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## Sustainable Retrofitting of Nordic University Campuses

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### ABSTRACT

**Purpose** The purpose of this paper is to identify the state-of-art of Nordic campus development and identify how campus areas can be retrofitted by addition of new technologies, features, functions and services. The leading research question is: how to develop Nordic resilient campus management in all five countries with closely comparable circumstances both on a societal and on an infrastructural level.

**Theory** The current Nordic campus built environment, which represent both a technically and functionally ageing real estate portfolio is approached by applying a systemic understanding of university campuses as socio-technical systems.

**Design/methodology/approach** State-of-art analysis is conducted using literature review and document analysis.

**Findings** The results identify the trends and challenges on strategic, tactical and operational levels and the three-level roadmap for future campus retrofitting and research is presented.

**Originality/value** The research is conducted as part of the preparation for a Nordic research and campus development collaboration initiative and will serve as a framework for demonstrations conducted on different Nordic campuses.

### Keywords

Retrofitting, campus development, Nordic, campus management, urban development.

## 1 INTRODUCTION

Retrofitting processes are the additions of new technologies, functions and services to existing built environment systems. In university campuses this means the development of embedded learning environments, new space typologies and a variety of platforms (digital, physical and social) supporting collaboration both within the university and in connection with diverse stakeholders. Nevertheless it is also about service concepts and new ways to produce services. Retrofitting processes are need-driven, user involving, agile, scalable and transferable urban acupuncture actions.

The Nordic countries have much in common, historically, culturally and linguistically. They have had a common labour market and strong co-operation in many areas for many years. The Nordic welfare state model is based on the rights of individuals to a decent life and equal opportunities for social promotion, often achieved through education. Higher education is a part of their large public sectors and has been influenced by a powerful nation-state in which regional policy considerations and the social thesis of equal educational opportunity have played an important role. (Fägerlind et al. 2004)

All Nordic university property management organisations emphasise, that their operations need to be sustainable from economic, environmental and social perspective (Nielsen et al 2012). Sustainable development targets can be structured according to the three dimensions of sustainability: society, the environment and the economy.

Social targets: supply of adequate buildings for work and life; compliance with health, safety and security requirements. Additionally there is the need to preserve the cultural heritage as a part of the property management organisation's social responsibility. This is also an important aspect in the other Nordic countries, since the university properties are often culturally valuable and reflect the society in general. (Stadsbygg Anon.2010 a; The Danish University and Property Agency 2013).

Ecological targets: reduction of resources, usage of recyclable building material; considering the separability of used material for re-use; reduction of energy consumption and usage of renewable energy sources; reduction of space requirements and soil sealing; safeguarding the ability to maintain and de-construct buildings; preventing the usage of material causing excessive emissions (prEN 15221-4). Economic targets are: building space optimization for a most efficient usage; optimization of building life-cycle costs; facilitating the most efficient management methods. (Junghans, 2011)

## 2 THEORY AND METHODOLOGY

At the core of socio-technical systems is the proposition that many systems are a combination of physical and non-physical artefacts and the human context (Geels 2005) and that change is dependent on the complex interactions between these elements. Socio-technical analysis can be considered at different levels of scale, from small work groups right the way up to large scale national systems (Geels 2005, Verbong and Geels 2007, Geels and Schot 2007).

Geels defines large-scale socio-technical systems as displaying the following characteristics: *“At the level of societal functions, a range of elements are linked together to achieve functionality, for example, technology, regulation, user practices and markets, cultural meaning, infrastructure, maintenance networks and productions systems.”* (Geels 2005, 1)

Transferring the system thinking approach by Geels (2005, 2 figure 1) towards a socio-technical system for University campus retrofitting the following perspectives might be integrated:

1. Learning environment - Markets and user practices in higher education
2. Information and communication infrastructure
3. Users of Universities (students, faculties employees: teaching, research, administration etc.)
4. Maintenance of existing buildings and infrastructure
5. Construction of new buildings, modernisation and rebuilding
6. Knowledge development
7. Culture and symbolic meaning
8. Regulations and Politics (Ministry of Education, Research Council, building law, environmental regulations, etc.)

