolism is discussed, especially in regard to understanding the urban fabric (built fabric) of a city in detail (section 2.),

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against this backdrop, the definition of a building is described, as a material configuration and a set of relationships, changing in time (section 3.). Finally, the conclusions of these 'essays' (section 4.) sums up the possibility for a mapping of the city, using the definition of a building introduced in section 3., aiming at actionable knowledge that can guide the processes described in section 1. The paper ranges widely across disciplinary boundaries, in the hope of finding locations of common interest and openings between different ways of assessing and planning urban change.

Planning Operations and Processes – Urban Change and Helsinki Today

The growth and change of the urban fabric of Helsinki happens through a number of ways, here described as *operations* and *processes*. *Operations* being planning decisions and the production of documents and resolutions by the city planning officials or by proxy (i.e. by the public planning authorities or by an outside consultant, like a developer or an architect) resulting in legally binding zoning plans – in line with the aims expressed through politically approved outlines, like the current general plan for Helsinki, approved by elected officials.[2,3] These operations are mainly led and initiated by the City, based on its monopoly on zoning and extensive land ownership.

A set of *processes*, maybe best described as 'organic'[4] partake in the formation of the city in a more case specific manner: opportunities are presented by the changing environment (economic, material, cultural), identified and seized upon by diverse actors and stakeholders. Usually reflecting wider trends, but always focused on singular projects and potentials. These processes are often driven by developers, looking for profitable opportunities – and as often in league with the City, looking for the balance for a private project that coincides with the public interest.

Operations – the General plan and planning as a blunt instrument

The goals of the City in the case of Helsinki are spelled out in the general plan, drafted by the appropriate agencies roughly once in a decade.[5] In the latest plan, one of the strategic goals is to make the city affordable through the building of housing and increase its competitive edge by focusing on an 'urban city environment' (Helsingin kaupunkisuunnitteluvirasto 2016). The tactical means of planning that are deployed for reaching this goal are threefold: zoning new housing in completely 'new areas' freed from earlier uses (harbors, airports), as well as planning built neighborhoods along 'urban boulevards', and proposing substantial infill densification (Helsingin kaupunkisuunnitteluvirasto 2016, 36-42), mainly along rail connections and around traffic nodes. Large, contiguous 'free' areas in the general plan are relatively unproblematic from the viewpoint of zoning guidelines and implementation, once the political foundations have been laid for the developments (as in the case of the Helsinki-Malmi Airport area). The urban boulevards present a set of political and technical challenges, the plans relying partially on architectural solutions and technical innovation[6], but the most considerable challenge of the plan may be the amount of infill densification (a third of the new housing units proposed). It will probably run quickly against the general opposition to infill (Farris 2001; McConnell and Wiley 2010; Vallance, Perkins and Moore 2005) as well as the decision making process concerning the Finnish housing company (Puustinen

[2] The planning system of Finland, and the dynamics between planning-led and development-led approaches is described concisely in Eero Valtonen et al. (2017).
[3] The latest plan approved by the City Council (Kaupunginvaltuuston kokous) 26.10.2016.
[4] Here understood as events that affect the turnover of the building stock in a city, but that are not centrally planned – events happening through the interaction between the material reality of buildings and their users and owners.
[5] Large scale General plans have been drafted during a duration of over a century: from Bertel Jungs plan of 1911, through plans in 1918, 1923 (not ratified), 1932, 1960, 1970, 1976, 1992, 2002, and finally to the plan of 2016.
[6] See http://www.yleiskaava.fi/tag/kaupunkibulevardi/ for an overview of some of the discussions and studies.

and Viitanen 2015, 475). The challenges are generally acknowledged in the plan, but as a remedy only a 'general regional overview' is proposed (Helsingin kaupunkisuunnitteluvirasto 2016, 41).

The general plan is an example of a top-down approach, a blunt instrument, constitutionally challenged in dealing with situations like infill densification in detail, where the realities of implementation are more complex than in situations of zoning 'free' land for new uses. The challenges and processes of integrative urban redevelopment, from the viewpoint of the planning organization and its processes, have been opened up in the work of Hirvonen-Kantola (2013), but here the main challenge to be highlighted is the friction between the public interest and the atomized private interests. The public authority can not use its planning resources efficiently for possibly very quarrelsome processes, where the number of apartments or amount of floor area or economic opportunity that can be added to a neighborhood is with a high probability not worth the effort and attention of the planning apparatus of the City.

Also the need for economic feasibility and quick development can force the hand of the City and different models for the City to delegate or 'outsource' the planning of more specific and demanding projects have been tried, most notably in the large scale developments of Central Pasila and Kalasatama in recent years and the Eiranranta area, where the decisions have arguably not resulted in solutions of greater environmental, contextual or architectural quality, than if planned by the public authority. The models used have secured implementation, but at the price of being examples of subsidized speculation and willing, as well as accidental, ceding of planning powers for sites and projects affecting the whole city region (on Eiranranta see Hyötyläinen and Haila 2016, on Central Pasila and Kalasatama see Lindgren 2017).

The 'broad strokes' planning tools available to the City makes it hard to achieve many of the goals set forth in the general plan, save stating a number of wishes concerning the future.

Processes – Myopic and Purposeful

In addition to ... planned urban change ... there is another level of change, a 'churn', that affects the city like a constant current

In addition to the above *operations* – planned urban change, centrally by the public authority or jointly with private actors – there is another level of change, a 'churn', that affects the city like a constant current. There is a turnover of the built structures in a city, sometimes languid and sometimes quick. The renewal and change of the building stock happens most spectacularly in the cases of war or other sudden catastrophes, but the daily transformation of the city is an usually slow and almost imperceptible cycle of upkeep, updating, extending, altering and rebuilding of single buildings or blocks in the city, one by one.

These transformations can be called *processes* – they are not the result of city plans or strategies, even though they can be affected by them[7], but they are planned as specific answers to specific material situations, usually by or with the immediate stakeholders. Processes of change can be triggered by a myriad of reasons – the performance of a façade material being deemed insufficient, fear of failure in the systems for water circulation and waste removal because of corrosion of the metals or plastics used in the components, a wish for more space – for sale or for the enlarging of existing spaces, a vision of a more profitable use for the building plot, or a more suitable one considering the present needs of its owners or controllers, etc. When dealing with smaller alterations, the immediate owners – for example the housing company – take the initiative and manage the process, in instances of larger projects, an investor or owner teams up with a developer for planning and implementation. In the Finnish context, the public authority acts as a gatekeeper and overseer, and in some cases comments on the process, but mostly stays out of the

[7] For example through subsidies for renovation leading to better accessibility, the public authorities easing up regulations for specific kinds of developments – like transforming attic spaces into apartments in Helsinki.

fundamental planning decisions.[8] The processes on this level of urban change can not be controlled or steered by the public authority, save for a slight weighing of the scales when private actors deliberate on their possibilities.

The role of *processes* in the change of the city is undeniable, as is the mismatch between the more general planning tools of the City and the challenge of controlling the very situated building-by-building transformation of the urban fabric. Surveying the city as flows of material and energy can provide us with a viewpoint, through the concept of Urban Metabolism, that may open an access to the triggering material actualities behind the processes.

Urban Metabolism as a Way to Understand the City and its Planning

The term 'Urban Metabolism' is used as a term describing the flows, repositories and transformations of energy and matter in an urban region. Metabolism, as a word ties the term to the metabolic processes of organisms and the relationships found in ecosystems. Kennedy et al. (2011) have divided the use of the term in two different 'schools', the other focusing on energy equivalents, the other on material flows. Here we will outline the ways in which urban metabolism has been used in understanding cities as material accumulations and how it has informed planning. Furthermore, we will argue that a number of the features of the city have been overlooked by the most prominent applications of urban metabolism in planning, and that these oversights reveal rich potentials for understanding the processes that shape a city, and harness this understanding when designing effective planning operations.

Describing the City

For considering the city as a material entity (as opposed to a network of connections, or a diagram of social relations or production, or any other abstract model) the relevant strain of studies around Urban Metabolism rely on uses of material flow analysis (MFA) developed especially in the 90s, by Baccini and Bruner (1991). Understanding the city as accumulated stocks (in buildings and infrastructure) in addition to flows is imperative, as construction materials are the second largest flow into urban areas, and the largest waste deposit.

The focus on flows in most studies - inputs and outputs - even while acknowledging the importance of the building stock and its composition (Kennedy et al. 2007) is often operating on the scale of a region or a whole city, and treating material accumulation either as general quantities or specific trace elements, mainly because of the nature of the available data. This turns the urban fabric, as well as the individual buildings and structures that it encompasses into a black box, an more or less unknown processor of material and energy.

Studies focusing more exclusively on the material stock accumulated in cities open up the processor and start to give us insights that can be used for planning as well as for assessing existing environments. For example Brunner and Rechberger (2002) call attention to the large material stocks built up in cities, and the risks inherent in hazardous materials as well as possibilities for 'city mining' and recycling. In their recent review of several studies on construction materials flows and stock with a focus on non-metallic minerals Augiseau and Barles (2017) highlight the different methods used in studies and their implications on the data. Their analysis of methods reveal the variation in the quality and coverage of data, often because a number of assumptions are

[8] This happens through the decisions on building (as well as alteration and operation) permits by the City of Helsinki, and by the requests of statements concerning cityscape and the value of the built environment in conjunction with this process. When a change in zoning is sought for, the City Council debates and decides on the proposition - when they are not considered 'minor' (for example only a raise of 20% of maximum floor area) and are approved by the 'council for the urban environment' (Kaupunkiympäristölautakunta).

made to simplify the model – from a homogeneity of material composition to similar lifetime assessments within groups of buildings. With their comparisons of studies Augiseau and Barles are able to infer methods (or more correctly combinations of them) that can be used in order to reach more accurate models of building stocks as well as their behavior in time.

Applications in Urban Planning and Design

Kennedy et al. (2011) have articulated the different applications of an urban metabolism approach to urban design (in addition to applications concerning sustainability reporting, urban greenhouse gas accounting and mathematical modelling for policy analysis). The application examples range from a reconstruction project where the plan (and more generally urban activities) can be assessed in terms of urban metabolism (Oswald and Baccini 2003), to examples of reviewing the ecological sensitivity of different urban plans (Quinn 2007), and ways of analyzing material and energy loops in neighborhood scale designs.

These applications retain the focus on material as substances – to be counted and measured – and thus are removed from the spatial reality of urban environments as well as the material reality of buildings. But methods for accounting for an artifact as formally and materially complex as a city - building by building – have been developed and they seem highly useful for understanding urban structures on a deeper level, see for example ‘Urban metabolism and the surface of the city’ (Deilmann 2009), where by using detailed geo-data and typological models (Urban Structural Types) the micro-scale of urban change can be revealed. Also the material reality ‘on the ground’ can be approximated by connecting the typologies to databases of construction materials and products – the added resolution to the picture is crucial, because it helps us differentiate an area or development into its actual ‘building blocks’ - instead of looking at the area as a black box with inputs and outputs.

Still, the even though we can present the city or the neighborhood on a scale that tells us about building type, material composition and the use and abuse of energy, we need to switch viewpoints once again for understanding the peculiar nature of a single building, in its materiality and environment.

What is a Building?

A building is a collection of material facts, that relate to its performance as a biological environment, its status concerning regulatory directives and its position entangled with cultural and economic realities. This twofold condition: a material composition in flux, and a set of contingent biological, cultural, legal, etc. relations – describes a building as a situated artefact, tied to its material reality and surrounding society. Below we elaborate on this definition, and the ways it can be used to interpret the built environment.

The Building Defined as Material and Space

A building is by definition a thing built, made of a number of materials, in certain proportions, combined in specific ways. This encompasses the fundamental structure of the building as well as its more ephemeral layers. All described by Stewart Brand (1995) as (paraphrasing and refining an argument by Francis Duffy): site, structure, skin, services, space plan and stuff. This breakdown is used by Brand as a way of separating the different durations or paces of the components of a building – it is also a categorization that often coincides with building conventions – the way buildings are put together, according to a division of responsibilities amongst designers and contactors – that extends to some measure to the materials and techniques used: poured in-situ concrete, copper encased in plastic, plate glass, insulating gasses, textiles and metal fittings all have their position vis-à-vis each other and the process of building. A building is not the raw sum of its material parts or embodied energy – it is a dynamic constellation that needs to be accounted for in its richness to be properly understood. For example, there is a qualitative difference between two buildings with the same amounts of concrete, insulation materials, timber, glass

and metals built according to different designs, by different construction crews and under different conditions. It is the difference between a dovetail joint and setting logs on top of each other – the same amounts of material can perform in a radically different way just because of their configuration.

This carries over also to the spatial and technical aspects of a building – the proportions of volumes of space, the way they are connected with each other and the exterior, not just what the building service conduits are made of, but also where they have been placed – encased in concrete, behind a molding or running in the open (this is a point heavily stressed by Brand). These are attributes that tell us about what the building consists of and also more importantly how it performs and what it can become.

The Building Defined as Relations

The building defined as the interdependent compilation of site, structure, skin, services, space plan and stuff – and their material composition has several relationships with its environment – that determine its meaning and value. Amongst other, the buildings biological, regulatory, cultural and economic surroundings are constitutional for its building-ness. They transform ‘a pile’ of material into a building, fit for habitation, work and production; to be sold as a commodity; that is able to tell about the values and relations of the people who built or commissioned it. These relationships are not ‘something extra’ – or added on, but essential for the building to exist.

As an illustration, it is a rare event that a building becomes a ruin because its material makeup alone. This is absolutely possible, and in most cases inevitable as a future prospect, but ‘ruination’ because crippling discord between the material reality of the building and its biological, regulatory, cultural and/or economic context comes usually first – making a need for change or dereliction imperative. This is the reason why surveys of material conditions are problematic without extensive regard for issues outside the strictly measurable brick and mortar. As conditions change, the building changes with them – we can see that most radically in the industrial ‘simple’ spaces with good bones turned into loft apartments, whether in SoHo or Helsinki, or in the more subtle ways that the deep building frames of the apartment blocks in Etu Töölö in Helsinki, built in the 10s and 20s, have answered the changing conditions around them: first the dimensions made possible arrangements for servant spaces, with double corridors and hallways, that then turned into problematic windowless square meters as the needs of society changed, but again made it easier to split large apartments into smaller units, according to the demands of the post-war years. Other kinds of transformations of buildings, where the actual material makeup doesn’t change – but its relation to its environment does – are numerous, from certain building materials being labelled toxic or dangerous (asbestos, lead, and so on) to new regulations being made concerning accessibility, energy conservation or fire-safety – rendering the same building suddenly in a different light.

The Building in the City

The building seen as a whole – its material reality as well as its relational qualities – does not easily translate into a measurable known quantity, to be used in modeling an urban area. But also, not every building can be treated as the subject of a building historic survey. However, methods and data for models that appreciate the qualitative aspects of the urban fabric are available – the challenges in creating surveys and models in ways that don’t miss the buildings for the city lie in the paring down of the data. Some of these methods are reviewed by Augiseau and Barles (2017, 158-159) and in the case of Helsinki we have surveys of buildings making it easier to make generalizations about their material composition and configuration (see Mäkiö et al. 1990, Mäkiö et al. 1994, Kaivonen 1994, Neuvonen et al. 2002, Neuvonen et al. 2015).

Conclusions and Complications

The material reality of the city is considered only in cases of immediate crisis – as in cases of deteriorating structures like collapsing bridges and roof structures or as an inconvenience to be overcome after a design has been settled upon – as in cases of remodeling without considering the strengths and weaknesses of the existing building. Arguably, answering to the material conditions of the buit environments plays a significant part in efforts aimed at vitalizing mono-structure neighborhoods i.e. suburbs built at once (part of the Neighborhood Project in Helsinki) – but it is also valid as an universal way of seeing the city and its potentials – an invitation to planned action by public and private interests also in more built up and heterogeneous urban areas.

Below a proposition for systematic mapping of the city – in a way that takes up the challenge of urban metabolism by defining the city as its material flows, transformations and accumulations, while taking account of the complex nature of a building – in a way that makes the map a useful tool for identifying locations for the planned operations of the city and opportunities for private actors.

The Image of the City

As a starting point for a mapping of the city that can be of immediate value for the urban designer or planner in identifying possibilities as well as assessing impact (applications listed by Kennedy et al. 2011), we need to use micro-scale modelling (Deilmann 2009) as a default 'resolution'. A micro-scale model can incorporate data for assessing the possibility of urban resource harvesting (Agudelo-Vera et al. 2012) through typologies and formal information, and act as an index on the different materials accumulated in the anthroposphere (especially in the construction stock) (Brunner and Rechberger 2002) for the management of hazardous waste as well as possibilities for 'city-mining'. For a full picture of the material city, we need to still augment the proposal by Deilmann (2009) for linking a model with databases of construction materials and products – for the information to be operational, we need to know the breakdown of the accumulated materials in a building as well as the way they have been configured (Brand 1995, Augiseau and Barles 2017). The dimension of time has to be reflected in the model – different configurations of different materials weather and corrode in different ways – and here the building has to be seen as a whole – a façade structure may get damaged beyond repair during a few years in a house without an appropriate sheltering roof design, while another with the exactly same material composition lasts for several decades with only minimal upkeep. A material model like this has still to be subjected to a review of the regulatory, economic and cultural context – the same material facts look different when the context changes. The interdisciplinary nature of this challenge is self-evident.

The Fecund Corruption of the Built Environment

The poetically powerful entry by OMA for La Dèfense in Paris (1991) proposed a somewhat arbitrary 'duration' for all the buildings in the competition area – presenting a plan that evolved in increments, 'liberating' the site for new development:

"… if we laundered the site in five-year increments simply by erasing all buildings over the age of 25, vast areas would be gradually liberated… We could gradually scrape whole areas of texture off the map and in 25 years the entire area would be available." (Koolhaas and Mau 1995)

The plan with the spirit of Le Corbusier hovering in the background made exceptions out of locations and buildings of significance (a cultural relationship) but otherwise can be seen as an extreme version of employing a map of the 'material city'. Here below a few proposal for applying the more nuanced mapping proposed in the earlier sections.

Positive and negative maps

A map of the material city that is used only to highlight the positions of probable weakness – the points where the urban fabric or single buildings are close to

ruin – can be called a negative map. The city as an organism slowly shedding dead cells that are then renewed or replaced. As in the example above, this way of seeing the opening of opportunities through material degradation has a certain clarity and simple charm to it. But as a way of seeing the city, even just the 'material city', it tells only half of the story. An assessment of the material qualities of the city, that highlights the possibilities provided for by its material configurations is equally compelling – a positive map. These two can combine a view of the 'facts on the ground' with the potentials for the future. We need to see simultaneously how a buildings 'inner layers' are eroding towards a total overhaul, while the structure is strong enough to carry a number of new floors. A map of negatives and positives.

The arcades project

A mapping of the urban fabric can present possibilities even in dense built up areas, as when the spatial and structural qualities of adjacent properties, that have to be renovated or altered within a close time span, make the creation of new interventions possible. For example, arcades crossing plot boundaries and opening up hitherto inaccessible locations. Here the need for material renewal can present itself as an opportunity for the City to enrich the uses and spatial qualities of central city blocks in a dialogue with the owners and operators of the buildings and spaces.

Serendipity

For private actors, a mapping of the city that makes it possible to localize the strengths and weaknesses of the built environment has several applications – from private citizens to assess their city and neighborhoods to property developers being able to systematically look for chances and openings. The processes of transformation described in the first section form the constant change of the urban fabric but it relies on first individuals identifying the need or room for change – a mapping of the material city is a way of seeing our environment as a number of potential futures and opportunities to be seized.

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Alternative Approaches to Urban Regeneration and Infill Planning

Case Turku, Finland

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Abstract

In Finland, cities consider infill development as a means for urban regeneration in existing suburbs. However, the preconditions for development may vary: some areas are more attractive for infill development projects than others. Therefore, cities must align their urban regeneration approaches with the specifics of the context.

This paper builds on the notions that the prevailing growth-dependent urban planning paradigm is not functional in areas demarcated by low growth or stagnation. Planning that seeks to bring value for the localities by appreciating their strengths and non-monetary assets might provide grounds for alternative planning approaches. From these starting points, we explore how Finnish urban planners align their urban regeneration approaches with different contexts. We aim at identifying when the growth-dependent approach is used, whether alternative approaches are deployed, and what are their underlying logics. Our analytical framework originates from organizational learning theory of action inquiry. It explains how urban regeneration visions, strategies and actions are adjusted to low growth contexts. The empirical material consists of three urban regeneration cases in the Finnish City of Turku.

As a result, three approaches to urban regeneration with different emphases on infill development are depicted and discussed. The growth-dependent approach is used in areas with strategic importance for the City, and possibilities for urban growth. Alternative approaches seek to support local development initiatives or inspire development in areas where it does not yet exist. The contribution of this exploratory paper is to demonstrate that urban planners in Finland deploy alternatives to growth-dependent planning and provide conceptualizations of alternative planning approaches.

Keywords: infill development, urban regeneration, growth-dependency, organizational learning, four territories of experience, Turku

Introduction

There is a growing interest in how urban planning could cope with challenging economic situations (Janssen-Jansen et al., 2012; Rydin, 2013; Savini and Salet, 2017). Since urban planning has traditionally been based on an

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assumption of continuous economic growth, there are concerns about its functionality in contexts where growth is discontinuous or absent (Janssen-Jansen et al., 2012; Rydin, 2013). Other researchers have discussed how resilient management of on-going urban development projects could help in responding to changes in market context (Majoor, 2015a; 2015b) and how flexibility of urban development plans might improve abilities to cope with economic fluctuations (Rauws, Cook and Van Dijk, 2014). Theoretical insights on how to combine the proactive and future-oriented nature of urban planning with flexibility and adaptiveness (Savini, Salet and Majoor, 2015; Boelens and De Roo, 2016), are also developed. This has created important insights into how urban planning could better cope with economic fluctuations.

However, the empirical research has often focused on the context of economic downturns, examining how on-going urban development projects are able to cope with challenging economic situations. At the same time, it is noted that in contexts demarcated by low growth or stagnation, alternative approaches to growth-dependent planning should be recognized already to begin with (Janssen-Jansen et al., 2012; Rydin, 2013). Therefore, we propose that there is a need to understand how cities align their planning approaches with low growth contexts already at the beginning of the planning process.

The purpose of this paper is to address this issue by exploring approaches to urban regeneration and infill development in selected Finnish suburbs, where the prospects of urban growth are more uncertain than in city centers and newer housing areas. We aim at identifying when the growth-dependent planning approach is used, whether alternative approaches are deployed, and what are their underlying logics. Our analytical framework originates from organizational learning theory of action inquiry (Torbert, 1972; Torbert et al., 2004; Torbert and Taylor, 2008) that we use to explain how urban regeneration visions, strategies and actions are adjusted to low growth contexts. We conclude that growth-dependent planning is not considered appropriate in all locations, and alternative approaches that seek to bring value to the localities by appreciating their strengths and non-monetary assets are considered as an alternative. Due to the exploratory motivation of our research, the results are formed based on grounded theory logic (Glaser and Strauss, 1967; Stebbins, 2011). The contribution of this exploratory paper is to demonstrate that urban planners in Finland already deploy alternatives to growth-dependent planning and provide conceptualizations of alternative planning approaches.

The paper is structured as follows. First, we discuss growth-dependent urban planning and its alternatives. After this, we present our analytical framework, research strategy and analysis of our empirical material, regarding urban regeneration and infill planning in three suburbs in the Finnish City of Turku. To conclude, we present the contextual alignment of urban regeneration approaches in the three suburbs and discuss the implications of our findings.

Planning in the absence of growth

Growth-dependent planning denotes planning that is dependent on the willingness of market-based actors to invest in an area to bring about sustainable urban development (Janssen-Jansen et al., 2012; Rydin, 2013). It is based on expectations of economic and demographic growth in specific urban areas, resulting in increased land values and demand for new urban development projects (Rydin, 2013, pp. 53–60; Savini, Salet and Majoor, 2015, p. 12). This logic is embedded in most contemporary spatial planning practices, based on public and private sector collaboration in achieving societally desirable urban development outcomes (Rajaniemi, 2006; Janssen-Jansen et al., 2012, p. 15; Rydin, 2013, pp. 28–34). In plan-led urban planning contexts, such as in Scandinavia and in the Netherlands, public urban planners set up objectives of sustainable urban development in land use plans, which are implemented through market-based urban development projects (Janssen-Jansen et al., 2012; Valtonen, Falkenbach and Viitanen, 2017a; 2017b). In

development-led urban planning contexts, such as in the United Kingdom, growth-dependent planning increases social and environmental benefits of urban development by negotiating planning gain with the private developers case by case (Rydin, 2013, pp. 62–64). The more regulatory powers public urban planning has, the better the prerequisites to negotiate for sustainable development (Rydin, 2013, pp. 62–64). This does not imply that growth-dependent planning only serves the interests of market actors, rather market-led urban development is utilized to bring about economic, environmental and social improvements (Janssen-Jansen et al., 2012, p. 15; Rydin, 2013, pp. 26–27).

The problem is that growth-dependent planning does not function in areas where there is no market demand for new development (Janssen-Jansen et al., 2012; Rydin, 2013). In plan-led urban planning contexts, the challenge is that plans may not be implemented if they do not provide viable development opportunities for market-based actors (van der Krabben and Jacobs, 2013; Valtonen, Falkenbach and Viitanen, 2017a; 2017b). In development-led urban planning contexts, the challenge is that public planners may negotiate environmental and social benefits only to a point where urban development projects stay economically viable; hence there is a risk that only a limited positive impact is gained (Rydin, 2013, pp. 99–101). These situations could occur in all urban areas in times of economic downturn but are a persistent problem in areas with low market position. One could argue that the problem disappears by waiting for the economic situation to improve. However, as economic growth does not spread evenly to all locations, there will always be areas that need sustainable urban development but have no market demand (Rydin, 2013, pp. 78–80). For instance, it is predicted that the economies in the developed countries of Europe and North America will grow very slowly in the future, if at all (Rydin, 2013, pp. 83–85). Therefore, while the absence of growth is becoming an increasingly common context for urban planning, there is no mechanism in the prevailing growth-dependent planning paradigm to address the situation (Janssen-Jansen et al., 2012; Rydin, 2013).

It is suggested that cities should recognize that the growth-dependent planning approach is not suitable in locations demarcated by stagnation or low growth (Janssen-Jansen et al., 2012; Rydin, 2013). Alternative urban development approaches could be formulated based on a logic that seeks to attend to local needs, not to market demand (Rydin, 2013; Janssen-Jansen et al., 2012, pp. 47–49; Boelens and Coppens, 2015; Savini, Salet and Majoor, 2012, p. 12). While the growth-dependent planning approach typically generates monetary value, which is partially re-invested to bring environmental and social benefits for urban areas, alternative urban development approaches could directly bring improvements for local communities, and support actions seeking to preserve local assets (Rydin, 2013). For example, in the United Kingdom, public policies that support community-led urban development schemes have been developed (Rydin, 2013, pp. 159–169). Other examples include do-it-yourself initiatives for urban development (Rydin, 2013, pp. 199–208; Savini, Salet and Majoor, 2015, pp. 11–14), experimental urban uses (Lehtovuori and Ruoppila, 2016) and planning that seeks to stimulate local actor networks that could generate yet unknown urban development trajectories (Boelens and Coppens, 2015). The challenge is that the alternative urban development approaches generate values that deviate from growth-dependent urban planning and may thus not be recognized as viable urban development logics (Rydin, 2013). At the same time, while urban planning alone is not able to generate local development activities, it could have an important role in supporting them (Rydin, 2013; Boelens and Coppens, 2015; Wallin, 2015). Planning practices that provide urban planners, politicians and citizens tools to bring about sustainable urban development in the absence of economic growth are thus needed (Rydin, 2013, pp. 243–250).

Growth-dependent urban planning and its alternatives in Finland

In general, Finnish cities have rather good prerequisites to proactively promote sustainable urban development. They have a land-use planning monopoly and the Finnish spatial planning system is plan-led, based on hierarchical levels of legally binding zoning plans. This allows cities to integrate sustainable urban development objectives in statutory land use plans (Valtonen, Falkenbach and Viitanen, 2017a). The cities in Finland can also deploy active land policy and public land-development as tools to integrate economic, environmental and social benefits in urban development projects (Hirvonen-Kantola et al., 2015; Valtonen, Falkenbach and Viitanen, 2017b). In addition, development-led urban planning practices are used in Finland, with the justification that they are more flexible in responding to the objectives of various actors involved in urban development projects (Valtonen, Falkenbach and Viitanen, 2017a). In principle, Finnish municipalities have the superior right to decide upon the contents of land use plans also when using development-led planning practices, which allows securing that the plans serve wider societal interests (Hakkola, 2009; Valtonen, Falkenbach and Viitanen, 2017b, pp. 249–250). However, there are concerns that utilizing development-led practices may undermine the proactive capacities of Finnish public urban planning, as planners are put on a more equal position with market actors (Hytönen, 2016; Puustinen et al., 2016).

In addition to these more traditional urban development approaches that often follow the logics of growth-dependent planning, urban planning that supports locally emerging urban development initiatives is discussed in the Finnish context (Leino, 2012; Horelli et al., 2015; Wallin, 2015; Partanen, 2018; Partanen and Wallin, 2018). Wallin (2015), as well as Horelli and colleagues (2015), have illustrated how local initiatives have created urban development activities in Finnish suburbs, which are not dependent on market-based development projects. However, as the statutory urban planning processes in Finland proceed in a linear fashion and opportunities for citizen participation are strictly predetermined, the ways to integrate local development initiatives in mainstream urban planning are still taking shape (Leino, 2012; Wallin, 2015; Partanen and Wallin, 2018; Rantanen and Faehnle, 2018). The challenge is to recognize local activities' contribution to urban development, together with cities' and private developers' aspirations (Wallin, 2015).

In Finland, some of the existing suburbs can be viewed as contexts, where it might be challenging to bring about sustainable urban development by relying on growth-dependent planning. The suburbs were built outside city centers from the 1940s to 1970s, along with the rapid urbanization of Finland (Hurme, 1991; Hankonen, 1994). While the existing suburbs today often have a central location in urban structure, they may not be as attractive locations for commercial urban development projects as city centers and newer housing areas. Yet, Finnish cities have a strategic aim of promoting infill development in suburbs. The motivation for development is to utilize the full capacity of the already built infrastructure and public services, provide pleasant environments for citizens, fight urban sprawl and prevent social segregation (Ministry of the Environment, 2014, pp. 135–138; Puustinen, 2016). In other words, infill development in suburbs contributes to urban regeneration, which can be defined as "comprehensive and integrated vision and action which seeks to resolve urban problems and bring about a lasting improvement in the economic, physical, social and environmental condition of an area that has been subject to change or offers opportunities for improvement" (Roberts, 2017, p. 19). However, since growth-dependent planning may not be functional in suburbs, selection of urban regeneration approaches requires special consideration by urban planners.

Analytical framework: Four territories of experience

In this research, we explore approaches to urban regeneration and infill development in selected Finnish suburbs, where the prospects for urban growth are more uncertain than in city centers and newer housing areas. To do this, we

utilize an analytical framework that originates from organizational learning theory. Organizational learning theories provide conceptualizations that explain how existing organizational frameworks are changed in response to environmental change (Tosey et al., 2012, p. 292). They commonly distinguish between two types of learning: first-order learning that changes organizational actions while leaving organization's existing frameworks and goals untouched, and second-order learning that changes also the underlying frameworks that are used to define the goals (Argyris and Schön, 1996, pp. 20–21; Torbert, 1972, p. 14; Tosey et al., 2012, p. 292). Second-order learning is needed in the face of profound environmental change (Tosey et al., 2012, p. 292): if the environment changes, the goals defined for the previous environment are likely to become outdated, too. In addition, a higher, third-order learning type is sometimes discussed (Tosey et al., 2012). While there are many conceptualizations of this third-order learning (Tosey et al., 2012), one is to view it as a change in the overall purpose and attention of the learning entity (Starr and Torbert, 2005; Torbert, 1972, pp. 10–16). Purpose differs from goals and frameworks in a sense that goals relate to certain times and spaces, whereas purpose relates to learning entity's existence as a whole (Torbert, 1972, p. 14). Goals are therefore pursued to fulfil the purpose (Torbert, 1972, p. 14). Attention, in turn, denotes the capacity to consciously consider alternative goals and frameworks (Torbert, 1972, pp. 14–15).

The theory of action inquiry (Torbert, 1972; Torbert et al., 2004; Torbert and Taylor, 2008) enables recognizing the different learning types through four 'territories' of human experience (Torbert et al., 2004, pp. 18–21; p. 39). The four territories of experience are: 1) the outside world, 2) behavior and sensation, 3) thinking and feeling, and 4) attention and intention (Torbert, 1972, p. 5; Torbert et al., 2004, p. 22). The first territory of outside world is experienced as events that occur outside oneself and consequences and effects of one's action in external reality (Torbert et al., 2004, p. 22). On organizational level, it corresponds with assessing the outcomes of organizational actions (Torbert et al., 2004, pp. 38–40). The second territory is experienced as deeds, patterns of activity, skills and behavior during the process of their enactment (Torbert et al., 2004, p. 22). On organizational level, it corresponds with organization's performance (Torbert et al., 2004, pp. 38–40). The third territory is experienced as the action logics, strategies, schemas, and other modes of reflecting experience (Torbert et al., 2004, p. 22). On organizational level, it corresponds with organization's strategies (Torbert et al., 2004, pp. 38–40). Finally, the fourth territory is experienced as attention, intention, and purpose (Torbert et al., 2004, pp. 22–23). On organizational level, the fourth territory corresponds with organization's vision (Torbert et al., 2004, pp. 38–40).

The theory of action inquiry suggests that accessing several territories of experience simultaneously allows detecting incongruities between organization's environment and its actions, strategies, and purpose (Torbert, 1972; Torbert et al., 2004; Torbert and Taylor, 2008). Corrective moves between the territories of outside world and performing correspond with first-order learning, whereas corrections between the territory of outside world, performing and strategizing correspond with second-order learning (Torbert et al., 2004, p. 19). Moreover, corrections between the territories of outside world, performing, strategizing and visioning, that is, all four territories of experience, correspond with third-order learning (Torbert et al., 2004, p. 19). The theory thereby views the learning types as nested: a higher type always contains the previous types (Torbert, 1972, pp. 47–49). What is more, the theory suggests that changing some territory of experience requires accessing one territory higher in hierarchy (Torbert, 1972, pp. 15–16; pp. 47–49). A first-order change between performance and outside world requires accessing the territory of strategizing, and a second-order change between outside world, performance and strategy requires accessing the territory of visioning (Torbert, 1972, pp. 15–16). Exceptionally, the highest territory of visioning is treated as an integrative level, implying that third-order changes on it can be made within the territory

itself (Torbert, 1972, pp. 49–52). However, this is considered rare and difficult to achieve (Torbert, 1972, pp. 230–231, Torbert and Taylor, 2008).

Viewed through this framework, alternative approaches to growth-dependent planning would require second- and perhaps even third-order learning, denoting changes in strategy or even in purpose. Other planning scholars, albeit deriving from different organizational learning theories, have applied similar understanding (Friedmann, 1987; Mäntysalo, 2000; Schmidt-Thomé and Mäntysalo, 2014; Mäntysalo et al., 2016; Rydin, 2010). Friedmann (1987, p. 185), refers to organizational learning concepts of single- and double-loop learning, where single-loop learning denotes change in strategy or tactics, and double-loop would change the actors' theories of reality, values and beliefs. Mäntysalo (2000, p. 310) and Schmidt-Thomé and Mäntysalo (2014, pp. 120–121) explain that the underlying assumptions determining the approach to a planning problem are formulated by second-order learning. As a concrete example, Mäntysalo et al. (2016, p. 6) describe how second-order learning resulted in a planning approach where urban planners acknowledged the local residents as urban development partners, instead of viewing them as objects of top-down participation. In this theoretical application of organizational learning to urban planning, originally developed by Mäntysalo (2000), the development of planning approaches through second-order learning is viewed as partially habitual, and transcending the established approaches requires third-order learning (Mäntysalo, 2000, pp. 309–315). Rydin (2010, p. 71), in turn, discusses that whereas second-order learning changes the definition of what is seen as a planning problem, third-order learning could change the entire purpose of planning.

Our framework of action inquiry suggests that accessing the highest territory of experience, visioning, is needed to change the frameworks and strategies through which (planning) problems are defined (Torbert, 1972, pp. 15–16). Further, this highest territory is experienced as the purpose of the learning entity, which could become a subject to change in itself (Torbert, 1972, pp. 49–52). Therefore, developing alternatives to growth dependent planning requires accessing the territory of visioning, which then enables accessing the other territories, too. Here, we suggest that different planning approaches could be identified by detecting how they manifest as four territories of experience, as presented in Table 1. In our framework, the territory of visioning manifests as the purpose and aim of urban planning in a particular context. Strategizing represents the frameworks and goals that are established to fulfill the purpose. Performing is about concrete urban development activities. Assessing is about observing the outcomes of urban development in the outside world.

Table 1. The territories of urban development

Territory of human experience	Territory of organizational experience	Territory of urban development
4) Attention, intention and purpose	Visioning	Urban development vision
3) Thought and feeling	Strategizing	Urban development strategy
2) Behavior	Performing	Urban development activities
1) Outside world	Assessing	Urban development outcomes

Empirical material and research strategy

Our research is exploratory in nature (Glaser and Strauss, 1967; Stebbins, 2011). Stebbins (2011, p. 3) defines exploratory research as "a broad-ranging, purposive, systematic, prearranged undertaking designed to maximize the discovery of generalizations leading to description and understanding of an

area of social or psychological life". It differs from confirmatory research in that it does not seek to verify a pre-defined hypothesis but generate new ideas that are grounded in the empirical data (Stebbins, 2011, p. 8). However, these ideas should be tested in further research, and not understood as complete theoretical models (Stebbins, 2011, pp. 10–14). It should also be noted that deductive prediction gradually increases also in exploratory research, depending on the emerging theoretical insights related to the phenomenon (Stebbins, 2011, p. 12). Here, we consider extant research as a guideline on what could be searched for from the empirical data, but not as a theoretical hypothesis (Stebbins, 2011, pp. 18–19).

Our research is a cross-sectional, qualitative case-study, which allows the generation of generalizable concepts across cases (Yin, 2014). Our case-study areas are three suburbs in Turku: Runosmäki, Härkämäki and Pansio-Perno. Runosmäki is a large suburb with a central location, where the City has examined possibilities for infill development by making an unofficial strategic development plan. In Härkämäki, residents and local organizations have initiated urban development. Pansio-Perno is a diverse housing area located near the prosperous Turku dockyards, but suffers from social segregation and its distant location from the city center. Due to these challenges, the City of Turku has chosen Pansio-Perno as a special target area for urban regeneration.

The empirical material consists of fifteen interviews of urban planners and other relevant actors in the case study areas (presented in Appendix 1). The interviews were semi-structured thematic interviews, where the themes of discussion are predefined, but the actual questions may vary (Hirsjärvi and Hurme, 2008). The interviewees were asked to identify different cases of urban regeneration in Turku suburbs, and explain why the urban regeneration measures were selected in each case. The role of infill development projects and local development initiatives was also discussed. Planning documents and research reports related to the cases were used as complementary material, to employ a case study method of source triangulation (Yin, 2014).

The validity of exploratory research can be enhanced by limiting the impacts of the research intervention on the researched phenomenon, avoiding personal bias when interpreting results, and acknowledging researchers' limited ability to witness all relevant aspects of the phenomenon (Stebbins, 2011, pp. 47–48). As urban regeneration processes in general last a long time, we estimate that our short research intervention has not had a major impact on the researched phenomenon. To avoid personal bias, we discussed our preliminary results with the research participants, namely with the representatives of the city organization of Turku, in a seminar organized in January 2018. There, our preliminary results were found plausible. We acknowledge that the validity of our research is limited due to the restrictions of our empirical material – deeper understanding on the issue under study could be developed in a longitudinal case study research project or comparing several cases in different cities. This highlights the need to consider the results of this study as preliminary concepts, to be validated in further research (Stebbins, 2011).

The reliability of exploratory research is improved by deploying a systematic and replicable process in the analysis (Glaser and Strauss, 1967, pp. 229–230). Here, we deployed thematic analysis and coding technique, where data are categorized and reconstructed to capture important concepts within the data set (Tuomi and Sarajärvi, 2009). The different approaches to urban regeneration were depicted using our theoretical framework, where the contextual alignment of urban regeneration measures is understood through the four territories of organizational experience: visioning, strategizing, performing and assessing. The theory of action inquiry suggests that the four territories of experience manifest on interpersonal level as four parts of speech (see Torbert and Taylor, 2008; Torbert et al., pp. 24–37; p. 39). These four parts of speech were used as units of coding and systematically recognized from the interviews. The parts

where the interviewees framed, identified and explained opportunities for urban development in different contexts were coded as visioning. The opinions, statements or action plans of what had been or should be done in this context were coded as strategizing. Illustrations of concrete actions that were or could be taken were coded as performing. Assessment of the selected actions and proposals for improvement were coded as assessing. The outcomes of the analysis were compared across cases, to identify whether urban planners deployed context-specific urban regeneration approaches in different situations, and what were their underlying logics.

Analysis

The forthcoming Master Plan 2029 for the City of Turku defines a strategic development zone for urban intensification, which extends approximately three kilometers from the city center, and along main public transport routes (City of Turku, 2018a; 2018d, p. 7; pp. 62–63). In addition, the master plan draft categorizes housing areas as “completed housing areas”, “suitable areas for infill development” and “new or profoundly changing housing areas” (City of Turku, 2018b; 2018d, pp. 10–11). While some suburbs are located within the urban intensification zone and defined as suitable for infill development, others are situated outside of the intensification zone, or defined as completed housing areas. Our interviewees expected that most of the new infill development in Turku will be located nearby the city center, not in the suburbs. While the interviewees hoped that all suburbs could be developed as pleasant environments for citizens, they highlighted the need to select an appropriate approach to urban regeneration in each area.

Runosmäki

Runosmäki is the second largest suburb in Turku, with an advantageous location in the city structure along one of the main roads, about five kilometers north of the city center (Figure 1). It is located in the Runosmäki-Raunistula area, where the city expects a 9.6% population increase by 2029 (City of Turku, 2018d, p. 68). In the master plan draft, Runosmäki is appointed as a local center and as a suitable area for infill development located within the strategic

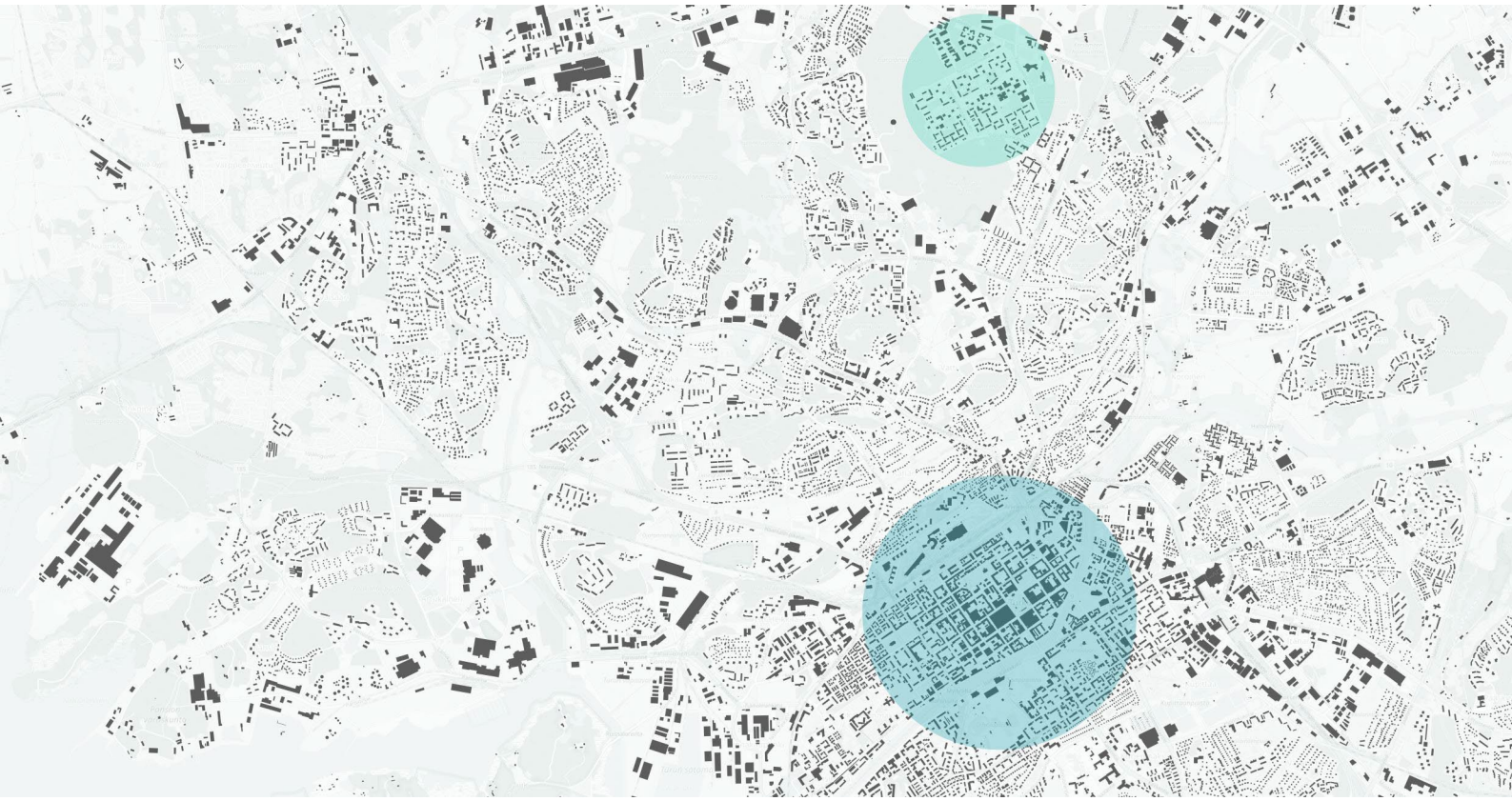

Figure 1. Location of Runosmäki (smaller circle) and Turku city center (larger circle) in the urban structure. Map data ©OpenStreetMap contributors and SPIN Unit.

urban intensification zone (City of Turku, 2018b; 2018d, pp. 10–12). The City of Turku also has plans for a new effective public transport connection from Runosmäki to the city center, which supports the infill development objectives (City of Turku, 2018c; 2018d, p. 10; p. 18). In the interviews, Runosmäki was framed as a large and lively housing area with good public and commercial services. The interviewees mentioned the advantageous location of the area often and envisioned that it could be an attractive housing area in the future.

The City's urban planning department has made an unofficial, strategic infill development plan for Runosmäki (City of Turku, 2015). The interviewees stated that the plan was needed because the development objectives mentioned in the forthcoming master plan had to be examined on a more detailed level. The development of Runosmäki is timely also because a new community center is planned in the area. Some of the existing public services in Runosmäki, such as a library, daycare services and youth services, are to be re-located in the new community center (City of Turku, 2016). The new community center has also been taken as a starting point of the strategic infill development plan. In the plan, infill development has been examined in the city-owned plots that will become vacant when public services are re-located in the community center. The City has also examined whether the community center project can be financed by selling the city-owned plots for infill development purposes (City of Turku, 2016). In addition, infill development has been examined in the plots of existing housing companies. However, the interviewees considered the realization of these projects uncertain and observed that such small projects would not have a remarkable impact in terms of population increase.

