Aalto University
School of Science
International Design Business Management

Strategic campus development of Aalto University

internal and international benchmarking of space resources

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Aalto University **Abstract of a Master's thesis**

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The nature of university campuses is changing because of a change in spatial demand. Therefore, spatial solutions and needs of university facilities have to be rethought. As Aalto University was established in 2010 by uniting three traditional Finnish Universities from the fields of art, economics and technology, Aalto's facilities were unorganized, scattered around and difficult to manage.

This study aims to define how Aalto University campuses and benchmarking practices could be developed in order to support the implementation of Aalto's campus vision. It investigates spatial demands of universities now and in the future and how future demand could be satisfied with strategic learning landscape planning. The emphasis is inside the walls, and therefore urban planning and outside connections are outside the scope of this thesis.

The structure of the thesis is based on three main research questions: (1) How do existing benchmarking practices support future development of campuses worldwide *in general*?; (2) How do existing facilities of Aalto University support the requirements of university education and related actions *in practice*?; and (3) How could the facilities be modified and developed in order to better and more concretely support the university's core business *in the future*? The methods used are a literature overview, based on which is created a benchmarking framework and an empirical analysis.

In general, thanks to the development of technology, global mobility and increasing cross-disciplinary thinking, working methods and learning patterns in university education vary a lot more than in the past according to individual teaching and learning styles and they are undependent on place. The research in this study is conducted based on development trends of space planning and the existing benchmarking framework applied accordingly.

In practice, Aalto University's spaces are used inefficiently and they do not fully meet the requirements of the modern learning landscape, nor do they match Aalto's campus vision. The existing space resources inside the walls are benchmarked from physical and virtual, functional, financial and strategic aspects and compared with cutting edge international benchmarks and campus planning trends in order to define the quality of the facilities today.

A future scenario is recommended based on the study conducted. Strategic elements include rethinking funding, the service landscape and re-designing existing unutilized spaces into multiuse platforms.

Key words: Campus development, CREM, learning landscape, benchmarking

Aalto Yliopisto **Diplomityön tiivistelmä**

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Yliopistokampusten luonne on murroksessa tilatarpeiden muutoksen takia. Siksi yliopistojen tilaratkaisuja ja tilahallintaa tulee kehittää. Kun Aalto-yliopisto vuonna 2010 perustettiin yhdistämällä kolme perinteistä suomalaista yliopistoa taiteen, tekniikan ja kauppatieteiden aloilta, tilat olivat eri tavoin organisoituja, hajallaan sekä vaikeita hallita ja johtaa.

Tämän diplomityön tavoitteena on määrittää, miten Aalto-Yliopiston kampusta ja sen arviointikäytäntöjä voitaisiin kehittää kampusvision toteutumisen tueksi. Se tutkii yliopistotilojen kysyntää nyt ja tulevaisuudessa, ja miten oppimisympäristön strategisella suunnittelulla voidaan vastata näihin tilatarpeisiin. Painotus on rakennusten sisätiloissa, minkä takia kaupunkisuunnittelu ja yhteydet on rajattu tutkimuksen ulkopuolelle. Työn rakenne perustuu kolmeen pääkysymykseen: (1) Miten olemassa olevat benchmark-käytännöt tukevat tulevaisuuden kampuskehitystä *yleisellä tasolla*?; (2) Miten Aalto-yliopiston tilakanta ja hallintatapa vastaavat yliopistokoulutuksen tarpeisiin *käytännössä*?; ja (3) Miten tiloja voitaisiin kehittää ja muokata yliopiston ydinliiketoimintaa tukevaksi *tulevaisuudessa*? Käytetyt metodit ovat kirjallisuuskatsaus ja sen pohjalta luotu benchmark-viitekehys sekä sekundääriaineistoon perustuva tilastollinen analyysi tilakannasta.

Yleisellä tasolla työtavat ja oppimismallit ovat paikasta riippumattomia ja ne vaihtelevat yksilöstä riippuen enemmän kuin aikaisemmin teknologian kehittymisen, maailmanlaajuisen liikkuvuuden ja alati laajenevan monitieteisen ajattelun ansiosta. Tämä tutkimus on toteutettu oppimistilojen kehitystrendien ja olemassa olevien benchmark-käytäntöjen pohjalta, jotka on muokattu kehitystrendejä tukeviksi.