In many ways, when looking at campuses and retrofit innovation in the wider context, all of these perspectives are necessary. Innovation is viewed as the lowest level, with new ideas entering a socio-technical domain of artefacts, rules and actors.

This paper aims to identify the state-of-art of Nordic campus development and identify how campus areas can be retrofitted. The leading research question is: how to develop Nordic resilient campus management in all five countries with closely comparable circumstances both in societal and infrastructural level.

The following section includes the state-of art overview with focus on the first five elements, which are considered most relevant for development of resilient campus management?).

### **3 STATE-OF-THE-ART OF RETROFITTING UNIVERSITY CAMPUSES**

#### **3.1 Learning environment - Markets and user practices in higher education**

A university's campus is seen as a huge learning environment, which creates possibilities for learning – also across the university's academic environments (Anon, 2013). The need of multi-use learning environments is increasing. Based on global campus development it is emphasised that learning landscape is about the connections between the spaces and how much they support encounters and informal learning. Learning landscape should support the different ways of learning. It includes the network, connections and the urban functions, which create a supporting ecosystem for the whole learning cycle. (Harrison et al. 1996) According to Long et al. (2005) the standards of learning spaces today do not support effective learning but are out-of-date and ineffective. They recommend a shift from too discipline-specific to more flexible and stimulating, learning enhancing spaces by focusing on two main principles and offerings: (1) self-discovering virtual networks delivering secure services to portable devices that dynamically join and depart the building operating system, and (2) spaces supporting sets of interactions with corresponding technologies optimized for particular locally identified goals.

The current issues in connection with development of higher education in different Nordic countries include issues like action plan for increased higher education internationalization and new financing model for state support of study-abroad students (The Danish Ministry of Education) – the issues are handled in the report titled Enhanced Insight through Global Outlook.

In recent months, the ministry has reworked some of the ‘actions’ and has presented a proposal for legislation with a totally new financing principle for exchange students entering and leaving Denmark. The Norwegian government recently wrote about open access publishing as a potential threat to academic freedom: "All research that is publicly financed should be openly accessible. This principle, however, must not hinder the academic freedom researchers enjoy to choose their preferred channels of publication." Sweden’s Ministry of Education has proposed legislation that would grant universities and colleges legal autonomy from the government – by institutions becoming private foundations. Universities have endorsed the need for change. The underlying objective of the legislation is to increase the autonomy of universities by decoupling them from the state. Higher education would operate according to ‘contracts’ between the government and universities. The issues connected to reorganising universities are topical in Finland and Iceland. Iceland had only two universities, but during the 1990s it sustained seven higher education institutions - four state-owned, the rest private - to serve a population of just 320,000. In the wake of the economic downturn, which devastated Iceland, an international panel of experts recommended that the country merge its universities. Finland is at the forefront of the merger trend: three new universities were created in 2010 (involving seven pre-existing institutions), with more mergers expected in 2013. The drivers in merging are quality and competitiveness - small universities are just not powerful enough. (Anon. 2013c)

### **3.2 Information and communication infrastructure**

The development of ICT (information and communication technology) and digitalization alter our activities and almost every space from working, studying, and teaching to leisure. In terms of learning environments the actual learning can happen both virtually and physically which makes it more complicated to plan the physical spaces (Dugdale 2009). According to Santamäki (2008), as the generation born in the technology era want to work in more casual places, the physical, virtual and social spaces need to be designed for a multitude of different needs and users. Such a profound change requires from campus management ability to develop flexibility, managerial learning and network organization capabilities.

All Nordic countries have been very active in research initiatives in connection with future learning environments. Examples of the development initiatives are presented in Table 1.