The interviewees assessed that making an infill development plan was meaningful in Runosmäki due to its advantageous location and master plan's growth expectations, and the community center project was expected to enable new infill development in the future. However, the practice of making an infill development plan was also considered very traditional because of its strong emphasis on physical urban development. It was assessed that such practice would only be meaningful in areas that would attract new inhabitants and therefore infill development projects. The original idea of the urban planning department had actually been to make similar plans for all other suburbs in Turku as well. This idea was later abandoned because the practice was not considered suitable in areas where market-demand for infill development was uncertain. In fact, the interviewees were not sure whether the planned development would actualize even in Runosmäki. They highlighted that the practices for urban regeneration would have to be chosen based on starting points of the area, and that strategic plans for new infill development were certainly not needed in all suburbs in Turku.

Table 2. Aligning urban regeneration approach with the Runosmäki context.

Territory of urban development	Urban regeneration approach in Runosmäki
Urban development vision	Support urban growth in an area with advantageous location and strategic importance for the City
Urban development strategy	Create prerequisites for infill development projects by making a strategic infill development plan
Urban development activities	Support actualization of infill development with a strategic project
Assessment of urban development outcomes	The approach is suitable only in areas that attract infill development, cannot be used in all suburbs

The alignment of urban regeneration approach with the Runosmäki context is summarized in Table 2. In visioning, the area was framed as a large housing area with a good location and possibilities for urban growth, necessitating strategic urban planning. In strategizing, possibilities for new infill development

were considered worth examining with an infill development plan. In performing, the community center was considered as a strategic project that would enable new infill development in the area. In assessing, the practice of making a general plan for urban infill was assessed as suitable only in areas that were attractive for new infill projects, but too laborious to be multiplied in all suburbs, as was originally planned.

Härkämäki

Härkämäki is located approximately five and a half kilometers northwest from the city center of Turku (Figure 2). It is in the Pansio-Jyrkkälä area, where the City expects a -1.4% population decrease by 2029 (City of Turku, 2018d, p. 68). In the master plan draft, Härkämäki is defined as a "completed housing area", located outside the strategic development zone for urban intensification (City of Turku, 2018b). Indeed, the area could be characterized as complete: all buildings have been built at the same time, and all of them are housing companies managed by their resident owners. The area has its own area maintenance company, Härkämäen Huolto, that has property management responsibilities and provides janitorial services in all the housing companies. Härkämäki also has an active neighborhood association Härkämäkiseura, which seeks to develop social and economic conditions and environmental quality in the area, and to create connections among its residents and communities. While the City has not initiated urban regeneration in Härkämäki, the housing companies, area maintenance company and neighborhood association have together shown interest in developing the area. In the interviews, Härkämäki was envisioned as a suburb where urban regeneration originates from within the area.

Locally initiated urban regeneration in Härkämäki originates from the need to repair the buildings in the area affordably. A common challenge in Finnish suburbs is that the building renovation costs are high compared to the value of the apartments. Therefore, the local actors in Härkämäki have examined possibilities for joint renovations with a help of a consulting firm. This also generated an idea of making an area development strategy, with an aim of improving public spaces in the area, and even examining possibilities for infill

Figure 2. Location of Härkämäki (smaller circle) and Turku city center (larger circle) in the urban structure. Map data ©OpenStreetMap contributors and SPIN Unit.

development. The public urban planners have shown support for these ideas and encouraged the local actors to carry on with their plans. Guidance, support and agility in responding to the contacts of local actors were considered as practices that the City could develop to better support this kind of spontaneous urban regeneration. For example, some interviewees suggested that the City could prepare an area development plan in cooperation with the local actors. In Härkämäki, this has already happened to some extent: the neighborhood association has previously made a green area development plan, which the City has approved and even implemented to some extent.

The interviewees assessed that locally initiated urban regeneration is needed in Turku suburbs, since they are not in the main scope of market-led urban development—infill development projects rather locate nearby the city center. However, since sustainable urban development in all housing areas is important for the City, it is necessary to support also locally emerging urban regeneration. Supporting spontaneous development was also considered effective, compared to an approach where public authorities would establish an urban regeneration scheme for each housing area. However, the interviewees highlighted that the City cannot unilaterally choose to use the Härkämäki approach to urban regeneration in some particular area, as the initiative has to come from within the area. In areas where spontaneous activities do not exist, the City should consider other urban regeneration measures. However, it is important for the City to recognize the spontaneous urban development and join it, since the area-based actors often are small and have limited resources and experience running urban development projects.

The alignment of urban regeneration approach with the Härkämäki context is summarized in Table 3. Härkämäki was envisioned as an area with spontaneous urban regeneration activities. In strategizing, the City considered it important to support local development activities. In performing, a need for new practices for the City to support local development was identified. Urban planning that supports local development initiatives was assessed as meaningful in those suburbs where the local actors are interested in improving the quality of the environment and housing. While the City cannot select the areas where the approach is used, it is important to develop practices to attend to the development initiatives, since local actors often are small and inexperienced in running urban development projects.

Table 3. Aligning urban regeneration approach with the Härkämäki context.

Territory of urban development	Urban regeneration approach in Härkämäki
Urban development vision	Spontaneous urban development
Urban development strategy	The City does not initiate urban regeneration but supports the spontaneous activities
Urban development activities	Practices for the City to act as a partner for local development could be developed further
Assessment of urban development outcomes	The approach is not suitable in areas where spontaneous development activities do not exist

Pansio-Perno

Pansio and Perno are two housing areas located next to each other, approximately eight kilometers west from the city center (Figure 3). Like Härkämäki, they are located in the Pansio-Jyrkkälä area, where a -1.4% population decrease is expected (City of Turku, 2018d, p. 68). In the master plan draft, the land uses for Pansio-Perno are defined as “completed housing areas” and “areas for services and housing”, located outside of the strategic urban intensification zone (City of Turku, 2018b; 2018d; p. 14). Pansio-Perno is separated from the city center by industrial areas, and from the seashore by

dockyards and other marine industries. In the past, it has served as a housing area for marine industry workers and their families. Nowadays, there is a lot of city-owned social housing, but also private single-family housing and semi-detached housing. In the interviews, Pansio-Perno was envisioned as a housing area where the City has a social motive for urban regeneration. On the other hand, it was also characterized as an important area for industry and workplaces. The area was considered challenging for infill development because of its isolated location in between the industry area and dockyards, relatively far away from the city center. While there are plots available for infill development, private developers have shown no interest in them. Also, the safety requirements of the nearby industry limit possibilities for infill development. However, many interviewees mentioned the recent prosperity of the marine industry in Turku and were hoping that this could at some point start new urban development in the area.

The interviewees stated that planning for infill development was not a suitable urban regeneration measure in an area that did not attract any development initiatives. Although some pointed out that the urban structure in Pansio-Perno was scattered and thereby afforded opportunities for infill development, most of the interviewees hold that there was no reason to make a physical development plan for something that was not going to be implemented. If a plan for future development was needed, it should be more about telling a story and building a positive image for the area. This was considered to both empower the residents and attract positive attention to the area from the outside.

Based on these observations, the objectives of urban regeneration in Pansio-Perno have been formulated together with the residents and local organizations (see also Mälkki, Norvasuo and Hirvonen, 2016; RAKLI ry, 2016). This has been done in regular meetings coordinated by a city worker, whose responsibility is to run the meetings, facilitate discussion, and coordinate the possible implementation of the development ideas. The idea is that local actors are empowered to work for the benefit of the area, which in turn will have more sustaining impacts than urban regeneration activities led solely by the City. Implemented development activities include environmental improvements

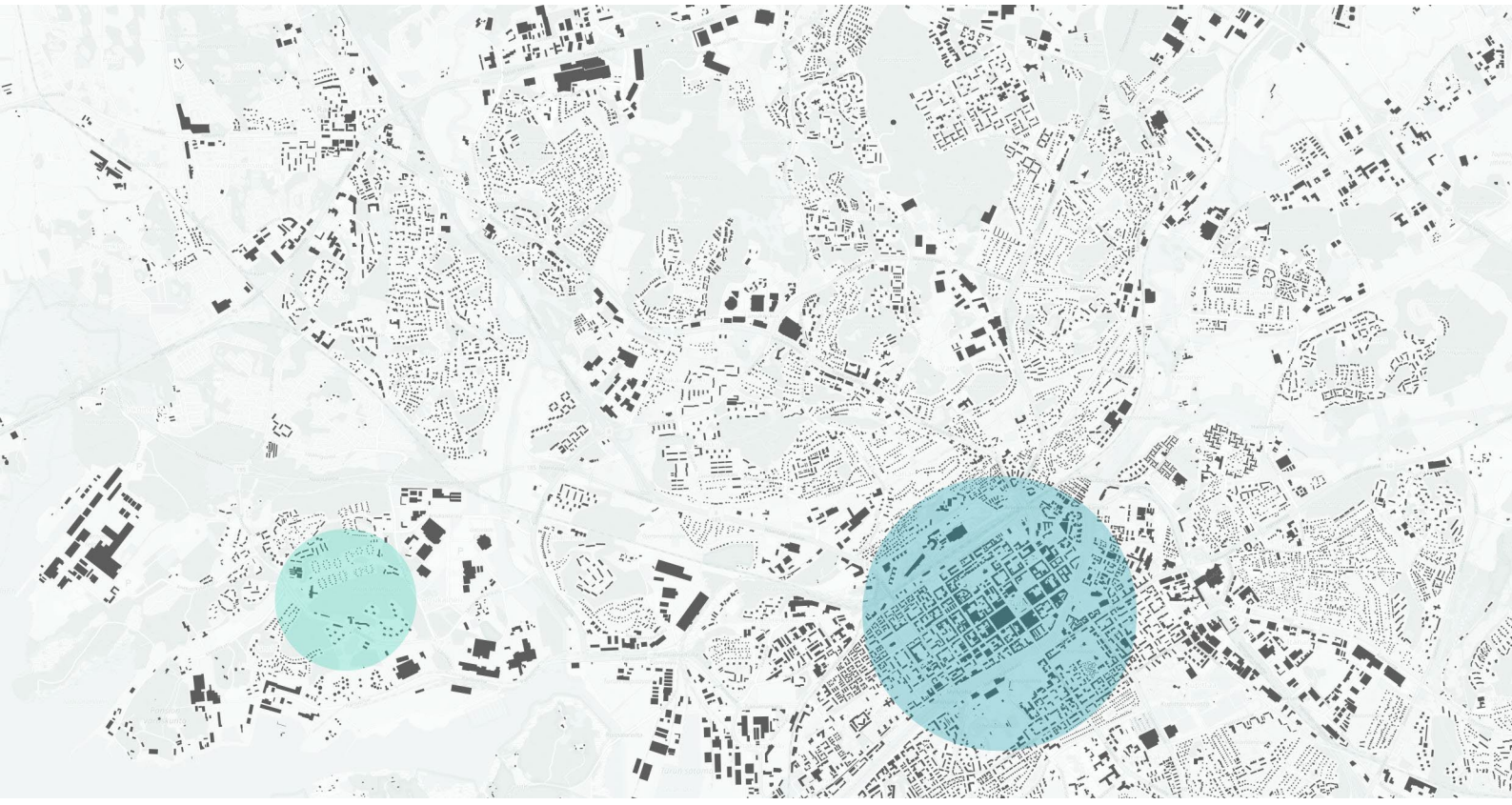

Figure 3. Location of Pansio-Perno (smaller circle) and Turku city center (larger circle) in the urban structure. Map data ©OpenStreetMap contributors and SPIN Unit.

organized in cooperation between the City, residents and area-based organizations, such as environmental artwork made for an old lighthouse building, and a new pedestrian path connecting the area to the seashore. The interviewees explained that these ideas were realized because they were important for the residents and would give a sign of positive activities taking place in the area.

The interviewees assessed that the most successful feature of the urban regeneration in Pansio-Perno was the recognition that planning for infill development was not a suitable measure there, and new practices were needed. The approach using local needs as a starting point of urban regeneration was considered as more appropriate. However, others considered it important also to find ways to make the area more attractive for external development initiatives. For example, it was suggested that the City should anticipate opportunities for urban growth that the prosperity of the nearby marine industry could bring to Pansio-Perno.

The alignment of urban regeneration approach with the Pansio-Perno context is summarized in Table 4. In visioning, the area was considered as a distant and segregated area that needed socially-oriented urban regeneration. While there were hopes that the area could also attract external development initiatives in the future, relying on market-led infill projects to bring about urban development was not considered a suitable approach. In strategizing, the urban regeneration approach which answered the current needs was developed. There were hopes that this would also bring positive attention to the area and improve its image. In performing, small urban development activities were innovated and implemented in cooperation with the City, residents, and local organizations. The approach was assessed as successful in terms that it was aligned with the current needs. However, anticipation of possible future development opportunities was also considered important.

Table 4. Aligning urban regeneration approach with the Pansio-Perno context.

Territory of urban development	**Urban regeneration approach in Pansio-Perno**
Urban development vision	The current conditions are improved, and area image is developed for the future
Urban development strategy	The City takes an active role in initiating discussion among local actors regarding urban regeneration
Urban development activities	Urban development activities are formulated in regular meetings between the City, residents and local organizations. Small-scale projects are implemented.
Assessment of urban development outcomes	While addressing local needs is important, also future development opportunities should be anticipated

Results

We have analyzed three cases of urban regeneration in Turku suburbs, utilizing an analytical framework originating from organizational learning theory. Our objective has been to explore how the City aligns its urban regeneration approach with different low growth contexts to bring about sustainable urban development. We have aimed at identifying when the growth-dependent planning approach is used, whether alternative approaches are deployed, and what are their underlying logics. As a result, we present a set of three approaches to urban regeneration that are used in the City of Turku, based on the three analyzed cases, in Table 5.

The urban regeneration approach used in Runosmäki was envisioned to suit areas that attract market-led infill development. Strategizing was about making an urban development plan, which created prerequisites for infill development projects. The approach therefore followed the logics of growth-dependent

planning, which seeks to bring about sustainable urban development by utilizing market-led urban development projects (Rydin, 2013). Infill development served the strategic aims of the City, as it was expected to increase the number of inhabitants in the area and lead to more effective use of public transport, services and infrastructure. The development was also considered to benefit the locality because it would improve local amenities and quality of the environment. However, in performing and assessing, it was noted that this approach is not functional in areas that fail to attract external development initiatives. Therefore, the idea of using the approach in all suburbs was reconsidered.

Table 5. Urban regeneration approaches in Turku suburbs

	Visioning and strategizing the approach	**Performing and assessing the approach**
Growth-dependent approach	Runosmäki: Area with possibilities for urban growth and strategic importance for the City, where urban planning seeks to create prerequisites for market-led infill development projects.	Suitable only in areas that attract infill development projects, cannot be used in all suburbs.
Supportive approach	Härkämäki: Area with spontaneous urban development initiatives and moderate strategic importance for the City, where urban planning supports local development initiatives.	New practices for the City to answer the local development are needed. The approach is not suitable in areas where spontaneous development activities do not exist.
Generative approach	Pansio-Perno: Disadvantaged area with possible strategic importance in the future, where the City and the local actors initiate development activities that answer to local needs and build area image.	While answering to local needs is important, also future development opportunities should be anticipated.

The urban regeneration approach used in Härkämäki was envisioned to suit areas where local urban development activities already exist. In terms of strategizing, it was considered important for the City to recognize and promote this kind of development. The logic of the approach was therefore to support urban development that directly creates value for the locality, which has been proposed as an alternative to the growth-dependent planning logic (Janssen-Jansen et al., 2012; Rydin, 2013). The representatives of the City considered this approach as an appropriate way to further the aims of sustainable urban development in suburbs where the growth-dependent approach is not functional. However, it was assessed that this approach may not be used in suburbs where local development activities do not exist.

The urban regeneration approach used in Pansio-Perno was also envisioned to attend to local needs. As in Härkämäki, the underlying logic was to identify the local assets and take them as a starting point of urban development. The difference was that in Pansio-Perno the City took a more active role in initiating discussion among local actors and building their capacity to participate in regeneration activities. In addition, urban regeneration measures also had the aim of building a positive image for the area and communicating that something was happening there. The urban regeneration approach was therefore also about improving the image of the area for the long-term, in case new opportunities for urban development would emerge.

Discussion and conclusions

The contribution of this exploratory paper is to demonstrate that urban planners in Finland deploy alternative planning approaches in low growth contexts, and that the need to develop alternatives to growth-dependent planning is therefore being answered in planning practice. It seems that the City of Turku complements the growth-dependent planning approach with approaches that support urban development answering to local needs and seek to generate development initiatives in areas where they do not yet exist. However, other researchers have noted that the ways to integrate local development initiatives into mainstream urban planning are still evolving in Finland (Leino, 2012; Wallin, 2015; Partanen and Wallin, 2018; Rantanen and Faehnle, 2018). Our research shows that this was the case also in Turku, where the city organization was just now starting to develop such practices.

Our research provides alternative conceptual models to growth-dependent planning and confirms insights discussed in the extant literature, which suggest that planning seeking to address local needs could complement the growth-dependent planning approach (Janssen-Jansen et al., 2012; Rydin, 2013). In addition, we found that this alternative planning approach manifests as two distinct approaches: the supportive approach that engages with the pre-existing local activities, and the generative approach that seeks to create new future development possibilities, be they commercial infill development projects or local initiatives. Similar planning approaches have previously been discussed in the context of self-organizing urban development (see Boonstra and Boelens, 2011; Boelens and Coppens, 2015). However, in disadvantaged housing areas such approaches may prove challenging as the local actors may lack resources to organize in terms of urban development (Boelens and Coppens, 2015). Applying this planning approach to low growth contexts thus requires further research.

The findings also imply that urban planners may define the means to achieve sustainable urban development more flexibly in contexts that are not in the main scope of city's strategic urban development plans, such as Härkämäki. However, in areas considered as strategically important for the city, the urban regeneration objectives are established based at least partially on logics of growth-dependent planning. This was evident in Runosmäki, which is mentioned as a target area for urban development in the strategic plans for the city, but also to some extent in Pansio-Perno, which is located near the prosperous marine industry. There, urban regeneration measures were intended to support also the long-term image-building for the area, which might improve its attractiveness for external development projects in the future. This implies that urban planners not only align their urban regeneration measures with the preconditions of the real-world context, but also with the strategic long-term aims of the city. Especially in the plan-led urban development context in Finland urban planners are accustomed to proactively seeking opportunities for sustainable urban development (Valtonen, Falkenback and Viitanen, 2017a). While the strength of this approach is that urban planners have a determined attitude towards envisioning future urban development possibilities, a possible limitation is that local development initiatives are not recognized as a contribution to sustainable urban development in areas that provide opportunities to utilize the growth-dependent model (see also, Boelens and De Roo, 2016, p. 58; Boelens and Coppens, 2015).

A limitation of our research is that due to its exploratory nature, the results should not be understood as complete theoretical models. Rather, they are preliminary concepts to be confirmed, refined or challenged in further research (Stebbins, 2011). Further, the empirical data is derived only form one city organization, operating within the Finnish spatial planning system. While exploratory research often deals with small data sets, the validity of the findings increases by concatenating research on the same phenomenon (Stebbins,

2011). Therefore, the models found in this research should be complemented with further research in other cities and within other spatial planning systems.

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Appendices

Appendix 1. Semi-structured interviews

Organization	Date and Time	Cases discussed
City of Turku, Department of urban planning	November 17, 2016, 1h 15min	Runosmäki, Härkämäki, Pansio-Perno, suburbs in general
TVT Asunnot [Real estate company owned by the City of Turku]	November 17, 2016, 1h 30min	Pansio-Perno, suburbs in general
City of Turku, Department of urban planning	November 18, 2016, 1h 20min	Runosmäki, Härkämäki, Pansio-Perno, suburbs in general
City of Turku, Department of urban development	November 18, 2016, 2h	Runosmäki, Härkämäki, Pansio-Perno, suburbs in general
City of Turku, Department of urban development	November 18, 2016, 2h	Runosmäki, Härkämäki, Pansio-Perno, suburbs in general
City of Turku, Department of urban planning	January 30, 2017, 1h 15min	Härkämäki, Pansio-Perno, suburbs in general
City of Turku, Department of urban planning	February 1, 2017, 1h	Runosmäki, Pansio-Perno, suburbs in general
City of Turku, Department of urban development	February 1, 2017, 1h	Runosmäki, Härkämäki, Pansio-Perno, suburbs in general
City of Turku, Department of real estate	February 1, 2017, 1h	Runosmäki, Härkämäki, Pansio-Perno, suburbs in general
City of Turku, Department of urban development	March 7, 2017, 1h 10min	Runosmäki, Härkämäki, Pansio-Perno, suburbs in general
Härkämäkiseura (Härkämäki neighborhood association)	March 8, 2017, 1h	Härkämäki, suburbs in general
Vahanen Turku (Consultant for joint renovations in Härkämäki)	March 8, 2017, 50min	Härkämäki
Härkämäen Huolto (Härkämäki area maintenance company)	March 9, 2017, 35min	Härkämäki
City of Turku, Department of urban planning	June 20, 2017, 30min	Runosmäki, Pansio-Perno, suburbs in general
City of Turku, Department of urban planning	June 20, 2017, 30min	Runosmäki, suburbs in general

Which Is the Most Cost-efficient Alternative, a New Build or the Rehabilitation of a Cultural Heritage Site?

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Abstract
Given the choice between the rehabilitation of a cultural heritage site and a new build, recent history in Norway shows that the new build is often chosen, with the justification of cost efficiency.

This paper compares approaches to cultural heritage sites from a property development and a protection of cultural heritage point of view to test this judgment. These two professional fields overlap and need to cooperate. Thus, a closer look at their similarities and differences should provide valuable insights.

This paper applies a case-study method to a large country estate building at a NATO air base in need of office space. The building has legal protection at the national level. Costs are calculated for three scenarios for new offices: rehabilitation of the protected building, a new build, and renting. All alternatives include legally mandated maintenance of the protected building, as the same public body carries out both tasks.

Of the three alternatives, the new build and renting were the most expensive over a thirty-year time span. Rehabilitation was the most economical. These findings indicate that owners of protected buildings should investigate possibilities to activate such buildings, due to not only their cultural heritage values, but also their economic potential.

Keywords: Cultural heritage, architecture, real estate development, real estate management, economic analysis

Of the three alternatives, the new build and renting were the most expensive over a thirty-year time span. Rehabilitation was the most economical.

Introduction
Cultural heritage sites form part of the common heritage of our communities, and are to be safeguarded for future generations (Lovdata, 2017a). There has been a series of disputed decisions to vacate and even demolish cultural heritage sites in Norway in the last decennium (Aftenposten, 2016). This includes sites such as the government quarter and the National Gallery (Stendebakken and Olsson, 2017a). A key argument in Norwegian decision-making regarding larger building projects, nationally and regionally, is economic

PEER-REVIEWED ARTICLE

Photo 1. Typical room on ground floor.

analysis, and costs have been a deciding factor in many of these projects (Concept, 2017). This paper is an academically based analysis to investigate actual costs and whether prejudice is in force. There are challenges connected to applying economic analysis to cultural heritage sites. Among the shortcomings related to economic analysis, we wish to highlight these four issues:

1. Economic analysis de-emphasizes unquantifiable values. Although they may be included as positives, neutrals, or negatives, they cannot be numerically incorporated in calculations (Finansdepartementet, 2017).

2. Economic analysis typically applies a time span comparable to the expected technical lifespan of a new build, such as thirty years. This is inadequate in dealings with buildings that are significantly older than thirty years and are to be safeguarded for future generations (in accordance with cultural heritage legislation) (Standard Norge, 2013).

3. Costs for rehabilitation of existing buildings differ significantly. While new builds have relatively similar costs when taking into account purpose, build quality, building ground, etc., this is not the case with rehabilitation projects. While new-build project cost potential in early project estimates can be tested top-down through standards, rehabilitation projects need to be estimated bottom-up based on technical analysis of the existing building at hand (Standard Norge, 2012).

4. Economic analysis depends on its assigned scope. There is a convention of limiting this scope to isolated building projects. However, if a public body needs to keep and reactivate the vacated building in addition to the new building that came at a lower cost than the rehabilitation project, as in the case of the National Gallery, this scope does not fully capture the economic consequences a given project

> decision has for the public body's total economy (Administrasjonsdepartementet, 1997).

Economic analysis is lacking as a decision-making tool in projects regarding cultural heritage sites today, as are other tools for analysis of cultural heritage sites, if one aims to grasp the fuller picture of reality. The DIVE model (Describe Interpret, Valuate, Enable) model promoted by the Directorate for Cultural Heritage in Norway is a cultural historic analysis model. It promotes a thorough analysis of a cultural heritage sites' historic values and their limits of tolerance (Riksantikvaren, 2009). The model does not emphasize architectural quality, potential for use, or economics. The lack of emphasis on architectural quality seems to be due to a notion of architectural quality as artistic, and of artistic qualities as being subjective and fluctuous while historic values are more objective and stable. This perception goes back to the art historian Alois Riegl (Stanley-Price, Talley, and Melucco Vaccaro, 1996). The DIVE model's analysis of limits of tolerance can be seen as the necessary opposite of looking for potential for use, while the model's multifaceted analysis of unquantifiable values can be seen as antagonistic to economic analysis and the plain language of the grand total. This suggests that both the economics and the protection of cultural heritage fields have blind spots in their dealings with building projects related to cultural heritage. This paper addresses these differences in focus. This is done through a single-case study of a vacated, state-owned, nationally protected cultural heritage site in Norway, "Værnes Hovedgård". Værnes Hovedgård is a 700 m2 wooden building from the early 19th century, situated in Trøndelag in Norway on a NATO air base, with associated access limitations, and is not presently in use. The building is managed by the Norwegian Defence Estates Agency (NDEA) (Forsvarsbygg, 2017). The site has been the subject of an indepedent cultural heritage-based analysis (Stendebakken, Grytli, and Olsson, 2015) conducted for academic purposes. The cultural heritage-based analysis deemed the building suitable for conversion to offices, deemed less invasive than quarters or a guest-house as it mainly allows for the original floor plans to be kept. Civilian uses, such as a private home or gallery, were excluded due to the access limitations. Due to the access limitations applying to a NATO air base (Wikipedia, 2017), the analysis recommends acknowledging both the air base's needs and the building's potential by using the building for offices. This choice of purpose can render the access limitations, currently blamed for the building being out of use, an asset rather than an obstacle to alternative uses. Coincidentally, the air base needs more office space and has requested a new office building.

In this paper, the cultural heritage site will be subject to an independent property development analysis conducted for academic purposes in dialogue with the NDEA. The aim is to provide insights on the similarities and differences between the fields of property development and protection of cultural heritage by comparing the two analyses. Property developers are often seen as promoters of change, whereas representatives from the protection of cultural heritage field's main aim is to protect existing values. Descriptive of the protection of cultural heritage field's image as static, protection of cultural heritage is also referred to as preservation, and the cultural heritage as preserved. We do not use these terms in this paper, as true preservation of cultural heritage sites is not only an old-fashioned approach unsuitable for the majority of today's numerous cultural heritage sites and the challenges they meet; it can also be described as a utopian dream, as the task of ideal preservation would require the ability to stop time. Within the protection of cultural heritage field today, there are proactive initiatives to ensure that the measures which will inevitably be taken with the passing of time are suitable (Miljødepartementet, 2016). Property developers work with cultural heritage values for added value in development projects (Aspelinramm, 2017). Still, cooperation between property developers and protection of cultural heritage professionals holds unrealized potential (Starr, 2013). Dynamics between the two fields have been regarded unconstructively, with the two in a chauvinistic deadlock in which property developers are perceived as the "gas" and

protection of cultural heritage representatives as the “brakes”. Obviously, this cannot be the complete picture. Property developers also have an interest in stopping disadvantageous actions, and protection of cultural heritage representatives continuously initiate activities that are perceived to be beneficial.

Instead of the term “preservation”, this paper refers to the professional field of “protection of cultural heritage”. This aims to cover the diversity of professions working with the protection of cultural heritage sites with safekeeping of cultural heritage values as a main aim. Protection of cultural heritage is a professional field in constant development.

The term “cultural heritage sites” covers both sites with formal protection as cultural heritage and other sites that have perceived cultural heritage value, as formal protection is a status that may change.

The term “site” as used in this paper covers both isolated buildings and larger sites containing buildings. It does not include archeological sites or underwater sites.

In this paper, the term “property development” refers to professionals working with building projects promoting change with economic profit as an aim.

Norwegian legislation presented in English in this article has been translated from Norwegian.

Method

The method applied is a property development analysis of the cultural heritage site Værnes Hovedgård and its potential for future use as offices. The theoretical framework is early phase property development theory. The aim is to provide insights on the similarities and differences between the fields of property development and protection of cultural heritage. Værnes Hovedgård has been the subject of a cultural heritage-related analysis of the site, including a preliminary architectural design for the transformation of the building into offices (Stendebakken, Grytli, and Olsson, 2015). The associated report will be referred to throughout this text.

The cultural heritage analysis recommended rehabilitating Værnes Hovedgård into offices. From a property development point of view, this initiative needs to be evaluated in light of economic aspects and compared to alternatives for providing office space for the air base. The property development analysis will valuate several economic aspects for a transformation of the site Værnes Hovedgård into office areas, along with other alternatives for providing office areas for the air base. The economic aspects this paper will investigate are as follows:

- investment cost
- project cost
- time perspective for the project
- time perspective for use of assets
- quality of result
- alternatives analysis

Investment costs and project costs will be estimated, or existing estimates will be referenced. The time scope for economic analysis will be compared to expected useful life for the alternatives for providing office areas for the air base. Quality of result will be compared for the alternatives to avoid comparing economic cost for alternatives of different use quality as though they were the same. These aspects will be discussed and summed up in the alternatives analysis.

All traces of human activity are actually defined as cultural heritage (Lovdata, 2017a). Formal cultural heritage status for cultural heritage sites varies; a site may be legally preserved under the Cultural Heritage Act (Lovdata, 2017a) as an object of national importance, which is a strong juridical protection. It can also be protected locally through area planning and the Planning and Building Act (Lovdata, 2017b). While protection by law establishes that a given site is indeed a cultural heritage site, lack thereof does not imply that it does not entail significant cultural heritage value; a given site can have important cultural heritage value without legal protection (Lauvland and Aasen, 2017).

There are different types of tangible cultural heritage. Built traces of human activity are present in a variety of forms spanning from detailed interiors to larger outdoor areas.

All sums are given in NOK and calculated in USD, using the currency calculator of Norway's largest bank (DNB, 2016). Tables and figures use NOK. 1 USD ≈8,40 NOK.

Property development

Stages

Property developers typically go through eight steps (Miles, Netherton, and Schmitz, 2015), though not always linearly; depending on the feasibility of a given project, for example, the sequence might be discontinued or rearranged. The typical sequence of steps is as follows:

1. Idea inception
2. Idea refinement
3. Feasibility
4. Contract negotiation
5. Formal commitment
6. Construction
7. Completion and formal opening
8. Property, asset, and portfolio management

This is a simplified and idealized version of such a development process. It is vital to consider all remaining steps at any point in the development process to give the process direction, seize opportunities, and handle difficulties at the earliest possible point. It is basic project management theory that a project's flexibility and ability to adapt are at their highest in the early phases (Samset, 2008).

Even in prosperous times, large investments such as property developments contain risks. A truly successful project includes several kinds of added value. Besides the monetary benefit for the developers, there are also other kinds of added value, such as urban development and safeguarding cultural heritage. Safeguarding cultural heritage is a value in its own right and may affect other values, such as image and reputation. Successful property development projects might prove themselves to such a degree that the finished project seems self-explanatory. This is seen in urban development projects where prices increase rapidly as new urban areas gain popularity in the market; in hindsight, this might seem obvious, and those uninvolved might think that they easily could have done the same. However, a successful urban development requires interdisciplinary cooperation, risk taking, and above all, timing. This might easily be forgotten when one walks the vibrant streets of successfully transformed urban areas.

Operating parameters

To test a given idea, one looks at the associated parameters. These include square meters or floor area ratio, building cost, market prices for the finished project, management of the project after completion, and time spent retaining funds, staff, and technical assets over the project period.

Concept development

Choice of concept is often based on alleged effect (Rolstadås et al, 2014). The starting point of a project is likely a need that has arised. One should address real problems, not possible problems, and the problem should be defined in a way that enables several alternative solutions.

Concept development should then be based on alternatives analysis. It is important that the alternative solutions are genuine alternatives, i.e. mutually exclusive. It is vital to also consider the zero alternative, the current situation, comparing it to the proposed alternatives.

After choosing one or more promising concepts, a process development in which the concept is rendered concrete and framework conditions are defined is due.

Risk analysis

In forming a property development project, there is typically an emphasis on time, cost, and quality (Samset, 2008). For enhanced project effectuation, risk analysis is also vital. The object is to target risks in connection to the project, the consequences associated to a given risk, and the probability that the risk will occur. Risk can be both systemic and non-systemic. Non-systemic risks need to be addressed on a project level and systemic on a superior level, typically with diversity in a property developer's project portfolio.

Certain risks are characteristic for property development projects involving cultural heritage, such as those connected to the rigid constancy that is a main goal for management of cultural heritage values (Senter for eiendomsfag, 2010). These risks should be treated thoroughly on a project level, and on a systemic level if the property developer has a significant number of projects involving cultural heritage values, in which case cultural heritage-associated risks become systemic.

Cultural heritage and property development

Traditionally, protection of cultural heritage has taken a museum approach to protected buildings. Today's protection of cultural heritage field began in the late 18th and 19th century and was institutionalized in the 20th century. In the 19th century, protection of cultural heritage depended on individual volunteers and private interest groups. In the 20th century, the field gained wider recognition and legitimation established through national initiatives and juridical framework.

From its juridical platform, the protection of cultural heritage field widened its scope and protected an increasing variety of sites. In its early years, the protection of cultural heritage field was employed as a tool to build national identity in young nations, such as Norway, by protecting rare monuments; time-honored, beautiful, grand elements of our built heritage suitable to strengthen the desired national self-image.

The devastations of the two world wars, social change, and the rapidly changing building industry have changed our built surroundings quite dramatically. Parallel to these changes, the scope of the protection of cultural heritage field has broadened to include more modest objects and larger, continuous areas such as old town centers, where each building appears quite modest but the whole has significant cultural heritage value. The juridical framework has adapted and presents updated requirements which property development on cultural heritage sites today must comply with.

The Norwegian project for legal protection of state-owned cultural heritage sites

In 2007, the Norwegian project for legal protection of state-owned cultural heritage sites claimed that "No building is too small, ugly or anonymous, if it documents an important part of state history" (Statsbygg). Until then, Norwegian

state-owned, profane cultural heritage sites had not been protected by law, in contrast to private cultural heritage sites. The exception was a relatively small number of sites that received “administrative protection” in the years 1933 and 1934. The project for legal protection of national property was started around the turn of the millennium. State-owned property was legally protected through a tailored regulation (Lovdata, 2017c) to ease the juridical process when the state is both landowner and deciding authority.

The project reviewed all state-owned profane sites to evaluate their cultural heritage values; if they were deemed of value according to a set of criteria, they were protected by law. The tailored regulation involved newwording, slightly affecting the selection of cultural heritage sites worthy of legal protection.

The criteria were to not only protect architectural and cultural heritage values, but also show governmental history, ensure examples from different time periods, promote understanding of state sectors, preserve historic document value, original elements and later additions representing historical developments and safeguard structures, interrelations, open space, and visual connections.

The set of criteria is listed below (Lovdata, 2017c, translated from Norwegian for this article by the authors):

Preservation regulations of the State-Owned Cultural Heritage Properties

§ 1.1. The purpose of conservation
The protection under the Regulation is intended to ensure and preserve a representative sample of cultural heritage in the form of structures and sites related to government activity. The listing will help to

a) ensure that architectural or cultural heritage values in buildings and sites are preserved
b) show the governmental sectors’ historical development and their importance, such as social development, building of Norway as a welfare state, and the relationship to indigenous peoples and minorities
c) ensure that representative examples from different periods of development are preserved
d) convey understanding of the sectors and eras they represent
e) preserve the buildings and facilities as historical references and sources of knowledge
f) preserve original elements and later additions, if these are considered to have an independent value as a representative of a historical development
g) ensure that the structures’ and sites’ interrelations are safeguarded
h) ensure that open areas are preserved and that the functional and visual connection with the protected complexes are maintained.

The project was expected to produce a significant increase in the number of protected buildings in Norway. This should be unsurprising, considering the criteria listed above. However, this was not addressed as a major issue in the early phases. No ceiling was placed on the number or share of sites to be protected to force prioritization. Ideally, the protection by law of a state-owned cultural heritage site should not lead to added costs, as the state should take proper care of their sites regardless. In hindsight, one can argue that a protection by law prohibits neglect of unused or even unusable buildings, that it adds quality requirements for the work carried out, and that it adds paperwork, uncertainty, and administrative burden, as one cannot make irreversible changes to a cultural heritage site protected by law without applying for dispensation. This requirement also applies to minor interventions, such as drilling in walls.

The need for new use in abandoned cultural heritage sites

Today, there are thousands of buildings with legal protection in Norway, more than 8,000 of which have the strongest form of legal protection (Riksantikvaren, 2017a), under the Cultural Heritage Act (Lovdata, 2017a). We use the unit "building" here, as our source, the Department of Cultural Heritage's database Askeladden (Askeladden, 2017), does.

The share of Norway which is under some form of legal protection has risen to 25% of the country (SSB, 2017a). However, this includes national parks, nature reserves, etc. Fifteen per thousand buildings are under the strongest form of legal protection. Additionally, thousands of buildings have other kinds of legal protection.

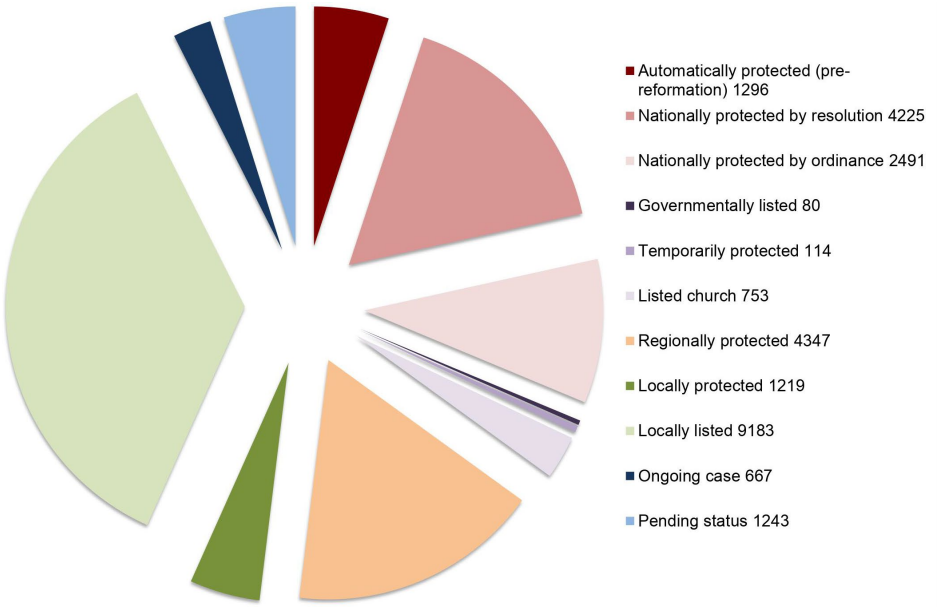

Figure 1. Buildings in Norway with formal legal protection as cultural heritage. The table in Figure 1 is based on the Directorate for Cultural Heritage's database Askeladden (Askeladden, 2017). Search performed on 2 August 2017 from 2:00 pm. The database contains information on archaeological sites, architectural monuments and sites, and cultural environments. As we investigate potential for rehabilitation, we have included buildings and churches. We have excluded technical/industrial heritage, ships, ruins, archeological sites, rock art, and outdoor elements from the search ("Protected" is by the Cultural Heritage Act, on national level, regionally and locally protected are by the Planning and Building Act).

In the early years of the protection of cultural heritage field, buildings were typically approached as entities without great consideration for surroundings and could be protected in a museum manner. Buildings were even moved to outdoor museums as out-of-size museum objects. This goes against today's preference for maintaining original fabric, historic document value, context, and (ideally) continuous yet conservative maintenance, an approach often credited to John Ruskin (Ruskin, 1880). Logically, the aforementioned museum approach is also not viable with today's number of protected buildings. There is an increasing focus on initiating new activities in cultural heritage sites. Today this is considered the best alternative for the majority of cultural heritage sites. Naturally, being in use and being adapted to new use causes some deterioration of cultural heritage sites, but this is considered less damaging than being left empty, even if one has the resources to simulate use, e.g. through heating (Riksantikvaren, 2017b).

The protection of cultural heritage field wishes to activate its assets. Property developers recognizing the potential in transforming cultural heritage sites have concurrent interests. The two fields also have potentially conflicting interests originating in their main goals; the protection of cultural heritage field sees new activity as a tool for protection of cultural heritage, while property developers

mainly see new activity as a goal in itself and a premise for profit. In property development, a cultural heritage site needs to adapt to its potential for use. In protection of cultural heritage-based management, the situation is reversed; the use needs to adapt to the cultural heritage site and its limits of tolerance. Profit is not a major focus for the protection of cultural heritage field, which sometimes lacks attention to economic consequences. This ignorance exists despite the comprehensive economic consequences legal protection of a given cultural heritage site has for the current owners, future projects on the site, and the responsible authorities due to administration. By assigning legal protection and its attendant restrictions on a given site, the state takes on an (admittedly vague) joint economic responsibility. Cultural heritage authorities may cover additional costs due to legal protection, but they are not obliged to do so (Finne, 2015). State funds are nevertheless used in the safekeeping of both public and private cultural heritage sites. This should encourage an economic awareness related to legal protection both among legislators and those managing protected properties.

Contrary to common beliefs, legal protection does not hinder all possible initiatives at a given cultural heritage site. However, as mentioned above, in relation to a growth in administrative needs and added costs for the state, a dispensation has to be applied for all irreversible interventions. As the law says, one can get a dispensation by meeting the requirements but is not automatically entitled to a dispensation even when meeting the requirements: To be granted dispensation, an intervention needs to be insignificant and a particular case. Assessment is left to the state administration's judgment. Cultural heritage authorities are relatively free in their decision-making. Property developers, fearing the unpredictability and added costs this uncertainty might add to a project, may dread the application process for such dispensations. The regulation for protection of state-owned cultural heritage properties, paragraph 1-4 on Dispensation, is listed below (Lovdata, 2017c, translated from Norwegian for this article by the authors):

Preservation regulations of the State-owned Cultural Heritage Properties (...)

§ 1-4. Dispensation
The administrative authority in § 1-7 may in special cases grant dispensation from protection and conservation regulations for measures that do not have a significant impact on the monument.

In deciding what constitutes such special circumstances, attention should be given to which degree the measure is necessary to achieve the purpose of the protection, including

a) *repair and restoration*
b) *replacement of damaged material and or vegetation*
c) *recoveries to original or previous appearance and structures under the assumption that the measure can be done in a secure documented basis and in accordance with traditional methods and materials*
d) *fire precautions*
e) *other measures to protect the monument.*

In assessing what constitutes special circumstances, measures of major importance for society, such as security, may also be emphasized.

The thought of such an application process might seem demotivating, but, as noted by German philosopher Gadamer, legal protection is a confirmation and formalization of existing values in a cultural heritage site, and is, according to Gadamer, inferior to the core qualities of the site. (Gadamer, 2014). The site's core values came to exist independently of the protection of cultural heritage field, but may depend on it for further existence. Thus, legal protection should

be regarded as a hallmark for significant values in connection to a given site (Stendebakken and Olsson, 2017b).

Case: Værnes

This article is based on a single-case analysis of what used to be the main building on a large farm in central Norway, which dates back to pre-historic time. The farm, “Værnes”, was bought by the Norwegian Armed Forces and gradually turned into the combined civilian airport and military air base of Værnes. Today, the old main building from 1818 is located on the air base. The building, “Værnes Hovedgård”, is the oldest building on the air base and the only remaining building from the previous farm. Due to Værnes Hovedgård’s position within the clearance zone at a NATO air base, it is inaccessible to civilians. The building is constructed and clad in wood, with a masonry foundation and slate roof, measures 36 x 9.5 meters, and has two main floors in addition to a loft and cellars. There are 25 rooms on the ground floor and 21 on the first floor. Most rooms are of similar sizes. The rooms are arranged in two rows, without hallways; access is through adjacent rooms.

The building is an example of local building tradition. Comparable buildings, although typically much smaller, are widely distributed throughout the area, still inhabited as main buildings on surrounding farms. Værnes Hovedgård is not in use; since 1992, the building has only been used a few times, and then quite intensely as an urban warfare training site.

The old, unused wooden building’s survival for decades in the stern environment of a military base is due to its build quality and the fact that Værnes Hovedgård was legally protected in 1934. As mentioned, state-owned profane cultural heritage sites were rarely formally protected. Because Værnes Hovedgård has enjoyed this rare formal protection, the Norwegian Armed Forces, as its owners, have been obliged to maintain the building. In 1934, the typical site to receive protection was the main building on a larger farm, such as Værnes Hovedgård. The building was protected for the second time in 2004, along with the old yard and other, newer buildings surrounding it.

Due to their juridical obligation to maintain Værnes and an earmarked governmental subsidy, the armed forces have quite recently carried out comprehensive maintenance of the building, repairing the foundations, cladding, roof, and chimneys and removing newer building materials exposing the building to moisture. This maintenance work cost 9 million NOK (≈1,1 million USD) (Forsvarsbygg, 2012). The building remains empty, and extensive further work needs to be done before it can be used, according to today’s legislation and standards. This work is calculated to cost 10 million NOK (≈1,2 million USD).

There is a pronounced goal in today’s protection of cultural heritage field that the majority of protected buildings should be in use, raising the questions of why this has not yet come through for Værnes and how it can be achieved.

The air base is in dire need of more office space, a use suitable for the building. The generic structure of the building, with many rooms of similar and quite good size, aligned in two rows, gives it flexibility in adapting to new use, as functions can be distributed in a variety of ways.

The cultural heritage analysis of Værnes Hovedgård recommended rehabilitating the building for office areas. The general floor plan of the building would quite easily adapt to office areas, with a majority of work stations in office landscape. The building’s original larger rooms were divided throughout the 19th and 20th century, and some can justifiably be re-opened. There will be some sacrifices regarding wearing indoor surfaces and some openings will have to be made in construction and cladding. Additional inner windows and wall insulation could be required due to both temperatures and the noise from

the air base. However, the main attribute of the building, surfacewise, is its exterior. On the inside, the repetitive series of similar rooms with copious daylight is a key quality. This would be preserved. A dreaded intervention in cultural heritage sites is the lowering of ceilings to allow for ventilation and other technical installations. The ceiling height would allow for this, but a preferable solution, which is recommended in the cultural heritage analysis, is to do these technical installations mainly vertically, giving up selected square meters rather than ceiling height everywhere. The most demanding technical rooms are put in the smaller and lighter timber-frame construction part of the building rather than the larger main cog-work part.