Käytännössä Aalto-yliopiston tilankäyttö on tehotonta, eivätkä tilat täysin vastaa modernin oppimisympäristön tarpeita tai Aallon kampusvisiota. Aallon olemassa olevat tilat tutkitaan fyysisestä ja virtuaalisesta, funktionaalisesta, rahoituksellisesta sekä strategisesta näkökulmasta, ja niitä verrataan kansainvälisiin esimerkkeihin sekä kampuskehitystrendeihin tavoitteena määrittää Aallon tilojen laatu nykypäivänä.

Tulevaisuutta ajatellen strategista skenaariota suositellaan tutkimukseen perustuen. Strategiset elementit pitävät sisällään esimerkiksi rahoituksen uudelleenjärjestelyn sekä olemassa olevien, käyttämättömien tilojen hyödyntämisen hub-tyyppisten monikäyttötilojen tarpeisiin.

Avainsanat: kampuskehitys, CREM, oppimisympäristö, benchmark

Foreword

Life is an ecosystem of learning and a university should offer a cutting edge playground for its processes. As Aalto University aims to increase cross-disciplinary, open and innovative thinking, it is what should also be reflected in and offered by its spaces. Aalto's history is short but colourful and its aims are high and ambitious. This was probably the main reason why I joined the campus development research project. I wanted to be involved in something creative, current and concrete; something that would give something back to the institution that has given me the possibility of having the time of my life as a student.

Thanks belong to my fellow thesis students Maarit and Konsta with whom I shared the joy and agony of writing theses. Thank you, Suvi, for being so supportive and for making me think about the possibilities in life in a new way. I never thought about it before but it might be so that there lives a small researcher in all of us. Thank you, Eetu, for inspiring me in terms of facilities and the people-centric ideology by introducing to me Aalto Design Factory. You have made me realise that one should not necessarily be satisfied with whatever the current situation is but that things can be carried out in a myriad of different ways – it is all about doing things and making the ideas concretely happen.

Thank you Dad, Mom and my brother Tuomas for the eye-opening discussions related to the thesis and the future. However, I do not have the words to express how much I owe to and appreciate my girlfriend Kristina. Even during the roughest time of your life, you have been patient in supporting and listening to me in everything related to the writing process and an existential crisis following the idea of leaving student life behind. Thank you, my Koala!

Before entering the world of learning landscape development, I encourage you to bear in mind the bright words of a childlike, stubborn and intelligent gentleman:

"My mind is my laboratory"
-Albert Einstein

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1 Introduction

1.1 Background

As Aalto University was founded by uniting three Universities, the new University was physically scattered into three main campuses in the Helsinki Metropolitan area and four campuses in other cities of Finland. In order to create an identity, to have a sense of one united Aalto and to best support its vision and mission, it was decided that Aalto University will have one main campus which would be situated in Otaniemi, Espoo and a supporting campus will be retained in Töölö, the former campus of Helsinki School of Economics (HSE),. The need of benchmarking existing campuses emerged in order to develop the former Teknillinen Korkeakoulu (TKK) campus into a new main Aalto campus.

This study is a part of an internal Aalto University campus development project consisting of three Master[1]s Theses[1] executed by the Built Environment Services research group in Aalto University. This study focuses on benchmarking internally and internationally the space resources of Aalto University from a strategic managerial point of view. The first of the other two theses[1] focuses on how space is currently used in Aalto University (Tuokko 2012) and the second study focuses onbalanced learning environments (Mäkikyrö 2012).

Benchmarking in this study is based on an application of the campus management framework (CMFW) introduced by den Heijer (2011). An application of den Heijer's framework is created to better support learning landscape trends discussed in this study. The applied framework takes a holistic approach to campus decision making from four aspects of Corporate Real Estate Management (CREM): physical and virtual, functional, and financial and strategic. As an outcome, a relevant future development scenario for the Aalto University campus is introduced. Aalto's two campus visions published in 2011 function as the fundamental drivers in the whole study (Aalto University, 2011a; Aalto University, 2011b).