Table 1 Examples of Future learning environment development activities in Nordic countries (Anon. 2009; Hansen et al. 2011) i

Country	Actors	Action	Focus
Denmark	Danish Building & Property Agency	Publications 1. Campus and Study Environment – Physical Settings for Tomorrow’s University in 2009 2. Campus Development: Method and Process 2013	What campus areas could look like and which functions they would benefit from including. The process to identify the methods and processes those are necessary for supporting campus development.
Finland	University properties of Finland and Strategic centre for Science, Technology and Innovation of the built environment in Finland	The Future learning environment R&D program 2011-2015. <sup>i</sup> The Energizing Urban Environments R&D program 2012-2016. <sup>ii</sup>	How to benefit from of the current international reputation regarding educational achievements and how to develop the world-class learning environments aligned with the latest educational knowledge and creative ways of learning. How the current pedagogical theories e.g. embedded learning and student-activating methods can be taken into account in designing, using and managing the campuses.
Norway	NTNU	Network of Competitive Campuses since 2007 Research activities in Usability of learning environments.	How to develop future campuses? How to improve the usability of learning environments? What methods can be used?
	Statsbygg	Sustainable development and cultural heritage	Effective building project and sustainability
Sweden	KI and SLL (Stockholm County Council).	Future Learning Environments - How Space Impacts on Learning R&D program 2010-2012. <sup>iii</sup>	How we should design our learning environments in the future. The aim has been to find new ways of designing space to support interaction and flexibility on all educational levels
	Akademiska hus	Publication Method support for developing knowledge environments. <sup>iiii</sup>	Supporting holistic development of campuses.

### 3.3 Users of Universities - New ways of collaboration and co-creation – tactical reflections

<sup>i</sup><http://rym.fi/program/indoor-environment/>

<sup>ii</sup><http://rym.fi/program/energizing-urban-ecosystems-eue/>

<sup>iii</sup>[www.ki.se/learningspaces](http://www.ki.se/learningspaces)

<sup>iiii</sup>[www.akademiskahus.se/downloadpubl.php?IPubliID=163](http://www.akademiskahus.se/downloadpubl.php?IPubliID=163)

Action and use of facilities is strongly related to experiences of the users and thus their possibility and will to perform. CIB Work Group 111 on Usability of workplaces – including Nordic researchers - has been exploring concepts, methods and tools, developed in the evaluation of all kinds of consumer products, applied to the built environment. In the most recent phase of this work, conducted over the past three years, an international network of partners has collaborated to focus on the usability of learning environments. The work has sought to identify and evaluate the ways in which users (and other stakeholders) in projects are involved in decision making about building use and the methods and tools they used to understand, as well as to design and manage the relationship between activities and places. (Alexander et al. 2013) The Use-Frame (Lindahl et al. 2011) and Use-Tool process (Hansen et al. 2009) provide frameworks for developing more usable facilities in collaborative ways. The success of the latest collaborative methods lies in user involvement, which has been practiced and researched in the area of residential and workplace planning (Olivegren 1974; Granath et al.1996) since the 1970s. In user-centric design both technical and psychosocial systems are considered. The purpose of user involvement has shifted from mere participation to co-designing, making fuller use of user knowledge and experience (Sanders and Stappers 2008; Eriksson et al. 2012).

### **3.4 University campuses real estate and facilities management in Nordic countries**

Real Estate and Facilities Management includes maintenance of existing buildings and infrastructure and construction of new buildings, modernisation and rebuilding of university properties. University properties have been recognised as a key asset in all the Nordic countries. The university properties are mainly owned and managed either by a separate, typically state-owned, organisation or a company. There is a difference between the countries. In Denmark Universitets- og Bygningsstyrelsen, UBST, (government agency) rents 75 % of the university properties. In Finland – 76 % of all university properties were rented from Senaatti-kiinteistö / Senate Properties (state enterprise). These properties were transferred to three newly established limited companies from 1.1.2010. The transfer of properties into separate property companies was a result of both strengthening the financial position of the universities as well as increasing their autonomic position. In Norway Statsbygg (government enterprise) rents in the higher education sector regional college/university properties and a part of the university properties. In Sweden – Akademiska Hus (limited company) has a market share of 64 % in the university, higher education and research sector. The division of the responsibilities regarding the services varies between the Nordic countries and there is variation between the tenants as well. In principal, the owner are in most cases responsible of facilities services in connection with maintenance – there are different ways to organise the user-services either outsourced or in-house services. (Anon 2010b)