Because the building is legally protected, dispensation has to be granted for all interventions affecting the existing built fabric. The NDEA has regular, professional contact with the Directorate for Cultural Heritage due to their extensive portfolio of cultural heritage sites and experience with protection and development of cultural heritage sites. This should allow for a less complicated design and application process.

Applying property development theory to Værnes

Værnes Hovedgård's two main floors have an approximate floor area of 700 m2 combined. The size of a rehabilitation project is determined by the size of the existing building. The other alternatives for office areas, a new build and renting, would not suffer this limitation. Still, we choose to compare costs for each alternative based on a project size of 700 m2 for comparability.

Other properties at the airport have been sold in recent years. As property prices have increased recently (SSB, 2017b), we have included those from 2014 (newest available) to 2008 (Eiendomspriser, 2016). Prices spanned from 1-19,5 million NOK (≈120 000–2.3 million USD). The statistics regrettably do not provide square meters for the buildings; however, they do provide insight into the sums one is dealing with for commercial buildings within the airport.

Based on the building's square meters, address, and original domestic purpose, its value is estimated (Eiendomsmeglerguiden, 2016) to be between 11,240,000 and 16,950,000 NOK (≈1.3–2.0 million USD) according to the general standard for domestic buildings in the area. The building is statelier that the average domestic building but also needs extensive work before it can meet today's standards.

Today the building and its cultural heritage values are secured, but the building is not in use. Safekeeping of the building includes inspections, maintenance, heating, alarm systems, and pipework for fire hoses. This costs ≈500,000 NOK (≈60,000 USD) per year (Nilsen and Reiersen, 2010). Nilsen and Reiersen calculated the costs of operating the building if it were transformed to office space at 1,100,000 NOK (approximately 130,000 USD). The calculation presupposes an initial investment for the rehabilitation of 10 million NOK (approximately 1.2 million USD).

The cost per square meter for construction of new office space is roughly estimated to be between 20,000–30,000 NOK (≈2,400–3,600 USD), adding up to 14–21 million NOK (≈1.7–2.5 million USD) for 700 m2 of office area. New build office areas seem to come at a higher cost than a rehabilitation of the existing building. One should keep in mind that a new construction offers the possibility to tailor that the transformation of an existing building does not allow, so office areas in Værnes Hovedgård might have a lower work station ratio than comparable new office areas. Still, these are alternatives with some degree of compatibility, although not identical in creation or in result.

The relatively recent comprehensive maintenance of Værnes Hovedgård was funded with a grant of 9 million NOK (≈1.1 million USD) directly over the national budget, reserved for this building. As these works have been executed,

and because the purpose was to cover decades of maintenance lag, the cost is not included in the calculations in this paper. Further work done on the building will probably have to be paid from the NDEA's own budgets.

Alternatives for providing office areas at the air base

The NDEA have a number of possible means both to provide more office areas at the air base and to keep the protected building Værnes Hovedgård safe. The alternatives considered by this paper are listed in table 1. Some of these alternatives ignore the legal obligations under the Cultural Heritage Act to maintain the existing building. The authors emphasize that this is an independent, academic analysis performed for research purposes. The NDEA is a reputable manager of cultural heritage sites with a sought-after specialist environment on protection of cultural heritage in house. The unacceptable alternative of doing nothing, Alternative 1, is included in this paper to exhaustively list alternatives that might be applied to cultural heritage sites in society in general. This alternative of doing nothing comes at the tempting cost of nothing. Still, this does not qualify as a zero alternative, as referred to earlier in this paper, under concept development, as it does not achieve the minimum requirement of obeying laws and regulations. Alternative 1 will therefore not be discussed as a viable path in this paper. This also applies to alternative 2. The zero alternative at the air base is actually Alternative 3, which maintains the status quo. This is generally referred to as a zero+-alternative, or doing as little as possible.

Table 1. Alternatives for maintaining Værnes Hovedgård and acquiring more office spaces at the air base, by means of investment

Alternative	*Approach*	*Cost in NOK*	*Is it legal?*	*Benefit*
1	Do not build new offices; do not protect the existing building	0	No; it is illegal under the Cultural Heritage Act	Zero cost
2	Build 700 m^2 new office areas; neglect the old building	14–21 million + annual expenses, estimated at 600,000[9] p.a.	No, it is illegal under the Cultural Heritage Act	Provide office spaces
3	Protect the old building against damage; neglect the need for office space	500,000 per year	Yes, it fulfills obligations to the Cultural Heritage Act	Fulfill legal obligations
4	Transform the existing building to office areas	Initial investment: 10,500,000 + annual expenses estimated at 1,100,000 p.a.	Yes, it fulfills obligations to the Cultural Heritage Act	Fulfill legal obligations and provide office space in a rare building of high value
5	Protect the old building against damage; build new office areas	14–21 million + annual expenses estimated to 1,100,000 p.a.	Yes, it fulfills obligations to the Cultural Heritage Act	Fulfill legal obligations and provide office space in a modern building

The calculated costs for rehabilitation of the existing building into office areas are based on a bottom-up analysis of the existing building performed by employees in the NDEA in 2010. They found the cost for rehabilitation to be ≈1.1 million USD (≈1,500 USD per square meter).

By Norwegian standards, 1,500 USD per square meter is not a high cost for a rehabilitation project in a protected building. The Eidsvolls building, an important cultural heritage site in Norway due to its centrality in the creation of Norway's constitution, exemplifies a high-cost rehabilitation project of a comparable building. The Eidsvolls building, from 1770, is constructed of wood, like Værnes Hovedgård, and was also originally a private home. It was restored in 2014 for the Norwegian constitution's 200th anniversary celebration (Kwetzinsky, 2017). The ambitious restoration of the 1,800 m2 building came at the cost of 350

[9] The same costs as the office-specific costs for the protected building

million NOK (≈42 million USD, ≈23,000 USD per square meter) (VG, 2017). Both the ambitions and the costs can be presumed to be higher at Eidsvoll than at Værnes Hovedgård; at Eidsvoll, the restorers sought to recreate the built frame around the composing of the constitution. At Værnes Hovedgård, the aim is to adapt to new use. This allows for more flexible solutions. Still, as sums involved in cultural heritage sites, these vastly different numbers invite questions. The NDEA's comment was that the calculated costs might be conservative, but nevertheless, it should not be problematic to rehabilitate at a lower price than that of a new build, as the margins between the two alternatives' costs are considerable. The exact final cost of a new build or a rehabilitation project also depends on the level of quality chosen for the project.

Renting offices in the vicinity of the air base

A larger investment in in-house areas is merely one alternative for new office areas. Another is to rent such areas. Based on the notion that the state should be able to pay directly for its investments, the NDEA is not authorized to take up loans. Given that, a direct payment seems the optimal option. However, when direct funding is inaccessible, for example when the armed forces have other priorities, the limitation on loans can lead to unfortunate results. The restrictive policy on taking up loans can seem incomprehensible to the public if it leads to seemingly unnecessary costly or impractical solutions. The NDEA received strong criticism for renting office areas in Oslo while owning 11,000 m2 of unused office areas in the vicinity (300 meters away from the rented office areas) (Aftenposten, 2015).

The NDEA could choose to rent office space for use by the Værnes base. The office area in Oslo was rented at market rate for high standard office areas, 2,700 NOK / m2 (≈321 USD). We thus use market prices at Værnes in our calculations. Market prices were estimated based on a new office building in Stjørdal, 2 km from the airport (FINN, 2016). Office areas are available in the span from 350 m2 to 4,500 m2. These offices had the highest price per m2 in the area Stjørdalen. The rent would be between 1,700 and 1,800 NOK / m2 (≈202–214 USD) per year. The option of renting office areas offers the advantages of low obligation, high flexibility, and low investment costs. As the legally protected building still has to be maintained by the NDEA in accordance with Norwegian law, these costs should be included in the calculation, as demonstrated in Table 2 below.

Table 2. Alternatives for acquiring more office space at Værnes, by means of investment at the air base or renting in the vicinity of the air base.

Alternative	*Approach*	*Cost in NOK*	*Is it legal?*	*Benefit*
A	Renting offices, paying rent, no or little investment costs	1490 NOK/m^2 in rent; 1,043 million/year	No	Low investment costs, less commitment than a larger investment project, but fails the legal requirement to safekeep the protected building
B	Renting offices, paying rent, no or little investment costs, and maintaining the legally protected building	1,043 million/year in rent + 500,000/year for maintaining the existing building	Yes	Low investment costs, less commitment than a larger investment project, and meets the legal requirement to safekeep the protected building

For comparability, all costs should be from the same year. As the detailed calculations from the NDEA are from 2010, we have chosen to adjust the costs for renting to 2010, using Statistics Norway's index for rental costs for offices (SSB, 2017c). The alternative would be to use a series of different indexes to recalculate the costs for rehabilitation and new build, making the numbers less accessible and the comparison less transparent. The authors have chosen

transparency over newness. The costs for renting are based on the index for 2010–2015, adding an expected price development for 2015–2016 based on the previous years 2010–2015. The costs for renting in 2016 should thus be divided by 1,177, which gives a calculated cost of 1,750 (average of 1,700-1,800) / 1,177 = 1,486.83093, rounded up to 1,490. As with Table 1, we will abstain from discussion of Alternative A, which fails to fulfill legal obligations under the Cultural Heritage Act.

Comparing costs

The differences in cost between alternatives will be affected by time. To illustrate this, they are compared in a line chart in figure 2. A thirty-year timespan has been applied, as this is the estimated life span for new buildings. It is also an estimated timespan for major rehabilitations of older buildings of quality indicating the time until the next major rehabilitation needs to be done to accommodate further use. The need for additional costs could thus be the same after 30 years, while the actual residual values may differ.

The difference in costs between alternatives changes with time. The differences in costs can be deemed dramatic. But several of the alternatives do not absorb the complexity of the situation, as the NDEA are obliged to maintain their legally protected buildings. This applies to the zero-cost alternative, renting only, and new build only (low and high estimate). These alternatives do not include the costs for mandatory maintenance of the existing building. While all these alternatives are seen in the reality of management, which is that protected buildings may be inadequately maintained, these examples represent a violation of the Cultural Heritage Act.

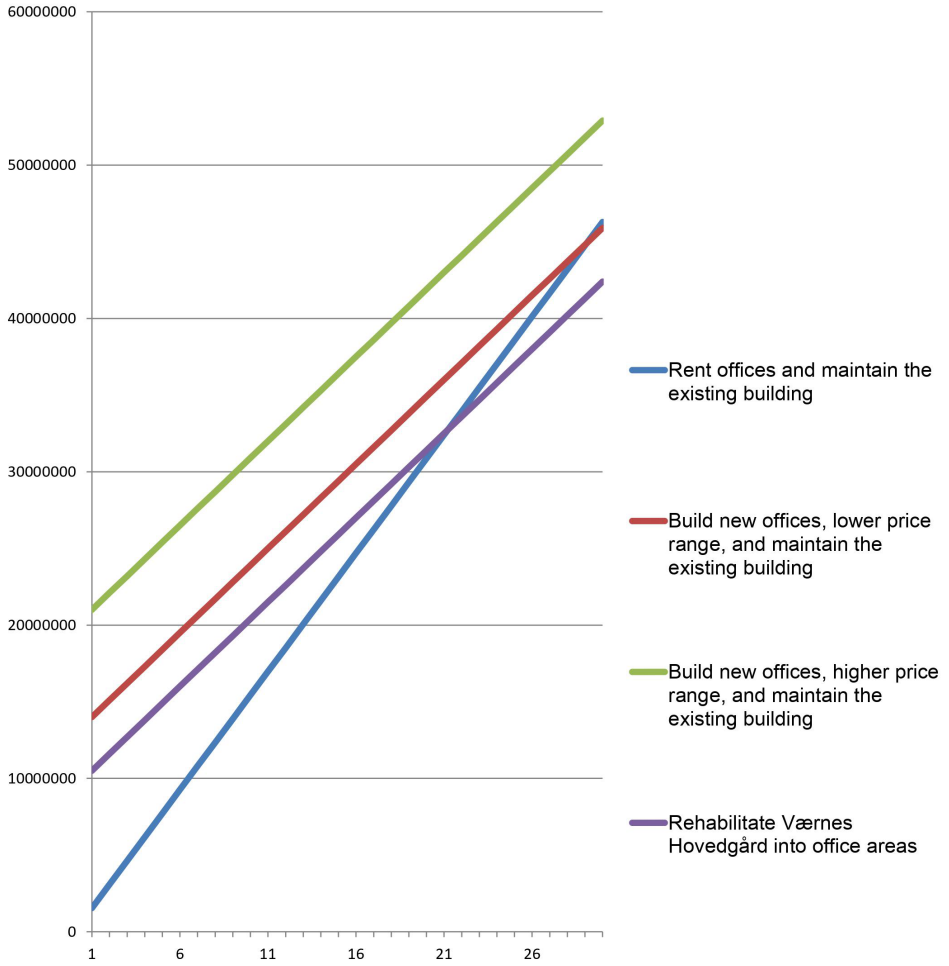

Figure 2. Valid alternatives for maintaining Værnes Hovedgård and acquiring more office areas for the air base by means of investment or renting. The y-axis represents NOK in millions, x-axis number of years.

Including only lawful alternatives changes the span in costs. These alternatives are given in Figure 1.

The incalculable value of cultural heritage should be considered and certainly not set to zero, as it is a recognized value of national importance, as demonstrated through the building's legal protection under the Cultural Heritage Act. Cultural heritage values are defined in the law as irreplaceable. One could argue that irreplaceable values are of infinite value. But, if we set all cultural heritage values to infinite value, it will paralyze calculations. With 8,000 buildings in Norway having the highest form of protection, this might not be a viable solution from an economic or even from a holistic point of view. Reality and management entail prioritizing.

Office areas at a cultural heritage site that are strongly connected to the history of the airbase have a value that is not found in a new build. Such office areas can provide identity and attachment in an otherwise stern and internationalized environment. A new build will likely provide better flexibility in the design phase, and possibly more comfort in the use phase. When the expected life span of the new-build has reached its end, the cultural heritage site is expected to turn the page for another chapter. This difference in life expectancy is mainly due to the changing building industry (Lauvland and Aasen, 2017). The point is that while costs for the different alternatives are directly comparable, the inherent qualities of the resulting office areas differ.

Concluding discussion

This paper poses the question "Which is the most cost-efficient alternative, a new build or the rehabilitation of a cultural heritage site?" The finding in this case study is that it may be the rehabilitation project. Alternatives with lowest costs were illegal. Rehabilitation emerged as the least expensive option by far. Rehabilitation is the best option for creating more office areas at Værnes from an economic viewpoint and with margins. However, prejudice regarding costs may be decisive, albeit wrongfully so.

This paper examined costs for a number of alternatives for new offices and the maintenance of Værnes Hovedgård at the air base. This overview has shown that the alternatives with the lowest costs did not meet both the juridical obligations connected to cultural heritage values and the Norwegian Defense Estates Agency's need for more office space at Værnes. Alternatives that fail to maintain the cultural heritage values are ruled out in this research. Sadly, this is not always the case in the actual management of cultural heritage sites. Attention should be given to the alternatives that maintain cultural heritage values but fail to meet the NDEA's need for more office areas at Værnes. Generally, prioritization of cultural heritage values at the expense of the organization's other needs might undermine the regard for cultural heritage in an environment over time.

We have included the cost of mandatory maintenance of the cultural heritage values in all viable alternatives, something organizations do not always do. Failing to include such seemingly unrelated, yet actually relevant costs in an alternatives analysis can lead to inexpedient conclusions.

Economy is a key factor for decision making in property development projects and in relation to cultural heritage sites. Precise estimates are important for correct decisions from a cost perspective. As a project's flexibility is at its highest in its early phases, these estimates should also be available early in the process. In the transformation of cultural heritage sites, one has less flexibility than in a new build project, as the existing site is defined as invaluable. This consolidates the importance of correct cost calculations at an early stage in the project.

Cost escalation is a risk connected to cultural heritage sites, which should be managed. It is also relevant to analyze the possible tolerance within a given project; which savings can be had within the juridical framework. It is not a goal in itself to do cultural heritage rehabilitations as low-budget projects, certainly not for our outmost valuable cultural heritage sites. Still, with the thousands of protected buildings we have in our society today, it is vital to understand that for a majority of cultural heritage sites in need of rehabilitation, the probability of such a rehabilitation decreases with every requirement that raises the costs.

The importance of an open and honest dialogue should be emphasized; from a short-term protection of cultural heritage perspective focusing on a given cultural heritage site, it could be tempting to sell in the lowest price estimate, although the real costs might be higher. This is inadvisable, and not only due to the risk of cost overruns. Over time, such a tactic can be destructive for the protection of cultural heritage field and its reputation.

The earliest formally protected buildings were typical bearers of the desired national identity. With the rising number of protected buildings in Norway, there are a growing number of protected buildings that are less recognizable, containing cultural heritage values that are undercommunicated or even inaccessible to the general public. Pairing high numbers of less esteemed cultural heritage sites with repetitive cost overruns or disproportional costs could severely damage the protection of cultural heritage field over time.

Dismissing cultural heritage sites for property development based on prejudice regarding costs can cause damage both at project level for individual projects and to the profession's reputation. On the other hand, an enlightened valuation of cultural heritage sites in property development could lead to true social development.

The opposite approach, dismissing cultural heritage sites for property development based on prejudice regarding costs, can cause damage both at project level for individual projects and to the profession's reputation. On the other hand, an enlightened valuation of cultural heritage sites in property development could lead to true social development.

To make informed decisions, decision makers need to have access to adequate information and calculations. Lack of information can obstruct decisions and thereby maintain the status quo. There are many reasons why calculation of costs for alternatives in the management of cultural heritage sites should be done at an early stage.

Transformation projects tend to be complex, involving numerous fields of expertise, and might have a higher cost than new construction. These added obstacles should be seen in connection with the invaluable gain from protecting our cultural heritage. If those paying the costs of protecting cultural heritage do not appreciate the non-monetary gain or perceive it as too expensive, it damages not only the given cultural heritage site, but also the protection of cultural heritage field as a whole. Over time, such negative perception has the potential to weaken protection of cultural heritage's position in society.

In the long term, demands that are perceived as rigid and exacting could weaken the protection of cultural heritage field at its core, the institute of legal protection of cultural heritage. There needs to be a degree of accordance between the protected cultural heritage values and the heightened cost level. This applies equally to private investors and public bodies aiming to utilize tax money in a justifiable manner.

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National Urban Park

A Model for a Sustainable City or a Legislative Cage for Development

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Abstract

This paper addresses the concept of the national urban park (NUP) (*kansallinen kaupunkipuisto*) as a planning tool for rapidly growing cities. The focus is on the establishment process of a NUP in Tampere and Helsinki, where it has generated strong views both in favour and against. The study reveals these conflicting arguments and examines the related objectives, values and stakeholders. The empirical basis of the study is a qualitative content analysis on the NUP planning and decision-making documents.

The paper demonstrates that the NUP can be seen either as a model for sustainable urban planning or as a legislative cage for development. On the one hand the NUP is regarded as restricting development, emphasizing static preservation, bringing no real added value, transferring municipal decision-making to the Ministry and engaging primarily environmental and heritage stakeholders. On the other hand, it is considered to be a long-term tool of urban planning, safeguarding values, contributing to tourism and engaging a broad range of actors. The research shows that the NUP process reveals the current tensions between continuity and change, and nature and city, in rapidly growing cities. The paper also emphasizes the importance of understanding the divergent views of different actors in the search for a shared vision of the future of the city.

Keywords: national urban park, urban planning, conflict, Tampere, Helsinki.

Introduction

Between continuity and change, amid nature and city

The balance between continuity and change, nature and city, are the cornerstones of sustainable urban planning. However, urban densification and aspirations for infill development are reshaping this balance and setting new criteria for sustainability. Even if green areas and historical environments are regarded as valuable, they are simultaneously being contested in urban densification (Uggla 2014; Tunström 2007; Lyytimäki et al. 2008). This is related to the conflicts between growth and protection and to the discursive struggle over the direction of urban development. Nature and city, like preservation and growth, are often seen as opposites. This prevailing dichotomy fundamentally affects urban planning and impedes the integration of green areas and historic environments in the development of cities (Erixon et al. 2013; Corner 2006; Frey 2000; Lundgren Alm 2001; Tjallingii 2005). This confrontation is also evident in the protection mechanisms of natural and historical environments,

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which have been largely based on segregating an area from its environment and protecting it against change (Erixon et al. 2013; Janssen et al. 2014).

In recent decades, there have been attempts to resolve the uncompromising confrontation between city and nature, continuity and change. In 1992, the World Heritage Convention recognized the interactions between nature and culture and introduced the first international legal instrument to protect cultural landscapes (Chief 2006, 335). Furthermore, Asikainen and Jokinen (2009) have challenged traditional nature conservation and highlighted the possibilities for a new type of nature and urban green to be created in cities. The protection of the built environment is also in a state of transition, with traditional conservation moving towards change management and future-oriented strategies (Janssen et al. 2014, 11).

On the one hand, the NUP is regarded as restricting development, emphasizing static preservation, bringing no real added value and transferring municipal decision-making to the Ministry.

Another good example of this new way of thinking is the concept of a national urban park (NUP), which was included in the Finnish Land Use and Building Act in 2000. According to the Act, a national urban park (NUP) may be established to protect significant cultural or natural landscapes and their historical, scenic and recreational values in urban contexts. The model for the national urban park was adopted from the Swedish National City Park in Stockholm, established by law in 1995. So far, ten NUPs have been established in Finland since 2000. In addition, several cities are aiming at NUPs, including Tampere and Helsinki, and it is these processes that are the topic of this paper. Despite the number of NUPs and the 20-year-long experience of the concept, there is only limited research on how the concept functions in practice and what kinds of negotiation are embedded in the establishment process. The paper arose out of a desire to open up the discussion and the discursive struggles that emerge during the process of establishing NUPs.

Research Design

This paper sheds light on the NUP process by analysing the planning of NUPs in Tampere and Helsinki during 2013-2017. The two cities are currently considering establishing a NUP: Tampere began the process in 2013 and Helsinki in 2017. In both cities, the process has generated strong views both in favour of the NUP and against it. The views are connected to three key questions: 1) what kind of story of the city do we want to pass on to the following generations, 2) who is allowed to participate in the storytelling and 3) is the NUP a purposeful tool for safeguarding the story? The aim of the study is to explore the conflicting arguments about the NUP and examine what lines of argument are used in the process. Additionally, the objectives, values and stakeholders related to these arguments are studied.

The research is based on the NUP debate, including the planning and decision-making documents. A considerable amount of material has accrued in Tampere, whereas it is more limited in Helsinki because the study focuses on the launch of the process. Nevertheless, both cases gave similar results. The paper demonstrates that the NUP can be seen either as a model for sustainable urban planning or as a legislative cage for urban development in big cities. These viewpoints are more closely explored and their lines of argument and backgrounds are examined. The research shows that the NUP process reveals the current debate concerning continuity and change, nature and city, in rapidly growing cities. It also contributes to a deeper understanding of this negotiation and the search for more sustainable urban planning strategies.

The paper consists of four sections, starting with this introduction. The second part addresses the concept of the NUP, with a literature review and the theoretical framework of the study, followed by information about the methods and materials used in the research. The third part presents the NUP processes of Tampere and Helsinki, clarifying first the background and then describing the conflicting views and the related objectives, values and stakeholders. Finally, the fourth section offers conclusions concerning these negotiations. The NUP is

described as an arena of conflicts but also of aspirations towards the shared vision of a sustainable city.

National urban park process as a research object

The NUP in the Legislation

The national urban park was defined in the Finnish Land Use and Building Act (§ 68–71) of 2000 and it consists of significant cultural and natural landscapes in the city. The Ministry of the Environment ratifies the decision on the establishment of a park on the basis of a city's application. The city itself compiles a management and land use plan for the controlled development of the area. So far, ten national urban parks have been established in Finland: in Hämeenlinna, Heinola, Pori, Hanko, Porvoo, Turku, Kotka, Forssa Kuopio and Kokkola. Each NUP must meet four criteria regarding 1) significant content, 2) sufficient extent and interconnectedness, 3) ecology and continuity and 4) a central urban location. According to these criteria, a national urban park must include significant natural areas in terms of the diversity of urban nature, important built cultural environments and green areas remarkable for their landscape architecture or aesthetics. The urban park must be extensive enough as well as being sufficiently connected in its green and blue structures. Furthermore, the national urban park must be part of the urban structure, beginning in the core of the city and reaching to the natural areas and countryside outside the city. In addition to these criteria, the values of the NUP must be safeguarded by urban planning, for example through master plans or local detailed plans (City of Tampere 2017, 5-6).

Research on National Urban Parks

There has been very little research on national urban parks. Several feasibility studies and management and land use plans have been carried out in Finland, but there is scarcely any actual research or systematic monitoring of the functioning of the concept. There are some exceptions, including Mika Raunio's (1999) Master's thesis that examined the NUP in Hämeenlinna as an experiential environment and a resource for urban development. In addition, Laura Leppänen (2006), in her Master's thesis, focused on the project for a national urban park in Varkaus from the perspective of urban development and community planning. Both these theses find that the NUP contributes to the image of the city, which benefits urban development. However, systematic follow-up research on the impact of NUPs is lacking. The NUP experiences of various cities were surveyed in conjunction with Tampere's own needs assessment, which included an extensive questionnaire to the network of NUP cities (Tajakka 2014). In addition to the lack of monitoring, there is also very limited research on the NUP process itself. In Tampere University, Laura Eloranta´s (2017) Master's thesis presents an analysis of the Tampere NUP, but otherwise the process perspective has hardly been opened up.

An interesting parallel to the Finnish concept is the Swedish national city park in Stockholm. In 1995, the Swedish Parliament decided to establish an area of 27 sq. km. to protect cultural and natural values in the districts of Ulriksdal-Haga-Brunnsviken-Djurgården. The park is unique, as it is the only national city park in Sweden. It also differs from the Finnish concept in that the park involves three municipalities and is governed by the County Administrative Board (Schantz 2002, 251). However, even though the Swedish concept has several differences from the Finnish NUP, the research on the national city park in Stockholm has a lot to offer for the Finnish cases. Lennart Holm and Peter Schantz (2002) have examined how the concept has been applied after its establishment. They detected several problems concerning the administration of the park and the efficiency of the law in protecting the area from exploitation and fragmentation (Schantz 2002, 250, 260). Despite these deficiencies, the national city park is regarded as a model for sustainable development where the limits between the activities of man and the environment have been recognized – and also constantly challenged. The Swedish case also offers perspectives for studying the establishment processes. In Stockholm, an active

social movement played a crucial political role. Ernstson (2007) and Uggla (2014) have demonstrated how the activists have provided narratives that were able to legitimize the need for protection. By effective story-telling the activists have managed to link the different parts of the park and construct a coherent unity. The story-telling not only combined different areas but also natural and cultural discourses and divergent values. Thus, the narratives of cultural heritage and conservation biology were used to construct the protective story of the area (Ernstson 2007; Uggla 2014).

Conflict Approach in the Process

This paper focuses on the process that makes visible the meanings, aims and values that often remain unrecorded in the final results of the decision-making process. The significance of the process is also highlighted by Patsy Healey, who states that the process should not merely be understood as a means to a substantive end but also as a valuable outcome in itself (Healey 2003, 111). The theoretical approaches to decision-making are in general divided into rational-normative and empirical-descriptive perspectives. The rational and normative approach focuses on how the decision-making *should* happen whereas the empirical and descriptive perspective describes how the decision-making *actually* happens. These approaches are different because actual decision-making behaviour often deviates substantially from the rational ideal. The formation of intent stage, which precedes the decision-making, is rarely straightforward, instead it involves groping around in a network of various forces, interests and valuations (Stingl & Geraldi 2017, 121; Möttönen 1997, 172).

Planning processes typically include conflicts, opposite interests and continuous disagreements. Conflict can be generally defined as a struggle between the discordant and incompatible objectives of the parties involved (eg. Coser 1956; Schelling 1960; Deutsch 1973). In conflict research the causes of conflicts are usually categorized into divergent interests, differing information and different values (Sairinen 1994, 25-28; Dietz et al. 1989). The NUP offers an interesting research object as the cross-administrative steering and planning groups had divergent interests and values per se. They represent, as Forester (1999, 187) describes, "rival disciplines competing to frame problems with their own languages, with respect to their own measures and values". For example, land policy, urban development, environmental protection and cultural heritage authorities had very divergent views on the project and its impacts. Therefore, the NUP has served as an arena for a discursive struggle, in which the various parties have defended their positions and striven to convince the others of the superiority of their viewpoint.

Conflicts in urban planning typically concern the oppositions of construction and protection. The underlying assumption is often the idea of a zero-sum game, in which everybody can’t win (Sairinen 1994, 27-28). Conflicts often involve interest disputes and value conflicts, which means that the arguments easily become matters of principle (Peltonen et al. 2006, 26). According to an enquiry in 2003 by the Ministry of Environment a characteristic feature of conflicts is the division into two coalitions: the builders and the protectors (Peltonen et al. 2006, 17-18). The former coalition typically includes the municipality, land owners and companies, whereas the latter consists of environmental and cultural heritage authorities andassociations . The builder coalition is seen to reflect what is known as the growth machine thesis. Conversely, those who react critically towards growth and actors who oppose environmental change form a counterforce to the growth coalition.

Attfield and Dell (1996, 3-26) have analysed the recurring arguments in the conflicts between development and protection and categorized them into economic, social, psychological, political, ecological and aesthetic. *Economic arguments* on the one hand have to do with the benefits of construction, for example, prosperity, jobs and progress. On the other hand they point out the drawbacks of construction, such as the overuse of natural and other resources

and the profit-seeking of the major landowners. *Social arguments* are linked with the production of reasonably priced housing, a decrease in travel times and the empowering of community spirit. The counter-arguments to construction for their part relate to the negative effects on the quality of the environment and thus to wellbeing, preserving as unbuilt those areas important to the residents, and the safeguarding of community spirit. *Psychological* arguments are connected to values and the positive or negative images of the development. *Political* arguments concern objective setting, the planning process or decision-making. One side appeals to the promotion of the public good, as well as to the end results of the planning process, or the majority decisions. The counter arguments claim that the project is against the interests of the public good, against public opinion or based on an inadequate process. As *ecological arguments,* some defend densification and see development as promoting sustainability, while the opposition regards construction as a threat to biological species and their habitats. *Aesthetic arguments* involve on the one hand the views that construction will bring about new aesthetic values and the promotion of creativity, while on the other hand, the reverse views defend existing aesthetic and cultural values.

Materials and Methods

The research is based on the NUP debate and includes the planning, policy and decision-making documents. In Tampere, these documents include five steering group and thirteen planning group meetings, which together describe in detail the discussion, the statements of cross-administrative actors and the process of the NUP in 2013–2017 (the steering group meetings are referred as SG and the planning group meetings as PG in the text). Together with the needs assessment of the NUP, published in 2017, these documents draw a clear picture of the NUP process in Tampere. Furthermore, as former project manager, the author has been able to follow the process closely from 2013–2017. In Helsinki, the study focuses on the starting point of the NUP process in 2017. Therefore, the data is more concise and consists of the decision-making documents, including the statements of six municipal boards. Despite the compact data, the starting point of the NUP process is revealing and captures the multidimensional and conflicting nature of the process. The author also participated in the first public hearing meeting, "start-off of the national urban park in Helsinki", on 12.6.2017.

The empirical basis of the study is a qualitative content analysis, of which the aim is to search for meanings in the texts and organize the data in a compact and clear manner. The work on the data-based content analysis is guided by the research questions, the answers being sought for in the empirical data (eg. Tuomi & Sarajärvi 2002). The study applies narrative analysis that primarily focuses on what is said about the NUP. According to Uggla (2014, 364), the narrative includes framing, which is largely about salience, that is, the information that is emphasized. The narrative analysis looks for central themes and main points, the repetition of information, distinctions and contrasts. These analytical tools are used to categorize the empirical material and identify the frame-shaping elements of the NUP discussion. The paper has a special interest in conflicting views on the NUP. According to the conflict approach, disputes include three standpoints: 1) the actors in the conflicts, 2) interaction between these actors, and 3) the specific context of the conflict (Peltonen & Villanen 2004, 14-15). Thus, the paper concentrates on the actors and their objectives and the main lines of argument in the NUP process. It also examines the interaction of the actors and the coalition building in the steering and planning groups and in the decision-making process.

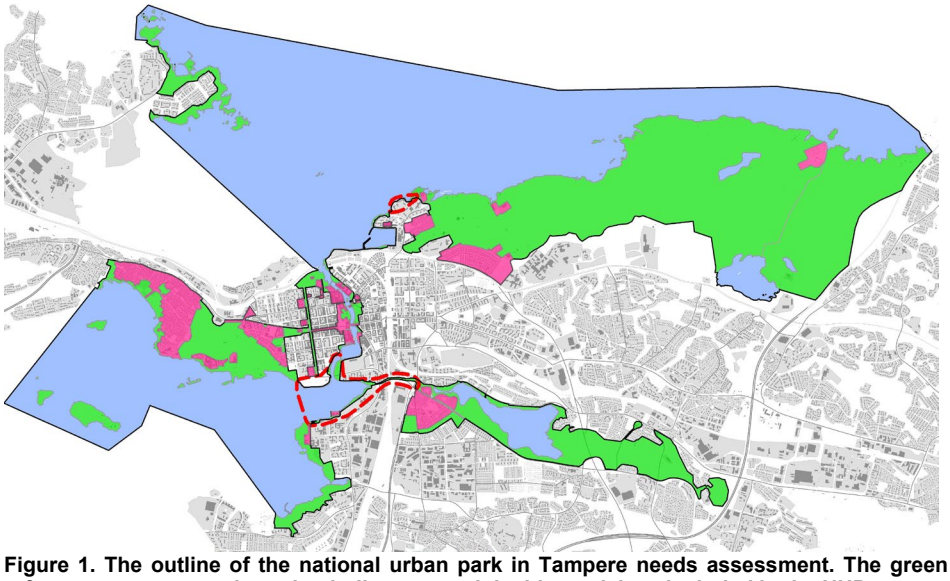

Figure 1. The outline of the national urban park in Tampere needs assessment. The green refers to green areas, the red to built areas and the blue to lakes, included in the NUP.

National urban park processes in Tampere and Helsinki

Tampere NUP process in 2013–2017

The needs assessment for Tampere NUP got going in the autumn of 2012 on the initiative of the city council. In spring 2013, the council decided to prepare a more extensive and profound survey on the establishment of a NUP as part of the ongoing preparation of strategic master plan for the centre. Nevertheless, it was also stated that the city at this point was not going to start a process aiming at the establishment of the NUP because it would limit the development projects in the potential park area and its immediate vicinity (Tampere City Council 15.4.2013). The decision refers to an earlier survey of 2011 when the result had been that the city would not enter an application for the park status. There have been several initiatives on NUPs over the years, such as in 2001, 2005, 2007 and 2011, but they have not led to any measures being taken. However, in 2013, it was decided after all to examine the starting points once more.

The needs assessment of the national urban park in Tampere was carried out from 2013–2017. A cross-administrative steering group for the project was designated by the city mayor, with the deputy mayor as chairman. The members of the steering group represented different administrations: master and local detailed planning, city centre development, land policy, environmental protection, landscape planning, sports, sustainable community, business, real estate services, and outside the city organization, the Provincial Museum of Pirkanmaa, the Centre for Economic Development, Transport and the Environment (Pirkanmaan ELY-keskus), and the Regional Council (Pirkanmaan liitto).

At the same time, a planning group was appointed to prepare the needs assessment. The task was to produce information relevant to the project decision-making and a potential application. The main goal was to define what kinds of impact the NUP would have on the city of Tampere. The needs assessment survey presented an outline of the NUP by exploring the essential themes and features of the city and forming the story of Tampere. Additionally, borders were examined as well as the criteria for NUP and planning prerequisites for the area. The impact assessment was a central part of the survey. The work included an extensive questionnaire on other cities'

experiences of NUPs. Expert workshops and resident surveys also complemented the process (City of Tampere 2017, 5, 13).

During the NUP process there arose a strong opposition, described in the steering group thus: "It is unlikely that a consensus will be achieved because the NUP can be seen as a protector of the different factions' own territories" (SG 14.1.2015). In the final meeting of the steering group in spring 2016 the different fields presented their own views on proceeding with the project. Eight factions offered their clear support and four expressed doubts (SG 22.3.2016). Representatives of environmental protection, landscape planning, sports, sustainable community, real estate services, the Provincial Museum of Pirkanmaa, the ELY and the Regional Council took a positive stand. Master and local detailed planning, city centre development, land policy and business were critical.

The project proceeded on a majority vote and the report of the needs assessment was handed over to the mayor in spring 2016. The work was taken to the city council in October, but the handling was postponed (Tampere City Board 31.10.2016). In February 2017, the city council approved the assessment and decided that Tampere would move on towards the NUP application stage. According to the decision, the next steps would be the preparation of the necessary extra surveys for the central development areas, and the preparation of a management and land use plan. Contrary to the proposal, the decision also required redefining the borders of the area, which reveals the tensions in the decision process (Tampere City Board 20.2.2017).

Helsinki NUP process in 2017

The NUP process began in Helsinki on the initiative of the city council (25.5.2016), accompanied by the citizen initiative (published 10.9.2015). Unlike the case in Tampere, the social movement, supported by 79 organisations and communities, played a crucial role as the initiator of the process. The movement "National Urban Park to Helsinki!" (Kansallinen kaupunkipuisto Helsinkiin!) was closely connected to the ongoing, strongly objected master plan process. Therefore, the initiative was a clear protest against the plan with high building volumes (http://kaupunkipuisto.fi/; https://www. kuntalaisaloite.fi/fi/aloite/2057). The NUP proposal was taken to the city council in November 2016, but the handling was postponed (Helsinki City Council 30.11.2016). The decision of the preparation of the NUP feasibility study was finally taken in February 2017, four months after the approval of the master plan. Therefore, the timing of the NUP was clearly connected to the aftermath of the contentious master plan process. In the opening statement of the final Helsinki City Council meeting, the NUP was supported as a counterweight to the master plan and as a strategy to protect valuable areas from construction (Helsinki City Council 22.2.2017).

As the case in Tampere, the NUP process evoked strong opposition that was obvious from the first statements. The preparation for the city council decision included statements from six different boards, with two negative and four positive standpoints. City planning and public works took a negative standpoint, whereas the city museum, education, environmental protection and sports supported the NUP (Helsinki City Planning Committee 6.9.2016; Helsinki Education Committee 13.9.2016; Helsinki Environmental Committee 20.9.2016; Helsinki Museum Board 27.9.2016; Helsinki Public Works Committee 20.9.2016; Helsinki Sports Committee 6.10.2016) . The city council decided that a NUP feasibility study would have to be prepared as a basis for a common viewpoint and support for the decision-making. After this it would be possible to decide whether to establish a NUP or not (Helsinki City Council 22.2.2017). The project was also made into an interactive pilot project in accordance with Helsinki's new participation and interactive model. The council designated a cross-administrative steering group with representatives from the city planning department, the public works department, the environment division, sports, the

city museum and the executive office (The decision of Helsinki Mayor 15.3.2017).

As in Tampere, the establishment of an NUP in Helsinki had been presented many times earlier. Nevertheless, it had not been considered necessary and for this reason no studies had been started. The NUP had been proposed in 2002, in connection with the previous master plan, but instead a so-called Helsinki Park was established, on the basis of some NUP criteria. The Helsinki Park became a substitute for the NUP, and would, according to the city council, fulfil the criteria concerning the values of the natural and built environment and be managed by the city's own means. Therefore, as response to the residents´ initiative concerning NUP in 2012, the city council decided not to apply to the Ministry for NUP status because the preservation of its values was seen to be ensured by the Helsinki Park and city planning instruments (Helsinki City Council 25.4.2012).

Conflicting Views on the NUP

The NUP processes in Tampere and Helsinki have served as an arena for tensions and negotiations between continuity and change. Concerning the conflicts, we need to return to the key questions about the NUP: 1) what kind of story of the city do we want to pass on to the following generations, 2) who is allowed to participate in the storytelling and 3) is the NUP a purposeful tool to safeguard the story? The documents of the processes in Tampere and Helsinki demonstrate that there is no shared understanding about the story of the city, nor about who can participate in the process, and finally nor about what kind of instruments are the most useful to foster the story of the city.

The analysis of the processes reveals several conflicting views concerning the benefits or disadvantages of the NUP instrument. The most controversial aspects address the negative impacts on urban planning by hampering development and transferring decision-making to the government. Furthermore, there are doubts about whether the status would bring adequate added value to the city (City of Tampere 2017, 11). In the analysis, the conflicting views have been categorized into five main lines of argument, addressing: 1) the restrictions of preservation, 2) the agenda of urban planning, 3) the added value gained, 4) the ownership of decision-making power and finally, 5) the ownership of the process itself. In the following, the objectives, values and actors related to these opposing arguments are examined and elaborated. The arguments make the tensions between growth and preservation profoundly apparent, in addition to the challenging interaction between the various actors.

Restrictions of Preservation

The NUP process reveals a clear opposition of two interests – development and preservation. In the "restriction story" the NUP is regarded as hampering urban development, and as halting change through protective regulations. Many such views emphasized the national urban park as a brake on development or as museumification of the city (City of Tampere 2017, 9-11, 53). The park's precise border and its ratification in the NUP decision were also seen as especially problematic (City of Tampere 2017, 7; PG 3.12.2014; Helsinki City Planning Committee 6.9.2016). In Tampere, these concerns especially addressed important development projects with the unpredictable needs for change, such as Eteläpuisto and Viinikanlahti. It is illustrative that in the initial process meeting in Tampere it was already asked whether an NUP decision could be reversed if an urgent need would arise (SG 6.11.2013).

The points of friction between the NUP and urban development were repeatedly tackled in both the Tampere and Helsinki statements (PG 23.10.2013; PG 13.5.2014; SG 14.1.2015; City of Tampere 2017 17, Helsinki City Planning Committee 6.9.2016). The NUP status appeared as possible grounds for appeal on urban planning decisions. In Helsinki, the urban planning committee referred to the difficulties experienced in Stockholm concerning the restrictions brought about by the NUP (Helsinki City Planning Committee 6.9.2016). In Tampere,

the steering group specifically focused on the complaints about the NUP area in Turku (SG 9.6.2014). Furthermore, the Ministry of the Environment was asked for a separate clarification of the points of friction between land use planning and NUP (PG 13.5.2014). The steering group also required more information on the impacts of NUP on urban planning and development processes, land policy and business (SG 14.1.2015).

In opposition to the arguments emphasizing restriction, an "enabling story" was created. This argument demonstrated that the NUP does not prevent development, but enables change and gives guidelines to urban planning (Helsinki Environmental Committee 20.9.2016; City of Tampere 2017, 9, 56; SG 9.6.2014). This was supported by the results of the enquiry among NUP cities which stated that the NUP had not had a negative impact on urban planning and land policy and it had not brought extra restrictions (City of Tampere 2017, 11; PG 23.10.2013). Furthermore, several cases of the development projects in the NUP areas were mentioned to support the argument (City of Tampere 2017, 18). The enabling story emphasized the guiding of urban development, instead of protecting values from exploitation. Even if the definition of protection was avoided in the discussion, the idea of safeguarding values from negative impacts was clearly present (SG 14.1.2015; City of Tampere 2017, 56; Helsinki Public Meeting 12.6.2017). In both cities, the pressure for infill development had generated strong opposition, and the NUP was considered to be a counterforce to balance the growth (Helsinki City Council 22.2.2017).

Agenda of Urban Planning

The NUP brings forth conflicting views on the agenda of urban planning and its relationship to the NUP. The future-oriented "development story" sees the NUP as emphasizing static preservation and lacking a link to strategic urban planning, for example, the master plan. The NUP is regarded as subordinate to the urban planning agenda, which dictates the storyline of city planning and infill development strategies. Therefore, in Tampere, the NUP was not connected to the master plan even though the master plan process was simultaneously in progress (PG 3.9.2014). In this way, the development story was underlined and the strategic significance of the NUP was underrated. Correspondingly, the areas where the NUP and the local master plan were in contradiction were described as sore points that stressed conflict, rather than an opportunity for improvement (SG 9.6.2014).

Contrary to the development story, arguments about safeguarding the identity of the city were produced. The identity was based on the story of the city, a shared vision of its significant features and unique values. In this "identity story", the NUP was regarded as an instrument for fostering the common values of the city. If the city did not apply for the NUP, it would send a signal that these values were not appreciated (SG 30.9.2014). In addition, the role of green areas was emphasized and the NUP was regarded as a tool that would stress their strategic significance as a counterbalance to infill development (City of Tampere 2017, 55). As opposed to the development story, the close link between the NUP and urban planning strategies was highlighted (PG 3.9.2014; SG 9.6.2014; SG 30.9.2014). In the steering group it was stated that the NUP was an integral part of the Tampere master plan process, not a separate decision (SG 9.6.2014). This emphasized the strategic significance of the NUP and considered it equal to other urban planning documents.

Added Value through the NUP

An important aspect in the NUP discussion addressed added value. In Tampere, it was decided from the beginning that both benefits and disadvantages would be assessed in the study (PG 23.10.2013). Therefore, the enquiry focused on the impacts on urban planning, land policy and business (SG 30.9.2014). Regarding added value, the views differed. A recurring argument was that the NUP would bring no real added value in big cities but would mainly benefit smaller towns. For the same reason, Helsinki decided to establish a Helsinki Park in the master plan 2002 as a substitute to the NUP. In bigger cities, urban planning instruments with master and local detailed plans

were regarded as sufficient, no extra tool thus being needed (City of Tampere 2017, 9; Helsinki City planning Committee 6.9.2016). The views were also supported by the survey which showed that the impacts on livelihood and land policy in NUP cities have been neutral or slightly positive. In Tampere, a member of the steering group asked why to introduce this kind of tool if the impacts were neutral. The results of the enquiry were also questioned because there were no exact quantitative surveys about the effects on tourism (SG 22.3.2016). It was also stated that the added value is not self-evident unless the city develops NUP and different administrations become engaged in the project (City of Tampere 2017, 10).

The opposing arguments were also based on the enquiry and pointed out that the NUP would be a desirable status bringing substantial benefits to the NUP cities. According to the survey, the NUP contributes to sustainable urban planning, local pride and tourism (City of Tampere 2017, 9; Helsinki Environmental Committee 20.9.2016). The NUP was considered a long-term tool for urban planning, safeguarding the story of the city and offering a holistic view of the city combining cultural heritage and nature (City of Tampere 2017, 9). The NUP was also considered to promote deepening cross-administrative co-operation between stakeholders. Furthermore, it would affect well-being and local pride and give opportunities to tourism, for example, in urban nature tourism (City of Tampere 2017, 9, 56; SG 14.1.2015).