1.2 Aim

This study aims to define how the Aalto University campus and benchmarking practices should be developed in order to support the implementation of the campus vision by 2020. It answers how existing benchmarking practices support the future development of campuses worldwide *in general*, how the existing facilities of Aalto University support the current and future requirements of university education and related actions *in practice*, and how *future needs* could be met with limited resources. The emphasis is inside the walls, and therefore urban planning and outside connections are outside of the scope of this thesis.

1.3 Research questions

(i) How do the existing benchmarking practices support the future development of campuses worldwide *in general?* This question is answered through studying benchmarking (BM), management practices in a university campus context and learning landscape development trends. A (mis)match between benchmarking methodology and learning landscape trends is defined and a framework is applied accordingly.

(ii) How do the existing facilities of Aalto University support the requirements of university education and related actions *in practice*? This question is answered by benchmarking Aalto University internally, comparing it with international benchmark cases and comparing the result with learning landscape trends discussed within the first question.

(iii) How could the facilities be modified and developed in order to better and more concretely support the university's core business *in the future*? The third question is answered based on answers to the two initial questions. With the help of applied appropriate foresight tools, introduced by the Center for Foresight and Innovation at Stanford University and reviewed in the literature overview, a possible future development scenario is introduced.

1.4 Structure

The structure of the thesis is based on four sections and it is presented in Figure 1 on the next page.

The first section, section A, aims to introduce general information about the background of the thesis. The theoretical part aims to answer the following questions: (i) How do existing benchmarking practices support the future development of campuses worldwide *in theory?* It is divided into three chapters: a literature review, physical measures and categorisations in space management and an applied benchmarking framework. The literature review consists of four chapters: (1) benchmarking, (2) real estate management in university campuses, (3) benchmarking in university campus development, (4) learning landscape trends and (5) Conclusions. The review aims to find out what the trends in learning landscape development are today. The basis of the framework used in the execution part of this study is also introduced in the literature review. Building on the literature review, the chapter on the applied benchmarking framework introduces an application of the framework which is used in this study.

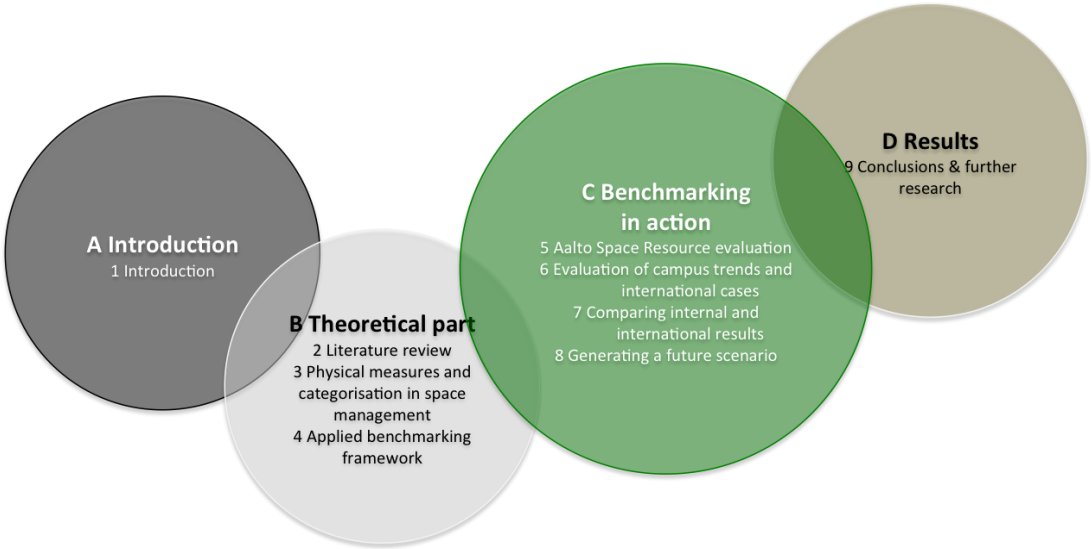


Figure 1 Thesis structure

In the empirical part, section C, the frameworks discussed in the theoretical section are applied, relevant international benchmark cases are presented and Aalto University is compared with other universities chosen on the basis of Aalto University's campus vision(Aalto University 2011a). Section C aims to answer the following questions: (ii) How do the existing facilities of Aalto University support the current and future demand of university education and related actions *in practice*? and (iii) How could the facilities be modified and developed in order to better and more concretely support the university's core business today and *in the future*? The section is divided into four steps: (1) assessing the current campus, (2) exploring changing demand, (3) generating future models and (4) defining projects to transform. The biggest findings and recommendations for future research are concluded in section D.