The expansions and modernisations over the coming years are connected to the fact that universities determine where the knowledge economy (still) grows or has more opportunities. Location and quality of the facilities is key in attracting and retaining knowledge workers. The campus represents value. The campus requires 10-15% of the university's resources. Funding models, cost structures and revenue models are in a core role in developing university infrastructures. The expenditure models of tertiary institutions, such as colleges and universities, consist of an increasing share of private sources. The relative amount of private expenditure varies from under 10 % in the Nordic countries to 60-70 % in the U.S. and the U.K. This

illuminates a reinforcing market-orientation approach in the field. Statistics show that both public and private expenditures have increased in the 2000's. (Van Damme 2001).

The position of the organisations in the markets is highly affected by the legislative framework, the organisation's legal status and its administrative form, e.g. Akademiska Hus operates quite freely and independently in the markets with market-based setting and ruling, whereas the two state agencies, i.e. Danish and Norwegian organisations, operate close to the Ministries. (Anon 2010b)

There are identified challenges for university properties, which were collected in Nordic project "University Property Management in the Nordic Countries" as a part of the KTI & IPD Nordic University Property Management Studies during year 2010 (Anon 2010b). In Denmark the development of laboratory space includes actions, where useless old laboratories will be modernized with the governmental support of 200 million euros. The collaboration challenge is obvious, because institutions want to work in closer relationship, but the possibilities are limited. The alternative property owning structures are in the discussion: e.g. university has made an official request about owning their properties (conditions for this will be cleared) – the process was in an initial phase in 2010.

In the Finnish situation the challenge is developing the processes and starting the operations of the different companies, which all have a specific position and market area – this is a matter of creation of credible value network. The other challenge is in strategic, tactical and operational co-operation nationally. Statsbygg's properties consist of colleges in remote areas - developing the regional colleges and making these more attractive is a key issue. Statsbygg aims to co-operate with the clients by developing the properties and providing new kind of solutions. Statsbygg has a challenge in competing with new, modern spaces with older properties – retrofitting has a significant role here. In Sweden Akademiska hus mentioned the increase of competition regarding large projects from the market. It is important to utilize the knowledge and specialised services that Akademiska Hus can offer i.e. regarding libraries and laboratories. The pressure to centralisation is present and there are large investment projects in the process and in general the project portfolio has grown significantly.

As a sustainable resource university campuses in the Nordic countries point out that the environmental aspect can be seen as the most crucial element of social responsibility. Environmental considerations are thus considered as a major issue in all the university property management organisations. In total, real estate sector represents some 40-50% of the total energy consumption, which makes it crucial to develop methods and systems that reduce energy consumption. Specific social responsibility strategies are not currently common in the Nordic university property management organisations. (Anon. 2010a) Statsbygg has defined social responsibility as one of their five strategic goals. In Denmark, UBST does not have a specific social responsibility strategy, but their operational level guidelines cover most of the topics of, e.g. the Global Reporting Initiative (GRI) and these are also reported. In Finland, the new university property management organisations have started their operations and as their strategies are being formed, they are naturally being structured in a socially responsible way. The responsibilities between the owner organisation and the clients and occupiers vary between the countries but also between universities. It is important to acknowledge and define the owners' and the occupiers' responsibilities and also the areas where both these parties can make an impact.