Ownership of Decision-Making Power

A strong disagreement addressed the decision-making power with the NUP. The view that the NUP would transfer decision-making power to the Ministry was an argument that constantly came up in the discussions both in Tampere and Helsinki (City of Tampere 2017, 9, 10, 53; Helsinki City Planning Committee 6.9.2016). Helsinki stated that "the establishment of a national urban park partly relinquishes the decision-making power over the development of the area and its management from the city to the Ministry of the Environment and also curtails the city council's role as the highest deciding body. There is a risk that the city's decision-making would be delayed and complicated" (Helsinki City Planning Committee 6.9.2016). Tampere reasoned that "it is not necessary for the preservation of parks and other areas to transfer the power of decision to the Ministry of the Environment. The city must have confidence in its own capability to make sensible decisions" (City of Tampere 2017, 10).

As the statements demonstrate, the intervention of the Ministry of the Environment in city planning was considered undesirable and detrimental to urban development. In spite of the fact that the Ministry of the Environment emphasized their consultative role and the responses of other cities did not identify any slippage of decision-making power to the Ministry, the image of interference in the city affairs remained resolute. The probable reason behind this idea lies in the Ministry's earlier role of sanctioning plans, which was seen as weakening the role of the local government. In addition, conflicts of interests between the state and the cities influenced their attitudes (SG 22.3.2016). Another new factor of uncertainty was the administrative reform and the changing position of ELY, the Centre for Economic Development and the Environment, which would also have an impact on the practices of the NUP (SG 22.3.2016).

In opposition to arguments that emphasized the interventions ofthe Ministry , a story of the city as the primary actor was brought up. These arguments were based on the enquiry which demonstrated that the role of the Ministry is merely consultative and the city itself decides how to interact with the Ministry. The main task of the Ministry is the preparation and application stages of the NUP. The instrument does not change the role of the ELY in the urban planning process (City of Tampere 2017, 9). The Ministry of the Environment also emphasized that the NUP is primarily an internal development tool of the city, with which to safeguard the city's special values in its urban planning, following jointly-agreed-upon principles (SG 6.11.2013). In this way, the NUP would

actually originate on the basis of the city´s own objectives, rather than being led by externally imposed demands.

Ownership of the Process itself

During the NUP process the actors involved were quite clearly divided into two camps with different standpoints and divergent interpretations of the ownership of the process. The critical coalition regarded the NUP primarily as engaging environmental and heritage authorities and citizens. In Helsinki, the citizen movement was a prominent feature which highlighted residents´ role in the process. The active role of environmental and heritage authorities also affected the interpretation of the ownership.

While critical members saw the NUP as a matter of only a limited number of actors, the supporting coalition regarded the NUP as engaging and benefiting broadly different authorities and citizens. In Tampere, the ELY criticized the fact that the process had concentrated on the effects on the City but not on the citizens (SG 14.1.2015). The need for participation was generally recognized in the Tampere steering group. Nevertheless, the actual realisation of the participation was very limited and publicity of the project was sparse. On the contrary, participation was emphasized in Helsinki where the NUP was introduced as a pilot project of a new participation model. As background to this, the participation in the recently approved master plan had been strongly criticized and the NUP was an attempt to restore confidence in the decision-making (Helsinki City Council 22.2.2017).

Table 1. The discursive struggle over the NUP.

CRITICAL COALITION & ARGUMENTS urban planning, city centre development, land policy, public works, business	**SUPPORTING COALITION & ARGUMENTS** environmental protection, landscape planning, sports, education, sustainable community, real estate services, museum, Centre for Economic Development, Transport and the Environment, Regional Council
Restricting development	A long-term tool of guiding urban development
Emphasizing static preservation, no link to the city strategies	Safeguarding the identity of the city for future citizens, closely linked with city strategies
Bringing no real added value for big cities, present planning instruments are sufficient	Contributing to sustainable urban planning, cross-administrative co-operation, well-being, local pride and tourism
Transferring municipal decision-making to the Ministry	City as the key actor
Engaging primarily environmental and heritage stakeholders and citizens	Engaging and combining broadly different stakeholders

Conclusions

The NUP processes in Tampere and Helsinki have revealed the current debate between continuity and change. They have been a collision point for the opposing interests of the different actors involved in urban planning. During the NUP process the actors were quite clearly divided into two camps with different standpoints. Representatives of environmental protection, landscape planning, sports, real estate services, sustainable community, education, museums, the ELY and the Regional Council took a positive stand. Conversely, land policy, city centre development, urban planning, business and public works were critical.

The NUP processes have been arenas of conflicts and contentious views. The paper demonstrates that the NUP can be seen either as a model for sustainable urban planning or a legislative cage for urban development in big cities. On the one hand, the NUP is regarded as restricting development, emphasizing static preservation, bringing no real added value to big cities, transferring municipal decision-making to the Ministry and engaging primarily environmental and heritage stakeholders. On the other hand, the NUP is considered a long-term

tool of urban planning, safeguarding the identity of the city for future citizens, contributing to sustainable urban planning, tourism and local pride, and engaging broadly different stakeholders.

These constructed narratives formed the discursive struggle over the NUP. The struggle related to the nature of the city's story, who gets to define it, and what kinds of tools can preserve it for future generations. The process of the national urban park can be seen more broadly as a laboratory of urban planning and a board game for participants, in which the different coalitions strive for their goals. The NUP also reveals the tensions between growth and preservation, in addition to the related objectives, values and actors in growing cities. The NUP is like city planning itself, nonlinear, polyphonic and contradictory.

The NUP appears to be an arena of conflicts, but it can also be exploited constructively. Further study is needed to explore its potential. Even if there is no shared understanding about the agenda of urban planning and the benefits of the NUP, the process itself is a useful arena for negotiation and striving for consensus. It is an instrument that can construct a shared vision of the story of the city and its substantial values. The process also adds understanding of the divergent interests and values of different actors. Consequently, the NUP process can be applied as a model for consensus-building. The NUP is also an exercise in urban planning and offers an important link between nature and city, history and present, and preservation and development. Whether or not the final result is a national urban park, the process in itself is valuable and manifests a shared aspiration towards a sustainable city.

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Resilient Housing and Care Services for Aging Municipalities

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Abstract

The *Social welfare and health care reform* in Finland will have an impact on the services provided by the municipalities. The housing services, health promotion and wellbeing of residents will remain in charge of the local authorities. Environmental factors are important for independent coping of older people who live in their own homes assisted by peers or by home care staff. Therefore, architects need to anticipate the demographic change in housing design and urban planning.

The Government Key project *TÄYTYY* (2017 – 2018) was a research and development project targeting at efficient and operational service network, combining housing, home care and remote care services. The objective was to provide a resilient service structure for small municipalities through resource efficiency, complementing the urban structure and sharing existing facilities and resources locally.

The multiple case study method was used to promote shared use of resources and spaces in local context. The project was carried out with cross-sectoral collaboration together with Aalto University, municipalities, health care service providers and local associations. As result, the project provided a model and a process of development for small municipalities. *TÄYTYY* project was carried out in collaboration with the Ministry of the Social Affairs and Health and the Ministry of the Environment.

Keywords: shrinkage, ageing, resilience

Introduction

Government Key Project: Home Care and Housing solutions for the needs of elderly people, TÄYTYY

The population dependency ratio relates to the number of population under 15 years old and those 64 years old and older to the working age population (Sotkanet, 2017). The percentage of older population is growing rapidly, especially in some parts of the country, and at the same time, fewer children are born. The demographic change affects especially sparsely populated areas with high dependency ratio and decreasing economy. The development is due to long life expectancy as well as low birth rates. This development will have effect on the current social and health care service structure. In consequence, increasing number of frail older people will be taken care of with less human and economic resources than previously. As result, older persons living in these areas and having difficulties to manage independently may also need to relocate. The dependency ratio is a relevant tool to measure the population change in the municipalities. Currently, 74 to 80 percent of the Finnish population live in the cities and urbanised areas (Aro, 2016). According to Helminen et al. (2017), in Finland, majority of older people live in urbanised areas as well. They observed that the relocation of persons 75 years old and older in remote areas has been mainly to the neighbouring villages or towards

the centre of municipalities. Their study indicated that little move had been taking place from remote areas to the big cities. The supply of affordable housing suitable for older population in these municipal centres is a challenge, however.

Long housing history and strong social ties may generate greater feeling of inclusion in small municipalities than in the city. The familiar social environment enhance place attachment. The strengths of the small municipalities are in the socially inclusive communities with high place attachment of residents. Kinossian (2017) points out, that non-core regions possess other characteristics, cultural and natural landscapes that can be related to health and wellbeing. Buffel, et al. (2001) argue that the physical layout, the geographical location, access to services and social activities increase the sense of integration within the community. Whereas, the environmental barriers and mobility limitations may diminish people's attachments to place. Older population with great place attachment may be less willing to relocate. Moreover, in sparsely populated areas, the value of land has not been increasing as fast as in the cities (Peltola and Väänänen, 2007, p. 5). Older population may have difficulties to sell their properties due to less demand. Therefore, some of them cannot afford to move to the cities even if they would like to do so.

When small municipalities provide housing solutions suitable for older population in their local centres and villages, residents are able to live in their homes. In this paper, ageing in place refers to the possibility to reside in the social community and in the neighbourhood of one's own choice (Wiles, et al. 2012). Ageing in place may enable residents to maintain their social identity and be integral part of the community. Moreover, housing options suitable for frail residents, located in the village centre enable to deliver home help and home care services in a more efficient way. Furthermore, according to Tedre and Pehkonen (2011) small scale sheltered housing or adult foster care in the village environment may provide job opportunities for local residents.

Innovation, user participation, co-design and co-delivery have been recognised as means to improve service delivery in rural regions (OECD, 2010). The resources of small municipalities are limited and therefore, new way of thinking of the service delivery is needed. Remote health care services and communication technology will increase the possibilities for older population to live safely in the home environment. The technology can improve the quality and the accessibility of services. Moreover, in rural areas, it can also help care professionals to maintain and develop their level of knowledge (Jennet, et al. 2005) and to assist the caregivers. Remote technology and telecommunication infrastructure will also provide remote work opportunities for the population living in sparsely populated areas.

Background

To anticipate the future demographic development, a major reform of social welfare and health care services is taking place in Finland. The target of the national reform is to assure equal quality of health care services and access to these services in the whole country. Traditionally, each municipality has been in charge of delivering social services and basic health care services locally. The reform aims to create a new structure, where all social affairs and health care services will be organized nationally by large autonomous care service areas (5 to 18), whereas the municipalities (totalling 311 in 2017) will focus on prevention, promotion of wellbeing and leisure activities of residents. Moreover, the area of responsibility of municipalities cover urban planning, building control and construction of buildings. Currently, municipalities own most of the local social and health care facilities located in their area and are in charge of the maintenance of the infrastructure. However, many of these facilities need major renovations. In municipalities with decreasing population and lower municipal tax revenues the investments in renovation or in new facilities is a considerable

risk. Therefore, careful evaluation of the potential and the quality of the existing infrastructure is needed.

The current care policy for older population is focusing on care at home. The aim is that people live at home for as long as possible (MSAH, 2017). The telecare, digital services as well as smart technology related to social activities and safety help people to manage at home. Moreover, communication technology connecting residents with health professionals, family and friends increase the wellbeing and feeling of safety. Furthermore, the technology is expected to reduce the workload of the home care personnel. The basis of independent coping remains, however, an apartment suitable for the resident's functioning capacities and access to local services. Small municipalities would need to provide age-friendly housing options and accessible local environment to enable people to live in the villages.

Local services and a variety of housing choices are important for municipalities to satisfy the needs of current residents, and to improve living conditions in these areas. In sparsely populated areas, many persons 75 years old and over live in apartments or private houses that do not support their functioning capacities and need renovation. According to a recent survey, 62 percent of persons 85 years and older live alone (Helminen et al., 2017). The physical and social environment of these older persons need to be improved. Short distances to local services, human scale environment that enhance wellbeing and a strong community can be an asset and an attraction for the residents in small municipal centres.

The walkability and access to services is one of the major issues when planning age-friendly environment (WHO, 2007). In the process of aging, the radius of daily circle is getting smaller. The 250 m radius from home is commonly considered a suitable walking distance for frail older population (Huttunen et al. 2012). The local groceries, nearest bus stop as well as green outdoor area should be situated within this circle to enhance resident's independence. Literature review by Yen, et al (2014) revealed that the improvements in aesthetics, land use, and connectivity may encourage mobility of older people. Moreover, several studies have shown that number of walking destinations (Wang and Lee, 2010) and the attractiveness of open spaces (Giles-Corti et al. 2005) in the neighbourhood increase the frequency and the time of walking. Therefore, the analyses of in this study regarding the municipal centres are focusing on the facilities and services within a walking distance from the centre.
Finland has invested in optical fibre technology to enhance digitalization. In principle, each municipality has today access to fast broadband internet connection. However, the technology is not yet in efficient use in the home care services. It will enable better communication, remote sensoring and health monitoring of older residents. A virtual local service platform can improve access to information and enhance networking and shared use of infrastructure, human resources and knowledge. In small municipalities, the close collaboration between public and private service providers as well as local associations may lead to a resilient service structure and add to the economical sustainability.

One of the Key projects launched by the Government focused on developing *Home care for older people and enhancing informal care in all age groups* (2016 -2018). During the project, municipality-level experiments were carried out (Government, 2016). Aalto University, City of Porvoo, Municipality of Lapinjärvi, Health Care District EKSOTE and the Service Centre Suvanto in Savitaipale municipality formed a consortium in one the sub-projects. Each participating area in this consortium *TÄYTYY* had a different population age structure (Table 1).

Table 1. The total population and percentage of population over 65 years in 2016 and projections for 2040 (Statistics Finland)

Municipality	total population 2016*	percentage of persons over 64 years (2016*)	population projections for 2040**	projection of population over 64 years (2040**)
Savitaipale	3 529	36,3 %	2 801	44%
Lapinjärvi	2 715	27,9 %	2 539	33%
Porvoo	50 142	19,7 %	54 029	27%

The population in Savitaipale municipality was the oldest among the three areas. In 2016, over 36 percent of the population had reached the age of 64 years or over, and by 2040 almost 30 percent of the population will be 75 years old and over. Between 2010 and 2016, the expenses of the municipality had increased by 30 percent per inhabitant (Sotka.net, 2017). Moreover, the population projections show a decrease of the total population, which may challenge the economic situation of the municipality further. Lapinjärvi municipality is estimated to have a moderate increase of older population by 2040 (OSF, 2017). The percentage of persons 65 years and over will remain constant, around 30 percent. In the City of Porvoo, the dependency ratio is estimated to increase less than in other municipalities due to the age structure of the population as well as immigration. However, the anticipated increase of the number of persons 64 years old and over is 50 percent. This will increase the need for services and housing for older population.

Aim of the study

The objective of the *TÄYTYY* project was to develop a model of integrated service structure for housing and care services for small municipalities. The model would result to housing solutions that are suitable for older population and a network of local service providers. Moreover, the project aimed at developing the capacity for sustainable change locally. The target was to manage increasing costs by using local potential. In order to develop and innovate their services, the three municipalities participating in the project decided to become test sites, collaborate and create strategical partnerships with local stakeholders. The local pilots aimed at improving cooperation between relevant actors.

The municipality of Savitaipale wanted to anticipate the demographic development through renovation and shared use of existing facilities. Networking with the residents, local service providers and municipal actors was enhanced. The aim was to strengthen the role of the Service Centre Suvanto and to concentrate all services for older population around it. The municipality of Lapinjärvi had the ambitious goal of becoming the most resident friendly municipality in Finland. The vision was to involve the local population in a community co-design process. The City of Porvoo was planning a new housing area in the district of Johannesberg. The housing area would provide housing options and local services for all age groups, including older population. The existing service infrastructure would be the bases of the new age-friendly residential area. The aim was to connect remote care services and information technology to the new housing area.

The overall aim of the project was to provide a model of resilient service platform for Finnish municipalities. Each municipality has its own challenges; therefore, the solutions need to be adaptable as well. However, shared use of existing resources and facilities can offer a sustainable solution for small municipalities. Moreover, the process of development of the municipal environment can be described, the urban area complemented and densified, if necessary, with new premises or housing for older people. All new spaces will be targeted for shared use of all age groups.

Method

The research and development project *TÄYTYY* was using multiple case study method. The method enabled to have a holistic view of the current challenges in real life context. The housing options and need for services for older people were studied in each of the participating municipalities, in the local context. Statistical analyses on population projections and age structure for each municipality was carried out. The quality and usability of existing buildings was assessed together with local stakeholders. During the project, each municipality elaborated a long-term urban development plan, which will be realised after the project. The researchers acted as facilitators for multisector local teams including municipal actors, private and non-profit service providers and local people. The project team met regularly, once a month.

Local residents were active partners in the development process. Resident's participation is implemented through various methods. In Savitaipale, a survey on housing needs for people 55 years old and older was launched. Moreover, workshops focusing on an age-friendly municipality were organized in the Suvanto service centre. The municipality of Lapinjärvi has several age-friendly initiatives and a bottom-up approach. A resident panel, the Dream Team, elaborated together with invited experts a model of age-friendly municipality centre and an online service platform targeted to all residents. Moreover, in Porvoo city a survey on current housing conditions of people receiving home care was published. Further, the city is developing a new urban strategy in cross-sectoral collaboration within the municipal actors.

Site visits and observations gave indication of the quality and usability of the existing facilities. The research group carried out an inventory and assessment of the services facilities for older people in each of the case study areas. The potentials of the existing infrastructure were identified through *A customer value index scale*, developed in Aalto University in the department of architecture (Suominen, 2019). It is a tool to evaluate qualities of buildings related to user experience and perceived customer value. The location, accessibility and visual openness of the spaces are part of the evaluation. Moreover, planning documents and architectural plans of local public facilities helped to assess the potential of existing infrastructure. The existing service structure (private or public services and other organizations) was evaluated together with the local stakeholders. The possibilities for shared use of facilities and infrastructure were studied for each municipality. Moreover, the availability of fire optic technology and the current use of the technological aids in elderly care are observed.

The analyses of existing service structure

The location of service facilities and other destinations in each case study area were analysed using a radius of 250 m walking distance. Lapinjärvi and Savitaipale municipalities had an existing urban and service structure, whereas Porvoo was in the process of developing a new housing area. The services for older population and other public infrastructure were all marked on the map. The commercial services in Lapinjärvi municipality were situated along the main street (Figure 1). The walking distance between the sheltered housing for older people and the commercial centre was approximately 400m long. The human scale and versatile environment of the municipal centre added to visual quality.

In Lapinjärvi, a demand for housing options for older population near the municipal centre was identified. There was a lack of small affordable apartments near local services, which could enable older people living in remote areas to move in. A model of private housing with access to remote care services and home health care would ensure that the older residents could maintain their quality of life.

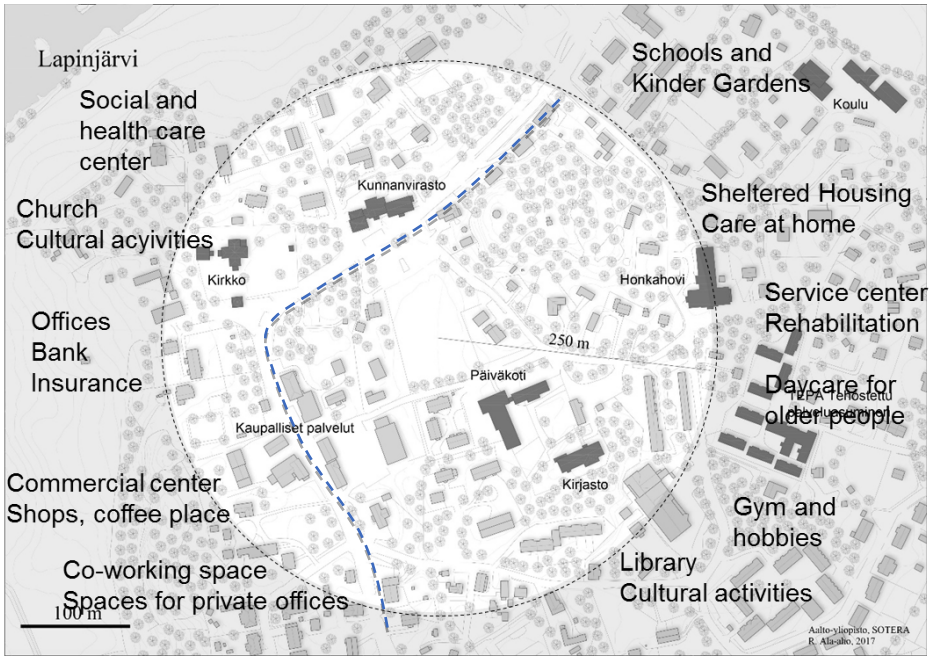

Figure 1. The services for elderly as well as public and private services situated within 250 m radius in Lapinjärvi municipality.

The strength of Savitaipale municipality was a compact urban and service structure. The Service Centre Suvanto acted as a base for the development of local services for older population. It was situated within the walking distance of other communal and commercial services (Figure 2). The service centre has 24 apartments and other wellbeing services targeted to all older people living independently in the area. The municipality has invested in fast fibre optic internet, which allows developing remote services and spreading widely information about the services. New digital services and innovative solutions can be tested in the municipal services, and further developed for remote areas. The service centre Suvanto will be the coordinator of local service networks.

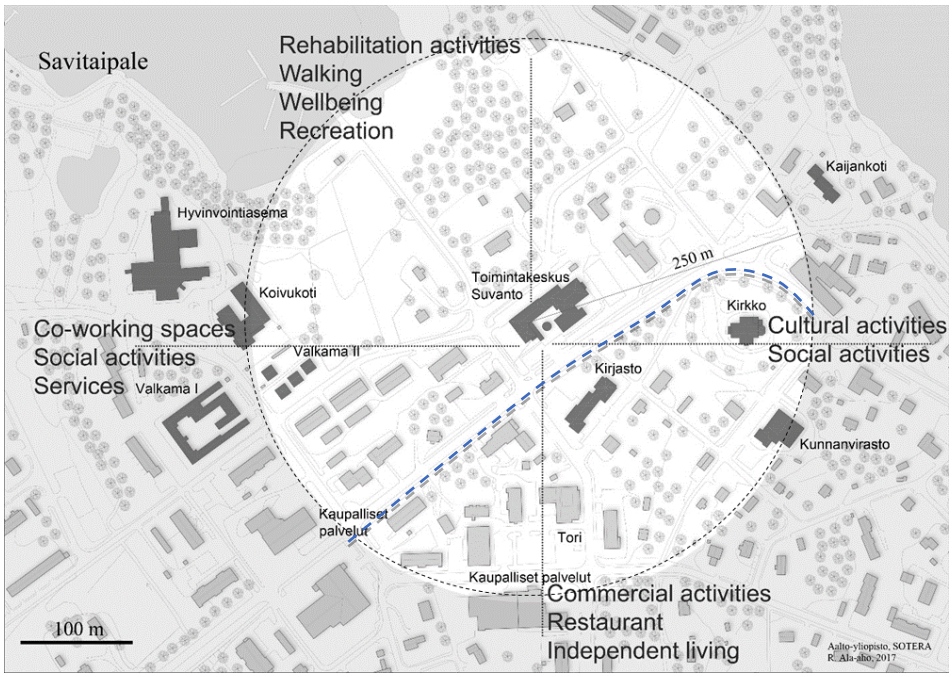

Figure 2. The services centre for elderly Suvanto and services situated within 250 m radius in Savitaipale municipality.

A new age-friendly housing area will be developed in the district of Johannesberg, in the City of Porvoo. The oldest buildings in the area targeted for care services for older population are under preservation. The site has high

visual quality and a beautiful garden but is located on a hilltop. Some of the buildings from the 1970's will be demolished or renovated. These buildings do not meet the current standards for care environments and do not support the functional capacities of the residents nor the work tasks of the staff members. Currently, lack of local services reduces possibilities for independent living in the area (Figure 3.). Therefore, the new urban development plan will include local services for all resident groups in the area. There is a need to reduce age segregation and mix housing solutions for different age groups locally. Therefore, new facilities, apartment buildings and local services are targeted to all age groups in the neighbourhood.

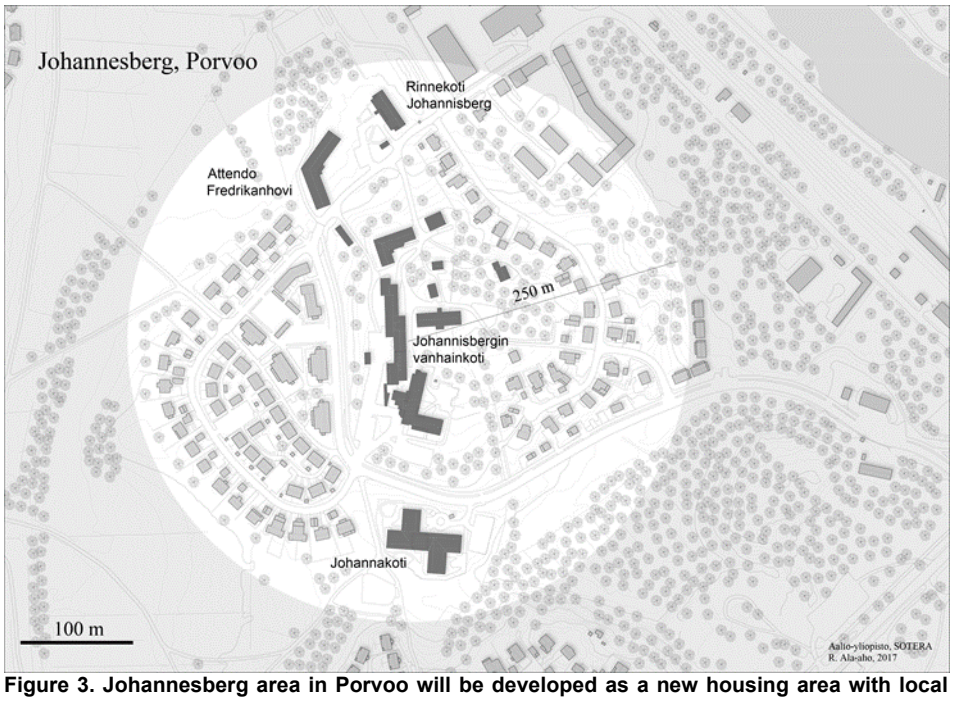

Figure 3. Johannesberg area in Porvoo will be developed as a new housing area with local services.

Preliminary results

The inventory of the existing infrastructure revealed that the quality of the facilities varies within a municipality. They are built during different decades and are designed with the best knowledge of that time. Previous observations in other municipalities have also revealed that approximately one third of the existing premises are functional and of good quality and one third can be refurbished or renovated. However, one third would need expensive and important modifications and are not currently suitable for effective care for older people. Remote location, institutional layout as well as lack of outdoor areas and spaces for rehabilitation are major problems (Verma et al. 2017).

The way of producing and delivering care services has undergone changes in recent years. Remote care services and online information are developed for people to take responsibility of their own care. Many older people living independently are frail and have multiple medical conditions. They may be unable to use new technologies. Moreover, the home care staff may have some resistance for using these technologies. There is need to invest time and human resources to implement the new technologies into practice. Over the time, people will opt for technology when it is useful and meaningful for them. According to Milligan, et al (2011) the technology that enables people to undertake more of the everyday tasks of daily living or which enhance the sense of security are widely accepted.

In small municipalities, the housing for older people, spaces for social activities and local services can all be located within a walking distance. In Lapinjärvi, the basic services: daily groceries, social and health care services, a restaurant,

bank and other commercial services are all situated along the main street within 200m distance. This compact urban structure increases the possibilities of aging in place. Moreover, in a small community, people know each other and have social control over the space. This may enhance the feeling of safety of the older residents. However, a lack of apartments suitable for older population in the centre of the municipality was identified.

The traditional way of living in sparsely populated areas favour private houses. The local resident panel brought up the idea of a small scale, affordable cottage suitable for older people located in the centre of the municipality. Therefore, an urban densification plan of the centre with small-scale single-family houses was proposed. Moreover, two students in architecture designed a model of an affordable small-scale modular accessible house suitable for older residents. The model will be used in the densification of the municipality.

Moreover, the urban plan included walking paths and increased access to daily services. The location of the new houses within walking distance from commercial services as well as from the existing sheltered housing would enhance ageing in place. The existing sheltered housing services will be able to provide home care services, monitor safety and communicate with residents remotely (Figure 4.) The GPS technology and remote monitoring may be used to help people with memory disease to continue daily life and walk safely in the familiar surroundings as long as possible. Furthermore, art and natural elements were proposed as visual landmarks that enhanced the navigation and wayfinding.

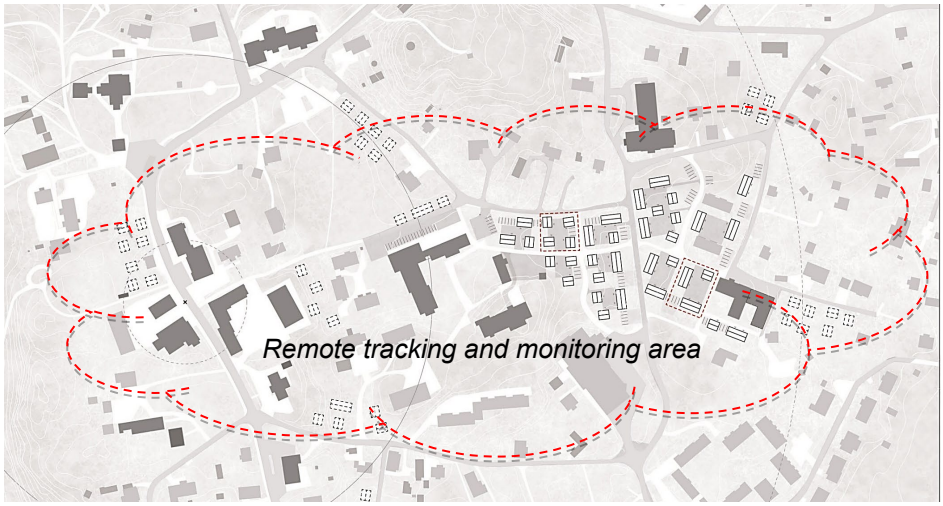

Figure 4. The new small-scale housing units can form a remote service area. (base map, Fraser, I. student in architecture).

In the same way, the city of Porvoo is planning the densification of the Johannesberg area with mixed housing solutions for various resident groups. Further, the area needs local services that can be targeted for the whole community. The existing care service structure can provide social activities, remote services, and home care for frail residents. The typology of apartments, the scale of courtyards, green areas and a network of walking routes in the new area are influenced by the old part of City of Porvoo (Figure 5.). The human scale, neighbourliness, and accessibility are in the bases of the urban plan.

Savitaipale has several service providers offering care and housing for the older population living in the proximity of the Suvanto service centre (Figure 6). The collaboration between these service providers locally would enable to offer a wider range of services related to daily living, wellbeing and health care for older residents. Moreover, the shared use of premises and a network of public, private, and non-profit organizations increase the resource efficiency. The most appropriate and most accessible spaces can be chosen for the shared use. Furthermore, some of the services of the Health Care Centre that is going to be

demolished can be organised in existing buildings. A new large-scale building for the Health Care Centre in a small municipality with shrinking population and decreasing resources may not be a sustainable solution. The fast fibre optic network in the municipality enhances the coordination the network. It is also a tool to communicate with older people living in remote areas. Moreover, persons with physical disabilities may participate in the activities of the centre remotely.

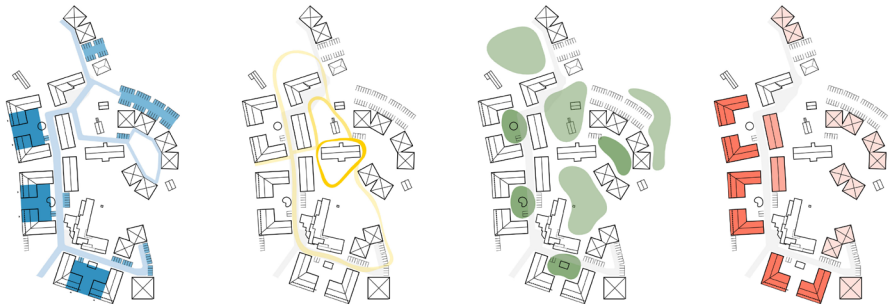

Figure 5. The schemas for outdoor spaces, walking routes, green areas and various housing typology in the new housing area. (UKI Architects)

The nature is important source of wellbeing and enhance mobility and physical exercise of people. It is a potential strength for small municipalities. In September 2017 in Savitaipale, a new outdoor fitness area suitable for older population opened next to Suvanto centre. Moreover, walking paths to local services help to maintain physical functioning capacities.

The network model for services

The core services for older people can be identified as 1) housing, 2) social activities, 3) heath care services and 4) maintenance. In the new model for small municipalities developed in this study, the core services are located in the community (Fig. 6). Instead of having all services under the same roof, they can be located within the community. Some of the information and care services can be offered online. However, local knowledge is needed to recognize the personal situation and need for care of each person. A comprehensive evaluation of the housing situation, social contacts and care needs is required to enhance one's independence and wellbeing.

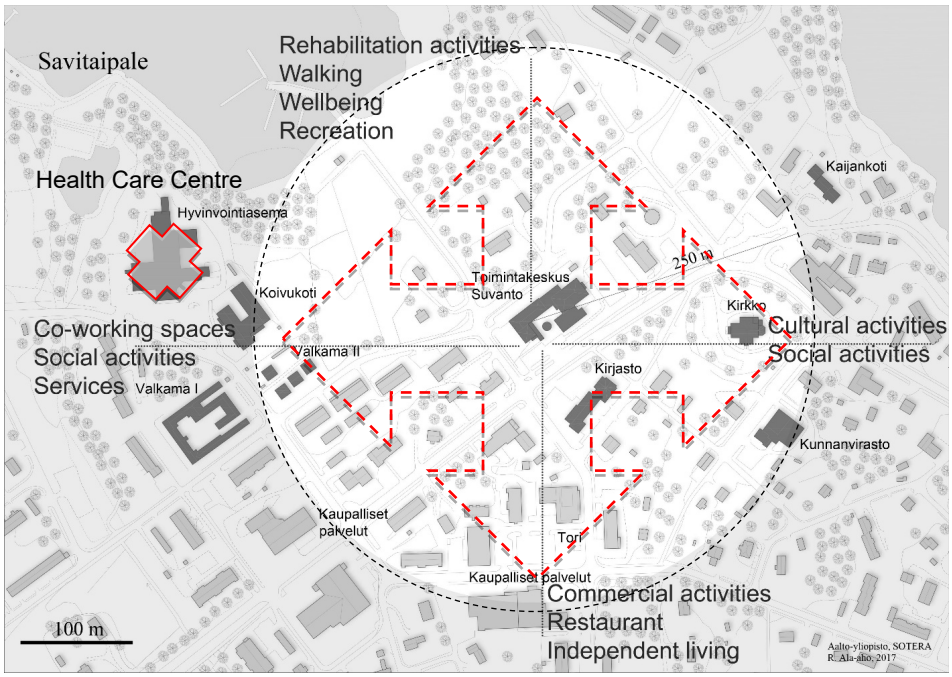

Figure 6. The commercial, social and cultural services as well as nature are at walking distance from Suvanto service centre in Savitaipale.

The local coffee shop, library or parish centre can be a space for social and cultural activities. The rehabilitation can take place in the local gym or in outdoor environment. Wellbeing services and office spaces can be located in premises that are suitable for those activities. Moreover, the older residents will be able to live in their own accessible homes in walking distance of all the local services. In the heart of the service network model is a low threshold space with information and coordination activities. It is targeted for both the residents and other stakeholders of the local network. In the model, the public facilities and other resources are in shared use. The residents' associations or local organizations can have access to the shared spaces.

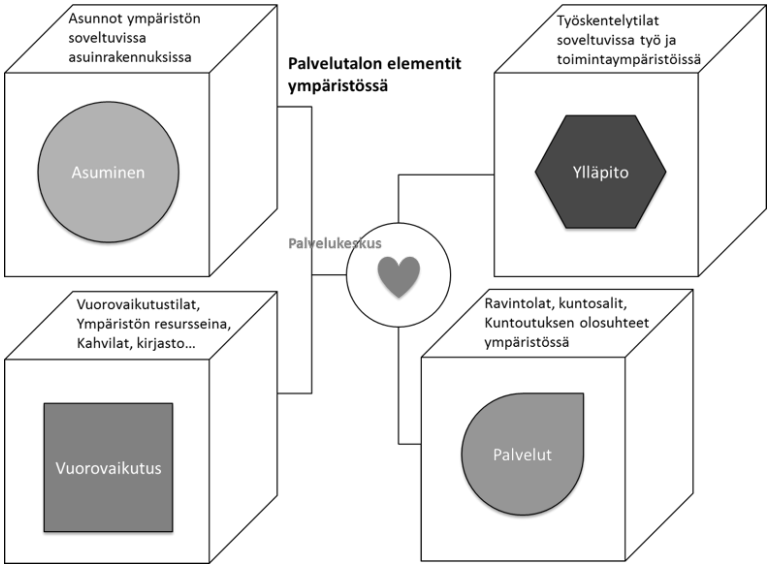

Figure 7. The different services related to housing for elderly can be situated in various facilities the small municipality. (Suominen, 2019, p. 58).

Conclusions and discussion

According to the population projections, the number of people 85 years old and over will increase during the coming decades. In the future, however, the number of older people in sparsely populated areas will grow slower than in the big cities. The need for new housing services is not increasing in the same speed with population aging. The population structure will lead to high dependency ratio especially in small municipalities. Home care and remote services will enable people stay at home longer. The care at home is the first option for older resident and housing modifications may enhance independent coping. The changes in home environment and home health care services may influence the feeling of home. Milligan et al. (2011) point out that the home modifications, home care and telecare may transform the home environment into a site of work, inhabited by both formal and informal careers. Therefore, relocation is an option when the home environment does no longer support the resident's needs.

The preparedness for one's own aging is only possible if there is a supply of suitable housing solutions available. Need for accessible housing, owner-occupied and rental apartments in the centre of the municipalities will increase in small municipalities. The densification of these municipalities with affordable housing will enable people to age in place. A recent study about co-housing for older people found that the residents appreciated the reciprocity of *social support, having someone to talk to, someone to go for a walk with, or someone to ask for help with shopping and daily chores* (Jolanki and Vilkko 2015). According to the study, emotions and shared experiences generated the sense of community. The social support and collective experiences may become the strength of small villages, where people know each other. Further, the remote

monitoring may enable residents with memory decline to continue their life in the community, in the familiar surroundings without fear of getting lost.

Each of the municipalities is different. They have their own strengths and weaknesses. Therefore, a resilient and sustainable solution has to be based on the local context. The participation of municipal actors is important to implement and to assess the feasibility of the urban plans. The location of existing housing, outdoor spaces and shared spaces in the community influence the independence and the residential satisfaction of older population. Most activities and services can be organized in these spaces. The bases of any possible new construction needs to be the accessibility, flexibility and multiuse. Especially, in small municipalities all new services and facilities need to be targeted for all resident groups and used by local stakeholders. The potential of the strong community in small municipalities is a good basis for the sustainable development.

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Individuality Included

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Abstract

Only a few percent of new detached houses in Finland are designed by architects. Most people planning to build a house use only free design services included in the price of house delivery. This means for example that a building engineer designs the house based on some standard model, which he changes according to discussions between sales person and customer. This often results in seemingly generic houses that do not capture most value of the plot. Log houses make no exception in the Finnish market, even if they are a somewhat luxury product abroad. Why do not people in Finland use architects for designing their log houses? Is it because of the price of the design work? How does the log manufacturer's system of configuring houses work without architects? Are log house companies satisfied with the current system? Could mass customization strategies be suitable for developing design and production processes of log houses?

This paper presents results of studying the need and supply of individuality of log houses, and current house design processes that let users participate configuring their new log homes in Finland. The study was carried out via consumer study and interviews of log house industry's managing directors and sales personnel. All of these companies are building non-speculative individually-commissioned houses, building houses to meet customers' individual orders rather than for stock.

Based on our consumer study, there is a great demand for individual houses. Only 8,8% of the consumers would choose a standard house model. However only 10% of respondents would prefer a unique house designed by an architect, while 68.9% would prefer a modified standard model. Most important reason for not using architect is the price of the design work. This results in contradiction, since consumers want an individual house, but are not ready to pay for designing.

PEER-REVIEWED ARTICLE

Surprisingly, all interviewed managing directors of log house companies said they produce only individual houses. Customers always want some modifications even in the standard models, and that results in designing each house anew. This has a negative effect on the profits of the companies, since design work is included in the price of the house delivery. What customers might not realize is that when design work is done at the risk of house builders or even sales people, it is done with as little effort and cost as possible.

Since the existing design process of log houses produces often seemingly generic but always laboriously planned houses, there would be need for improvement. Systematization of individual choices could benefit log house companies in terms of design resources. And If mass customization approach would bring architectural quality available to a broader group of new log house dwellers, they would benefit, too.

Keywords: mass customization, log house, wood architecture, individuality, design process, affordable housing, affordable individuality

Introduction

Building a house of one´s own is often a big dream come true, and a heavy financial effort to most people. This biggest investment of a life-time is however often executed as a seemingly generic standard house model whose designer might even never have visited the building site. In an extreme situation there might be a great plot by the river and a dream house chosen from the house manufacturer´s catalogue, resulting in a house where only one window faces the river view.

Based on our consumer study, there is a great demand for individual houses. Only 8,8% of the consumers would choose a standard house model.

In order to make the most of a plot and fulfill the needs of the customer, individual design is required. However automation of design (Duarte and Simondetti 2002) is still utopia. Design work of individual or tailored homes is laborious.

Finnish log house manufacturers- and also other house manufacturers - provide design services included in the price of the house delivery. Customers have learned that they only have to pay, if they in the end order the house delivery. In some log house companies even more than half of the staff might be engaged in design work.

An architect might think that using the help of architects would be the obvious solution for designing an individual house that fullfills the needs of the dwellers and fits the site best. However, there is a considerable marketing pressure of house manufacturing companies' seemingly easy and "free" services. And at the same time there is absolutely no marketing pressure from architects willing to design low budget houses. It is hard for architects to compete with seemingly free services, so there are not many who would try. While best architectural quality and value for money might be reached via using an architect and hiring good constructors, it demands a customer to take a more active role in various stages of the design and building process of the house. Uncertainty of building costs is also greater when compared to house manufacturer's services.

There will always be room and need for individual houses designed by architects. However, there is also need for developing complimentary design services of house manufacturing companies. Aim of this development should be in adding architectural quality and at the same time systematizing and thus streamlining the design process.

Mass customization in housing is a process optimization strategy which aims at providing individuality for the price of mass production. For example according to Noguchi (2001), mass custom design approach, in which housing products and services are well standardized and integrated into the system, may have the great potential to reform the current housing delivery system and contribute

towards producing good quality affordable homes that corresponds with today's market demands for housing—i.e. affordability and customizability. (Noguchi 2001). According to him, mass customization aims at combining individuality with affordability.

When developing and designing mass custom housing there are many aspects to consider. Systematization of individual choices is the key. Customer interface, manufacturing systems and supply chain management must all be taken into account.

When developing a mass custom housing model, house design and customer interface should work seamlessly together with production processes. Mass customizers allways need to develop a mechanism that elicits and reveals individual customer needs and transforms these needs into suitable products (Zipkin, 2001).

Out of all these aspects arise following research question: Could adopting mass customization approach benefit both finnish log house manufacturers and future log house dwellers?

This study is part of Modern Log City research program and its preliminary study phase in Oulu School of Architecture. The project aims at studying new log architecture within cities, use of mass customization and life-cycle economy of log buildings.

Theoretical background

Mass customization in housing is in this paper understood as a process optimization strategy which aims at providing individuality for the price of mass production. This idealized state might never be fully reached, but mass customization can still be used as a strategic mechanism, and a process for aligning an organization with its customer's needs. (Salvador et al 2009) This will over time supplement and enrich an existing business.

Mass customization in housing is in this paper understood as a process optimization strategy which aims at providing individuality for the price of mass production.

According to Salvador et al, mass customization requires a business to develop three fundamental capabilities: 1.) The ability to identify the product attributes along which customer needs diverge 2.) The ability to reuse or recombine existing organizational and value-chain resources to fulfill a stream of differentiated customer needs 3.) The ability to help customers identify or build solutions to their own needs while minimizing complexity and the burden of choice.

Mass customization should not be seen as a stand-alone business strategy for replacing old processes, but as a set of enriching organizational capabilities. Zipkin has argued for three capabilities of mass customization systems: 1.) Elicitation is a mechanism for interacting with the customer and obtaining specific information. 2.) Process flexibility means having the technology to fabricate the product according to the information and 3.) Logistics is distribution of right items to right customers.

For a mass custom system to work, these three must be linked tightly to form a coherent, integrated whole. Mass customization systems cross traditional organizational boundaries, particularly those between sales and production. Companies must have organizational agility in addition to technical agility to enable co-operation across the boundaries.

Elicitation is essential and difficult. Customers are easily overwhelmed by too many selections. Deeper levels of customization often require an elaborated enabling mechanism, sometimes called a configurator. Mass customization needs several kinds of elicited information. Typically there is the need for

physical measurements, customer's selections from alternatives and reactions to prototypes. In architecture, 3D prototypes can be used.

According to Zipkin, potential for mass customization can be seen in products where customers differ sharply in their preferences for certain product, and in products that are already on the market in customized (not mass customized) versions. Zipkin warns that mass customization has its limits. Several elements have to work well to make mass customization a plausible business strategy. There are also other ways to create variety. For example adjustable car seats make individual customization of car seats unnecessary.

Theories mentioned above originate from the business sector. Theories of mass customization in the context of housing (Barlow and Ozaki 2003, Noguchi 2000, Zipkin 2001) stress the importance of developing communication techniques that let users systematically participate in designing their new home. Mechanistic by nature, they aim at systematization of complex communicative processes.

According to Noguchi (2000), mass customization system can be described as a conceptual model of MC= f (PS). In this model, the 'service sub-system' (S) concerns communication techniques that lead users to directly participate in customizing their new home. 'Product sub-system' (P) covers production techniques to encourage housing suppliers to mass-produce housing components.

Further Barlow and Ozaki (2001) describe Japanese lessons on customer focused housebuilding. Big Japanese house builders have concentrated their competitive strategies on three aspects: on their production processes, focusing on 1.) Supply chain management and 2.) Manufacturing systems, and 3.) The customer interface. The approach to manufacturing homes, including standardization of components and subsystems, has enabled them to offer high levels of customization.

So depending on theoreticians, processes that let users participate configuring their homes are called "Customer interface" (Barlow and Ozaki 2003) or "Service sub system (S)" (Noguchi 2000) or "Elicitation" (Zipkin 2001).

In mass customization, optimization of the production process is directed by "pull", the clients´ wishes. (Cuperus et al 2003) Houses are built to meet customers' individual orders rather than speculatively for stock. Simply put, the term "pull strategy" means production according to individual orders. The opposite of this would be "push strategy" which in housing would mean building housing developments speculatively and selling them to customers as turnkey products.