1.5 Methods and tools

1.5.1 Literature overview

In the literature overview, existing research and tools of real estate management in relation to campus development and their relation to learning landscape trends are reviewed.

1.5.2 Benchmarking framework

One of the main questions in benchmarking is how to keep the scope focused on the relevant elements, in other words, how to find relevant benchmarks and the right tool for comparing them? Many different kinds of benchmarking frameworks and categorisations have been developed for various fields but not so many for the purpose of university management. In this study, the campus management framework introduced by den Heijer (2011) is applied in the practical section.

1.5.3 Campus space resource analysis

In the practical section, data on the campus space resources of Aalto University and other Universities is gathered, analysed and compared in order to develop relevant future scenarios for Aalto University.

In this study's current campus assessment section, information on physical spaces is collected from the space resource database of Aalto University's Facility Services, created by Ramboll. The primary use of the database is allocating rents to different departments and units.

Data regarding the aspect of functionality was also gathered from the space resource database and obtained from the HR of Aalto University.

The numbers for the financial analysis were gathered from Aalto-yliopistokiinteistöt and Aalto Facility services. The main resources for the international benchmarks are annual reports, strategies and campus visions available online.

As the emphasis of this study is on the strategic aspect of space planning, the two campus visions of Aalto University released in 2011 have had a strong influence on this study and the way it is conducted.

1.5.4 Scenario development tools

In Chapter 8, a future scenario will be introduced. In order to develop a relevant future scenario, the set of tools and methods created by William Cockayne & Tamara Carleton from the Center for Foresight & Innovation at Stanford University are applied on applicable parts in the Scenario Development section. This short description helps to understand why the methods are used and how they work.

(Cockayne & Carleton 2010)

The methods and tools are categorised under a process of three overlapping phases: perspective, opportunity and solution. The main questions, explanation and tools to be used to build these phases are introduced in Table 1.

Table 1 Foresight tools (Cockayne & Carleton, 2010)

Phase	Question	Explanation	Tools
Perspective	How do I begin looking for future opportunities?	"The first phase is to develop a historical perspective about an area of interest relevant to the future you want to live in. You must look back first in order to	Context Map, Progression curves and Janus Cones. Used in this study: Context map.

		look forward.”	
Opportunity	How can I create a path to these opportunities that anticipates the inevitable changes along the way?	”The second phase helps you develop an ability to see growth opportunities that exist today and extend into the future. Today’s opportunities become tomorrow’s innovations.”	Demographics, Future Users and Future Telling. Used in this study: Future telling, application of a Context Map.
Solution	What can I start doing today that will help me get there first?	”The third phase seeks to define the questions that exist along different paths to innovation. Innovative solutions are specific to your industry, customers, organization and individual skills.”	White Spots, Change Paths and Paper Mock-ups. Used in this study: application of a Context Map.

2 Overview of benchmarking and the learning landscape in a campus management context

2.1 Benchmarking

As stated by Sarkis, benchmarking is a continuous, systematic process for evaluating products, services and work processes of organizations that are recognised as representing best practices, for the purpose of organizational improvement (Sarkis 2001). According to the space planning guidelines of Tertiary Education Facilities Management Association Incorporated (TEFMA, 2009, p. 20): ”Benchmarks are a ’top down’ approach and are used to get a big-picture view of how space is used. They tend to be applied at a broad level for comparison purposes. ”

In order to create the campus of the visionary dreams, it is extremely important to know what kind of spaces already exist, what spaces need to remain, what spaces need to be altered and what spaces are not needed anymore. As stated by Alexandra Den Heijer: ”The essence of ’assessing the current campus’ is to generate information about the (mis)match between what we have and what we need or should have currently” (den Heijer, 2011, p. 123).