In Norway, regarding the regional colleges and some universities, whose real estates Statsbygg manages and owns, the relationship regarding social responsibility is more linked together. Regarding those universities who own and manage the properties by themselves, the ownership and occupational aspects are linked together, and Statsbygg does not have a role in their social responsibility matters, except for the construction phase. In Finland the universities are also partial owners of the properties by owning shares in the property companies, which means that the owner and occupier aspects get linked to each other. The level of involvement of the Finnish universities in real estate related social responsibility issues is more prioritized than previously, when universities got the space from Senate Properties. In Finland, there is discrepancy between the different parties in the responsibilities regarding, e.g., heat, electricity and water consumption and costs, between the university property companies and also the universities. The standardised principals within the companies support the alignment. (2010a.)

The statistics from 2010 indicate the amounts of university properties in four Nordic countries (Table 2).

Table 2 Property ownership and rent and turnover of Nordic University property management organisations

Country/Organisation	Property ownership	Rent & Turnover
Denmark /UBST	3.7 million sqm, of which 2 million sqm occupied by universities and higher education	Capital rent model (cost based rents applied, these doubled with a percentage to cover the capital costs, applies some market based elements)
Finland /University Properties of Finland Ltd	105 properties with 378 buildings - Rentable area 1.1 million sqm	Total rent model, Rental cash flow 126 million euros/year
Finland/Helsinki University Properties Ltd	50 properties with 200 buildings - Rentable area 0.4 million sqm	Capital rent model, Rental cash flow 50 million euros/year
Finland/Aalto University Properties Ltd	Rentable area 0.25 million sqm	Total rent model, Rental cash flow 40 million euros/year
Norway/Statsbygg	Rentable area 2.6 million sqm (floor space), of which 1.1 million sqm is rented foreducation and research (mostly regional/university colleges)	Total rent model (cost based rents applied, admin. decisions in contracts made before 1992)
Sweden/Akademiska Hus	Rentable area 3.2 million sqm university and research properties	Total rent model (market rents applied), Rental cash flow 4927 Mkr (million Swedish crones)

#### 4 FINDINGS AND CONSLUSIONS

Based on the state-of-the-art one can identify three types of challenges for Sustainable Nordic Campus Retrofitting. Changes in property ownership as well as in university organisation

structure and identity require retrofitting actions for campus areas including strategic, tactical and operational dimensions and long-term demand and market creation.

#### Strategic challenge

- There is a need to respond to the structural changes in education and university organisations.

#### Tactical challenge

- There is a need to make the aging built environment more usable with small actions.
- There is a need to make the impact of the retrofitting actions greater.