Masa Noguchi has proposed a choice model for the delivery of mass custom homes. (Noguchi, 2004) The main purpose of the choice model is to systematize a decision making process for the selection of alternatives that helps mass customizing an end product, such as a housing unit or development.

In order to mass customize an end product, there are five stages within the choice model that may need to be followed cyclically.

1. Identification of need: Homebuilders build homes that need to meet the market demands. Identify local market demands for housing.
2. Formulating of industry´s objectives and specifications: Identify industry´s wishes, variables and concerns that will be taken into consideration. Task related variables focus on the "economic" choice, and they can be for example with regard to the cost, quali-ty and time factors. Non task variables generally concern the "emotional" factors. This stage serves to establish evaluation crite-ria including both task-

and non task related concerns, so that the alternatives generated in the next phases can be evaluated.

3. Generation of alternatives: After the multiple evaluation criteria are established, a set of alternatives will be generated. These alternatives – combination of products and services - contribute towards mass customizing an end product that corresponds to market stimuli. The combination of existing or standardized elements helps make the end product mass customized.
4. Evaluation of alternatives: The value of the alternatives formed in the preceding stage will be analyzed in terms of the task- and non-task related concerns. The choice model for mass customization focuses on analyzing the value that represents not only the cost of the products or services in question, but also the industry´s needs, desires and expectations.
5. Selection and visualization of alternatives: The "value visualization" helps the industry make the final decision for the selection of the preferred alternatives, in response to market stimuli.

Any research of mass customization in the context of log house architecture is not known to our research group.

Research process

As part of the Modern Log City research program, this paper presents results of the parts of the research dealing with demand and supply of individuality and current processes that let users participate in designing their new homes. Three parts of the research were relevant from this viewpoint: consumer study, interviews of log house industry's managing directors and interviews of salespeople.

Consumer study was carried out via an electric survey using Google Forms. A link to the questionnaire could be found on the home page of eight log house companies based in northern Finland from April to June 2016. The language of the questionnaire was Finnish and the target group local. It was also possible to fill a paper questionnaire in a construction fair in Oulu in April 2016. These answers were added to Google Forms later.

The questionnaire was divided in 9 parts. First part dealt with basic information of the respondent and last part was for personal information if interested in participating a lottery. Other seven parts were questions regarding the appearance, qualities, experience, ideas, planning and buying a log house. Both open long text answers and scale ratings were used. Respondents were for example asked how they would prefer their house to be designed and what kind of site and budget they had.

It took about ten minutes to answer the questionnaire. We got 256 answers, which was big enough sampling for this research. Most consumers answered all questions, but some only part of them. Answers were automatically updated in Google Forms, which also created diagrams for the analysis.

Industry`s experiences, needs and expectations were first studied by semi-structured face to face -interviews to managing directors of eight log house companies based in northern Finland, all participators of Modern Log City – research program. All of these companies build non-speculative individually-commissioned houses, building houses to meet customers' individual orders rather than for stock.

Interviews proceeded following a questionnaire, but the interviewer asked also further questions during interview. These interviews took between 60-120 minutes, and they were recorded and transcribed. Questions were not shown to the interviewees in advance.

Managing directors were further asked to suggest each 1-2 salespeople to be interviewed. Seven of them were chosen from different locations: Helsinki, Kuopio, Oulu and Tampere in Finland and one who sold Finnish log houses in Germany. Semi structured face to face interviews were carried out also with them following a questionnaire, but the interviewer asked also further questions during interview. These interviews took between 60-120 minutes, and they were recorded and transcribed. Questions were not shown to the interviewees in advance. All of the interviewed salespeople were independent entrepreneurs who sold log houses on sales commission basis.

Questions to managing directors and salespeople dealt with individuality, design processes, flexibility, architectural quality, market potential and possibilities of mass customization.

Managing directors were asked to express their views about individuality, serial production and architectural quality also graphically. (Figure 1) Individual house on the left and serially produced house on the right, they were asked to mark A) their production focus at the moment, B) best choice for fulfilling the needs of the customer, C) best choice in terms of architectural quality, D) best choice in terms of flexibility of the floor plan and E) best choice in terms of market potential.

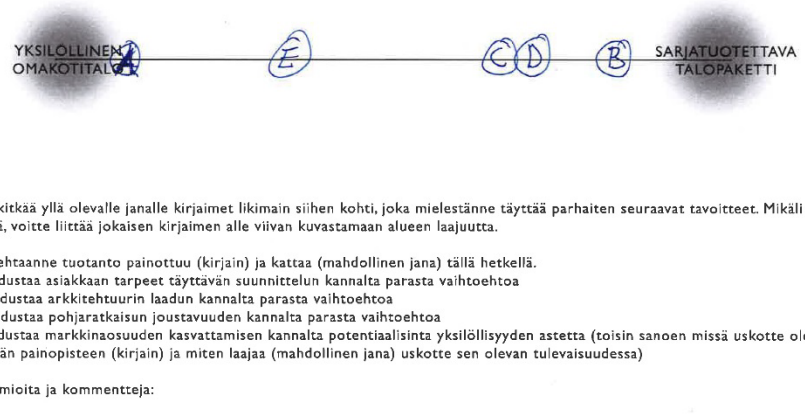

Figure 1. Managing directors were asked to express their views also graphically. Individual house on the left and serially produced house on the right, they were asked to mark A) their production focus at the moment, B) best choice for fulfilling the needs of the customer, C) best choice in terms of architectural quality, D) best choice in terms of flexibility of the floor plan and E) best choice in terms of market potential.

Results

Based on the consumer survey, there is a great demand for individual houses. (Figure 2) 91,2% of the consumers want individuality, since only 8,8% of them would choose a standard house model. However only 10% of the consumers would prefer a completely unique house designed by an architect, while 68.9% would prefer a modified standard model.

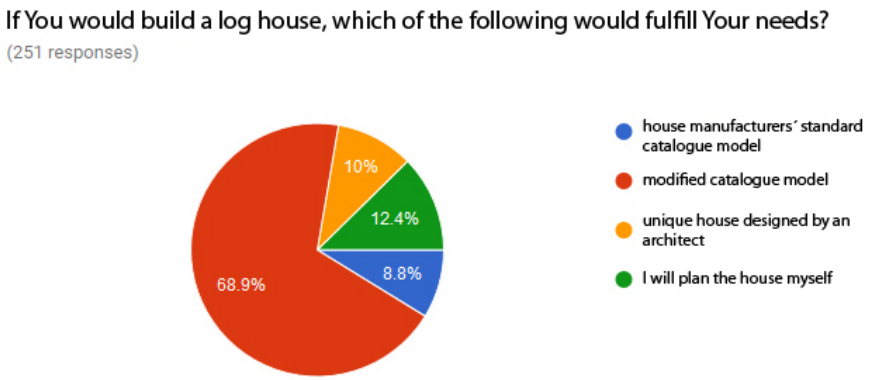

Figure 2. Customer demand for individual houses. 68.9% of customers would prefer a modified standard model.

Also all eight interviewed managing directors said their company produces only individual houses (A). Customers always want some modifications even in the standard models, and that results in designing each house almost from the scratch.

According to salespeople, demand for individuality can be explained by some key features. These are the attributes along which customer needs diverse (Salvador et al 2009). Log houses are nowadays built on many different kinds of plots varying from countryside locations to densely built urban environments. Varying plots have different conditions, landscapes and building regulations. Especially most densely built areas around Helsinki and Tampere have small plots and strict demands for appearance.

Budgets vary and set different limits each time. It is also important to make customers feel like the house has been tailored for the individual needs and tastes. Many interviewees also said that fulfilling individual needs of the customers is the most important criteria of architectural quality.

Even though automation of production process enables easy production of almost any kind of log architecture, design work of individual or tailored homes takes lot of resources. In some companies even more than half of the staff might be engaged in design work. This has a negative effect on the profits of the companies, since design work is often included in the price of the house delivery. Customers are not used to pay for individual design, they expect to get an individual house at the same price as a standard model.

This phenomenon in especially problematic for log house builders, since they often only sell the log frame and wooden parts of the house, but end up designing all the bathrooms and saunas as well – for free and not being sure if all the work will get paid at all. Another company might give a lower priced offer for the house plans made by their competitor. Or the customer might not have enough money to build, after all. Several managing directors discussed the free design work done even by 3-4 competitors simultaneously.

Most important reason for not using architect is the assumed high price of the design work. This results in contradiction, since consumers want an individual house, but are not ready to pay for the design work. When consumers were asked reasons for not using architect, high price was mentioned in 60 % of the answers and it appears to be clearly the most significant reason. 16% said there are enough ready, modifiable models and 10% said they were capable and willing to plan themselves. Only 6% mentioned some prejudices such as architects designing only for themselves and not the client, and their structural solutions being expensive or not lasting.

All interviewed managing directors of log house companies said they produce only individual houses. Customers always want some modifications even in the standard models, and that results in designing each house anew.

House budgets of the respondents are low. 41,4% of the respondents had a budget of less than 200 000 and 42,1% of less than 300 000 euros. The average cost of new houses for example in Oulu in 2016 being 280 000 euros (Kviik 2017), it can be said that at least half of the customers had unrealistically low budgets. Even if hiring an architect would not cost much, with an unrealistically low budget you need to cut every cost you can somehow avoid.
Most log houses in Finland seem to be designed quite reluctantly and with as little effort and cost as possible, since the work is done at the financial risk of the log house builders or even sales people. And since the design work is done at own risk, it is in most cases not an architect- an expensive professional – doing the work. As one managing director put it: “A Finn will do even with inferior as long it is free.”

Managing directors would in principle wish to either get customers pay for the planning work via design deals, or just simply get the customers come to them with ready drawings. On the other hand this is not the whole truth: Guiding interested customers to some free designers can be a risk of losing the deal, since sovereign plans can be used to get competing offers from others. Offering

individual plans included in the price is a competitive strategy. In times of economic boom builders can focus on repetitive production while in low economy individuality is offered more generously.

Current design processes

Many interviewed representatives of log house companies stressed the importance of the site. However, they had different views on how common it was to visit the building site during design. Based on our research material it seems that in most cases some professional – salesperson or designer – does visit the site.

Roughly categorized, architects are often part of the design processes in Helsinki, Vantaa, Espoo and Tampere, all densely built urban areas in southern Finland. There it is difficult to handle the complicated bureaucracy of building permits without architects. In rural areas and smaller towns design processes are led by salespeople, whose education vary from social worker to business. Most often salespeople do not have any education from the building sector. “You have to have some psychological eye”, explained one managing director.

Sketches are done either by the sketch service of the log company, by salespeople or their contact –in one case even by the daughter of the sales representative –or by architect. To lower the design costs, some salespeople took care of the site visits and customer meetings themselves and architects´ design work based on memos and pictures. Some companies had had for example trade show campaigns where they had offered architect service for free and architect had done 5 house design as a kind of serial design work: Visiting sites and meeting customers at once in the same area.

According to salespeople, best collaborative design processes with architects include economical and structural evaluation of architects´ designs done by the log house company already in the sketching phase. Salespeople saw a need to develop collaboration processes between architects and log house builders. They preferred to do this by developing collaboration with same architectural offices.

When architect is not part of the design process, designing is usually done by modifying standard models. Unmodified standard models are used only when budget is very low and site sets little limits. Standard models are still important for catching interest of customers and since they show what for example 150m2 is enough for.

Best models have been refined via repetition and feedback, and they have a strong character and some recognizable features that stay recognizable even when making big changes in size and layout. Common changes are for example mirroring floor plan or making the model fit the site in some other way, chancing log types, changing style between modern and traditional, adding or removing rooms and dividing walls, changing room sizes and changing window positions, sizes and colors. Interior decoration of kitchen and bathrooms are usually not part of the log house delivery, but their floor plans are drawn and they are one big design theme that causes changes in layout. Changes to the standard models are often considerable. Customers might, for example, wish to combine floor plan of one model with the exterior of another model and roofing structures of a third model.

Since modifying standard models is the most common way of designing a log house, mass customization as a product development and customer participation strategy would seem to suit log houses well. From the view point of log house builders, more repetition in design – not so much in fully automated production - is seen as desirable.

Interestingly, all managing directors believe that a move in the direction of developing some standardization would increase architectural quality (C) and

flexibility of the floor plan (D), be the better solution for fulfilling needs of the customer (B) and grow the market potential (E). The summary of the markings of all managing directors can be found below. (Figure 3)

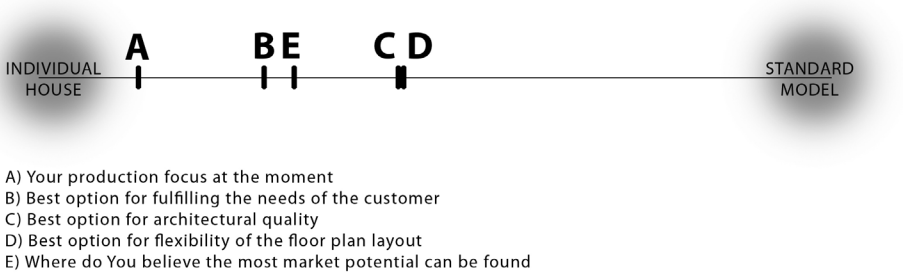

Figure 3. Summary of the markings of all interviewed managing directors. All eight interviewed managing directors said their company produces only individual houses.

However only few representatives of log house builders had heard of mass customization. When discussing this theme, most managing directors said they saw potential worth testing in developing ideas of mass customization further in their industry. Only one said log is primitive and tailorable by nature, and mass customization would not benefit log industry.

Some mass customization solutions are actually already in use. Some companies use garage- and bay window modules. They also provide same models as both traditional and modern versions and with different corner designs for different kinds of logs.

Interviewees suggested possibilities of developing more repetition in designs. Since most expensive spaces are in the kitchen and bathrooms, some limited choice of bathrooms would have cost-lowering effect. It was also suggested that technical spaces or even walls could be produced as modules.

It is important to give customers a feeling of tailoring for the individual needs and taste, but according to our interviews, this does not necessarily have to mean enormous changes. The feeling of getting an individual house designed just for You is important, even if small changes in floor plan and facades could be enough.

Conclusions

This paper presented results of studying demand and supply of individual log houses in Finland. The aim was to find out whether adopting mass customization approach could benefit both Finnish log house manufacturers and future log house dwellers. The research was carried out via consumer study and interviews with log house industry's managing directors and sales personnel.

From the consumer study we found out that 91,2% of the consumers want individuality. Only 8,8% of them would choose a standard house model. However only 10% of consumers would hire an architect, since they do not want to pay for design work. Finnish customers have learned to use the "free" design services included in the house delivery, and that they only have to pay if they in the end order the house delivery. Customers want an individual house for the same price as standard model.

When design work is done at the financial risk of house builders, it is done with as little effort and cost as possible. This results in risks about the quality of the design. If adopting mass customization approach could improve architectural quality of the houses, future log home dwellers would benefit greatly.

This paper also explored log house industry´s views about individuality, serial production and architectural quality of housing. All interviewed managing

directors of log house companies said that they produce only individual houses. Varying plots, budgets, families and needs set different requirements each time. Everybody wants to get the feeling of individuality.
Offering individual plans included in the price is a competitive strategy. In times of economic boom builders can focus on repetitive production while in low economy individuality is offered more generously.

However log house companies are unsatisfied with the current system. Even though automation of production process enables easy production of almost any kind of log architecture, the design of individual or tailored homes is laborious. This has a negative effect on the profits of the companies, since design work is often included in the price of the house delivery.

In some companies even more than half of the staff might be engaged in design work. Finding skilled staff for design is even the bottleneck of growth in many log companies.

Managing directors expressed interest in finding mass customization solutions that would combine benefits in terms of design resources, productions costs and architectural quality. Systematization of making individual choices could benefit log house companies in terms of design resources, if adopting mass customization principles would streamline the design process.

In the light of mass customization theories and this research, mass customization strategies could be suitable for developing design and production processes of log houses. Potential for mass customization can be seen in products where customers differ sharply in their preferences for certain product, and in products that are already on the market in customized (not mass customized) versions (Zipkin 2001). In log house architecture there is a great demand for individuality, and customers differ sharply in their preferences for housing products. Varying plots, budgets, families and tastes set different requirements for each house. All interviewed managing directors of log house companies said they produce only individual houses. Customers always want some modifications even in the standard models, and that results in planning each house anew. Process flexibility (Zipkin 2001) is already well developed thanks to automation of production, and Logistics will not be a problem for delivering houses to right customers. What remains critical is Elicitation, developing an elaborated enabling mechanism or configurator that let users participate in configuring their new log houses. This requires developing co-operation and crossing boundaries between sales and production. Easy to use web application for configuring a log house would seem to be desired by at least one of the participating log firms.

Since modifying standard models is the most common way of designing a log house, mass customization as a product development and customer participation strategy would seem to suit log house companies well. Mass Customization theories often describe a movement from mass production to more customization. However from the view point of log house builders, more repetition in design – not so much in fully automated production - is seen desirable. Since now in 2017 is a time of building boom in Finland, time should be right for developing mass customization strategies. However affordability and feeling of individuality must be combined, in order to meet customer demands.

Using mass customization as a strategic mechanism would benefit both log house companies and future residents since they help develop affordable housing products that meet the demand, and bring architectural quality available to broader group of residents.

What remains critical is systematization and control over the process of making customer choices. Mass customization should lighten the design work, not add to it. Providing high levels of customer service and choice over design can be

resource-intensive. (Barlow and Ozaki 2001). Mass customization also requires developing tight co-operation between sales, production and design. Configuring should be made easy to attract house builders.
In the next phase of Modern Log City research program, mass customization will be studied as a strategic mechanism to develop design, participating and production processes of Finnish log house architecture. The aim is to find out what kind of elements of mass customization- user participation, standardization, prefabrication and supply chain management - prove useful in architectural and industrial context in Finland.

Developing aspects of mass customization could combine affordability with individuality and architectural quality and thus broaden the group of potential log home buyers.

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Perceptions of Log and Log Buildings among Finnish Architectural and Building Industry Professionals

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Abstract
Log as building material is undergoing rapid technological changes due to the introduction of industrially developed lamella log. This new material expands the technological repertoire that is available to architects when designing with log. Furthermore, various societal trends relating to ecology, occupant health, and contemporary architectural expression are potentially altering the status and desirability of log as a building material. Thus, from the point of view of architectural research, the log as a building material should be re-investigated. In this paper, our aim is to scrutinise log and log construction through exploring *how log is currently perceived as a material among Finnish building professionals*. For this purpose, we analyse interviews conducted with 15 professionals in Finland. To gain these research materials, we utilised a method where a traditional semi-structured interview is combined with an in-situ interview in a pavilion construct built by our research team. We complement these materials with brief reviews into wood research and the history of log construction in Finland.

Keywords: log building, log architecture, architects, building industry professionals, design ethnography, interviews.

Introduction
There can hardly be a more traditional building material than log in the boreal areas of the world. The use of this ancient material saw a significant decline in the 20th century as novel building materials and construction methods prevailed. However, in recent decades the humble log has become an object of industrial research and development work. The contemporary industrially produced log, then, is a piece of engineered wood that could be argued to have more in common with cross-laminated timber than traditional logs, which have been hewed from a single tree trunk. This enables novel architectural uses of the material, but also raises many interesting questions regarding the use and non-use of log as a building material. Furthermore, it can be argued that in the previous decades, the architectural quality of log buildings has been mostly

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rather poor. Industrial log has so far been used in very few professionally designed public buildings. For the architectural field, then, there is a distinct need to research and develop log as a building material.

In this paper, our aim is to scrutinise log and log construction as a phenomenon, and to explore the question of *how log is currently perceived as a material among Finnish building professionals*. For this purpose, we analyse interviews of 15 professionals in Finland, utilising a method where a traditional semi-structured interview is combined with an in-situ interview in a pavilion construct built by our team (e.g. Denzin & Lincoln, 2005; Evans & Jones, 2011). This paper, then, focuses on Finnish professionals, and attempts to gain in-depth understanding of how they, as individual professionals, view log as a building material. To support our analysis and discussions of these materials, however, we will first examine briefly some related work.

Studies on experiencing wood as a building material

While we were not able to find many studies of log in particular, numerous studies have been conducted in several fields concerning the experiential effects of wood. Indeed, log research can be seen as a subset of wood research in general, thus, the issues overlap greatly, and the results gained in wood research can offer useful viewpoints into log as a material. Overall, these studies on experiencing wood seem to be physiological, psychological and cultural in nature.

All in all, wood is often seen as being “warm” and “natural” (Rametsteiner et al., 2007). This finding has been explained in two ways: it might be due to the coloration or hue of the material, which reflects long-wavelength light, and possibly because it produces only minor amounts of UV radiation from its surface; this might provide less stimuli and provide a sense of relief (Masuda, 2004). For the most part, wood has been found to have positive or neutral effects in these studies (Jensen et al., 2001; Guo et al., 2002; Gasser, 2001; Sakuragawa et al., 2008; Morikawa et al., 1998). While many of these studies quantify individuals’ responses in terms of biological markers, many researchers also utilise integrative strategies, which include psychological aspects (Beatley, 2000; Pearson, 2001; Kellert, 2005; Kellert et al., 2008) According to some studies conducted within environmental psychology, it would seem that participants prefer natural scenes and environments to non-natural ones (e.g. Kaplan et al., 1972). This phenomenon has been dubbed *biophilia* (Wilson, 1984; Kellert, 2005; Kellert et al., 2008). Some explain this affinity towards nature through the fact that natural elements are possibly seen as nonthreatening (Kaplan & Kaplan, 1989; Ulrich et al., 1991; Hartig et al., 1997). Whatever the reason, this effect seems to work well, since natural video scenes have been shown to promote restoration from stress (Ulrich et al., 1991; Parsons et al. 1998; Laumann et al., 2003). While our approach here is different, all of the physiology and psychology-related research in wood has obvious implications for log as well if we are to design indoor environments that support occupant well-being.

Additionally, many cultural meanings have been found to be in connection with various types of wood. Rametsteiner et al. (2007) have shown that for Europeans, wood in general is a natural, warm, healthy, good-looking, easy to use and environmentally friendly material. These meanings can also be gendered: oak is seen as a masculine material (Blomgren, 1965). Indeed, people seem to even hold notions of wood that are more issues of reputation rather than of direct experience: individuals’ perceptions of the genus of wood and the actual experience of a real sample of wood have been shown differ markedly (Bumgardner & Bowe, 2002). Furthermore, the various uses of wood in living environments have been studied. For example, indoor environments with natural elements are usually highly regarded (Bringslimark et al., 2007). Furthermore, the treating of wood has also been studied: oiled wood floor was perceived of as more pleasing than oiled parquet and lacquered parquet (Berger et al., 2006). Thus, experiences of wood as a building material are

highly context-driven, and the various cultural notions of the genus of wood and its surface treatments have an effect on how it is perceived. Some studies have also compared wood to other materials, such as composites that imitate wood products: These are seen as unnatural, processed and unlike wood in comparison to real wood samples (Jonsson et al., 2008). Thus, the experiential value of wood products renders the material very desirable, but the perceived value of composites might be compromised. This warrants further research into log and especially the lamella log as a material.

While these studies indicate towards some interesting features that log as a wood material might have, these studies do not deal specifically with log. Thus, *there is a major gap in knowledge concerning experiences of log as a specific subset of wood.* Secondly, the literature cited here seems to heavily focus on lay person participants; it *does not address the perceptions or experiences of professionals.* Our study here begins to address these two gaps in knowledge. Our approach could be described as being experiential, empirical, designerly and culturally informed.

Log and timber as cultural concepts

Our study is embedded into its Finnish cultural context, since our original research materials, participants as well as ourselves are all Finnish. Additionally, the research also took place in Finland, and log is a very traditional building material in the country. Thus, the Finnish terminology on the subject of log and timber has played a major part in how the subject has been understood in this context. Usually, the Finnish word *hirsi* is translated into English simply as ‘a log’. However, according to a dictionary definition, a log is “a part of the trunk or a large branch of a tree that has fallen or been cut off.” (Oxford Dictionaries, 2017a); thus, a more accurate Finnish equivalent of this definition would be *tukki*, a log or trunk that has usually already been felled. To be precise, then, in the Finnish language, *tukki* becomes *hirsi* only when it is hewed, or otherwise prepared to be used in a building, or already in place in a log building. If used in some other kind of building as a singular element, it is merely a beam. The dictionary definition for the English word ‘timber’ is “wood prepared for use in building and carpentry.” (Oxford Dictionaries, 2017b). This resembles the definition of the Finnish word hirsi since the tree trunk must be subjected to further production in order it to become timber. However, timber can refer to a wide variety of other wood products. This is not the case with *hirsi*; it only is used in the context of log building. These subtle differences inform our participants’ views, our interpretation, and our reporting in this article. It should be borne in mind that within this article, we are mainly discussing log and log building in the Finnish sense of *hirsi*.

The historical significance of log construction in Finland

The significance of log construction in the history of the Finnish built environment cannot be overemphasized. The simplest and most commonly used technique in log construction, the half-lap joint spread in the country during the 7th century from the southeast of Finland. Log buildings of some sort had existed in Finland long before this, since some 5000-year-old residential constructs made out of horizontally laid tree trunks have been reconstructed based on archeological findings and observations (Vuolle-Apiala, 2012). Virtually all buildings of practical use in Finland were built out of logs until the beginning of 20th century (Jokelainen, 2005).

The appreciation and status of log has shifted during the various historical periods in Finland. According to Jokelainen, three different periods can be established based on the status of log. First, the period of peasant builders, which lasted until the middle of the 19th century. This was followed by the beginning of industrialization in Finland at the turn of the 19th and 20th century. The last is the period of modern industrial production beginning from the 1950’s. Each period has produced its own kind of architectural expression and affected Finnish people’s attitudes towards log building according to Jokelainen. The first

period was characterized by the wooden churches of Finland. Due to the arrival of Christianity in Finland in the 12th century, demand for these large, high-quality buildings was created. These were built by skillful and professional craftsmen and required a high level of craftsmanship. The architectural styles of the time – which imitated stone or brick churches, which were considered more valuable materials – were adapted to wooden church architecture making them truly unique pieces of architecture. The architectural and structural solutions of wooden churches developed and discovered by professional builders were then embraced in more everyday buildings of the time. During this period the general attitude towards log as a building material was highly approving. (Jokelainen, 2005)

In the beginning of the 20th century, the traditional image of log became a disadvantage. In the rapidly industrializing nation, a material that represented values of past times was readily abandoned (Jokelainen, 2005) and the generations of church builders faded away, resulting in the gradual vanishing of the orally transferred knowledge related to building log churches (Soikkeli & Koiso-Kanttila, 2006). Since then, excluding a few rare exceptions of wilderness ateliers of Finnish artists and Lapland tourist attractions, log constructions were mainly used only in secondary buildings, such as summer cottages and sauna huts (Heikkilä, 2002). In these buildings the structures and joints were basic and simplified and based on these solutions the industrial production of log buildings was developed from the 1950's onwards (Jokelainen, 2005). After the reconstruction era, separate practices, differing from building with other techniques, had been developed in industrial log production: No professional designers were used, no research was conducted, and there was no formal education to enter the industry (Jokelainen, 2005). Planning and building officials' attitudes towards log were also critical. According to Heikkilä (2002), the problem was not the material itself but the poor design of these recent log buildings. Furthermore, recent building regulations concerning insulation and energy efficiency have limited the use of log in Finland (Jokelainen, 2005). To summarise, then, log as a building material has suffered a long decline in Finland from the glory days of the pre-industrial society to the present day.

There are several trends in construction that are currently affecting wood and log construction globally. Firstly, since the turn of the new millennium, the ecological aspects related to wood have increased its popularity as a building material (Minke, 2009; Ritchie & Thomas, 2009; Bergman & Bowe, 2008; Upton et al., 2008; Dodoo et al., 2009). Secondly, especially in Finland, log as a massive, homogenous material has gained a reputation as a structurally safe and healthy method of construction. From this perspective, log is seen as a safeguard against moisture-related problems, which often result in microbial issues. Third, some international architectural trends that can be observed to have become popular; these current trends have encouraged a type of architecture where large masses of homogeneous materials are used, and these have resulted also in some interesting contemporary log and wood buildings, e.g. Final Wooden House by Sou Fujimoto, Haus Luzi by Peter Zuthor or Norwegian Wild Reindeer Centre Pavilion by Snøhetta.

Importantly, the fact that the production technology of logs has evolved a great deal leads to yet another interesting contradiction in utilizing the word log. Contemporary industrially manufactured logs are commonly manufactured by gluing smaller pieces of wood together. Thus, they begin to greatly resemble glued laminated timber, which by definition is "an improved form of solid timber in which the growth-related defects in the wood that tend to reduce the strength have been partly eliminated. Glued laminated timber consists of at least three dried softwood boards or laminations glued together with the grain parallel." (Herzog et al., 2012) Technically there are very few differences between these two, but the log house industry in Finland uses the word log to describe their laminated, log-shaped products. This raises an interesting issue for our research.

Thus, in addition to the two gaps in knowledge we identify complex history of log in Finland, the changes in ecology, safety and architectural trends, as well as the rapid technological changes in the material serve as the motivation and background for our study of Finnish professionals' perceptions, attitudes and views of log as a building material. For this purpose, a study setting was devised; we will describe this next.

Study setting, materials and methods

Our overall study setting and method consisted of a two-part semi-structured interview in an architectural pilot construct, the Timber Tetris pavilion (Hirsitetris in Finnish). The study and the pilot pavilion were carried out within Modern Log City project, which is a research project conducted in 2016–2019 in Oulu School of Architecture, University of Oulu. The objectives of the project are to investigate and develop new kind of architectural expression for log buildings suitable for urban environment, to study the utilization of mass-customization in the design process of log buildings and to research the life-cycle economy of log buildings.

Timber Tetris pavilion in the city centre of Helsinki

As a part of architectural education in Oulu School of Architecture, a workshop for architectural students was organized aiming to design and construct a summer pavilion for the Museum of Finnish Architecture (MFA) in Helsinki. Also building architect students from Oulu University of Applied Sciences were invited to participate to workshop. The assignment was to design the pavilion using log as a building material. The intended use of the pavilion was to be an event space for the museum for the summer. Altogether 37 students took part in the design phase. Students were divided into seven groups, of which each group during the week made one proposal for the design of the pavilion. After the design week, the pavilion's design was developed further by the tutoring teachers and also the future user of the pavilion, MFA, was involved. The final design could be seen as a synthesis of the student groups' proposals, containing the best and most interesting as well as suitable elements and features of the proposals. Among other things, the pavilion also got its name, Timber Tetris, from one of the proposals.

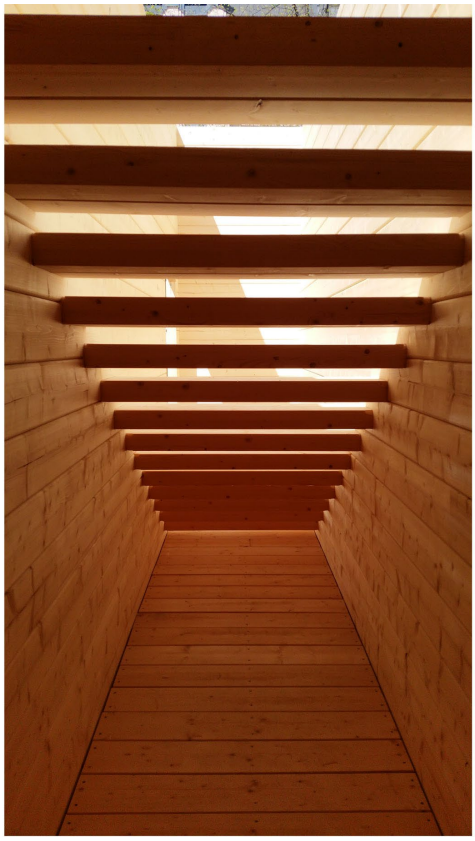

Figure 1. The Timber Tetris pavilion in the urban square (Copyright Aki Markkanen, used with permission), and Figures 2-3 interior pictures from underneath the staircase and from the hallway space (Copyright Matti Lakkala, used with permission).

In the second phase of the workshop the pavilion was constructed by the students. Logs for the pavilion had been manufactured in advance in order to get the pavilion erected in five days by students. The pavilion is constructed of industrially produced spruce logs, which are 90mm in width and 185mm in height. The appearance of the pavilion is very simple. It is a rectangular block of wood, into which the inside spaces are carved.

Participants

Altogether, we interviewed 15 professionals who operate in the building and architectural design industry. These included four architects in design practice, four architects employed as officials in urban planning and building permissions, four architectural students, and three professionals in the log building industry. Our sample included both women and men (seven and eight, respectively); however, we must point out that all officials were women and private sector design practitioners were entirely male. We attempted to recruit male officials as well; however, it was female officials who responded to the request. Furthermore, we wished to recruit design practitioners who were owners or partners in leading firms; the prevalence of males in these positions might reflect a situation in the field especially among older generations of architects. We did attempt to contact a young female architect who is a partner in an emerging practice; however, we were unable to get a response from her. In our future studies, more attention should be paid to achieve a more even representation of sexes in our materials.

Due to the inclusion of students as well as seasoned professionals, the age range of our participants was very wide, ranging from individuals in the twenties to mostly middle-aged, with the inclusion of one non-retired senior individual. Thus, the study achieved a well-rounded sample of individuals with varying education and employment backgrounds. This enabled us to gain a broad range of individuals' views and experiences.

Table 1. Breakdown of participants, occupations, gender and age ranges.

Educational background/profession:	*Female/male*	*Age range*
Design practitioner #1	Male	40-49
Design practitioner #2	Male	30-39
Design practitioner #3	Male	70-79
Design practitioner #4	Male	60-69
Official #1	Female	40-49
Official #2	Female	60-69
Official #3	Female	30-39
Official #4	Female	60-69
Industry representative #1	Male	50-59
Industry representative #2	Male	50-59
Industry representative #3	Female	40-49
Architectural student #1	Female	30-39
Architectural student #2	Male	20-29
Architectural student #3	Male	20-29
Architectural student #4	Female	20-29

Research methods

The semi-structured interview was deemed an appropriate method for gaining knowledge about professionals' attitudes, views and opinions. Our interview protocol consisted of a two-part semi-structured interview (e.g. Denzin & Lincoln, 2005). The first part was carried out in a café in central Helsinki, in close proximity to the Timber Tetris pavilion. This part included questions relating to. e.g., the *image of timber log building and timber log as a material* among professionals; participants' professional and personal *experiences of use and non-use of timber log*; and professionals' views of *the technical aspects of timber log, such as safety, expense, and ecological aspects*. The second part of the interview was a go-along style interview in which participants were taken to the site where the pavilion stood. They were instructed to speak freely of any thoughts that would arise, but also prompted through questions relating to the *general architectural quality* of the build and how it related to its urban surroundings; the *detailing* of the pavilion*; the lamella timber log material itself* and whether participants saw it as being log; and any *suggestions for improvements* that participants might have. The pavilion enabled us to discuss specifics relating to the material, its detailing, structural solutions and how the pavilion fit into the urban streetscape. We also asked the participants what their dream building material would be like.

We employed an audio recorder to record both the first and the second part of the interview. Additionally, for the second part, we used a portable High Definition action video camera (GoPro) which hung from the interviewer's neck. This enabled us to capture any gestures the interviewees would make. All in all, this method yielded roughly eight hours of audio material and eight hours of video material. The audio was subsequently transcribed into 146 pages of text documents which were utilised for close reading of the material. The video was used as a visual aid in the analysis.

The analysis approach we have followed can be described as abductive (Kolko, 2010); i.e. we did not have any prior theoretical concepts guiding this exploratory research. This is due to the fact that our aim was to remain open to all opinions, ideas and experiences that our participants have. This was reflected in the wide, holistic manner in which questions have been devised and results analysed. Through several readings of the material, both as singular narratives, and through comparing accounts across several individuals, we have allowed themes and issues to emerge. These issues, however, are here discussed through the lens of relevant literature.

This overall method has some natural limitations which should be considered. Firstly, all of our participants, as well as ourselves, are Finnish; thus, the results reported here cannot be considered to reflect prevailing attitudes and experiences elsewhere. This is normal as building is a holistic effort that necessarily engages with local culture, including practices, traditions, and experiences, and local physical issues, such as climate and weather. Secondly, all interviewees were professionals in the building industry; thus, no conclusions can be drawn concerning laypersons. We have conducted a prior survey (Juuti et al., 2017) regarding these. Third, as this is an in-depth qualitative study, the sample size is necessarily small, and thus, the results should not be interpreted through a quantitative lens.

Perceptions of log and log building

Overall, our materials confirmed the importance of studying perceptions of log and log building, as there seemed to be a prevalence of strong images among these professionals, and comparatively little experience in constructing with log, excluding those who were explicitly working within the log industry. Next, we will present the results of our semi-structured interviews by presenting findings that arose from the research materials.

Both traditional and contemporary

It was strikingly clear from our material that the participants viewed log as very traditional material. This was also evident in what would ideally be desirable for them in a log, exemplified by statements such as: “Ideally, I would like it to be traditional log, solid wood” (O1), “A hand carved log is a genuine log to me, it’s one piece of wood and made by hand.” (O2) However, the log industry representatives, rather understandably, highlighted the shape of the material rather than its composition. This definition of a log as a long-shaped piece of wood is naturally also consistent with their everyday experience. As stated, other participants had less real-life experience with log; as such, their perceptions can be viewed as being more idealised. Some participants accurately highlighted the use of log; it must be used in a way where logs are stacked one on top of the other. Log, then, must meet at least three requirements to be real log: material, shape and use-context.

Furthermore, log was also seen as a “tried and tested” (D2) material, used for millennia by vernacular builders. This was also connected with the idea of homogeneity, which was seen as not only healthy, but as a timely and trendy attribute. One official was especially adamant in her opinion that the general public wants “buildings that they can understand” (O4), and this, for her, seemed to be the prime reason that made log a very interesting material. Thus, there seems to be a connection here between vernacular building and current high-end architecture trends that might breathe new life into log as a building material.

However, while these attributes of traditionality and trustworthiness were expressed unfailingly in a positive light, the log shape that was seen as being the most traditional, i.e. round log, was seen as very undesirable by our participants. Among these professionals, then, we can identify a sort of a seemingly contradictory principle. Within this logic, it is desirable for materials to be traditional; however, its form-factor and architectural use should ideally be contemporary, or perhaps even avant-garde. This combination, we suspect, is a deeper, underlying principle. Our argument here is supported by the participants’ view, wherein they saw that the Finnish log industry had marred the reputation of log as material in the previous decades. In these previous decades, log cottages and houses were often highly traditional in their overall appearance but built with industrially produced round logs and square logs that lacked the roughness of hand-carved logs.

Thus, the following principles might be drafted from our participants’ statements overall:

> ***Traditional material – Contemporary architecture*** *seems to have generally positive connotations*
>
> ***Contemporary material – Contemporary architecture*** *seems to have generally positive connotations*
>
> ***Contemporary material – Traditional architecture*** *seems to have generally negative connotations*
>
> ***Traditional material – Traditional architecture*** *was not even considered by our participants; this would require further research*

Overall, then, log was also seen as a very relevant, contemporary material by these professionals. The trend towards homogeneity in current architecture, as discussed above, clearly affected this outlook. However, the detailing of the log and log buildings, especially the corners of buildings, had a major role to play in this aspect. Here again, the traditional, long-ended corners were seen as undesirable, and various novel corner types, where the logs ended precisely at the corner, were seen in a more positive light. This was especially seen to be connected with the suitability of log houses among other types of buildings, and with the idea of modernity, or rather, contemporary architecture.

The size and shape of the bevel was also seen as important in using log in a contemporary manner. The non-traditional round bevel of the Timber Tetris pavilion was also mostly well received by participants. However, more minimalist-style bevels were also suggested by several participants. These would have been rectangular, not round and generally smaller. The overall reasoning here seemed to be that it whatever the bevel was, it needed to be different in order to send a message: this is a contemporary building.

Some participants also expressly viewed log as a material of the future. These perceptions had mostly to do with environmental factors and health factors, as well as the changing regulations in Finland. Participants were very much aware that wood is a renewable resource that can be harvested locally, and that log buildings have a reputation as 'healthy' buildings. Participants were also very much aware that in the past, regulations in cities had made it difficult to gain a building permit for log buildings, due to esthetic concerns and fire regulations. Of these, the fire regulations were still seen as impeding the building of larger scale wooden buildings, and most participants were waiting for these to be "updated" or "optimised", in their language. The esthetic concern, however, was seen as an impediment to small houses, for example single family homes; however, our planners and building permit officials recognised this as somewhat of a thing of the past. Most were ardently of the opinion that log could be used in an aesthetically pleasing manner.

Predominantly rural, but potential for urbanity

Our participants were unanimous in their opinion that log is very much a rural building material and does not automatically suit urban settings. Only some participants alluded to the fact that up until the 20th century, Finnish cities had been mostly made of log buildings, albeit often covered with wood panel siding and other details to emulate classical stone buildings.

However, participants also acknowledged that the confinement of log into rural settings was undergoing some changes. Among these participants, the current preoccupation with log can be argued to revolve a great deal around what we might term the "urban question": Can log be an urban material? Overall, while participants viewed log as a material with a strong rural identity, most were of the opinion that this was a matter of how the material was employed architecturally. According to our participants, this hinged yet again mostly on the detailing of the corners. The traditional Finnish style corner, the so-called long corner (*pitkänurkka*), was unanimously considered to be unsuitable to urban settings. The traditional Finnish short corner (*lohenpyrstönurkka*) and variations of it were deemed more desirable. One senior designer remarked that he liked the fact this style of corner enabled the viewer to see that the wall was, indeed, massive wood.

For our designer participants overall, an important aspect of the corner was pure novelty. Many remarked positively on the specially designed corner of the Timber Tetris pavilion, stating that it was nice that it was not totally traditional. Overall, the whole discussion among the architects (students, officials and designers) can be seen as being heavily rooted in the architectural desire of using materials in what is described as an "honest manner" (which could be described in contemporary terms as "what you see is what you get") and a demand for novelty or avant-garde. From the point of view of the Finnish log industry, this urban question has also resulted in novelty, a new type of corner, the so-called zero corner. Unlike the traditional short corner, the zero corner conceals the ends of the log completely.

It could also be remarked here that Western urban culture itself might be characterised as having a sort of pull towards the avant-garde. Urban centers are seen as hotbeds of innovation (e.g. Hall, 1998; Florida, 2005; Glaeser, 2011). This might affect the image of log, as well. Novel designs might be more readily accepted as urban, despite what the actual design is like. Similarly, the

architectural trend towards homogeneity, to which we alluded previously, will likely serve to dissipate the rural image of log.

Purity and non-purity

One word that appeared often in our participants' comments was "pure". While pureness or purity was always expressed as a desirable aspect, this word, however, seemed to have varying and distinct meanings in relation to log as a material.

Firstly, pureness was used quite obviously in the microbial sense of the word, referring to hygienic purity. In this sense, log was alluded to in a mostly positive light. Log was seen as a healthy, pure material due to its naturalness. Another factor was the massiveness and simplicity of log construction. As a massive structure, log was seen to avoid many of the moisture problems of layered structures, and this was deemed also reassuring, as it is easy to understand for professionals and non-professionals alike. Participants also cited studies wherein indoor air quality was improved through the use of log in comparison to other materials. However, a couple of participants were hesitant to consider log as a suitable material in hospitals, alluding to hygienic issues. Thus, for our participants, log was simultaneously a pure and impure material, depending on the use context.

However, there was a more complex aspect of purity that emerged in the materials as well. While all participants regarded log and wood in general as a beautiful material, some remarked that they might not want to see too much of it in interior spaces, because this was not "visually pure", as stated by some participants. Furthermore, this lack of visual cleanliness was associated with summer cottages. In these leisure homes, this visual (im)pureness was suddenly tolerated, and deemed appropriate. While we can naturally argue that log has some properties, such as knots and bevels, that indeed make the material more visually busy (and thus, in the modernist sense, less pure), this does not fully explain the situation, since this busyness is tolerated elsewhere, and moreover, in a place of rest, the summer cottage so beloved by Finns. We argue that this finding could be explained through Mary Douglas' argument on cultural purity. Douglas argued that the concept of dirt and impurity, as used in everyday life, does not refer only to microbial excess, but to cultural categories: More often things that are seen as being impure are simply *matters that are in a wrong place*. Thus, cleaning is a method of organising our world. As one of our participants self-reflectively stated many times "I guess I just want things to be in clear categories" (O1). When anything transgresses current cultural boundaries, this becomes closely connected with the idea of dirtiness and undesirability. This process works subtly in the background of our daily life. Things which do not align with our pre-existing categories can, in some cases, be considered even disgusting, morally corrupt, or even dangerous. (Douglas, 1966) Indeed, the modernist preoccupation with visual cleanliness does suggest that ornate features in architecture are a threat to occupants' health.

From the point of view of log, then, this results in subtle tensions: we found the association between log and rural and leisure settings to be very strong for our participants, despite the fact that they were professionals, and knowledgeable about the changes that the material was undergoing technically and architecturally. Thus, there is a continual and distinct threat that log, described by participants as inherently natural, healthy, trustworthy and beautiful, becomes very undesirable when it is "out of place". These findings, interpreted through the concept of cultural purity, can help us better understand the situation in which log as a building material is currently. While many feel that its use is beneficial and desirable, we do not want to see it in categorically "wrong places"; unless it goes through a transformation of some sort, it becomes culturally impure, especially visually, as both a facade material as well as an indoor material. Thus, log has an uneasy relationship with various building types. This explains why log as a material must undergo an alteration (most

often through novel details that are non-traditional) before it can retain its status as an appealing and healthy material.

Natural and industrial at the same time

When first inquired about their perceptions of log, most participants described the material as natural, massive and even as having an element of craftsmanship about it. This was deemed very important; indeed, it seemed to be the most alluring quality of log for our participants. With some participants, ecological aspects also played into this idea of log as a material that is somehow close to nature.

However, when discussed in more detail, participants were very much aware that lamella logs are not just pure wood, but also contain adhesives. Here, the industry representatives and architects differed greatly in their opinions of what this means for log. While industry representatives considered the stability and preciseness of lamella log as a crucial advantage, they were remarkably, albeit understandably, quiet about any concerns that the adhesives may cause. However, the officials, design practitioners and students, who were all architecturally educated, mostly felt that while the lamella log otherwise was a definitive improvement, the adhesives they contained were definitely not a positive feature overall. Something of the ‘realness’ and ‘naturalness’ that made log desirable in the first place had been lost, and several participants went on at length about this conundrum.

However, it was not totally unacceptable for our architect participants that logs are industrially processed. Indeed, the novel opportunities excited them. When queried whether the Timber Tetris pavilion was ‘real log’, almost all were sure in their opinion that the material was indeed ‘real log’ to them. It would seem that since ‘naturalness’ is a difficult concept that is hard to justify, lamella logs sit at the edge of the categories of natural and artificial, resulting in a kind of compromise that was, on the whole, acceptable, if not desirable. Thus, log seemed to be both a low-tech and a high-tech product at the same time.

Discussion and conclusions

In the following, then, we will discuss our findings further, in the light of our literature review.

Log is a material that is mired in deep contradictions

Overall, it would seem that log is a material that is, at least currently, mired in deep contradictions. As we analysed in our participant materials, log is seen simultaneously as a traditional material, but also as a contemporary material, owing to current trends in international architecture, ecology and environmentalism, and occupant health. Similarly, it is seen as both pure and impure hygienically and culturally; its use is limited and controlled by a large number of notions in both regards. Finally, it is both industrial and natural, making it a low-tech and high-tech material. No wonder most of our participants outside of the log industry had never used log professionally.

An ideal log product, then, would retain the natural, or even handcrafted feel of the pre-industrial log and combine it with the ease and predictability of the non-settling lamella log. For these ends, the adhesives should be replaced with another method of combining crisscrossing lamellas into a log, most likely a mechanical one. Based on our participants’ views, solving the conflict between the natural and the industrial could increase the desire to use log as a building material among professionals. Such a product would be malleable and exact enough to transcend the traditional detailing associated with log construction.

Images associated with log building are very strong

A second finding we would like to highlight is the fact that the images associated with log and log building were very strong indeed for our participants. This empirical finding is quite understandable when seen through the historical and cultural context of log in Finland that we briefly summarised earlier. Our participants’ statements reflected this past, and we could even say

that in prior decades, log in Finland has been a material stigmatized as an undesirable, overly traditional material of limited architectural potential. Similarly, buildings made out of log were seen as un-modern and not suitable outside of leisure time circumstances.

While the traditional-ness of log seems to be changing into a positive feature, the summer cottage connotation seems to persist in a problematic manner. The implication for design and product design here, is that log must undergo a further transformation. The desirability of log, then, seems to depend on more high-status contemporary design, achieved through novel architectural uses and use cases. However, an interesting question we might pose for architects here is whether or not some traditional details could be successfully integrated into urban environments, and if so, under what conditions?

Log as material is undergoing a rapid change in perceptions

The changes that are currently affecting log appear to run the gamut of what is possible. Some of these changes are technological in nature: the introduction of industrial log and computer-controlled manufacturing methods, which are changing the nature of log itself. These result in architectural questions of what can be done with this new material. Some questions are regulatory in nature: where are the limits of using log in urban settings, especially vertically? Finally, all this affects and is affected by what we culturally think log is, and what it should be. Culture plays a major part in what is happening around log as a material; the surging interest in the ecological aspects of wood changes our perceptions of log, as was also seen in our materials.

A central question that still arises from this material is, whether or not the use of lamella log is still relevant in the age of CLT and its glue-free alternatives? This line of questioning was not pursued directly in our interview, and, as such, it would warrant further research. However, on the basis of the materials at hand, we can argue that the very nature of lamella log is different from CLT, despite the physical sameness of the material. This is due to the fact that for our participants, 'log-ness', and everything that was culturally related to it, was most definitely a combination of *material*, *shape* and *use-context*: a long, horizontal piece of massive wood, stacked on top of each other. Log, then, is a cultural assemblage, and not a mere raw material. Since log is defined by at least three parameters, the addition of adhesives into this assemblage does manage to render it somewhat unstable, but not unrecognizable – lamella log was still log to the participants.

Log, then, is still relevant in the cultural contexts that it has been found. The crucial factor, then, is whether or not log is desirable to professionals and their customers. From this point of view, a better future could well be in store for log as a material: Our analysis did suggest that there may be differences between the generations of professionals in their relationship to log as a material. Although we cannot ascertain this through our current study, this would make a fascinating research question for further investigations. While the senior architects were more hesitant and had a somewhat distant relationship to log, the student participants we interviewed were definitely very curious about the material, especially due to its ecological and health-related benefits. However, the students' knowledgeability concerning log and log construction varied considerably. It would seem that the architectural education system did not expressly teach them about the subject; rather, the matter was left for them to explore on their own.

Future (for) log buildings

As one of our participants expressed, "log has unused potential". This potential relates to ecological issues, health issues, log as a business commodity, as well as architectural expression. Our research at this point manages to scrape the surface of what is possible with and for log as a building material. In the future, more studies should conducted from various points of view. Some of these would include a better integration of the general wood literature with the much smaller log literature, and a discussion of what those findings might mean for

log research. Secondly, several multi-pronged studies on log should be conducted; for example, some relevant questions might include how the extra cost of the material could be offset by either architectural design strategies or by business measures.

At this point, it seems quite certain that if the glue were to be removed from lamella logs and replaced with, e.g. mechanical fastening methods, a sweet spot might be achieved where the material integrity of log would not be compromised while a technically contemporary and architecturally desirable product would be created. Even more so than the material, then, shape was a crucial factor in establishing both the log-ness of the material. Thus, much attention should be placed on the form factor of log. The thickness and shape of the bevels, as well as the design of the corners were clear and powerful cultural signals to our participants. It could almost be said that the most important factor about these details was the newness of the design. In regards to the bevel, the smaller it was, the better is seemed to fare with our participants. This raises the questions, should there be a zero-bevel log? Architecturally, this would certainly open up new ways to use log. However, it remains an open question whether this would have finally changed the essence of log enough that our participants would have said “This is no longer log”. Thus, the question of the bevel remains an object for further inquiry.

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Novel Architectonic Solutions for Industrial Log

Five Examples of Contemporary Architecture

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Abstract
There is a growing demand on using log as a construction material. In addition, production technology and technical properties of log products have undergone rapid changes in the era of industrial production. Examples for use of industrial log, that are architecturally suitable for the requirements of new uses, are few. For these reasons in this paper, it is explored what are the properties of industrial log building, and what kind of novel, structurally characteristic architectonic solutions for industrial log emerge in contemporary architecture. Besides a literature review, a qualitative analysis on five examples of contemporary architecture is conducted. As results, we showcase several novel architectonic solutions for industrial log. The first category of results, overall configuration of logs, includes entireties of logs that are structurally bearing, but also entireties where the logs act in other function than as structurally bearing. Entireties of logs are supported by next two categories – joining of logs and properties of individual logs, which can both be seen as components of the overall configuration. This study creates basis for further research on architectural possibilities of industrial logs. In addition, findings of this research can serve as an inspiration for designing architects and log house industry.

Keywords: log building, log architecture, wood architecture, contemporary architecture

Introduction
In Finland there has been a major public concern regarding problems in quality of indoor air of buildings – especially schools and other public buildings, but also smaller single-family houses. The reasons for these problems are quite well known today thanks to active research on the matter. Present-day multilayered wall structures have proven to be vulnerable to moisture related

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issues, in cases when even seemingly minor mistakes occur in construction phase or damage is made accidentally during the use of building (Mölsä 2016). This is why more simple and comprehensible building techniques, such as massive, homogenous wall structures have become topical. In log building walls consist entirely of solid wood. Massive, homogenous structures are considered by many the most reliable alternative for wall structure in terms of moisture related issues, because homogenous structures are far less sensitive – compared to multilayered wall structures – for errors that could cause moisture to condensate inside the wall.

Along with its structural simplicity and comprehensibility, another reason why log constructions have become very current, is the ecological aspect of using wood in buildings (Heikkilä 2002, p.19). Built environment is responsible of almost one third of all CO2 emissions worldwide (Kuittinen 2016, p.2). One simple and fast solution to reduce the emissions would be to increase the use of wood, a renewable natural material, in buildings (Ruuska and Häkkinen 2012). Especially in large-scale buildings, the use of wood has been marginal compared to other materials such as steel and concrete. This is however beginning to change. More and more wood structured apartment blocks and other large scale buildings are being built around the world as well as in Finland at the moment, mainly using solid wood products, such as cross laminated timber, CLT, as bearing structure (Harju 2017). Log building, a construction technique of ancient origin, makes even more use of wood: In log buildings, the only material used in wall structure is solid wood – as an insulation as well.

In ancient times, logs used to be mere tree trunks that were notched to form walls. Since then, contemporary, industrially produced log has become a long way in terms of technical quality and production techniques. Industrially produced logs of today are usually glued together from multiple smaller lamellas of wood, and are manufactured in a factory setting. Architecture of industrially produced log houses on the other hand is less developed, compared to developments in the manufacturing of log and log buildings. In the past, in areas of boreal forest, log was nearly the only material that was used for building. There are for instance many examples of sophisticated log architecture in the history of Finnish church architecture, built by skilled craftsmen (Soikkeli and Koiso-Kanttila 2006). In Finnish context, log was superseded in the beginning of 20th century by frame construction (Heikkilä 2002, p.15). After that log remained to be used in smaller volumes in sauna huts and few Lapland tourist buildings until the turn of 1950’s, when log houses began to be produced industrially.

The tradition of skilled craftsmen did not transfer in to the industrial production of log houses. Industrial log houses have been traditionally summer cottages, sauna huts and single-family houses by use and have been built to areas of dispersed settlement. What is also noteworthy is that during the first five decades of industrial log house production, no professional designers were used in the practices of log house manufacturers (Jokelainen 2005, p.12). Consequently, log houses eventually became merely industrial products where buildings’ appearance was dictated by optimization of production technology (Heikkilä, 2002, p.15). Log house manufacturers have since the turn of the millennium developed their products further and today some industrial log houses that are acceptable for more urban residential areas exist. Today, there is a growing demand on using log in urban areas in large-scale public buildings as well as in residential buildings of all sizes, where requirements for architectural quality are strict. Thus, it is clear that architectural solutions for industrial log houses still need to be developed to match these new requirements and new properties of developed product and production technology.

Log building has since industrialization been a rather uncommon way of constructing, and this reflects to scientific research concerning log building as well. The few examples of scientific research in the field of log building

concerns mainly industrially produced logs' structural qualities from engineering's viewpoint, such as structural strength of log constructed walls under compression (Bedon and Fragiacomo 2015; Grossi, et al. 2016). In addition, log home manufacturing has been studied from the viewpoint of forestry (Peters et al. 2017; Thony et al. 2006). When broadening the scope to other research concerning wood, numerous studies have been conducted concerning the experiential effects of wood, which can offer useful aspects to log research as well, as noted by Luusua et al. (2019). Examples of other literature dealing with log building exist, but are quite few by number with subjects concerning mainly history of log building and hand hewing of logs. (Phleps 1982; Vuolle-Apiala 2012) In addition, studies on other solid wood architecture – that is, CLT architecture – exist. Bejder (2012) in her dissertation studied the aesthetic qualities and materiality of cross- laminated timber; and Falk (2005), in his dissertation studied architectural aspects of massive timber plates in the scope of structural form and systems. These studies contain some knowledge on log architecture as well, as part of the history of wooden architecture.

Thus, the architectural viewpoint in the scope of log building is almost completely unexamined field of research. However, research from this viewpoint has been conducted by Jokelainen (2005) who in his dissertation studied the significance of log structures to the architecture of historical railway stations in Finland. In historical context, Jokelainen examined what kind of architectural possibilities and restrictions log as a building material possesses and what kind of requirements log structure sets for the architectonic form. As a result, Jokelainen indicates that there are several factors due to the log structures, which affect the architectonic form of studied buildings. The significance of structural configuration of logs in log architecture creates the starting point for the paper at hand as well. Besides functioning as a bearing structure, log structure often acts as an insulation layer and forms the visible surfaces both inside and outside. Thus, in order to develop architecture of industrial log buildings, it is crucial to examine architectural solutions from structural viewpoint.

The aim of this paper is to map novel architectonic solutions for industrially produced log that are based on the characteristic structural properties of industrial log and log building. This is done in the scope of contemporary architecture, as a natural continuation for Jokelainen's work in historical context. The research question is, what kind of visible architectonic features that are based on the characteristic structural properties of industrial log and log building, that are particularly novel and thus architecturally interesting, emerge in contemporary architecture? The notion of novelty means that we aim at exploring such solutions that demonstrate – compared to everyday industrial log building of today – new possibilities for log architecture. Therefore, as a by-product, this research aims also to take first steps in broadening the orthodox conception of log building to match the new industrial properties of log building. Next, a literature review is presented on what are the characteristic structural properties of industrial log and log building, followed by results of qualitative analysis on example buildings of high-quality architecture.

2. Literature review

2.1. Multiple definitions of log

Log building is a very old technique. The earliest archeological proofs of log constructions are from Stone Age, from 5000 years ago. The origins of the building technique might be in Italy and the Alps, but it is possible that basic notching of logs has been realized locally over the centuries and millennia in boreal forests of the world (Vuolle-Apiala 2012, p.52). In the beginning, log was simply a tree trunk that was felled and then notched to form walls. Taking a leap to present day, log is described as "solid, at least 68 mm thick building material manufactured by plane or turning machine, used mainly as log for walls."

(Building Information Ltd. 2014) This is a general concept for log, which is supplemented by definitions of lamella log or glue-log: “It is glued together out of two or more pieces with vertical, horizontal or cross bonds.” (ibid.) Industrial logs of the new millennium are quite different from the mere round tree trunks of ancient history, not least because they are usually manufactured by gluing lamellas of wood together (Bedon et al. 2015, p.475). Log has undergone a massive development in terms of technical quality during its existence. Contemporary log is a high-quality product of engineered wood and is homogenous by grade as well as precisely measured (Heikkilä 2002, p.17). Heikkilä even contemplates if contemporary industrial log is already too a precise industrial product and therefore possibly lacking some positive qualities such as liveliness of hand-hewn log (ibid., p.17). Industrial log resembles considerably glued laminated timber, which by definition is “an improved form of solid timber in which the growth-related defects in the wood that tend to reduce the strength have been partly eliminated.” (Herzog et al. 2012, p.40)

To fill the gap between ancient history and present day, in terms of definition of log, it seems that tools for woodworking enhanced, and so did building techniques for log buildings. Eventually logs of round shape were started to be hewn so that the sides were vertical and straight. Hewing the outer side of log wall vertical made logs more durable against the weather since surface wood – which is more quickly decaying – was removed to expose the more durable heartwood (Heikkilä 2002, p.11). In addition, hewing the outside surfaces of walls flush enhanced – by the standards of the time – the looks of a log building (Kaila 1996). It made a log building appear more as a brick building, and thus fitting better to urban context. When it comes to dimensions of logs, for example in Finland since 18th century, a typical width of logs used in log walls was six inches. This was due to common guidelines based on good building practices of the time, which recommended a four-inch-wide caulking gap between the logs and an additional inch of wood on each side of the wall (Kaila 1996). To elaborate, the purpose of caulking gap is to make the structure weather tight against rain and wind. The height of individual logs was the same as the trees’ diameter. This way a reminiscence of the trees original round cross-section profile remained visible in a form of a bevel of approximately one inch

The cross-section profiles of present-day industrial logs consist mainly of rectangular shapes with small variations in profiling of corners. As seen in figure 1, characteristic to these cross-sections are small tongues and grooves whose specific shape depends on the manufacturer and whose purpose is to achieve proper interlocking between overlapping logs (Bedon et al. 2015, p.475). Also

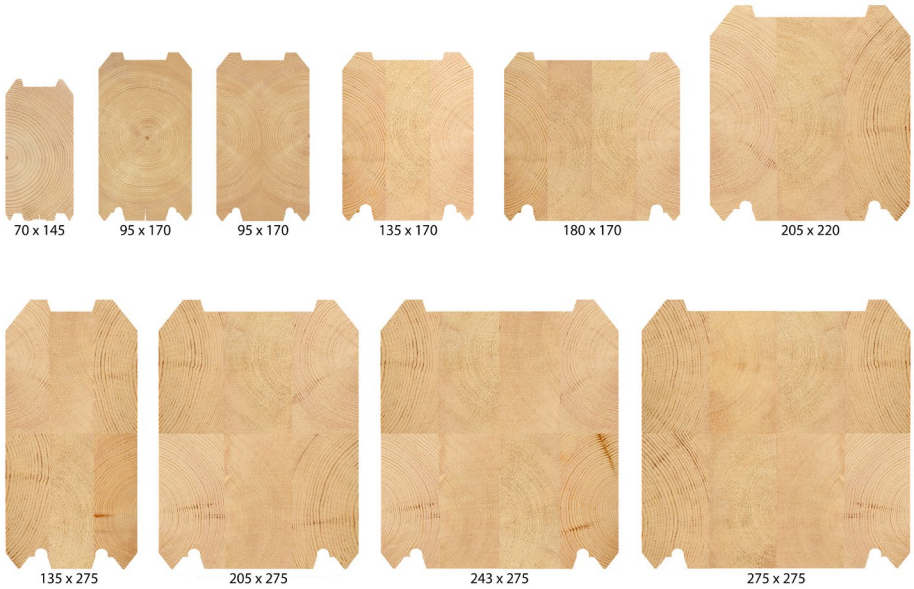

Figure 1. Industrial log profiles made out of single piece as well as multiple pieces of wood for different uses. (Images courtesy of Kontiotuote Oy)

some round or so-called D-profiles exist but rectangular profiles have nearly superseded them in contemporary log buildings (Building Information Ltd. 2014). In the selections of Finnish industrial log producers, there is a wide variety of logs with different cross-section sizes with widths ranging between approximately 90 mm and 270 mm and heights between 145 mm and 270 mm. The smallest of these can be planed out of single piece of wood but with cross-section sizes more than 100mm of width or 200mm of height the logs are mainly produced by gluing lamellas of wood together, the amount of lamellas ranging from two up to eight. (Mammuttikoti 2015; Kuusamo Hirsitalot 2017) Minor profiles are used for sheds and cottages while larger are used for purposes of residential and public buildings.

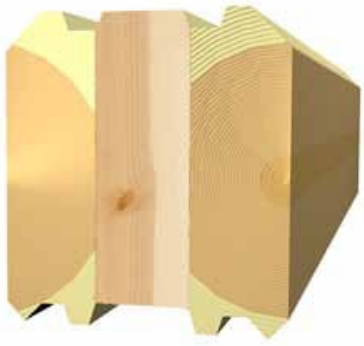

Figure 2. Non-settling log. Wood shrinks only in direction perpendicular to grain, and in here the vertical layer of wood in the middle prevents shrinking. (Image courtesy of Matti Alasaarela, Inspis Oy, used with permission)

Sizes of these industrially produced lamella-logs vary by use, but it could be argued that in general they imitate more or less the dimensions and proportions of so-called original or traditional logs consisting of one tree trunk. In addition, the bevels in profiles of industrial logs have long resembled earlier logs where the round shape of the tree was visible in the corners of the cross-section profile, as described above. Only recently have some log manufacturers established profiles with minor, delicate bevels to their repertoires.

Most significant technical development of past years for industrial log has been the so-called “non-settling log” – a lamella log in which the wood material in the middle part of the log is in upright direction while the wood in the two sides is in longitudinal direction of log (Vuolle-Apiala 2012, pp.185-186), as seen in figure 2. Using this type of logs removes the one feature of log building, which requires the most consideration in design and construction – that is, settling. Sometimes it is questioned, if industrial log solutions are even log building. Vuolle-Apiala for example, bypasses industrial log building by few general mentions, because “different manufacturers have their own solutions, of which functionality can be assessed only by experiences accumulated during future decades.” (ibid., p.6)

2.2. Structural characteristics of log building

General characteristics of log constructions

German term for log house, blockhaus, makes an indication of one essential feature of log construction. Term tells the simplified essence of log building. It is actually stacking blocks of wood one upon the other, which then stay together due to gravity hence making it in a way similar to building with stone or bricks. Swiss architect Peter Zumthor (2006), portrays log wall as a wall of layered beams of wood – wall is constructed by placing beams of wood on top of the other. Traditionally, these layers of wooden beams are called courses. In his home region, log buildings – or blockhouses as he puts it – are called strickbauten, which according to Zumthor means knitted houses. The term refers to the actual construction process of a log building, where the whole is knitted together with beams. (ibid.) Log wall achieves its structural strength mainly from fitting and interlocking at the corners (Phleps 1982, p.52). To form a corner, which is structurally relevant, it requires one meter of solid wall on both sides of the corner (Jokelainen 2005, p.167). This is an indication of another important structural feature of log wall. Log wall can form a structural wall plate – that is, a shear wall (Herzog et al. 2012, p.127). This is achieved by doweling, in which individual logs are joined together by wooden pegs or steel screws (Heikkilä 2002, p.21-23). This feature can be taken advantage of also by forming log beams where two or more overlapping logs, which are doweled together, form a beam (Building Information Ltd. 2014).

Settling

One characteristic feature of log building is settling. Wood is a hygroscopic material, which means it will gain or lose moisture from the air, and this causes wood to expand or contract according to humidity changes in surrounding environment (Meier 2016). Thus, a building frame consisting of horizontally laid logs settle during time as the logs shrink when they dry out. Because wood is

an anisotropic material (Thibaut et al. 2001, p.704), shrinkage of wood is particularly strong in direction perpendicular to grain. Some of the overall shrinkage is due to gravity, when the fittings between the logs tighten over time. Settling is thus exploited making a log structure airtight (Falk 2005, p.28). Settling of log constructions made out of industrially produced logs is significantly lesser (Heikkilä 2002, p.23) compared to earlier log houses, since the timber of industrial logs is dried in advance prior to production. Settling brings about some challenges structurally speaking that need to be considered. Generally, this means that any construction such as concrete wall or building parts such as windows or doors that are attached to a log wall must allow movement of the wood across the grain (Zumthor 2006). When using the so-called non-settling log, which was described above, log structure does not settle almost at all. The shrinkage is the same as for example of structures made out of CLT. Technically non-settling log is a strip of CLT.

Joining of logs

Joining – that is, knitting of strickbauten – is how log wall achieves its structural strength. Joining of overlapping logs could be divided in two main categories: joining of parallel logs and joining of crossing logs. Parallel logs are joined together besides by tongues and grooves, also by steel or wooden dowels. Joining of crossing logs is used when two crossing logs encounter. This occurs in intersections of two walls – such as corners and when wall abuts on crossing walls side – or when a single log intersects with wall. Simple round notching, where log ends extend beyond the joint is the oldest of corner types. However, in order to achieve certainly tight-fitting joint at the corners, log builders throughout history have developed a variety of alternative corner types, as some examples are seen in figure 3. In the course of time also dovetailed corners, where log-ends are flush with the crossing wall, were developed. This was done in order to emulate the smooth walls of solid masonry construction and in some cases to facilitate the application of exterior cladding of some type. As noted above, the function of cornering is primarily structural, but during its evolution, cornering began to be used also as a distinctive decorative motif of log buildings. (Phleps 1982, p.60)

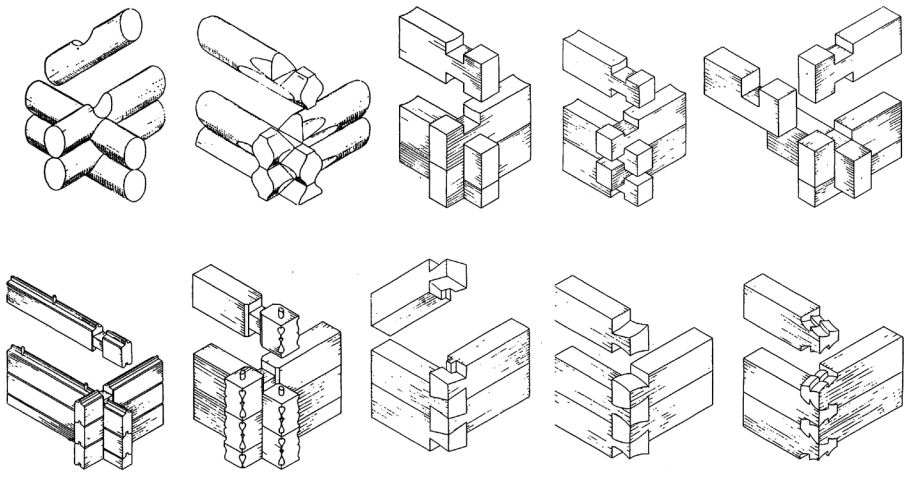

Figure 3. Few examples of the abundance of traditional cornering techniques ranging from simple round notching to sophisticated lock notching, in which log ends create a strong decorative motif in a flat corner. (Figure by the authors, according to Phleps 1982)

Though in hand-hewing tradition flat, flush cornering is a centuries old tradition, in industrial production it is relatively new development since Jari Heikkilä (2002, p.21) states the lack of such corner option being one of the greatest deficiencies of industrial log production at that time. Today such corner types are available in industrial production. In addition, as seen in figure 4, a hidden dovetail joint has been developed to meet the visual requirements of densely built urban areas (Mammuttikoti 2015). In this solution, intersecting logs are miter cut. Interlocking between the logs is achieved by hidden dovetail joint in the center of the miter cut. Characteristic for all other corner joints is that they

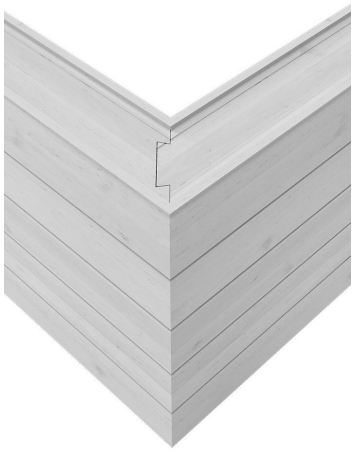

Figure 4. Corner of log walls with a hidden dovetail joint. (Image courtesy of Mammuttikoti)

reveal and emphasize the construction technique as well as wall's thickness. Hidden dovetail joint also enables the log courses to be even instead of the traditional half-lapping courses. Thus, when hidden dovetail joint is utilized, log buildings that don´t appear as log buildings – by orthodox definition – are created.

As a summary it can be stated that contemporary, industrial log is a product that is made out of solid wood, either a single piece of wood or multiple lamellas of wood that are glued together. However, this type of beam or block of wood becomes log only after it is assembled in a certain way – that is, laid upon each other horizontally. Thus, the addressed knowledge gap and aims of this study together with literature review on rapidly developed structural characteristics and other nuances of industrial log and log building serve as the motivation and conceptual framework for our study of novel architectonic solutions for industrial log. Next, we will present the research process, which we devised for this purpose.

3. Materials and methods

The analyzed example buildings of high-quality architecture were selected from a set of architectural publications. High-quality architecture is defined here through the institutional concept of architectural quality, which in this case means, that the professional actors in the field of architecture define what is considered as high-quality architecture. (Pihlajaniemi 2014, pp.63-66). Publications were chosen through an iterative process so that they could be expected to cover sufficient number of published buildings considering the research topic. Chosen publications included two major international web-based publications (ArchDaily, Dezeen), two international printed publications (Detail, Architecture and Urbanism) as well as two Finnish architectural publications (Finnish Architectural Review, Wood). Publications were general by nature, meaning that they cover buildings of all sizes and uses, and buildings in urban and rural environments. This was seen essential as our presumption was that log buildings are traditionally used more in rural environments and they are relatively small-scale buildings. Wood magazine is concentrated solely in publishing wooden buildings. The temporal scope for our study is from year 1990 to October 2017. The printed publications cover the entire temporal scope of the research. However, Archdaily was established in 2008 and Dezeen in 2006, and though they entail some published buildings from the entire temporal scope, primarily they cover approximately the last decade of the temporal scope of this study. Despite their shortage in the temporal coverage, we wanted to exploit them as well since they cover such a large number of published buildings in an easily searchable format.

As the selection criteria for the buildings, we used a broad definition of log building that was established in the previous section of this paper, instead of orthodox conception of a log cabin. Used definition takes into account the recent developments of log products. This way we could find besides the obvious log buildings, also the buildings that are not called log buildings nor could be unambiguously regarded as ones but nevertheless contain such features and solutions that are of interest in the framework of this research.

All the buildings that fit the given criteria were listed, see table 1. The total amount of found examples was 86 buildings. As a sidenote it could be said that the number of listed buildings is relatively small compared to the amount of buildings that these publications comprehend. For example, in Archdaily alone, 2744 buildings were published in year 2016 (ArchDaily 2017a). This can indicate to the fact that log building is relatively rare in general as a construction technique or / and that it is rare for log architecture to be regarded as good enough architecture worth publishing. This interesting question is not however in the focus of this study.

Table 1. All found building examples from separate sources.

Source	*Building examples listed*
Archdaily	21
Architecture and Urbanism (A+U)	19
Detail	7
Dezeen	8
Finnish Architectural Review	22
Wood	38
Total	86*

**Some examples were published in multiple sources, but each of these is included in total sum only once.*

From top left: Figure 5. Final Wooden House (Image courtesy of Iwan Baan). Figure 6. Haus Luzi (Image Courtesy of Ralph Feiner). Figure 7. Yusuhara Wooden Bridge Museum (Image courtesy of Takumi Ota). Figure 8. Workshop AWEL. (Image courtesy of Jürg Zimmermann). Figure 9. Norwegian Wild Reindeer Center Pavilion. (Image courtesy of Ketil Jacobsen).

The listed buildings were tentatively evaluated and out of these the five example buildings were selected. The aspect of novelty directed the choosing of the examples. From this viewpoint, the chosen examples were considered as the most illustrative in the found selection of buildings. That being said, it should be noted that the expertise of the authors as architects that have experience in the field of wood and log architecture, obviously strongly affected the selection of the examples. The chosen five examples are Haus Luzi by Peter Zumthor, Final Wooden House by Sou Fujimoto, Yusuhara Wooden Bridge Museum by Kengo Kuma & Associates, Norwegian Wild Reindeer Center Pavilion by Snøhetta Oslo AS, and Workshop AWEL Andelfingen by Rossetti and Wyss Architekten, see the figures 5-9 above. The buildings were completed in 2002, 2006, 2011, 2011 and 2015 respectively. Analyzed buildings are diverse by means of scale and use.

The qualitative data, through which the example buildings were analyzed, consisted here of photos and drawings representing the buildings as well as text descriptions by the architects responsible for the building designs. Even though the examples were discovered through the publications mentioned earlier, more drawings and photos were then searched from additional sources when needed in order to reach a sufficient understanding of the buildings. Table 2 represents the material available, and sources used for each example.

Table 2. The sources and material available of the selected buildings.

Example building	*Used sources*	*Available documents*
Haus Luzi *(originally listed from Dezeen)*	(Zumthor 2006)	5 photos, floor plans, sections, elevations, sketch drawings, text description by the architect
Final Wooden House *(originally listed from Detail)*	(Archdaily 2008) Additional 14 photos from Iwan Baan Studio	30 photos, site plan, assembly diagrams (plans and sections), elevations, detail drawings, text description by the architect
Yusuhara Wooden Bridge Museum *(originally listed from ArchDaily)*	(ArchDaily 2012, Divisare 2016)	9 photos, site plan, floor plans, elevation, sections, detail drawings, text descriptions from the architect
Norwegian Wild Reindeer Center Pavilion *(originally listed from Wood)*	(ArchDaily 2011)	7 photos, plan, section, elevations, text description by the architect
Workshop AWEL *(originally listed from Detail)*	(Schweizer Baudokumentation 2015, Competitionline 2016, ArchDaily 2017b)	10 photos, site plan, sections, elevations, detail drawing, conceptual sketch, text descriptions by the architect

The actual method of analyzing the data has many similarities with qualitative research as described by Groat and Wang (2013, pp.215-258). In this method the research process has an emphasis on an inductive process (ibid., p.218)

and is usually framed "within either the intersubjective or subjectivist paradigms." (ibid., p.242) Our approach could be regarded as descriptive but also as exploratory research in the sense that the aim here has been to explore and remain open for novel solutions for industrial log. O'Leary (2009, pp.262-263) describes the process of qualitative analysis as six step cycle moving from raw data to theoretically meaningful understanding, and points out that instead of a linear process, it is typically an iterative one. In our research, after preliminary analyses, in order to move from raw data to organized data, each of the five examples was first analyzed separately according to aspects that were detected in the literature review to be structurally characteristic. These aspects included: 1) General description on how the logs of the building are assembled together and what kind of entirety they create; whether log is used as a bearing structure or not and what structurally characteristic features are there in the general structure. 2) How the logs are joined together? 3) What kind of logs are used; composition of log, size and shape of log and quality or texture of the surface of the log? 4) How architects have described their buildings from the viewpoint of the first three aspects? The same practice of analyzing buildings by the chosen identifiable factors of interest has been used before also by Jokelainen (2005) and Bejder (2012).

Photos and drawings were analyzed as documents illustrating the examples, from the chosen viewpoint of structural characteristics. Text descriptions were analyzed in order to reach more thorough understanding of the buildings and on intentions that the designing architects had described having regarding the solutions in the focus of this study. Textual data was used as complementary material in analyzing the buildings but also as a deepening material to reach better understanding of the meaning of the solutions that emerge in the example buildings. According to the aim of this study, in the analyses we focused on visible architectonic elements of the examples.

Building illustrations were transcribed into textual data with these analyses. Acquired textual data was then gathered into a comparative chart where all the analyses of individual buildings were alongside each other, divided according to the analyzed aspects one below another, and therefore easily comparable. Data reduction was then continued by detecting emerging themes in the separate analyses. These themes were then compared with each other inside one example as well as between examples to reach a thorough understanding of their significance and to draw conclusions.

4. Analysis

We found many novel visible architectonic features for industrial log that were structurally characteristic. When speaking of structurally characteristic architectonic solutions for industrial log, we found the following classification of results into three categories useful. The first category of novel solutions is the overall configuration of logs, or the entirety that the logs create. By this, we mean the kind of pile of wood – so to speak – the logs form. Entireties of logs that form the bearing structure of the building were present, but surprisingly also some structurally characteristic configurations of logs were found that had other meanings for the whole than structurally bearing. Second and third categories of joining and properties of individual logs can be seen as supplementary components or elements of the overall entireties. These other features mainly – with their properties – support the architectural idea created by overall entirety of logs. Thus, our findings are of different scales ranging from the scale of the entire building to the scale of properties of a single log. Next, we will present and discuss the found solutions through aspects of relevant literature, classified into three categories.

4.1 Overall configuration of logs

Structurally bearing entireties

In four of the examples, the overall structural configuration of logs was clearly the main architectural theme. In three of these examples, we considered the

overall, structurally bearing configuration to be particularly novel. Workshop AWEL is virtually a traditional shed by means of the entirety that logs create, so it is not examined here in detail.

To start with Haus Luzi – which is at first glance a very typical log building since it consists of traditional and structurally bearing log walls that are interlocked at the corners – there is certain novelty in the general structural configuration of logs. Building is composed of four log towers in the four corners of the house. As Zumthor (2006) has noted, log walls lose their natural strength if large openings are cut to them. By making four very solid log towers to the corners, see figure 6, Zumthor has been able to create large, glazed surfaces in between the towers. Since corners give the rigidity for the log house, this way the structure becomes very stable, despite the large, glazed surfaces.

Zumthor has established a set of rules for log building and followed them when designing Haus Luzi (ibid.). These rules are based mainly on characteristic structural features of log and log building. In Haus Luzi, they create the structural principle of four log towers, which has then served as “the spatial compositional principle of the ground plans”, as Zumthor (ibid.) puts it. Further, Zumthor has used floors, roof and walls as distinct slabs and planes, which give the building its characteristic looks. Considering the effect that the log structure has for the house by means of functionality and appearance, it can be seen how crucial this overall structural configuration of logs is for the architectural appearance of this building.

Yusuhara Wooden Bridge Museum on the other hand is not a log building by an orthodox conception. In Bridge museum there are no log walls at all that could be interlocked in the corners – but there are stacked beams of wood that cross each other, just as in a traditional log building. However, in this case, the beams are not directly one upon the other but displaced systematically in horizontal direction on each level of logs. Traditional log walls form a rigid wall plate. Quite similarly, in here the logs are stacked one upon the other and joint together in intersections and thus forming a bearing structural entirety for the bridge, as can be seen in figure 10.

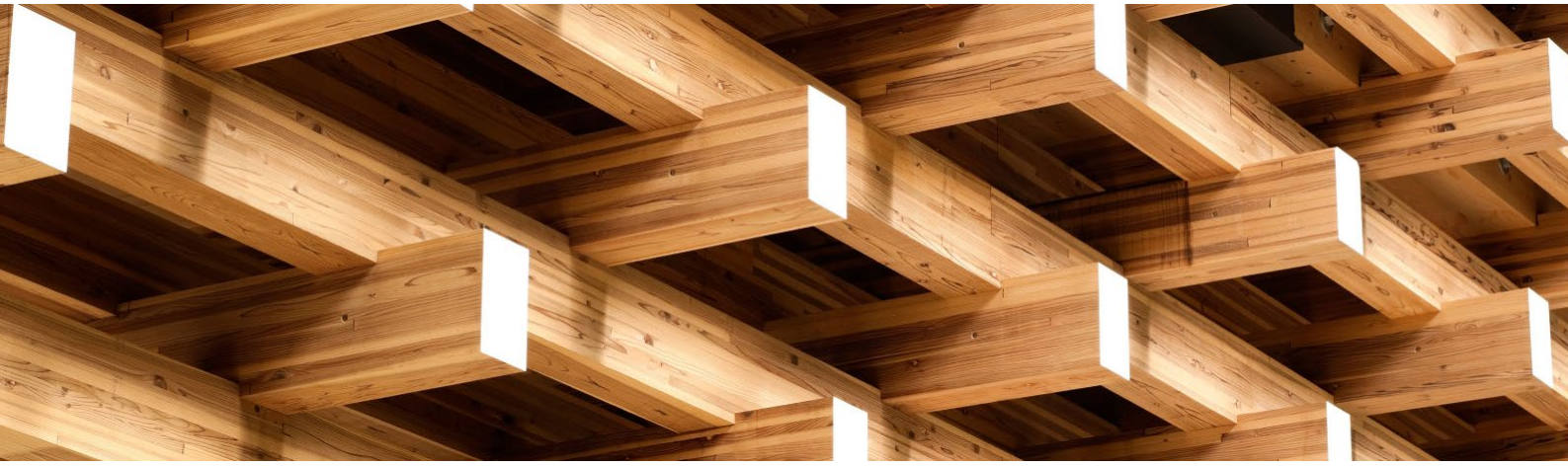

Figure 10. Structural entirety of logs in the Yusuhara Wooden Bridge Museum. (Image courtesy of Takumi Ota)

When looking closer to the detail plans of the museum several matters indicate that the visible structural entity is not the only bearing structure for the bridge. For example, there is a steel beam on top of the central column of the bridge supporting the floor slab of the bridge. However, even if the structure of beams would not be used here as the only bearing structure, the principle of the visible structure is functional and very novel in the scope of this research. The structural entirety can be viewed as a log wall, where the parallel longitudinal beams are the logs, and the crossing beams are the dowels of that same wall. When the parallel logs are joined together with these dowels, the logs form a larger beam, a structural entirety that can cantilever a considerable span.

Like the Bridge Museum, nor is Final Wooden House unambiguously a log building based on the assembly technique of logs. Unlike in a log house of an orthodox conception, in Final Wooden House logs do not form walls by contiguous rectangles, although the basic shape of the building's layout is a square. Instead, the logs are laid upon each other not in a conventional manner but more freely, seemingly in almost random order. The structure of the building is basically a stack of wood blocks. This type of laying the logs creates the cave like space for the building, which is its main architectural theme.

Entireties related to other functions that bearing structural

Entireties described above manifest the bearing structural function of logs. However, such overall configurations where logs act in other function than as structurally bearing element – but still exploit the same structurally characteristic properties – emerged from the material as well.

Wood is known to be versatile, but the notion that logs of a log house can also be used in providing necessary furniture, fixtures etc. as an integral part of the log structure is something rather untraditional and novel in the context of log building.

Fujimoto talks about extreme versatility of lumber as the starting point of the design of Final Wooden House (Archdaily 2008). The architect wanted to create ultimate wood architecture (ibid.), of which the name Final Wooden House is an indication. "Rather than just a new architecture, this is a new origin, a new existence" (ibid.), Fujimoto describes. The architect has envisioned this imaginary new origin for wood architecture, a primitive condition, where different functionalities – such as "columns, beams, foundations, exterior walls, interior walls, ceilings, floorings, insulations, furnishings, stairs, window frames" (ibid.) – have not yet differentiated. Final Wooden House is virtually a stack of wood blocks, where – as the architect describes – "one thought was a floor becomes a chair, a ceiling, a wall from various positions." (ibid.) Versatility of log, or logs acting in other function than as bearing elements is the novel architectonic solution here. But how is this structurally characteristic? Firstly, even though logs are used in non-bearing manner, they are visually and functionally part of the same structure. Secondly, this is technically possible because of wood's structural properties. As seen in figure 11, these properties enable the logs to work as beams that can cantilever when needed and be used for hanging underneath structures from them. On the other hand, it is possible to use the same wood material as the surface material in these various uses that were counted above.

Figure 11. Interior of Final Wooden House. (Image courtesy of Iwan Baan)

In Norwegian Wild Reindeer Center Pavilion by Snøhetta, the architectural starting point has been the function of the building as a sheltered place for observing the surrounding nature. The outer shell is rigid and cold designed to withstand the harsh climate, while the interior of the building is warm and cozy. Logs of the pavilion are stacked upon each other but also besides each other

and all in parallel. This is the only one of the example buildings where logs do not function as the bearing structure of the building. Inside the log structure there is a secondary framework whereto the logs are attached. Instead of structurally bearing wall plates the logs of the building form something of other use than bearing structural. The stack of wood blocks is carved in to a free-shaped form, which creates a strong decorative element, but also a functional element by defining the space and providing a seating area for the use of the building. The element that the logs create is also visibly present in the two open facades of the pavilion, as seen in figure 12. This novel way of using log material is related to two things. Firstly, it is possible to sculpt something like this out of logs because of the homogeneity of the material. Secondly, this building illustrates what is possible with logs if present day computer aided milling machines and 3D-design software are exploited.

The versatility of log material is manifested in these two examples. In addition to structurally bearing components logs can be used to generate also parts that have other functions, as described above. Wood is known to be versatile, but the notion that logs of a log house can also be used in providing necessary furniture, fixtures etc. as an integral part of the log structure is something rather untraditional and novel in the context of log building.

Figure 12. Free shaped log structure is visible in the façades of Norwegian Wild Reindeer Center Pavilion. (Image courtesy of Ketil Jacobsen)

4.2. Various ways of joining the logs

In the entireties that were described above, logs are joined together. This joining can be done in multiple ways. Various types of joining were used in our example buildings as a way of underlining the architectural themes of the buildings. According to Zumthor (2006) the corner joints of a log building have a fundamental and expressive effect in log constructions. We believe that by this Zumthor refers to the fact that they reveal the very means of how the structure is crafted, and affect the appearance of the building.

Various types of joining were used in our example buildings as a way of underlining the architectural themes of the buildings.

Haus Luzi makes use of two different types of novel corner joints. In the interiors a finger joint is used, which differs from the more traditional half-lap joint. In this type of joint, logs' ends have symbolically speaking two fingers, instead of a traditional half of the log. The other type of corner joint, applied in outer walls of Haus Luzi, is a so-called T-joint. In this type of joint one wall plate extends past the corner while the other limits to the extending wall. This corner has a really distinctive effect for the looks of the building. Outer walls of Haus Luzi consist of two contiguous log walls that have an insulation layer in between. Both of these contiguous walls are rather narrow, and in the T-corner the outer one of these contiguous walls is the one extending, creating the distinct impression of a narrow wall slab.

Although no ordinary corner joints are used in Final wooden House or Bridge Museum, the way of joining the logs support the architectural idea created by the overall entity of logs. In Final wooden house, the blocks of wood are stacked on top of each other without notching. This supports the basic idea of the building as being a stack of wood blocks. Similarly, in Bridge museum there are no ordinary joints, since there are no log walls. The architectural idea of the whole structure is the traverse beams of wood stacked on top of the other. This idea is strengthened by notching the logs as little as possible in the joining spots. Beams are notched only as much that they keep in place and do not slip off from the intended joint.

In Workshop AWEL the architectural idea is to be a really simple shed made out of logs. The basic technique of log building and the enormous scale combined with the emphasized plain execution creates the strength for the architecture. Corner joints between the logs support this theme by being only really simple notches on both upper side and underneath of the logs.

In this category, we bypass Snøhetta's pavilion by mentioning that the logs are attached to a separate structurally bearing frame, which is why there are no particular log joints.

4.3. Properties of individual logs

As well as by the manner of joining, also by the properties of logs the architectural themes of the buildings can be strengthened. These properties include type, dimensions and shape as well as surface grade of the logs.

As joining of logs, also the properties of individual logs appeared in our material as components of the overall entirety of logs. As well as by the manner of joining, also by the properties of logs the architectural themes of the buildings can be strengthened. These properties include type, dimensions and shape as well as surface grade of the logs.

Zumthor (2006) describes how the length of the available tree trunks decides the size of the room and eventually this constrain leads to a certain scale of intimacy. This is only true when log is made out of single piece of wood, which is the case in Haus Luzi. The narrow cross-section size of logs of Haus Luzi is approximately 200 mm of height by 100 mm of width, which enables the slab like appearance of the walls. Logs are also free of any bevels so they form a flush wall surface, which also supports the same impression. Logs seem to be really smooth by surface, manufactured industrially by planing, which can be seen to suit the coziness of home.

Logs or beams of Final Wooden House are also made of single pieces of wood. A square cross-section profile of some 350 x 350mm for logs is utilized. The spatial architectural concept of the building requires application of wood blocks of considerable proportions, since with only few building blocks a usable space for human dimensions has to be created. What is also noteworthy is that these logs are not as much beams – not the shorter ones especially – as they are blocks of solid wood and thus resembling a brick or stone building blocks by proportions. The surface quality is not planed but rather fine cut – a technique which leaves the logs a bit rougher than plane – which supports the bungalow feel of the construct.

Also, in Snøhetta's pavilion, logs are made out of single tree trunks and are squares by cross-section profile. Regarding the surface quality of logs, the free shape of the log structure is created by CNC-milling. According to architects, they wanted to use quality and durable materials to withstand the harsh climate of the building site, as well as use natural materials in reference to local building traditions (ArchDaily 2011). In this sense, the 250 mm by 250 mm timber beams made of single piece of wood seem like a justifiable choice: Solid wood could be seen as a material that is certainly durable even if hikers sit and walk on the wooden stand, and sometimes with wet clothes. Cracks emerge to the logs when they dry over time, and the round annual rings of the whole tree are visible in the ends of the logs, emphasizing the naturalness of the material.

In Workshop AWEL basically the only thing that separates the building from a traditional shed is the size – and not the size of the building alone, but especially the size of the utilized wooden elements, the so-called logs.

Unlike the three examples above, industrial log houses of today are mainly built with lamella logs that are glued together of multiple pieces of wood. The final two examples showcase the possibilities of logs of glued laminated wood. In Kuma's Bridge, logs of the structure are precisely speaking glued laminated timber beams of 180 x 300 mm, consisting approximately of eight slices of wood that are glued together on top of each other. The size of the beams is carefully considered in terms of building's architectural presence and structural performance. By accumulating glu-lam beams of 180 x 300 mm, a cantilever structure is composed without using "oppressive-looking crossbeam with enormous sections" (Divisare 2016) This way, according to the architect, the structure would merge into the surrounding forest better (ibid.).

In Workshop AWEL basically the only thing that separates the building from a traditional shed is the size – and not the size of the building alone, but especially the size of the utilized wooden elements, the so-called logs. They are over thirty meters long and approximately two meters high glue-lam beams, see figure 13. Workshop hall shows that industrially produced logs can definitely differ a lot from original logs in terms of dimensions and still utilize the construction principles of a log construction.