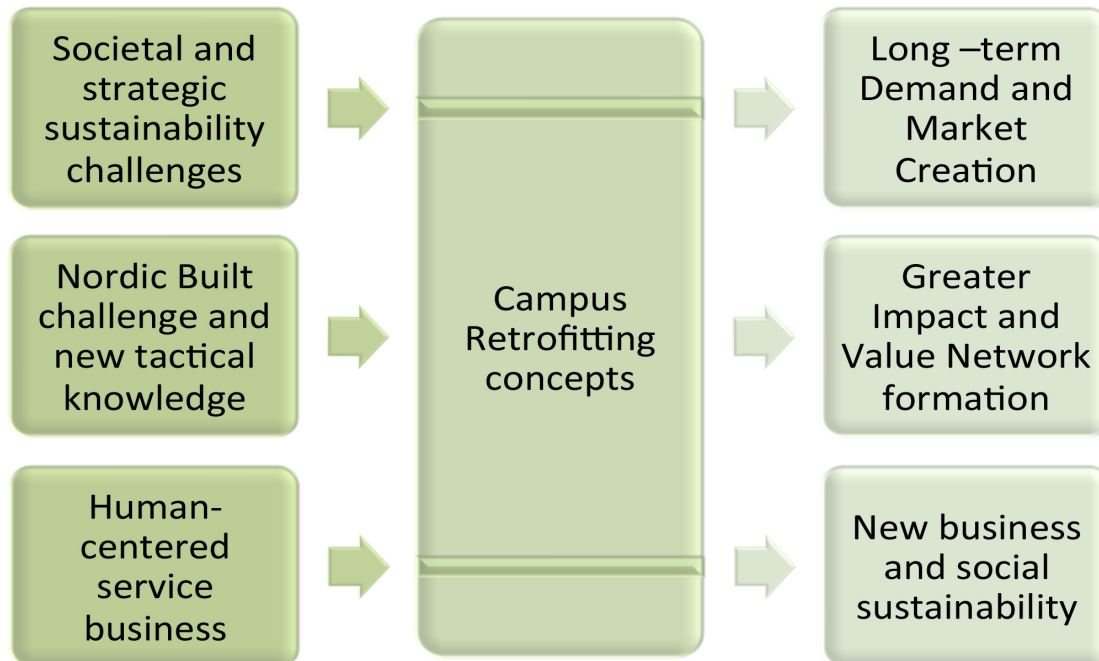
#### Operational challenge

- There is a need to fill spaces with users and increase the user-efficiency of the campuses.

The very low usage rate, combined with specialized facilities and often buildings with cultural value calls for usability increase through actions with manageable environmental impact as well as economical sustainability. Space-redefining Retrofit concepts are needed due to the fact that the university resources are not in full use. Reviews of space utilisation across different countries in higher education estate indicate that utilisation rates of teaching spaces were often between 15% and 20% during core learning hours. The rate of use of campus facilities is often very low - this creates wide sustainability potential and need for innovations and development – in terms of retrofitting and sustainability it is an important opportunity. At the same time there might exist an expressed need for more space and new buildings (e.g. Nielsen et al 2012).

The campus building stock has limitations with regards to decrease of energy consumption and therefore there is also a call for an increase of user-efficiency in order to achieve an increase of energy-efficiency. The actors in the field of construction and real estate need new ways of working together in order to achieve success and overall sustainability. The use of retrofitted informal learning spaces and the implementation of space management systems as a method will highlight the true cost of academic space to the occupiers of the space. The effective facilities management techniques are an important management tool in the increasingly dynamic and diverse higher education environment. In addition there is a need for new services both to increase the user-efficiency and to manage the retrofitting processes. The results are summarized in the Figure 1.

Figure 1 The three-level roadmap for future campus retrofitting and research.



Final conclusion about the steps of future research activities towards integration of joint roadmap for Nordic campus retrofitting on strategic, tactical and operational level: There is a reasonable source of research data to be used for the retrofitting considerations. Nordic countries have a strong theoretical database for campus development. The challenge is to apply the research results and develop concepts for the demonstrations.

The tactical challenges are connected to issues of co-creation. Co-creation allows and encourages a more active involvement from the users of the campus to create a value rich experience. The qualitative methods in connection with more traditional quantitative and objective methods can together provide the valid process for proof of concept. The question is to establish a structural approach and process to be conducted and evaluated in a relevant and comparable way.

Operational challenge emphasises a need to manage and share resources in university campuses internally and externally in connection with other stakeholders. The solutions through efficient and sustainable campus retrofit applications are appropriate. This is based on existing body of knowledge and Scandinavian tradition to involve users to the processes. The focus should be on developing good practice guidance for campus retrofitting as a part of the development of institutional estates strategies. This assists universities and service providers to identify and implement best practice in the management of space.

The Nordic context sets challenges in comparison with e.g. European universities. The high quality learning outcomes in Nordic countries is at the same level than e.g. in the Netherlands. However e.g. doctoral degrees of foreign students is only slowly rising up. Campus management can have a significant role in identifying the similarities of Nordic countries and increase the magnetic effect of them. Universities' planning grows in scale when they combine and develop their activities. Planning of a university's area is therefore comparable to urban planning. Planning does not relate solely to the individual university's activities: the university opens up towards the surrounding world – also physically – and thus actively affects the area and the surroundings. Campus development is more than just bricks. It is a tool for change. It is about buildings and physical areas, but equally about social and functional needs, organisation, communication, and funding as well as strategic objectives. There are many aspects suggesting that pioneer activities within campus development soon can act as models for urban development.

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