Figure 13. Workshop AWEL (Image courtesy of Jürg Zimmermann)

5. Results

This paper has presented a study on novel visible architectonic features that are based on the characteristic structural properties of industrial log and log building, in the scope of contemporary architecture. In the literature review, it was defined what are the structural characteristics of industrial log and log building. By this new definition and by exploring novel solutions for industrial log, this study has presented new possibilities for log architecture and broadened the orthodox conception of log building to match the new features of industrial log building.

Novel solutions for industrial log in the scope of contemporary architecture that were found in this study were divided into three categories of solutions affecting the architectural appearance of the buildings. First category was the overall configuration of logs, which was divided into two sub-sections of structurally bearing and non-bearing. Structurally bearing entireties included the four log towers of Haus Luzi, cantilever structure of Yusuhara Wooden Bridge Museum and the stack of wood blocks of Final Wooden House. In entireties, that were not related to bearing structural function of logs log was given other meaningful functions. These included solutions such as log chair or stairs in Final Wooden House, and the free-shaped log structure of Norwegian Wild Reindeer Center Pavilion, which serves as a seating area but also as a strong visual element in the architecture of the pavilion. Other categories were such that they can be viewed as components of larger entireties of the first category. These were joining of logs and variable properties of individual logs. Essential was that the type of joints and other features of individual logs can be chosen so that they support the overall architectural idea of the entirety that the logs create. There is a large number of different corner joints in the history of log building to choose from, or one can invent completely new ones, like the T-joint of Haus Luzi, if needed. In addition, features of individual logs, such as the size of the log can be chosen according to the context. When using lamella logs, the range of possible sizes is naturally a lot wider, which was showcased in Workshop AWEL.

6. Conclusions

This study can serve as a basis for further research on architectural possibilities of industrial log architecture. The results can have also implications when designing and manufacturing industrial log buildings in the future. Found solutions can serve as an inspiration for designing architects. Also broadening of the orthodox conception of log building helps architects and industry to see the possibilities that industrial log building can have. All the solutions that were presented here are possible to manufacture in modern woodworking facilities, but log house manufacturers have their own routines by which they currently produce logs. Some of the presented solutions would require the manufacturers also to develop their factories and production lines. Thus, these results offer possible trends of future development for the log house industry as well.

None of the found examples utilized non-settling logs. This is probably due to the fact that non-settling log is a rather new product. However, it is possible that in the future, especially in the larger scale log buildings, the use of this type of non-settling log will increase, because it contains such considerable benefits compared to ordinary log, which settles crucially more. However, even with non-settling log some basic principles of log building still apply, though the logs do not settle. There is still a need for corners and dowelling in order for the log structure to become rigid.

Some characteristics of log building, including settling and the need for cornering, are often seen as complicating factors in designing log buildings. Nevertheless, sometimes these restrictions seem to be the very reason, why the architecture is so powerful. This is particularly evident in the case of Haus Luzi. Zumthor presents essential features of log building as constraints or

restrictions for log architecture that are fundamentally due to wood´s properties as a natural material. He describes achieving a pleasing form of architectural expression despite these constraints (Zumthor 2006). This is admittedly true, but we argue that this achievement was reached not despite the constraints but because of them. The fact that the architecture is based on the innovative and novel but still characteristic ways of using logs gives the strength for the architectural expression.

Industrial production of logs offers great possibilities for architecture, as was shown in this paper. When the logs are manufactured by gluing lamellas of wood together, there are no restrictions for the size of the logs. In addition, present day woodworking machinery enable a variety of possibilities. These advanced properties of log and log building in mind, it raises a question that should this kind of building be called log building anymore. As for example our analyzed example buildings, it is difficult to define unequivocally, which one is truly a log building and which not. Jokelainen (2005) raised this same question in his dissertation. He states that imitating traditional hand-hewing technique is a factor that restricts development of log architecture in the scope of industrial production, but adds that this new way of industrial log building should be called for example solid wood construction rather than log building. This essential question related to the concept of industrial log building would serve as an important subject for future research. Other natural, and more tangible, future research topics would be issues related to all three categories of results presented in this paper, as they were discovered having great effect on the architectural appearance of log buildings. Different kinds of structural configurations of logs for different building typologies, joining of logs and variable properties such as size of individual logs and their implications on architectural appearance would all need to be investigated further in order to exploit them better in practice.

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Lighting Cultures in Northern and Southern Europe

An Investigation of Living Spaces

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[…] a northern and a southern lighting culture exist. This study focused on some of the aspects in the complex discussion of lighting cultures and was able to define some common issues to delineate preferences for the north and the south.

Abstract

In order to create awareness of different qualities of light in indoor living spaces, two different lighting cultures are being investigated; Northern and Southern European. We therefore investigate the relation between natural and artificial light, based on geographical position as well as social/cultural habits of different countries. The aim is that this approach will inform the user on how different lighting scenarios can improve the use of the space. The investigations are based on end user’s preferences and illustrate how awareness of different lighting cultures can be used in different lighting design scenarios. The findings from this specific project are meant to support the development of scenarios for future lighting fixtures and control systems based on a deeper understanding of cultural and geographical parameters.

Keywords: Lighting Cultures, North and South Europe, User centered design, Lighting design scenarios, Indoor living space, Dynamic lighting, Artificial light

Introduction

This investigation is based on the hypothesis that the use of artificial light has a relation to the natural light in different geographical locations. For example, people in the Southern region of Europe use and experience artificial light differently than people of the Northern Europe. There are many factors that could influence the experience of light from different areas.

PEER-REVIEWED ARTICLE

When the first three authors arrived in Denmark to study at a master programme in Lighting Design they each had different ways of perceiving the use of natural and artificial light. The hypothesis of this paper is that this difference was influenced by their diverse life experiences in their home country and their distinctive cultural backgrounds.

The various regional origins of the authors played a significant role in the group's understanding of residential lighting design using both artificial and natural light. Two group authors are from Southern European countries, Italy and Greece, and one from a Northern European country, Lithuania, living and studying in a multinational environment, such as the international Master programme in Lighting Design in Copenhagen, and having the opportunity to exchange opinions and experiences with each other, created awareness of the differences mentioned above, and created the interest for this topic.

The investigation, understanding and definition of Lighting Cultures was defined as the main task of this research paper. A qualitative user centered approach was considered to be the most appropriate methodology. Experiments were set up to define and test lighting design scenarios and solutions. A multitasking lighting fixture named Orb, was used for the experiments, testing the lighting scenarios. The luminaire can provide different modes of illumination from different directions.

Lighting Cultures

Through a definition of the term Lighting Cultures, a consensus was reached to describe the term as a relationship between natural and artificial light. This was achieved by describing how natural light affects the use of artificial light in indoor living spaces, based on the various geographical positions and along with cultural and social habits. Thus far, there was not an existing specific definition of lighting cultures, only personal observations and examples of using the lighting in different regions. Therefore a northern and a southern European lighting culture were defined. As a result, the perception and use of artificial light in indoor living spaces will be analysed to find regional varieties and users' preferences

Definition of Northern and Southern lighting

To investigate and define the Northern and Southern lighting cultures in Europe, four different countries are considered. Two in Northern Europe: Lithuania and Denmark, and two in Southern Europe: Italy and Greece. The Northern countries are unique because of their relative proximity to the North Pole. The capital cities of the northern European countries are located at 54° N and above (UNSD 2017). Natural light in these northern countries is different from southern regions in Europe, due to very low solar angle during the year, long moments of twilight and frequent overcast sky (Mathiasen 2016). These particular geographical and climate based factors have a strong impact on the illuminance level on the ground, the colour of daylight and the modeling of the landscape, buildings, terrain and people (Matusiak, Anter a 2013 25-38). The mixture of different natural lighting conditions such as colour of daylight, the direction of the sunlight, long and colorful shadows during the twilight and overcast grey sky could be defined as Northern Lighting. (Mathiasen 2016) (Figures 1 and 2)

Figure 1. Colourful sky during the twilight (WallpaperPulse, 2016)

Figure 2. Long Shadows (DIAL GmbH, 2017)

Unlike the concept of Northern lighting, the concept of Southern lighting is not well described in the literature. Therefore, it will be defined in contrast to Northern Lighting, by adding personal experience of the perception of natural light, the use of artificial light, and the comparison of these observations between the countries mentioned above. In the southern region of Europe the majority of the daylight intake is direct sunlight. Since the sun has a rigorous light it characterizes bright environments which sometimes can be identified as glary and with sharp shadows. Few variations in the direction of the sunlight colour, intensity and hardness are visible throughout the year, even if the changings are not as evident as in the northern part of Europe; they are the ones defining distinct perception of the indoor and outdoor spaces during different seasons (Figure 3 and Figure 4).

Figure 3. Sharp shadows in Southern countries (Baker, 2017)

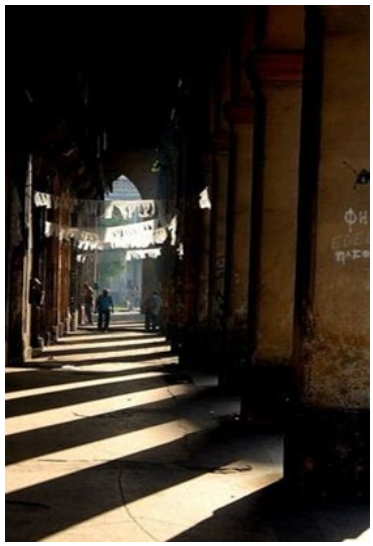


Figure 4. Sharp shadows in Southern countries (Baker, 2017)

Perception and use of light in Northern and Southern European countries

Figure 5. North European counties

Figure 6. South European counties

Our basic ability to sense and interpret light, comes from our experiences of natural light. In addition, people's cultural background, religion, and social habits play a significant role in perceiving light. Understanding of light is tightly connected to the interpretation of the world surrounding us. This interpretation of sense impressions is so deeply rooted in us that we often take it for granted (Jensen 2007). The perception of the space surrounding us is a subjective experience, strictly related to the environment and lighting conditions we are used to live in. Since both factors are dependent on the geographical position, they have an influence on the population's habits and culture. It is possible to deduce that perception of light, both natural and artificial, is entirely different in Northern and Southern European countries (Figure 5 and Figure 6).

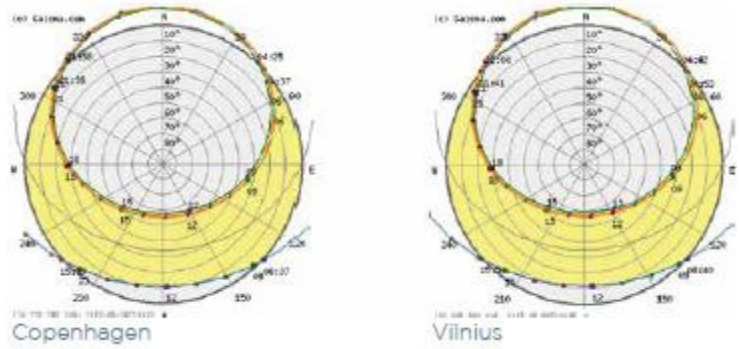


Figure 7. Sun path diagrams in Copenhagen and Vilnius (Gaisma.com, 2017)

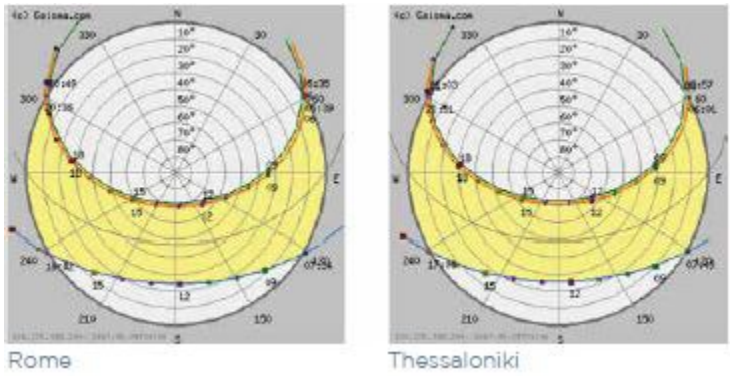


Figure 8. Sun path diagrams in Rome and Thessaloniki (Gaisma.com, 2017)

In the Northern countries, people tend to use lighting with a warmer white colour temperature. This might be because of the geographical position and the low angle of the sun (Figure 7). This means a longer twilight period, which creates sky patterns and hue environments. While in Southern countries, natural daylight is perceived in another way and a short cycle of twilight eliminates the options for different colours (Figure 8). The artificial light in Southern region has often a colder white colour temperature, similar to the intense natural daylight. The angle of the sun in Northern and Southern European countries varies substantially; making the direction and distribution of artificial light to be different from region to region. Due to long and soft shadows in Northern European countries, people use more diffused lighting in the living spaces. Mathiasen, N. (2016). The domestic environments in Northern European countries have a mix of direct and indirect lighting, and the distribution is designed according to the activities and needs. In Southern European countries, due to a high angle of the sun, domestic environments are designed to have light direction from above, and distribution of the light source is managed evenly in the space. Multiple use of lighting layers such as general lighting, task lighting and ambient lighting is a common combination in Northern European countries. As it was mentioned above, the environment of nature creates these different choices (Ledvance 2017). In Southern European countries, residents try to replicate the natural bright environment and use only one lighting source, as bright general lighting. (Table1). The differences between the regions and how the light is perceived and used in the domestic environments can be interpreted as “Lighting Cultures” illustrated in Table1.

Table 1.

Methodology

To gather knowledge about Lighting Cultures in Europe, as well as the user's preferences and the use of light in indoor living spaces, four methods were employed. The methods were:

- review of academic papers
- interviews of lighting experts all over the world
- investigation of user's preferences through an online survey
- on-site tests

Tests of lighting scenarios in northern and southern European apartments were conducted.

Academic papers are studied to understand other theoretical definitions of Lighting Cultures. Lighting experts' opinions, regarding their projects and installations from all over the world, are being investigated and analysed in order to reach a deeper knowledge on the way professionals work in relation with different Lighting Cultures. The online user's survey was elaborated to investigate people's' different preferences in the use of artificial light at home, based on the country they come from, as well as their personal experience and habits. The aim was to collect accurate results on the way users from diverse regions use artificial light, in relation to specific spaces and functions. This procedure leads to the following research question:

Is it possible to define a northern and a southern lighting culture, and will the users from the northern and the southern countries choose the appropriate lighting scenarios in a test according to this definition?

The following under-questions and related methods have been defined:

1. Is it possible to confirm the existence of different Lighting Cultures? Research, review of academic papers.
2. Do lighting designers refer to lighting Cultures in their work? Practitioner's citations from interviews with lighting designers.
3. Which are the user's preferences according to the definition of Northern and Southern European Lighting Culture?
   User's survey

Four apartments in the four different countries were selected and analyzed to investigate how the user's cultural habits influence the preferences of the use of

artificial light in a living space. The socializing activity in the living room and the eating function in the kitchen were chosen.

By selecting two spaces and functions, the authors wanted to test different design solutions for different lighting scenarios in an indoor living environment, according to the Northern and Southern European lighting culture. The goal was to test if the user would choose a lighting scenario according to their geographical background.

Literature Review

In this section, the selected literature is reviewed. Every paper is introduced briefly, along with an explanation and how it is linked to the theme. The main criteria and viewpoints of the chosen literature are defined, and statements are supported by quotes.

The paper “Light and the Aesthetics of Perception”, Carlo Volf (Volf 2011 40-41) conducts a study of our perception, focusing more on the effects of light and less on the physical light (lux). The paper attempts to establish a link between the regional daylight and the use of artificial lighting, showing that sunlight, as a background, along with our perception, are determinant factors for how the artificial lighting and the brightness of the room are perceived. Carlo Volf analyses with a scientific and cultural approach, the reason why Scandinavian Countries prefer to use a warm artificial light and people from Southern European countries tend to use cooler CCT. The approach is more than an aesthetic analysis throughout history which leads him to consider geographical and cultural data as well as scientific explanation and perceptual descriptions. In addition, he underlines that lighting perception is not only a matter of scientific knowledge and explanations but a cultural subject strictly connected to the geographical position of each country.

An anthropological lighting approach by Mikkel Bille and Tim Flohr Sørensen (Bille, Sorensen 2007) is presented in the article “An Anthropology of Luminosity: The Agency of Light.” This article addresses the relationship between light, material culture and social experiences. By analysing three case studies, they define the role of light in different contexts. It explores through history and different countries the role light plays as a metaphor, material agent and social value. The aim of this paper is to investigate the ways in which light works as an element in experiencing the world surrounding us by introducing anthropology of luminosity, as well as an examination of how light is socially used to illuminate places, people, and things, in a residential context. The content of this paper explores the light as a cultural phenomenon addressed to people’s social behaviour and habits. The paper offers an exciting method for analysing light from the anthropological perspective as well as an overview on the different meanings light can have by exploring several cultures all over the world.

To broaden the knowledge about the natural daylight differences of the countries, research paper “Nordic Daylight” by Barbara Szybinska Matusiak (Matusiak, Anter b 2013 25-38) has been reviewed. It shows the analysis and results of daylight environments in different latitude. One of the most important findings of this paper is the dominating low solar elevation angle during the year in the Northern European region. Low solar angle during the year causes glare and people living in this area are familiar with various shading options. That could be intuitive body turn against the sun or windows’ blinds in the buildings. Due to this fact, the reason why people in Northern European countries prefer indirect and shaded lighting could be defined. Other important information to mention is long periods of twilight in Northern regions. According to the author, this creates a colourful environment which could last up to two hours even though the sun is not visible anymore. Due to that, the assumption could be made that people in the Northern European region tend to use warm white and more colourful lighting.

Lone Stidsen, Niels Thuesen and Poul Henning published a paper in Nordic Journal of Architectural Research called “Mapping Danish Lighting Trends” (Stidsen, Thusen, Henning 2014). The publication is a research project about Danish lighting trends in domestic environments. They investigated identifying marks of arranging artificial light in a horizontal tripartition of space.

The paper introduced the theory that the lighting trends in Danish homes are defined by high, central and low positioning of illumination, depending on the activity in the domestic environments.

According to the authors, atmosphere can be shaped by light, but there should be common socio-cultural understanding of the group. This means that lighting designers must add a socio - cultural condition in their design in order to create an applicable atmosphere to be experienced by the user. For this reason, investigation of different cultural aspects is a must.

A paper by Rosella Tomassoni called “Psychology of Light: How Light Influences the Health and Psyche” (Tomassoni, Galetta, Treglia 2015) analyses the light from a psychological point of view, investigating the relationships between light-based emotions and behaviours and the psychophysical responses to lit environments providing the interpretative keys of an increasingly complex reality. Even the dark (i.e. the opposite of light) was analysed, describing the effects of particular sensory deprivation. The strategic layout and modulation of lighting by designers may influence the perceiver’s mood. The paper takes into consideration light as well as darkness describing them as two opposed values which can shape and direct human perception, characterizing the space and describing the different scenarios. The scientific approach through which light is analysed in this article can be considered as a psychophysical prove to support and explain the author's different perception and understanding of light, based on their cultural background.

In “Lighting up cosy atmospheres in Denmark” Mikkel Bille (Bille 2014) explores the use of light in staging atmospheres in a residential area of Copenhagen. He interviewed 60 people from a particular area of the city about their lighting habits. Through this research, he found out that most of the participants, even though they use light mainly as a way to illuminate a room or create an atmosphere when asked they provided adequate justification and emotional backgrounds of their actions. For some of them, it is a way to communicate with their neighbours creating a feeling of a larger community beyond the confines of an apartment. One participant stated that she always leaves the light on in her living room, when she studies in her bedroom, just to keep her company. An older couple said that they do not feel like they have returned home unless all the lights of their house are turned on. Most of the participants in those interviews gave different reasons for leaving a light on showing that the latter is not only a form of illumination or a wavelength of energy but also it can provoke cosiness, safety, companionship and it can even be used as a way of salutation.

As a conclusion, the literature review gave an understanding of how natural and artificial light can affect the human body, confirming as well several differences between Northern and Southern regions of Europe. The psychological and anthropological approach, described by some of the authors, illustrated the potentials of investigating light from user’s perspective, and knowledge on users’ perception of light in different cultures.

Lighting Designers’ experience

One of the major influences for this research was the book “Light and Emotions, exploring lighting cultures/conversations with lighting designers” by Vincent Laganier and Jasmine van der Pol. (Laganier, Van Der 2011). In the following section, citations of the interviews from this book that are related to this topic have been selected. They are provided in a format quote, country of origin-profession and years of experience in lighting design. “For example in India red

signifies danger, but in China it is the most sacred colour. That's a cultural difference " – Manav Bhargava , India, Architect in 8 years "All the projects we are working on right now in Dubai and Cairo are so much about colour change but not because they want to be Las Vegas. I think it's because in their culture, it's important to find colour, vibrance, in everything. Think about it-everything is neutral; their clothes are black and white. So to create something like that makes people feel good or becomes celebratory or is just different." Barbara Horton, USA, interior designer for 29 years.

"Your use of various colour temperatures of white is different when compared to other cities such as Hong Kong or Shanghai, which have lots of colours. Each city has a different latitude and climate. I recently visited Copenhagen. They never use white light there; the colours are much warmer. In tropical cities people like to have whites or blue whites. Tokyo or Osaka has a much whiter landscape than Paris, New York or London. Colour temperature is largely based on climate." Kaory Mende, Tokyo, Industrial and Environmental design for 32 years.

It seems that lighting designers around the world agree upon the fact that people's preferences about light can be affected by two factors: the cultural background and the geographical position of the country they are staying in. Religion also plays a significant role but it is out of the scope of this research. The geographic location is in relation to the natural light and its nuances through dusk and dawn. People from the south are used to an entirely bright environment due to a prolonged sunny weather and prefer the same kind of light in their apartments as well. On the contrary, people from the northern part of the northern hemisphere and due to the various colours of the sky during sunrise and sunset, are accustomed to a more warm light. When it comes to cultural background, each country has its history and social habits that can affect their choices about light. For example, as Barbara Horton stated, people in Dubai wear only monochromatic clothes and mainly black and white. So they need some colour in their life, and that's why they sometimes prefer coloured light. Furthermore, the culture can be described as a fact that has been happening for many years and now is embedded in people's minds and preferences. People from the southern part of Europe are used to a rich sunlight and they prefer a strong, white light. Even when they move to the north, they will still choose a white light. It is part of their culture now. To sum up, lighting cultures are affected by cultural background, history and social habits, according to the experiences of the lighting designers. And based on the characteristics of the natural light at each geographical position, people from the northern countries prefer a warm colour of light whereas people from the south prefer a bright white light.

Survey

To identify the user's preferences for artificial light used in indoor living spaces in Northern and Southern regions of Europe, an online survey was conducted. The objective was to identify the tendencies of the colour temperature of the light, the direction, the distribution and the placement of the luminaires in two different spaces, the kitchen and living room. A total of 28 questions were asked to 300 participants, most of them born, raised and still living in Italy, Greece, Lithuania and Denmark. Immigrants, international workers, and students that have moved from north to south and vice versa were excluded in order to avoid possible bias.

The first four questions were used for the demographic identification of the participants. The additional five questions supported the understanding of the choices of the participants in relation to some of the functions in their apartments as well as its interior. The rest of the questions of the survey were more specific regarding the functions, the CCT and the positioning of the luminaire, as well as the direction of the light. Visual stimulus was provided in the form of pictures-along with the answers in order to inform the participants and make their choice easier and more understandable. The questions asked

were quite clear and straightforward to avoid confusing the participants with technical details and to allow them to express their preferences clearly and based on their emotions, following the qualitative approach (e.g. “When you eat alone, what kind of intensity do you prefer- a bright light, an average intensity or something like a candlelight?). The target group for the survey was the age group from 18 to 35 years old for three reasons:

i. Most of the participants belong at that particular age group, a total of 196 out of 300. That helped to extract safer results as it was a satisfactory sample size.
ii. It is the age where people usually create their home from the beginning. As a result, they have a more active participation in the selection of lighting fixtures of their taste.
iii. The first three authors belong to that same age group and have a stronger connection and understanding of the participants.

The online survey provided the authors with valuable information and brought them closer to the preferences of the average individual without any knowledge about light. These results were the most important from the online survey:

a. Globalization has possibly created a similarity to people’s habits when it comes to functions in their apartments and the light required for them.
b. In the northern regions of Europe, people are more consistent with their choices about light, its CCT, and directionality. In the south regions, people are experimenting with the variety of their choices, failing to present any consistency on their choices.
c. People from northern Europe prefer light on an average intensity coming from numerous sources indirectly, whereas people from southern Europe prefer a bright intensity, coming from one or two luminaires, sometimes indirectly and sometimes directly.
d. There is a difference in the CCT between the two regions but is not as big as expected. Some of the Northern Europeans prefer a warmer light whereas some of the Southern Europeans prefer a cold light, but in general, both groups prefer a neutral white light between 3000K and 4000K. Additionally, people from southern Europe showed that while they are socializing they prefer a brighter environment and sometimes direct light and people from northern Europe prefer an average or dimmed down intensity, indirectly.

Northern and Southern apartments

As four different apartments in Denmark (Figure 9), Lithuania (Figure 10), Greece (Figure 11), and Italy (Figure 12), have been analyzed, some similarities and differences between Northern and Southern European regions could be extracted. First of all, when talking about the kitchen and living room in the apartments, Northern European regions tend to have them in a separate room which is not the case in Southern Europe. An open space, such as a connected kitchen with the living room, is more common in Southern European regions. Secondly, the CCT of the light in North Europe is between warm and neutral white, whereas in Southern Europe people tend to use neutral and cold white. The position of the luminaires differ from place to place, but there is a tendency to use pendant and table lamps in Northern Europe while ceiling recessed or mounted luminaires are found more often in Southern European countries. When comparing the direction and the distribution of the light between the countries, differences stand out. There are more lighting layers, brighter and darker spot areas and narrow lighting distribution in the Northern European region. On the contrary, a wide distribution of light and evenly lit spaces is more frequent in Southern Europe. More dimmed environment stands for Northern Europe and much brighter spaces for Southern Europe. As the results cannot be taken for granted, that the different use of light is only common for the specific region, some differences stand out as guidelines for use of light in the Northern and Southern European countries.

Figure 9. Denmark

Figure 10. Lithuania

Figure 11. Greece

Figure 12. Italy

Testing Lighting Design Scenarios

In this chapter, the findings are translated into lighting design scenarios and being tested to the end user's preferences. The goal of the project is to illustrate lighting design potentials for indoor living spaces based on the qualities of Lighting Cultures in Northern and Southern Europe. To be able to consider and judge different elements in the final design proposal, two success criteria have been defined, in which various design elements as well as social and cultural habits, will be included (Table 2)

Table 2.

EVALUATION	
• Quantitative • criterion	• Qualitative • criterion
FUNCTIONS	ATMOSPHERE
. . .	. . .
Specific activity in the defined space	Comfort based on cultural habits
LIGHTING DESIGN PROPOSALS	

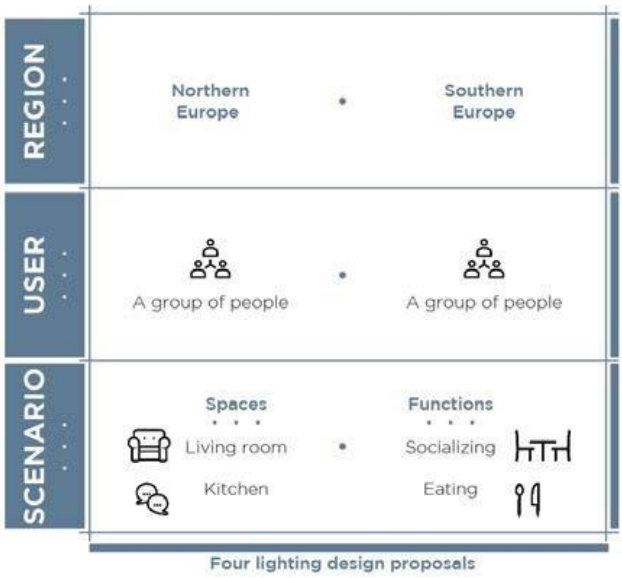
Lighting Designs based on Northern and Southern European cultures in different scenarios

The lighting proposals represent two different lighting scenarios for the kitchen, and two for the living room. Each lighting design is based on the knowledge upon Northern and Southern European light cultures.

A total of four different lighting scenarios were created. The first two scenarios were designed for a group of people socializing in the living room. They were

created adjusting the position of the luminaire, the CCT, the direction of the light, the intensity and the distribution. The other two scenarios were designed for a group of people eating in the kitchen. They were also created by adjusting the position of the Luminaire, the CCT, the direction of the light, the intensity and the distribution. (Table 3) was created to visually show the space and functions the authors considered to be relevant for the final lighting proposals-scenarios.

Table 3.



As a guideline to follow during the design and test stages, two more tables of relevant findings are presented below: (Table 4) summarizing the results for the living room for Northern and Southern European countries and (Table 5) for the kitchen for Northern and Southern European countries. Those two tables show the guidelines to create each lighting scenario.

Table 4.

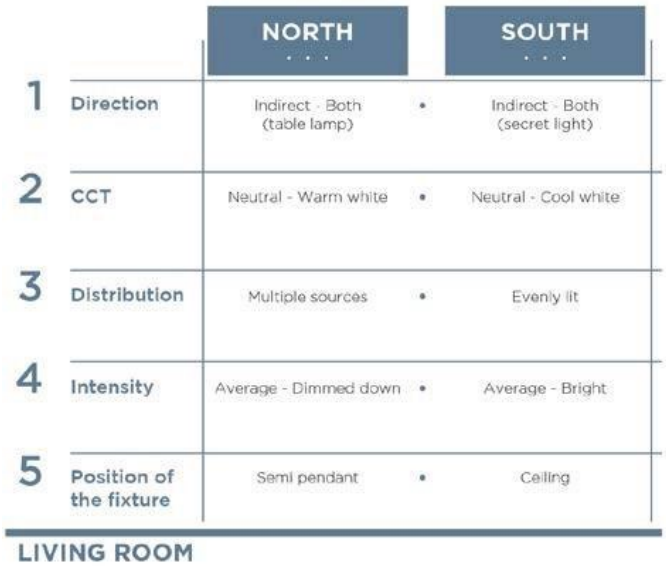


Table 5.

		NORTH	SOUTH
1	Direction	Direct	Direct
2	CCT	Neutral - Cool white	Neutral - Warm white
3	Distribution	Atmospheric	Functional
4	Intensity	Average - Bright (16% candle light)	Bright - Average
5	Position of the fixture	Ceiling	Semi pendant

KITCHEN

Four test scenarios

Based on the findings from the analysis, lighting design scenarios were created in collaboration with the luminaire Orb (Shade 2016). These scenarios are illustrated below.

First scenario: Northern lighting in the living room

Two Orb luminaires were used for this lighting setup. A pendant lamp placed over the coffee table and a table lamp next to the sofa (Figure 13 and Figure 14). The CCT is warm white and the light is direct downlight. The distribution of the light is narrow, creating brighter spots on the table area and next to the sofa. The combination of brighter and darker areas around generates different lighting layers. The intensity used is an average of Orb's maximum level.

Figure 13.

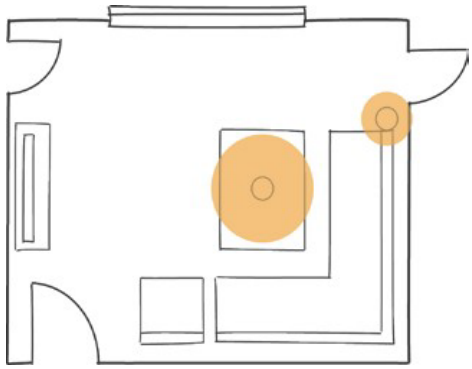


Figure 14.

Second scenario: Southern lighting in the living room

Two Orb luminaires were used for the Southern scenario as well as for the Northern one. The difference is the position of the fixtures. They are two semi-pendant fixtures placed over the coffee table (Figure 15 and Figure 16). The CCT is cool white and the direction of the light is both direct downlight and indirect uplight. The distribution of the light is wide. The combination of two luminaires hung closer to the ceiling and with the option of up and down light together creates a brighter and evenly lit space. The intensity used is higher than an average of Orb's maximum level.

Figure 15.

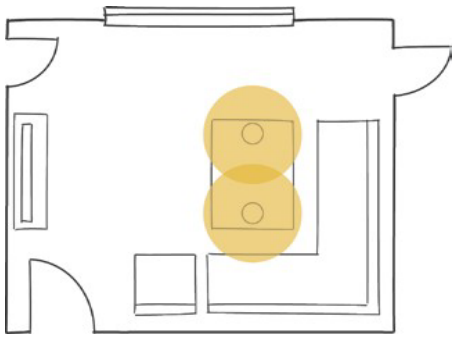


Figure 16.

Third scenario: Northern lighting in the kitchen
One Orb luminaire was used for this lighting setup. It is a semi-pendant fixture over the dining table (Figure 17 and Figure 18). The CCT is neutral and cool white and direction of the light is direct down. The distribution of the light is narrow, creating a brighter spot on the table area mainly. The intensity used is an average of Orb's maximum level.

Figure 17.

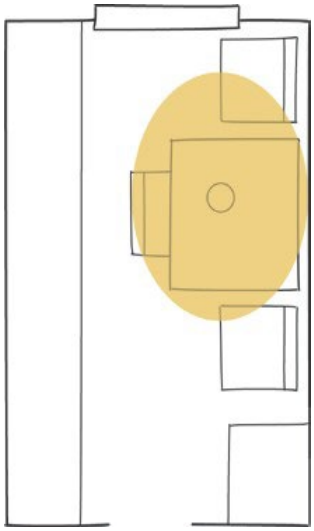


Figure 18.

Fourth scenario: Southern lighting in the kitchen
One Orb luminaire was used for this lighting setup. It is a semi-pendant fixture placed over the dining table (Figure 19 and Figure 20). The CCT is neutral and warm white and the direction of the light is direct down light. The distribution is wide, creating a brighter spot on the table and the area around it. The intensity used is higher than an average of Orb's maximum level.

A testing phase is followed to validate the relevance of various lighting settings and how they can change people's perception of the surrounding space, and how this is referring to the definition of the Southern and Northern European lighting cultures.

Figure 19.

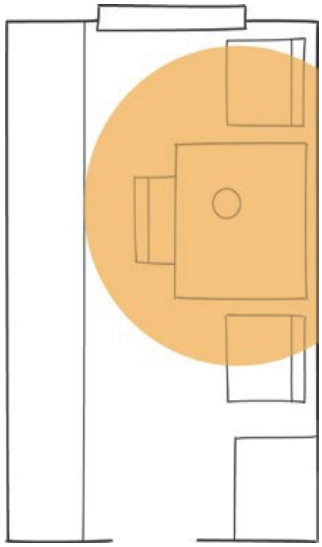


Figure 20.

The test took place in an apartment in Copenhagen, in order to provide a genuine environment to the participants of the test. There were 10 participants in total; 6 from the Southern region of Europe and 4 from the Northern region. None of them had any professional relation to light. Each phase of the test was conducted at the scenario related room. (e.g. at the living room for the living room scenarios). Snacks and beverages were provided along with easy listening music in order to invite the participants to relax, make themselves comfortable and feel confident about their answers. The participants were introduced, one at a time, firstly in the living room and then in the kitchen. At each place, they were shown two lighting pre-sets (one for North and one for South) and asked to make a choice. The origin of each lighting pre-set was kept secret as there was a chance to influence the answers and alternate the results. After this and based on their previous choice, they were shown three different variations of possible lighting scenarios, based on the intensity and the directionality of the light, and asked once again to choose. One of these three choices was the lighting design based on the findings in this project. Later, the participants answered questions based on their experience of the lighting.

The aim of the test was to examine how the design of the scenarios referring to the Southern and Northern European regions were experienced and to see if the goal of creating awareness by using various lighting pre-sets in indoors living space could be achieved. In addition, the test could indicate the correlation between the collected knowledge and data, about the preferable lighting standards depending on the origin of the people, and the actual preferences of the end user. Participants were not only asked to choose their preferred lighting scenarios but also to judge the atmosphere, glare and intensity of the settings. The answers provided were in a form of scale from 1 to 5, being: 1=not satisfied, 2=little satisfied, 3=satisfied, 4=very satisfied and 5=completely satisfied.

Findings

The on-site testing indicated that there is a tendency to choose a brighter environment even in a residential space, and this preference is not related to the test person’s nationality.

Another observation was made in the living room. When people from north were socializing, they tend to lean back on the couch exposing their faces and their eyes fully to the lighting fixture, whereas people from South have a more “aggressive” body posture. They either sit with their backs in a vertical position or they lean forward as to show that they pay attention to other people. This observation is a parameter that needs to be investigated deeper in future work.

When analysed, the proposed scenarios managed to score satisfactory results. For the test persons from the North and the living room, all the participants were satisfied and above. The scenario scored 3 and below on the scale about the direction of light and the position of the luminaire.

In the kitchen scenario 3 out of 4 participants were from Denmark where people, prefer the luminaire a few centimetres above the eye level. For the people from South 5 out of 6 participants were satisfied and above and the main problem was with the direction of the light. That could arise from the fact that when people from the South regions refer to indirect lighting, they usually mean cove lighting, a possibility that the group could not offer with the orb.

Conclusion

The first step was to define lighting cultures; it was correlated through a literature review, the lighting designer's experience and an online survey. The literature review gave an understanding of how the light affects the human body, the importance of the natural light and knowledge on user perception in different countries. The experiences from the lighting designers gave an understanding of how cultural background and geographical position can define a lighting culture. Finally, the user survey gave information about the user preferences according to light level, colour temperature, light distribution, placement of luminaries etc.

The second step was to combine the results from the first step, in a northern and a southern lighting design for a kitchen and a living room scenario in order to be able to answer the research question: Is it possible to define a northern and a southern lighting culture, and will the user from the northern and the southern countries choose lighting scenarios in a test according to this definition?

A research study, experiences from practitioners and an online user survey showed that a northern and a southern lighting culture exist. This study focused on some of the aspects in the complex discussion of lighting cultures and was able to define some common issues to delineate preferences for the north and the south.

In one case the online survey showed that the people from the north preferred a cool light from a high positioned fixture in the kitchen and the people from the south preferred a warm light. The test of lighting scenarios was made according to this finding but showed that the test persons from the north preferred a luminaire a few centimetres above the eyelevel. Otherwise the lighting scenarios had a high score but with a few comments on the positioning of the fixture and the direction of the light. The users preferred a brighter light than suspected and the differences in the body position of the people from the north and the south in a socialization situation also had an impact on the perception of the lighting scenarios. To answer the question if the users prefer lighting scenarios according to the northern and southern lighting culture definition, we can answer, yes-in most cases-but this study shows that the answers can vary, and it is difficult to take all cultural, historical, geographical and personal preferences into account when you aim at making lighting scenarios that match user preferences.

Future works

A future investigation of this topic could include some of the topics mentioned below. Firstly, the crucial issue of religion. Especially in the southern regions, religion has an important impact on the culture of the people which could alternate their perspective of light.

Analysis of daylight and the importance of it in shaping the lighting culture of a region could be investigated further. Daylight was covered in this paper only as a part of the geographical position of the country.

On the matter of testing the effectiveness of the lighting scenarios, it could be interesting to test them with other multitasking and standard luminaires, to investigate various possibilities and compare the testing results when using lighting bulbs with different characteristics.

Also, a fact of great interest would be to conduct the testing phase in a Southern country and then compare the results to see if there are any alterations. Lastly, a much deeper investigation including more countries from both the North and the South European regions could provide more in-depth results and better understanding of the use of light in various countries.

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Ambient Adaptive Lighting

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Abstract

The concept of adaptive lighting suggests architectural lighting designs that adjust and react to the living practices of inhabitants and variations in the environmental conditions. Current developments in lighting technologies, such as LED light sources and IoT infrastructures, open for new opportunities with adaptive lighting, where the control of the lighting possibly operates as an IoT service rather than build into building management systems.

The dynamic flux in lighting changes the experiential presence and brings focus on change and variation rather than states, levels and structures. The suggestion is to enable adaptive intertwinement through an expanded field of dynamic flux in the artificial lighting, and couple between the daylighting and the artificial lighting through an integration of ambient contexts.

The project develops experiential prototypes, with which the dynamic design parameters of adaptive lighting can be investigated, analysed and scoped into architectural programming processes. The staging's are full-scale architectural scenography's, which situate investigations into how the experience parameters of fluctuating artificial lighting, integrated with daylight flux in an architectural space, are experienced to influence the experience of architectural space, social situations and everyday activities.

Keywords: Light, daylight, adaptive lighting, ambient, dynamic light

Adaptive Technologies

The new lighting technologies, such as LED light sources and infrastructures of connectivity and data communication, develop expanded opportunities for complex coordination and control. This enhanced infrastructure allows for the development of relational design paradigms, such as adaptive lighting.

"adaptive lighting dynamics has potentials; they enable a new condition"

The emerging adaptive control paradigm utilises Internet-of-Services to coordinate abstract information and scenarios across previously separate domains of building technology, living practices of inhabitants and architectural lighting design.

The new light sources, such as LED, are adjustable and individually controllable, which enhances the time-based aspect of lighting design and opens for new detailed qualities of lighting dynamics. Simultaneously the development of smart building adaptivity based on IoT infrastructures will enable coordination between lighting systems, sensor networks and the living practices of the inhabitants.

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Design opportunities emerge with dynamic and adjustable lighting, opens for the dynamics of adaptive lighting to be included in overall architectural design considerations in a much more elaborate way. Adaptive designs can include how lighting systems continuously adjust to environmental lighting conditions, for instance daylight flux. It can involve adaption to shifting user scenarios, individual needs and consideration of health and wellbeing. It can include decisions of energy usage and demands related to the indoor climate.

Figure 1. The experiential prototype in the lab.

The developments towards lighting adjusted to human experience, and the luminous environments adjusted to sensibilities of architectural design, follow the ideas of W.M.C. Lam in his seminal work: 'Perception and Lighting as Formgivers for Architecture' (Lam 1977) and the design strategies explicated in D. Kuntzsch edited work 'Light Perspectives: between culture and technology' (Kuntzsch 2009). Perspectives on lighting design that seek to emphasise the experiential and formgiving qualities of the luminous environments, but with the adaptive lighting dynamics brought into concrete relation with the flux of daylight and the fluency of perceptual adaption.

New spectrum distribution in artificial light

The LED technology generate light in very narrow bandwidths, which is then brought into emitting a broader spectrum of light through phosphorus coatings. Current developments seem to enable an even spectrum distribution across the colour scale, and even beyond current limits toward a spectrum similar to the visible part of daylight. This correlation of colour distribution similar to natural light spectrum enables a more fluent integration between natural and artificial light and opens for enhanced design opportunities of the composite illumination of architectural space. Furthermore, the composite LED engines, such as

tuneable white, allows for a separation between the variations of luminous levels and colour tone, and thereby enables fluid changes of colour and intensity across scales by choice in the moment.

New presence of luminous bodies with artificial light

With the ability to distribute and embed LED in to any shape and surface, the presence of the luminous source changes towards luminous material, forms and zones, as well as emitting very clear and directed light as points, lines and luminaires. The light can be embedded in walls and texture where the luminance comes from the material or arrive from non-distinct primary source, and thus form part of the lighting design in ways previously normally enabled by reflective surfaces and object. [i]

Figure 2. The experiential prototype in the lab.

New dynamic presence of artificial light

The technical construction of LEDs opens for detailed and instant control of the qualities of the emitted light. The connectivity and feedback opportunities of networked lighting infrastructures allows for fluent variations in the composition and dynamics of the lighting bodies and how the lighting shapes presence of space. The control infrastructure allocates the possibility for advanced software to form the composite dynamics of the light and facilitate fluent dynamics across spatial distribution and durational development. This inherent dynamic presence of the luminous environment produces a design condition, where continuous variation could be viewed as the norm, and stable light as an exception.

IoT and building automation

The infrastructures needed for the development of adaptive lighting automation is emerging from industry-research collaborations, such the standardisation project OpenAIS[ii], an EU supported initiative, which have developed specifications for an IoT based, Lighting-as-a-Service infrastructure[iii]. The technical specifications in the OpenAIS project will influence a common EU standard towards 2020 [iv]. OpenAIS allows for integration of an open-source Internet-of-Things system architecture with networked and interconnected devises. The IoT infrastructure opens for the new building management and design model: Lighting-as-a-Service. Management as well as design becomes services, attributed to the infrastructure rather than build-in. The infrastructure connects to everything else in the building (heating, sun shading, security, etc.)[v]. The services potentially allow for continuous adjustment of the building design and support changing usage patterns and enable customised services to each individual user.

Functions, management and services are customised, selected individually by users, gradually transformed and adapted to changing needs and desires. The building behaviour becomes adaptive and in continues transformation. This type of automation is, as suggested above, very different from previous control paradigms with centralised and pre-configured control. It is a transition towards software-based management, as a service, in a systematised network of devises. The adjustment to new lighting technologies, altering user scenarios, input from sensor elements and data streams is happening through software updates rather than physical reconfiguration. The maintenance of functions is an evolutionary process of gradual and frequent updates. The architectural lighting design enables capacities of potential operations rather than pre-defined function. These developments of the adaptive lighting design are concrete realisations of what in other scales are described as Smart Homes, Smart Buildings and Smart Cities[vi].

Services for flexible solutions

The lighting infrastructure is the last to be negotiated as a platform within the IoT paradigm due to the complexity of designs and functions that lighting is involved in beyond mere illumination. The central and entangled role of lighting and its infrastructure will further expand in the future. System of the future will be the communication backbone, through wired network, wireless network, light as network, and the infrastructure will provide two-way data streams and therefore effectively making a mesh of interrelated nodes across every square

meter of space, with capacities to engage with any element attached to the system, wired or wireless, e.g. thermostat, blinds, sensors etc.
A particular feature in the way these new infrastructures are thought and designed is that they do not exclude non-connected elements. There is connectivity through feedback between the luminous and the data world through sensors, and there is feedback between system through data flows. The ordinary lamp with independent switch is part of the system through light sensors. The ordinary central control unit in the building management system is incorporated as part of setting the scope for the software driven automation. There is as such an opportunity for enabling robust redundancy into all levels of the system architecture, minimising dependence on the complexities of such systems. The layered, abstracted and software driven processes enable integration of localised manual systems and is in no conflict with the single person turning on their individual non-connected luminaire.

You can have radical different services from your neighbour, and building can be re-configured and re-designed in gradual ever ongoing transition. Enabling variations related to personal desires, weather and daylight variations, adjustments to daily rhythms, responses to flux in the energy supply, or political decisions on usage patterns, are provided by the services. Unfortunately, this type of flexibility only become available when the infrastructure passes the threshold into a full-functional software service platform, where functions are applied by software after the place is personalised and maintained by software providers dislocated from the user. Simple functions and relations can be implemented, but the more radical transition is dependent on the adaption of common standards and the implementation of smart devises.

Ambient computing

The new IoT infrastructure platform generates a condition of ambient computing as a consequence of the ubiquitiveness of the computational capacity in the fabric of the building material and functions. None of the elements (devises, functions, materials, forms) exists by themselves but act as mediated correlations, which seen from a user perspective allows for simplicity on a higher level of abstraction in the experience of the automated activities (a response to sudden daylight influx might enact correlated activities across shading, transparency, reflection and lighting in negotiated scenario dynamics). The distributed and embedded computing allow for composite responses made up of many dynamic constituents. These responses can be generated specifically to what is relevant in the moment, as procedural content generated out of pre-defined parametric relations.

The experiential prototype staging has embedded a generative software environment, named ‘Digital Weather’ in this project, which is our first implementation of such a parametrised generative software.

The system environment envisioned are different from management system with pre-defined response scenarios in the way they become continuously adjustable without prior prescripted options. This is achieved by the connectivity of all elements into an abstract software environment, where the behaviour of the ecology of elements can be generated separately from the physical function of each element. The suggested design explorations with experiential prototypes aim to enable investigations into this new adjustable field of design. What could be the relevant model for the design, and how is that qualified through experience into design strategies?

Perception of Dynamic Flux

Fluctuous environments

The new light sources are adjustable and individually controllable, which enhances the time-based aspect of lighting design and opens for new detailed qualities of lighting dynamics. The time-based aspect of adaptive lighting opens for dynamics relative to other elements such as daylighting flux and the fluidity

of everyday living practices. We have asked: How will the inhabitants experience these adaptive conditions, and how might lighting design strategies support comprehensible designs? How are the flux and transitions to be understood, designed and be incorporated in everyday living practices? How do we enable proper sketching environment for architectural lighting designers on the design qualities and strategic parameters of the dynamics of adaptive lighting? The suggested research methods and prototypes enables experiential investigations with focus on the fluctuating dynamics of the luminous environment, and through the participatory engagement in experiencing while adjusting, we are able to incorporate the adaptive dynamics of visual perception relative to the dynamics of the lighting fluctuations. (Figure 3).

Figure 3. Three states of the adaptive lighting in a situation with two participants. This is staged for the camera and therefore the changes are made very explicit. In the ambient settings of adaptive lighting only nuances appear.

Perception in Action

The experience of lighting in dynamic flux re-directs the attention towards how the lighting is experienced by inhabitants in their flow of living practices rather than how it can be analysed from formalised and generalised overview as light in 3D space. In the flow of living the experiential situations change, the inhabitants move around, and the eyes change focus and direction continuously. Seen from the perspective of the inhabitant, the experiential condition could purposefully be viewed as perceptual processes of multimodal actions.

The philosopher Alva Nöe (2006) suggest an enactive approach to perception, and the core concept 'perception in action' as a perspective towards this experiential condition. We are, he observes, sensing, probing, rehearsing, and adapting to the experiences in a continuous perceptual negotiation. Sensing, experiencing and perceiving is in the enactive view not a sequence of course and effects, but entangled in ways that integrate the processes: the activities involved in perception are mutually dependent and dynamically adapting in the flow of enacting our living. Our vision capacities do not, as perception processes, resample a camera or camera obscure, but is an enacted performance of probing and correlating between impressions, previous experiences, and the narration of our lifeworld. Light and colours are features of the environment that appear through the perceptual activities. The view is here that experiencing, and the perception in action, is intentional activities, enabling perception as 'a *way of* thinking about the world' (Nöe 2006, 189), and that 'Insofar as perceptual experience is intentional, experience seems to be bound up with our broader capacities to *think about* and *understand* the world.' (ibid, 189). The experience of the lighting environments is then real and meaningful instantly, but with possibilities for changing assumption through perceptive activities.

The enactive view on perception is a position that seems to be able to facilitate a view on adaptive lighting as a dynamic flow of continuous emergence of enacted experiences, rather than the dynamics becoming a disturbance of assumed stable conditions. The assumption is that we have to learn to experience what we experience, and we have particular processes and strategies, biologically and cognitively, on which we rely to be able to see and understand space and our place in space. We have the pre-conditions, but need to develop and refine sensory modalities, that are adequate for the experiential task at hand. The enactive approach aligns the experiential qualities of adaptive lighting with those experiences evolving in encounters with the flux of daylighting, and thus enable a lighting design paradigm that integrate and reach across natural and artificial lighting.

Rehearsing sensibilities towards adaptive lighting dynamics

Alva Nöe (2006) explicates the experiential perspective as a relational process between actions of perception: the world appears because we engage and deliberately enact perceptive account of ourselves in the world and the word surrounding us. The focus is not on how we perceive, but on how we make perception appear: "… perceiving is a way of acting. Perception is not something that happens to us. It is something we do (Nöe 2006, 1)". The knowledge of the spatial composite appears through reflections on our movement: "Size, shape, voluminousnes, and distance are experienced by us thanks our possession of sensorimotor knowledge (ibid, 79)" and "perception may be a mode of encountering how things are by encountering how they appear (ibid, 85)". Nöe formulates the enactment of perception as a continuous learning process and gradual adaption to how we experience, which have the consequence that "perceptual adaption, from the enactive standpoint, is a process of learning to apply the appropriate sensorimotor knowledge. Once this is accomplished, content is refashioned (ibid, 92)" by processes where "…one's sense of movement (kinesthesis) and body position (proprioception) come to adapt to vision (ibid, 93)".

The enactive approach to adaptivity builds broadly on an ecological approach to perception, as envisioned by J.J. Gibson (1979) in 'The Ecological Approach to Visual Perception' (referenced by Nöe 2004, 20-21). The idea that sensing and acting, by ourselves and in relation to others and the environment, can be viewed as an interrelated ecology of events, mutually constitutive and interdependent, all forming part of our experience of our lifeworld. The evolutionary attunement between animal perception and living environment, as embodies wholes, correlate sensing and acting as a dynamic flow, where objects, persons, surfaces and architectures, as well as the more composite complexes of lighting, visibility and appearance, is emerging in the active process of living through integrated and composite experiential processes. These observations become especially relevant when the lighting environment are in constant dynamic flux, and cannot be counted on as a stable factor in the perception activities. The stable factor is then the radical first-person view of being in activity.

Staging experiential investigations

The enactive view highlights the constant probing activities of visual perception, moving eyes and head, as well as the body position, distance, speed in space, often in repeated investigatory patterns, to constantly re-assess the perceptual processes. The prototype environments and staged investigations, outlined in this paper, enable an expert situation for deep rehearsal and investigation into the correlations between adaptive dynamics and active living practices. Our imperfect access to the world, as a process of experiential coordination of multiple sensory and cognitive modalities, is brought into play in the experiential design investigations. (Figure 1, 2 & 3).

In an attempt to grasp the dynamics of experiencing, the semiotician Per Aage Brandt (2002) introduces the term 'the human real', – an endeavour to develop a cognitive semiosis as a non-reductive, semiotic realism. Brandt suggests that the appearance and cognition of forms in the environment is emerging within

the cognitive processes as a meaning building process, a process of semiosis. Our cognitive capacities act with a time-window of approximately 3 second for the experience of now (experience of actions and dynamics), and 7-10 seconds for the appearance form (recognition of form and space), which then are the constituents of the duration of experiential form. We are, in this view, cognitively primed to encounter environments in flux and find firmness in our experiences through the very active processes of semiosis. What we experience through our living practice is what feeds the experienced reality of the person, and through a continuous weaving of meaning, processes of semiosis, the person develop and maintain adequate understanding of their experiences.

A further weaving of the experiences into an understanding of the environment and one's experience of place within it, might be described as narrativation: the active process of narrating experiences in the flow of their appearance, as articulated by Monika Fludernik (2006). She terms this emergent view on sense-making 'post-dramatic', in the sense that in the process of continuous narrativation, the experiences immediately transform into perceptive context for the next experience. The narrative experience seen as emergence rather than evolving from preconceived narrative structures. The actions generate events understood in the context of situations, which is then transformed by the action and events to new contextual situation. These enacted perceptual processes, the semiosis of the apparent as real, and the continuous adaption of narrative context, are the core components in the staging of explorative narratives in the prototype environment.

The staged prototypes enable an integrated analysis through design probing, using staging methods similar to and influenced by experiential staging strategies deriving from the scored actions in Fluxus events (Hendricks 2008), Happenings (Kaprow 1993, Sandford 1995) and performance art (Petersen 2011c). Scores of activities organise patterns of actions, events and situations, and thereby form the experiential investigations as they evolve over time and through space as a continuous process. The interest is in the morphology of the dynamics; how the experiential process couples with the flux of light; and how to stage an analytic and creative processes with distinct validity for the lighting design. Staged as experiential processes that aim at rehearsing and maturing the ability to analyse, reflect, sketch and design adaptive architectural lighting.

Figure 4. The flux of daylight as experienced within 30 minutes in June 2017 in Denmark.

Dynamics of Ambience

Adaptive intertwinement through dynamics of ambience

The concept of adaptive lighting suggests architectural lighting designs that adjust and react to the living practices of inhabitants and variations in the environmental conditions. The dynamic flux in lighting changes the experiential presence and brings focus on change and variation rather than states, levels and structures (Petersen B2015b). This change from static to dynamic alters of core aspects of lighting as design material. The suggestion is to enable adaptive intertwinement through an expanded field of dynamic flux in the artificial lighting, and couple between the daylighting and the artificial lighting through an integration of ambient contexts. (Figure 4). Ambience in this thinking

is the experience of fluctuations integrated as context, as an emergent material quality in-between several environmental influences (Schmidt 2010, Böhme 2013). The suggestion is that adaption through the contextual qualities of ambience will expand and qualify a much larger range and dynamics in the lighting, and thus expand the qualitative design scope for adaptive lighting (Maglielse 2009).

The philosopher Ulrik Schmidt (2013) builds upon the aesthetic problem related to the more fluid states of the forms of light and space, experiential problems which are particular prominent in adaptive lighting. He discusses the special qualities of ambient space, referring to Böhme (2013). Here he suggests that ambient space appears as intensities rather than as contours, shapes, scales, and perspectives. One can say that with the dematerialising variance of adaptive dynamics "intensity is added as the spatially defining parameter" (Schmidt 2013, 19) and the "gradual and graduated modulations in space unfold in different ways in a condensed passage in a concrete sense [...] which the subject can follow intentionally, or physically enter into, without ever leaving the environment at any time. Formations and modulations concretely take part in the environment as continuous, intensive variations" (ibid, 19). Through the adaptive dynamics there arises a new firmness in the experience of spatial shape through relationships arising in intensities in an otherwise dynamically changing context – a relationship in the experience facilitated by the perceptive constancies[vii], where "the surrounding's different elements weave [...], in all their diversity, together into a consistent plan" (ibid, 19). Adaptive dynamics thus generate a continual variation in spatial definitions, retracting the firmness of relational space in terms of the categories of scale, form, and perspective – in order to instead introduce ambience, defined by fluid constancies of intensities occurring within changes.

Figure 5. A very crude way of illustrating the ambient surrounding effect could be a blurred image like this; the motif is neither distinct nor indistinct.

Ambience and the adaptive light

The adaptive light functions as an environmental effect, a quality attached to the dynamic light in the environment, most similar to the way the influx of daylight presents itself as complex environmental. As experience, the movement in the light is a combination of the dynamics of the light itself, the dynamic processes of perception, and the experiencer's vision activities and movement in space. A central concern with adaptive lighting is to maintain the visual experience as ambient, that is, as environmental consistent. If one views architecture, and architectural lighting, as a basically ambient practice, then the design of physical space (Schmidt 2013, 71) can be seen as establishing particular physical framings, which stages the lighting conditions and "promote the environmental character of the framing and the sense of being surrounded" (ibid: 72). The compositional material within adaptive lighting is that ambivalent condition of the lighting phenomena appearing as significance to the ambient form, neither disappearing into diffuseness, nor appearing into particularity, but the dynamic potential in-between: the ambient light. (Figure 5).

Digital Weather Generator

Evolutionary design generation

The ambient mediation in the adaptive lighting is delivered by a software generator, which we call 'Digital Weather', conceptualised and designed by the software artist Ole Kristensen[viii]. The design of this generator is based on processes used in games, where environments, scenes and texture are continuously generated as the game unfolds. It is a change from lighting management system with pre-defined scenes and behaviours, to a design of potential variations, which is navigated from a set of generative parameters. Within this generative capacity, formulated in software, there is no limitations in number of dimensions that can be involved. There can easily exists several time-perspectives simultaneously. There can be feedback of sensor input on actual lighting conditions in the space or related to outdoor lighting dynamics. It is an important aspect of the substance of dimensional and integrated software, that it coordinates across modalities and experiential domains, which for the

human normally are separate categories, and uses weavings of relational parameters in the creation of lighting dynamics rather than data on measures and states. The design of generative compositional algorithms is in definitions of scope and procedures, which negotiate lighting outcomes that is not defined in the system but emerge from the system processes. This enables a larger scope of outcomes and a clearer negotiation of relevance.

The software driver of the adaptive operations is a system of Procedural Content Generation (PCG) (Shaker 2016) based around the Perlin generator algorithm (Perlin 2017, Bevins 2017), which allows for parametric control of textual phenomena with material qualities reminiscent of natural occurring phenomena. (Figure 6). The assumption is that if we view the fluctuation of light as an experiential material, then the perception of artificial lighting fluctuations can be generated reminiscent of daylighting, and thus allow for more seamless integration of for instance daylight influx and the indoor lighting.

Figure 6. Two instances of Digital Weather produced by Perlin Noise generated images.

The design of a generative system, rather than a configured management system, opens for adaptive lighting dynamics, that have pre-defined scope of options and a complex relational coupling to contexts and environment. Compositional systems within the context of parametric design defines a set of rules where the parameters are selected but the values and dynamics are a result from events outside of the control of the system, either as generated values from generative algorithms, or as contextual data from sensors or other control systems. In the Digital Weather we use a predictable, or at least repeatable, generator using the particular capacity of the Perlin Noise algorithm. This is not a noise in the sense of generating variation of uncontrolled random output, but an algorithm that enables complex orders of outcome beyond immediate prediction. The outcomes can be probed and selected for their experiential qualities, and then used to define the boundaries of the scope of activity of the Digital Weather. The Digital Weather is in a way a particular weather system with well-rehearsed variables and scope of outcomes.

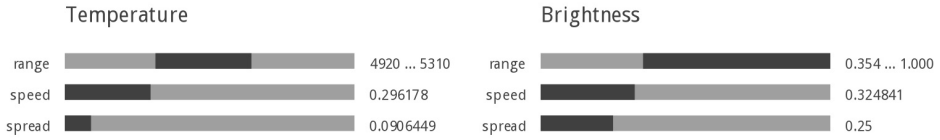

Figure 7. The simplified view of the core parameters, scales and ranges that compose the dynamics of digital weather system.

The Digital Weather is a rule-based system, which inherently has the potential for variation by changing the value on the defined parameters. (Figure 7). Some aspects are not parameterized and will not have variables. These can be constants or boundaries that define the concrete specifics of a design space, for instance the position and type of light sources, and the shape and reflectivity of the architecture. Other conditions can be dynamic but outside the reach of the parametrised system, such as the daylight influx and the turning on or moving of individual luminaires. The variables only make sense within a certain range. Defining the range of values is one way that designers can assert their aesthetic sensibilities in a parameterized system. Finding the parameters for the Digital Weather and defining their probable ranges, scales and speeds was developed through a complex process of design iterations, repeatedly probing and testing different possibilities until a final set of variables was reached. The final version has a limited set of high-level parameters that satisfied the design

demands of a delicate and nuanced pattern that also was able to produce a vibrant dynamic outcome.

Experiential Prototypes

Almost all areas in our lifeworld require some form of competence and experience in order to be seen and understood. The radical character of the fluidity and relational capacity of adaptive lighting could be in need of experiential investigation to gain competence on how it appears and influences our experience of light, space and each other. The suggestion is to meet the adaptive lighting dynamics on a compositional level rather than a functional, biological or psychological level. Like music is a combined effort of rehearsing, listening and performing, guided by structures for composition and strategies for rehearsal, the reach towards adaptive lighting and fluid integration of artificial light with the flux of the environmental light flux, reflections and movement, require an enhanced analytic and design capacity. The instruments and methods described in this paper have the role of staging and guiding the rehearsal and development of experiences and capacities for adaptive lighting design.

Staging experiential Prototypes

The concept of 'experiential prototypes' emerges out of arts based methods of minimalist art (Battock 1995), installation art and performance art. The minimalist ideas of shaping experiences by staging simple form, such as the sculptural works of Robert Morris (1993) where the introduction of very simple sculptural elements in space situate complex visitor activities and experiences. Significantly the participatory artworks at the exhibition 'Bodyspacemotionthings' at Tate London 1971 and 2009[ix]. The Olafur Eliasson's exhibition 'The Weather Project' at Tate London 2003-4[x] extends this approach to one elemental effect: a mirror. The visitors are situated under a gigantic mirror image of the space and can perform for themselves, for others and as part of a collective enterprise, all situated by the minimal spatial intervention of the full-ceiling mirror (Ursprung 2016, 118-23).

The activities of installation art have a diverse history across fields of art (Petersen 2015), including the visual staging of painting, theatre, film and games. In the context of experiential prototypes the main perspective is of installation art as environmental instruments that attunes the visitor to particular sensitivities, and structure participatory activities through the staging and scripting of a particular experiential situation (Søndergaard 2010). The adaptive lighting prototypes is an experiential instrument focused on the relation between the flux of light and the fluency of perceptual adaption. The experiential prototypes create reflective environments (Petersen 2011b, 2011c), within which the investigators can perform. Through systematic explorative rehearsals, the investigators perform their engagements while experiencing, analysing and testing aspects of the dynamic design parameters of adaptive lighting. To the extent that perceiving is tied to actions and sense making to semiosis and narrativation, the enactment of adaptive lighting investigations could be viewed as 'lived abstractions', as Massumi envisions (Massumi 2009), articulated into the world of professional dance and performance by Maaike Bleeker (2016, 35-53).

The methods of investigation combine architectural probing and performative engagement. Architectural probing such as sketching spatial dimensions and positioned relative to the larger environment (Burry 2016), and the staging of participatory engagement in installation art, within which the visitors perform their own experience while probing social situations (Petersen 2013). The experiential prototypes could be classified as *speculative*, by the way they enable sketching of ideas on adaptive dynamics and refinement of design parameters within a refined full-scale and perceptually correlated environment. These speculative situations are not designed to verify, measure or quantify any parameter directly applicable to a building. They are designed to enable the development of a scope for architectural programming. The investigations with

the experiential prototypes are meant to refine a first set of variables and models on an adaptive lighting paradigm.

Architectural programming for adaptive lighting

Architectural practice has design processes in several stages and situated in different context. The experiential prototypes, and the scope of design options they situate, fits to the early programming process of an architectural idea. Not related to a particular building or building topology, a specific place or inhabitation practice, but programming as the process of scoping the architectural challenge into a comprehensible synthesized model, that can be utilized to guide the further process into a particular implementation.

The suggestion is, that adaptive lighting with its merger of experiential dynamics, architectural form and flux of light from the environment with complex dynamic artificial lighting, will best be understood by actual inhabitation in full-scale prototypes. As Edith Cherry (1998) argues: “the architectural programming is defined as a process of problem analysis and identification” (p.xx), and, ”architectural programming is the research and decision-making process that defines the problem to be solved by design (p.3). The specific of the design scope is only occurring when related to a concrete architectural proposition.

Further studies will need concrete contexts in actual inhabited buildings with real-life activities, to enable the complexity and variance of the real to be the context for a formalised analytic set of events. Attached to these future contextualised studies, the effect and qualities of implementations of adaptive lighting can then be studies, measured and possibly formalised into generalised insights.

Formalised performance of presence in space

How the investigations are performed in relation to the prototype has its roots in performance arts: the activities of developing detailed experiences and capacities to perform by systematic investigations. Sometimes this is called ‘to develop the character’ and ‘to inhabit the space’. In the experiential prototypes for the investigation of adaptive lighting these methods of engagement and rehearsal is formalised as investigative inquiries on relations between a design and the experience of engagement within that design. (Petersen 2011a)

The staged situations in the prototype builds on a few core scenarios of persons inhabiting the set. The scenarios have a few different social configurations in the space, as simplified analytic event of spatial presences, enacted from simple scores that describe the dramaturgy of the acts to perform. This approach is based on simple relational categories: (1) the view of the other person, face or whole body, and their lighting conditions; (2) the sense of one’s own position and lighting condition; and (3) the sense of relation to lighting conditions outside the set (e.g. through the window) and the influx of light from outside. In short: the relation to oneself, to others, and to the environment. From this basic model of relations, scores of performing experience are scripted and repeatedly performed.

The analytic situation is then a collaboration between at least three people, who take the roles of (1) performing/experiencing enactment, (2) observing and documenting the performance, and (3) directing the performance and the adaptive lighting design. Through a schedule of rotation of roles, iteratively creating and rehearsing, the participant gradually develops a capacity of insight from the combined viewpoints. Through the constant processes of performing-observing-directing and the simultaneous processes of adjusting designs, testing experiential qualities and articulating observations, the team refined an insight into design qualities while probing design strategies.

Probing the dynamics of visual experience in adaptive lighting designs

The prototype is built in 18% grey material with slight transparent and rough textual material so that from this neutral basis the light can equally change to more or less luminous, more or less coloured towards warm and cold white, and more or less solid, reflective and luminous. The design enhances focus on the relative changes through the dynamic of the light, rather than on absolute luminous levels, colour tone and presence of materials. This design allows for variation in all directions adjusted to the perceptual capacities of our experience of light. The design enables that the experiential investigations can integrate the flux of perceptual adjustment of the human visual system alongside the flux in the dynamics of the light, enabling tests across the range and variations inherent to visual adaption. In interest in the relative dynamics of perception, action, adaptive lighting and environmental flux, rather than any specific spatial configuration or luminous composite.

The interest of the investigations is primarily in how dynamics in the lighting flux correlate with the experience of the space and presence in the space, and thus the dynamics of perceptual adaption is an integrated element in the probing of the possibilities for fluent dynamics in the artificial lighting. The offset for the investigations and the experiential prototype rest on a three-year artistic exploration into understandings of the adaptive dynamic features as experiential form, and a first attempt to outline a model of dynamic scales and parameters that reach between software behaviour and experiential materiality. An outline of these investigations is published in the books: ‘Adaptive Lighting, (Petersen 2015a) and ‘An Exploration into Integrating Daylight and Artificial Light via an Observational Instrument’ (Petersen 2015b). (Figure 8 and 9)

The design of the instruments – experiential probing environments

The instrument makes certain aspects clear and analytically available – the set-ups are detailed formed towards the particular framings, concepts and parameters under investigation. Other questions would require a different prototype design. The prototypes enable sketching through experiential activities – as abstract and as concrete as drawing or performing. They are adjusted to visual perception with a middle level in light transparency, luminosity and contrast regulation. They have clear marked directions in space and grey/white painted furniture objects. They have soft borders of the space to be able to fluently walk in and out and extend the probing space. There are well-structured visual directions and view lines, and observers of the events can situate themselves and adjust to any particular condition under investigation.

The challenge of adaptive lighting dynamics has potentials, they enable a new condition, and therefore the prototype is an attempt to stage the full estimate of that new condition. What comes into strategic ability is a parallel development of insights into dynamic lighting design, experience of inhabitation, and development of generative software. The prototypes are instruments, not something like architectural mock-ups or in any way aiming at lighting design propositions. They are abstracted staging’s of a refined set of variables, to enable investigations into the core parameters of an adaptive lighting design strategy. We have arrived at a set of scales, ranges and relations – a tuned investigation tool-set. The scope for adaptive lighting is very large given these qualities in the variations of the dynamics, but as a starting point, the investigations have focused on the subtle continuous adaptions as ambience in and of the environment.

Figure 8. The 'Adaptive Lighting' project in 2012-15 investigated the particular adaptive relation as experiential accounts, when the lighting follows the activities of the inhabitants. Direct relations between position and movement followed by luminous or colour change, or subtle variations on how the lighting dynamics follow or are followed by the person. Situations investigating the relation between several people when situated in lighting adapting to places or people in space.

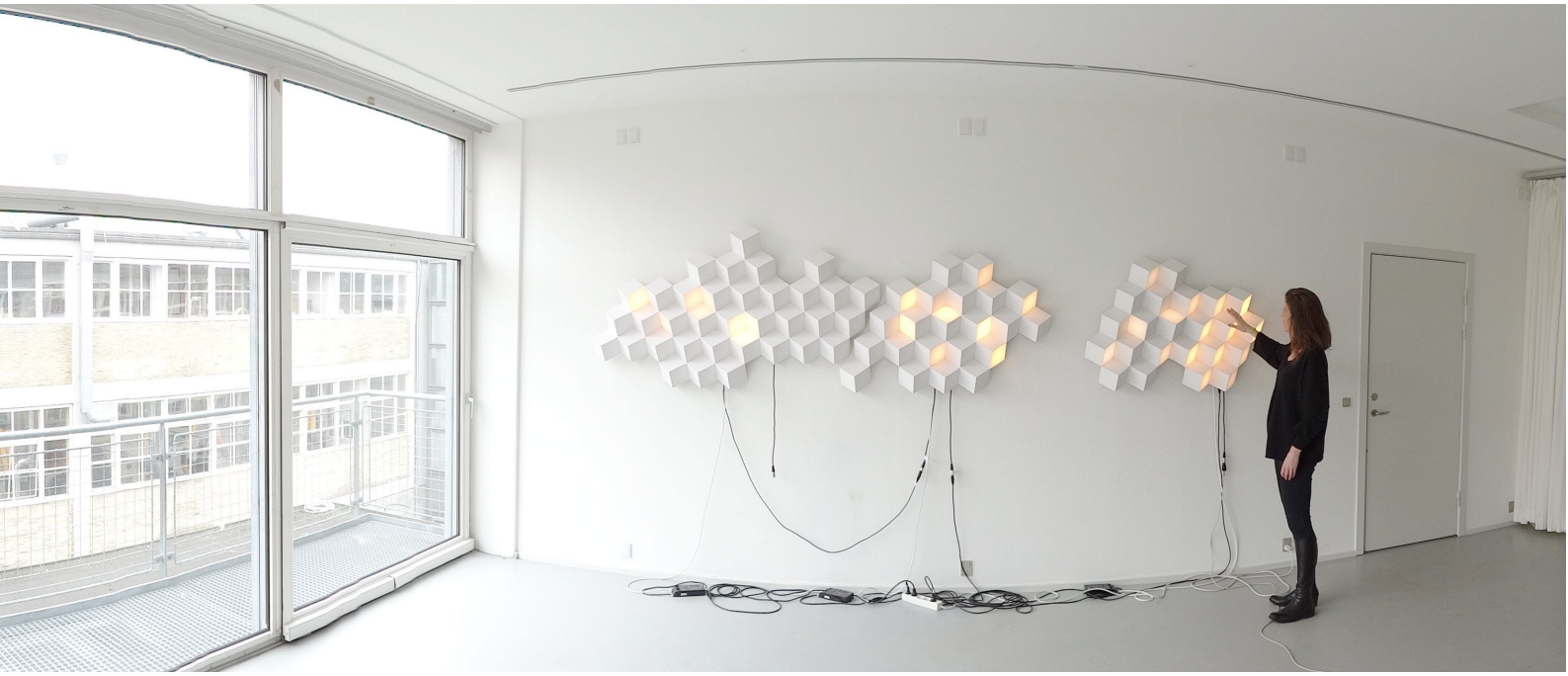

Figure 9. The observational instrument with which one can explore and experiment with the dynamic relations between daylight flux and adaptive lighting driven by a 'digital weather' algorithm.

The test environment is a high-resolution prototype environment where any parameter in need to be included in the investigations are formed into a structural component of the system. In the rehearsals and continuous re-configurations, the parametric capacities are then simplified. The interfaces are made to be guiding for the designer, therefore they have clear visual, auditive, and tactile feedback. (Figure 10). The design of the software is then, very accurately, a proposition for an adaptive system configuration, at least on the level of a coordinated parametric model brought into simplified operations.

The prototypes enable continuous experiential investigation and rehearsal for designers to develop insight into the dynamic lighting as material for lighting design, and develop experiential accounts on adaptive compositions and dynamic. Probing and rehearsing is essential to develop design sensibilities and gradually reach a skilled capacity to engage with adaptive lighting variables and compositional strategies. The prototypes are inhabitable sketching environments, to envision and try possibilities, to explore intents, visions and concepts through systematic probing. (Figure 11 & 12).

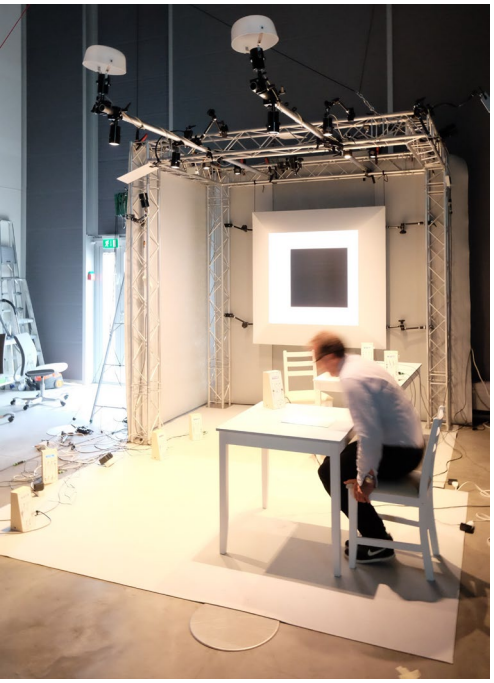

Figure 10. (Top) Interfaces to the adaptive lighting system, with clear visual, auditive and tactile feedback. The sliders move, the brightness and colour of the screen changes, all adjustments make particular sounds, and when touched, there is tactile feedback. All this to integrate the complex of dynamic changes in the sensibilities of multimodal engagement.

Figure 11. (Above) Test in an office space using the prototype components to install the functions of the adaptive lighting system. In this environment the changes of light influx during day and night, including light from the houses, cars and streetlight.

Figure 12. (Left) Exploring adaptive compositions with an extended setting, which allows for more complex spatial relations and diversified adaptive lighting compositions. The inhabitants introduce change by entering the room, by reaching the table, by sitting at the table, and similar when he leaves. A larger geography of presence form in space is nuanced in the relational design, and further brought into fluency by the influence of the ‘digital weather’ algorithm.

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[ii] http://www.openais.eu/en/results/
[iii] http://www.openais.eu/user/file/openais_object_model_annex_(d2.7)_v1.0-pub.pdf
[iv] http://www.openais.eu/user/file/openais_implementation_verification_guidelines_(d2.2)_v1.0-pub.pdf
[v] for instace: http://www.mivune.com/en-US/Home.aspx
[vi] (http://www.smartlighting.org/ , http://www.smart-sensing.org/).

[vii] The perceptual constancies are a wide range of perceptual and cognitive processes that allows us to assume coherence and stability in otherwise variant and fluctuating appearances, e.g. the experience of a wall as one colour even though the luminous level and colour tone across a wall varies dramatically. For an introduction, see Livingstone 2002.
[viii] ole.kristensen.name
[ix] http://www.tate.org.uk/research/publications/performance-at-tate/perspectives/robert-morris
[x] http://www.tate.org.uk/whats-on/tate-modern/exhibition/unilever-series-olafur-eliasson-weather-project

Light and Media Projections in Patient Rooms

A Preliminary Case Study

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Abstract

New media and lighting technology and new ways to connect and control it have the potential to improve the environment in hospitals with the goal of increasing patient satisfaction. How should such system be designed to do so and how can it be tested? In this paper it is investigated how a specific case, an interactive lighting and media system installed in a patient room, can be improved to support a greater experience of patient satisfaction. Through questionnaires given to 14 mothers who have just given birth and their husbands staying in an interactive patient room, the experience of staying in the room and the patient satisfaction have been assessed. The results from the questionnaires are hereto combined to data log on how the media system has been used, which additionally leads to a design evaluation for the interactive media system. The results imply several areas which can be improved to meet the specific needs of the patients and thereby provide higher patient satisfaction. Hereto, the main findings suggest that the control of the lighting needs to be less complicated, the different lighting settings needs to be better tailored to the actual needs, noise from the projector and light coming from the iPad needs to be reduced, and for critical situations, the medical equipment needs to be an exact copy of what the caregivers are used to.

Keywords: media projection, lighting design, interactive lighting, patient satisfaction

When adding an interactive media system to a space to enhance the atmosphere through projections, light and sound, one should always carefully consider the side effects that might be introduced as well. This includes, but is not limited to, noisy equipment, light pollution equipment, technical errors and insufficient support.

Introduction

Any environment impacts the people within it. The size, the colors, the perceived safety, the quality of the lighting and architectonical elements, etc., all alters the overall feeling of a person's well-being in that specific space (Böhme, 2013; Cold, 2001). The term Healing Architecture covers how spaces can be designed to impact the people within it in a positive way by providing a higher sense of well-being and safety. In a hospital setting, when done right, the environment can even make patients feel a higher degree of personal identity and less pain (Nielsen & Mullins, 2017; Ulrich et al., 2008).

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Healing architecture can be achieved through designing a space with room for relatives, possibilities for privacy and physical comfort and where attention has been paid to the overall mood of the room through lighting, art, furniture, etc. Furthermore, the current research done within the field of Healing Architecture shows how architectural elements such as sound, light and color have the potential to support patient healing and well-being (Frandsen et al., 2011; Nielsen et al., 2017; Timmermann & Birkelund, 2013; Ulrich & Gilpin, 2003).

Additionally, other studies show that it might not even be necessary to physically be in a healing environment to experience its healing effects. Tricking the brain into thinking it is, is enough. Studies that used the technology of VR to *emerge* test subjects into an artificial environment, showed positive impacts on the sensation of pain as well. In a study dealing with burn victims, when entering a snowy environment, the self-reported pain score decreased from an average of 6.3 to 2.8 on a 10-point scale. In addition, the amount of time the patients spent thinking about pain fell from 76% to 22% (Hoffman, n.d.).

The crowing knowledge of effects within the field of Healing Architecture are in these years inspiring hospitals around the world to consider the physical environment as a supporting tool for healing, thus applying a more holistic and sensorial approach to patients and their recovery process. In Denmark, this tendency is especially applied within birth environments, where physical environments are designed to support the release of the oxytocin hormone, which supports relaxation and contractions and thus a more soothing sensation to the process and experience of giving birth. Even within the last five years, five birth units in Denmark have incorporated two types of design concepts to their birth environments, by the integration of media screens and different elements of light, color and sound (cf. figure 1 and 2).

Figure 1. Sensory Delivery Room at Northzealands Hospital - Wavecare

Figure 2. Interactive Delivery Room at Herning Hospital - MODOS

While research has been carried out on the effects of sound, light and color for healing and well-being, a holistic evaluation of patient's experience of the space when applying media screens in hospitals settings is scarce.

Aim

The aim of this paper is to investigate how new media and lighting technology and new ways to connect and control it have the potential to improve hospital environments with the ultimate goal of increasing patient satisfaction. This is addressed by evaluating the use and experience of The Interactive Patient Room - a specific case of an interactive lighting and media system installed in a patient room - and how this system can be designed and improved to support a greater experience of overall patient satisfaction during hospitalization.

Case

As a further development of the integration of media screens in the birth environment, The Interactive Patient Room was installed in the beginning of 2017 at the Gynecological-Obstetric Ward at the Regional Hospital in Herning, Denmark, co-designed by MODOS and staff members of the birth unit. The Interactive Patient Room is an experimental room, where an interactive media system serves as the main source for mood giving digital art, entertainment and

information. The mood giving elements consist of sound and video projections of nature scenery which are supported by the electrical lighting in the room. The patients are via an iPad able to pick and choose at any time between relaxing moods (cf. figure 3), information and entertainment. Besides the media system, the interior space has been designed using homey furniture and hospital equipment is hidden in neutral cabinets. The aim has been to support a homey and comfortable atmosphere in the room and at the same time increase the feeling of safety.

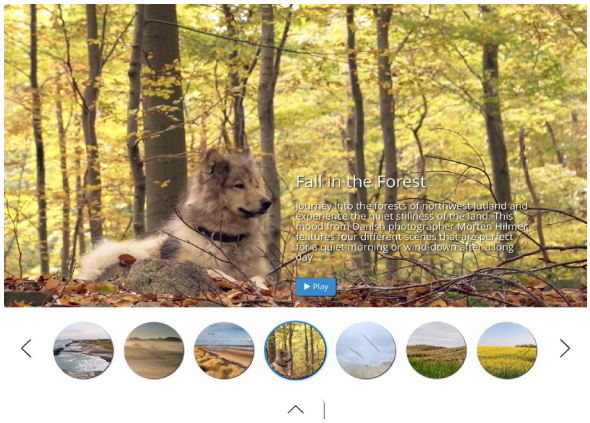

Figure 3. iPad screenshot showing the user interface for selection the predefined moods and projections.

The interactive lighting and media system consist of a projector, lights and speakers, all wirelessly connected and controlled from an iPad positioned on the left side of the bed. Through an app on the iPad, the projector can be controlled to show information about the patient's hospitalization, general information for new parents, stream television, and show different sceneries to create certain moods in the space (cf. figure 4). The five available moods are named: Fall Forest, North Sea Serenity, Spring Morning, Winter Silence and Evening Atmosphere in Copenhagen. All moods are designed by MODOS (Modos, n.d.), (cf. figure 7 and 8) and are based on knowledge about the positive effects that nature has on the human body and mind (Ulrich, 1984; Wilson, 1984).

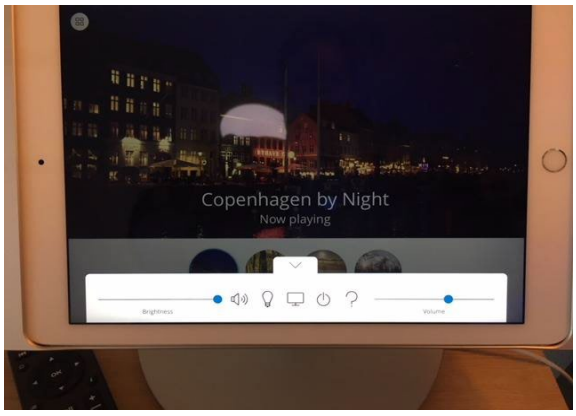

Figure 4. iPad positioned left to the bed showing the user interface for controlling i.e. brightness of the lighting and volume of the sound.

All five moods are based on one or more pieces of seamlessly blending and looping footage with accompanying sound through speakers integrated in the ceiling. The design intent is to create an experience of calmness and serenity. There are no or little camera movements in the footage. Just a view into different nature sceneries (cf. figure 7 and 8). The lighting in the room adjusts automatically to fit the colors and brightness of the lighting in the footage to enhance the spatial experience of being present in the specific scene and not only isolate the scenery to a screen picture. After selecting a certain mood, it is

possible for the patients to customize the lighting and sound/music according to individual needs.

Methods

A preliminary case study was carried out at the Gynecological-Obstetric Ward at the Regional Hospital in Herning, Denmark in the period of March-July 2017. The test subjects were new parents, mothers and fathers, who had just given birth. The patients were staying at the hospital to recover from the birth in a timespan of 7 to 240 hours depending on their individual condition.

Originally, the case study was designed as a comparative study, thus consisting of both The Interactive Patient Room and a control room. In relation to this, two adjoining rooms with the same dimensions and orientation were used for the study. One of the rooms (The Interactive Patient Room) was equipped with the interactive lighting and media system along with a modern interior layout (cf. figure 5), while the other (the control room) was a standard patient room with standard interior and no interactive system (cf. figure 6).

The entrance to both rooms is a hallway half the width of the room itself. To the right, there is a door to the bathroom. To the right in the interactive patient room there is a homey looking double bed with a white neutral cabinet above it. At both sides of the bed small lamps are mounted in the wall. The standard patient room contains an institutional looking single bed with exposed medical equipment above it. Next to the bed in the standard room is another single mattress on wooden legs. The height of it is different from the other bed. To the left in the interactive patient room, opposite the bed, the projection from the media system is present. It is approx. 2.5 meters wide and 1.5 meters high. The similar wall in the standard patient room features a small flat screen TV. A large window is placed at the end wall in both rooms. In the standard patient room, the incoming daylight can be blocked with white diffuse curtains while the interactive patient room is equipped with venetian blinds. In front of the windows, there is a seating area in both rooms. In the standard patient room there is a desk and two upright chairs in the left corner and an armchair in the right. In the interactive patient room, the seating area is centered and consists of a two-person couch with large pillows, an armchair and a small coffee table. The area is furthermore decorated with art, a bookcase with flowers, a mobile and a pendant hanging from the ceiling. In the standard patient room there is nothing.

The patients were assigned to one of the two rooms randomly in the hours after giving birth.

To assess the interactive lighting and media system and its effect on the patient satisfaction, data was collected through a questionnaire, completed by the patients towards the end of their stay. The questionnaire for the interactive patient room consisted of 36 questions revolving around their experience of the room and their use of the interactive media system, rated on a 6-point Likert scale (Gut & Fuglsang, 2015). Indirectly they were asked about their perceived experience of competence, autonomy and relatedness, which is defined by Ryan and Deci (2002) as three innate psychological needs, that when satisfied leads to enhanced self-motivation, mental health and a greater sense of perceived security and safety, and thus, a greater overall satisfaction. The questionnaire was answered on an additional iPad handed to the patients by the caregivers.

The questionnaire for the control room didn't contain the questions directly related to the interactive system but was otherwise similar to the questionnaire given to the patients in the interactive patient room. 14 answers from the interactive patient room and 3 from the control room was collected. Due to the low and a skewed amount of test subjects between the two rooms (14 against 3), the results were mainly analyzed as a preliminary design evaluation for the

interactive media system, only considering the answers from the interactive patient room.

Figure 5. Interactive Patient Room

Figure 6. Standard Patient Room

Figure 7. Spring Morning

Figure 8. Evening Atmosphere in Copenhagen

Results

The 14 answers from the patients staying at the interactive patient room revealed a row of insights to how the interactive system is used and how it can be improved.

The moods were used between 2-40% (0.5-30 hours) of the total length of the stays. Furthermore, patients mainly used it in the beginning of the stay and in the afternoon/evening for relaxation.

Although supporting a relaxing and homey atmosphere, data showed how the interactive lighting and media system can be greatly improved before investigating its impact on patient satisfaction further.

First of all, the control of the projections and especially the lighting could be less complicated to use. Although the system is rated intuitive to use by most of the patients, more than half of them state that they needed an introduction to the system. A couple who couldn't get an introduction to the system, failed to use it at all. Also, three of the patients stated that it was overcomplicated to switch the lighting on/off compared to using a traditional switch. One of them says: *"There are many things to deal with when having a new baby. It is easier to turn on the lights using a switch than on an iPad".* That the lighting can only be controlled from one side of the bed, is also mentioned as a problem.

Secondly, the lighting schemes can be improved. Especially the night setting is mentioned as being too harsh. Here it is also mentioned that the lighting coming

from the iPad screen was a problem during the dark hours. Furthermore, a need for the possibility to be able to turn on a single functional light for i.e. changing diapers during night time was pointed out.

Thirdly, it was mentioned that the projector was noisy and couldn't be turned off through the iPad. Only by manually using a broom to turn it off, the patients could get a silent room to sleep in.

Lastly, a couple experienced connection errors and the caregivers didn't have time to troubleshoot the system. One states that *"it is a nice room and you feel comfortable here, but the technical challenges with the projector and the lighting made it a less great experience".*

Besides the less critical technical problems, one patient experienced that the interactive patient room made her feel less safe. She says: *"When I got ill due to heavy bleeding, the facilities above the bed seemed clearly foreign or inadequate for the staff. They had to hold things manually, which wasn't comforting."* She further stated that she would have liked to be in a normal patient room as the furniture are more practical. A couple of other test subjects stated that the non-adjustable height of the bed in the interactive room was a problem as it was difficult to enter for lower women.

In relation to the overall patient satisfaction between the interactive patient room and the control room, the answers about the experienced competence, autonomy and relatedness showed no difference. Patients from both rooms gave high ratings.

Discussion

Generally, the results of the preliminary case study showed that the different use cases of the patient room need to be investigated further to give relevant input to how a holistic lighting and media interface design meets the needs of the patients to a greater extend.

Whether using questions about the perceived competence, autonomy and relatedness as a valid measure for overall patient satisfaction, is not clear from this preliminary study. The number of test subjects were expected to be higher. But due to the complexity of collecting data in a real-life environment dependent on staff, patients and the implementation of the technical systems, the numbers of test persons are low and heavily skewed between the interactive room and control room (14 against 3). Furthermore, it would be beneficial to support the data from the questionnaire with actual quantifiable data, i.e. tracking the use of the moods and adjustments and i.e. compare it to the cortisol level of the patients, to provide more valid results. Additionally, a higher level of qualitative research methodologies could be of value in order to further investigate the potential of light and media-projections in patient rooms, e.g. in relation to when, which and why patients apply the moods of the interactive system during hospitalization. Also, to test the effect of the lighting and media system alone, the two rooms should have similar interior designs.

This preliminary study also suffered from an inconsistent collection of data. For further studies, all parties involved in the project must be instructed in the importance of a consistent flow of data and agree that specific resources have been assigned to make sure that all relevant data is collected.

Finally, the results of the preliminary case study should be viewed in consideration to The Interactive Patient Room being installed just one month prior to the starting time of data collection. Thus, startup issues with the interactive lighting and media system affected the data.

Conclusion

This preliminary case study gave answers to how The Interactive Patient Room - a specific case of an interactive lighting and media system in a patient room - can be improved before further investigating its impact on overall patient satisfaction. The results showed more attention needs to be given to the fact that the patients of the study are in a state where they are focused on and overwhelmed by their new-born baby. Thus, the lighting needs to be easier to adjust and turn on/off. Also, a general introduction to the system should be prioritized. Furthermore, results showed how technology-related sound and light pollution should be addressed and optimized.

When adding an interactive media system to a space to enhance the atmosphere through projections, light and sound, one should always carefully consider the side effects that might be introduced as well. This includes, but is not limited to, noisy equipment, light pollution equipment, technical errors and insufficient support. To take these negative effects into consideration seems especially important for spaces where people tend to stay for an excessive period of time, and where people are in a stressful situation, like in a patient room. The positive effects a person potentially will experience from the media system can be diminished or even abrogated by these negative phenomena. The design must take the very sensitive situation into consideration and see the media design as a holistic design meeting people in a stressful situation, where patients have cultural expectations to a room in a hospital. In some cases, the overall experience of a space might even be more stressful with the system than with no system at all.

While emerging technologies open up for many useful interactive features for low cost, they also open up for more complex user interfaces. It can be argued that for the best possible experience, turning a light source on and off through an application interface, shouldn’t be more complex than turning a regular switch on and off. That is a one-click procedure. Again, this is especially important for spaces where people are staying for a longer period of time. For more sophisticated changes like adjusting the color temperature or intensity of the lighting, switching the projected footage, etc., in other words, things you can’t do with a regular lighting setup, a longer procedure can most likely be accepted, although it should be kept to an absolute minimum.

On this note, this preliminary study is stressing the importance of understanding and qualifying the design of light and media projections as architectural elements in our build (health care) environment. The effects of the projections should be considered as an impactful media to create illustrations, such as natural phenomena. At the same time light and media projections can be very impactful for the atmosphere of a space. Thus, it should be considered that light and media projections are new elements in our build environment and that user's interaction and perception of these media and its effects must be taken into further consideration and investigation. This is why this kind of case studies in real-life environments are both challenging and yet highly important.

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