It is very important to keep in mind that the data gathered through benchmarking is not exact and cannot be completely relied on as such. For example, the comparative units might be somewhat different and the data entered in the databases might not tell the total truth. There are and will always be hidden variables and compilations for the data, which must be taken into account in order to be accurate. Without a clear context and validation, benchmarking is nothing more than numbers. But understood to the point and the deficiencies pointed out, it is a very efficient tool and might bring an enormous amount of advantages with it (Mignola & Terry 2006). On the other hand, it must be remembered that today’s trends have altered the idea of effectiveness and the efficiency of space use and new strategies are needed to rethink the budgeting of spaces due to the development of technology and learning methods (Dugdale 2009). In conclusion, benchmarking methods of spaces do not seem to be up to date and new methods should be developed.

After all, benchmarking, when done correctly, can be considered a good evaluation process of creating a basis and an overview of a current situation. Nevertheless, actions must be taken to develop the organization based on the benchmarking results and analyses – otherwise benchmarking is useless.

2.2 Real estate management in university campuses

Corporate real estate management can be defined as ”The management of a corporation’s real Estate portfolio by aligning the portfolio and services to the needs of the core business (processes) in order to obtain maximum added value for the business and to contribute optimally to the overall performance of the corporation” ((Krumm et al. 2000) as quoted by (Kaleva & Olkkonen, 2001, p. 7)). Gibson (2000,

p. 15) defines corporate real estate management to be ”The economic, efficient and effective acquisition, integration, co-ordination and disposal of real Estate resources in order to achieve (ever changing) organisational goals.” Krumm’s definition is considered by Njungbwen & Udo (2011) to be more holistic compared to Gibson’s. However, the emphasis in Gibson’s definition on aiming to achieve ”… (ever changing) organisational goals” reflects the iterative nature of organisations constantly reinventing themselves and of different aspects building on each other, a dimension which is absent in Krumm’s definition.

De Jonge (1997) presents four holistic approaches to corporate real estate by dividing it into four main focus areas: the business focus, real estate focus, strategic focus and operational focus (De Jonge 1997). Building on corporate real estate with the management aspect, Krumm divides CREM into four perspectives: general management with the main task of supporting corporate goals, asset management to review how financial opportunities of real estate relate to the financial position of the company, facility management looking at day-to-day accommodation and flexibility, and cost control for controlling the expenses and financial goals of the corporation (Krumm, 1999). In the past years, den Heijer et al. have developed a conceptual framework linking the aspects of stakeholders to matching perspectives (den Heijer et al. 2011).

”Estate is an asset of strategic importance, representing the second biggest proportion of costs in many businesses after labour, even more than 35% of the total assets” (Njungbwen & Udo 2011, p. 5). Therefore, managers consider efficient corporate property management to be increasingly vital to businesses. CREM concerns every real estate and facilities related issue in a public and private organisation whose core business is not in real estate business, and the success of the organisation should be thought of as the CREM ability to create added value for the businesses and to contribute to the overall performance of the corporation (Njungbwen & Udo 2011).

On the other hand, even though public organisations incorporate the same disciplines as corporations in theory, there are also some major differences between public and private real estate management. Therefore, public real estate management (PREM) should be distinguished from CREM. That is why some of the developments are not always applicable to a public setting (Evers et al 2002).

Lindholm (2004) lists four important differences between public and private organisations. They are fundamentally different organisations that are driven by different drivers: in public organisations the financial profits are less important than in corporations, public real estate managers are confronted with many more external stakeholders than their colleagues in the private sector, and security measures also differ between these two (Evers et al 2002). Some are of the opinion that the public sector should work more like businesses (Lindholm 2004), others criticize governments because of operating like businesses (Mintzberg 1996).

2.3 Benchmarking in university campus development

However, as stated by den Heijer (2011), CREM theory turned out to be the most applicable existing theory of all real estate theories to campus management theory. Accordingly, den Heijer introduces a framework which is presented in the following pages.

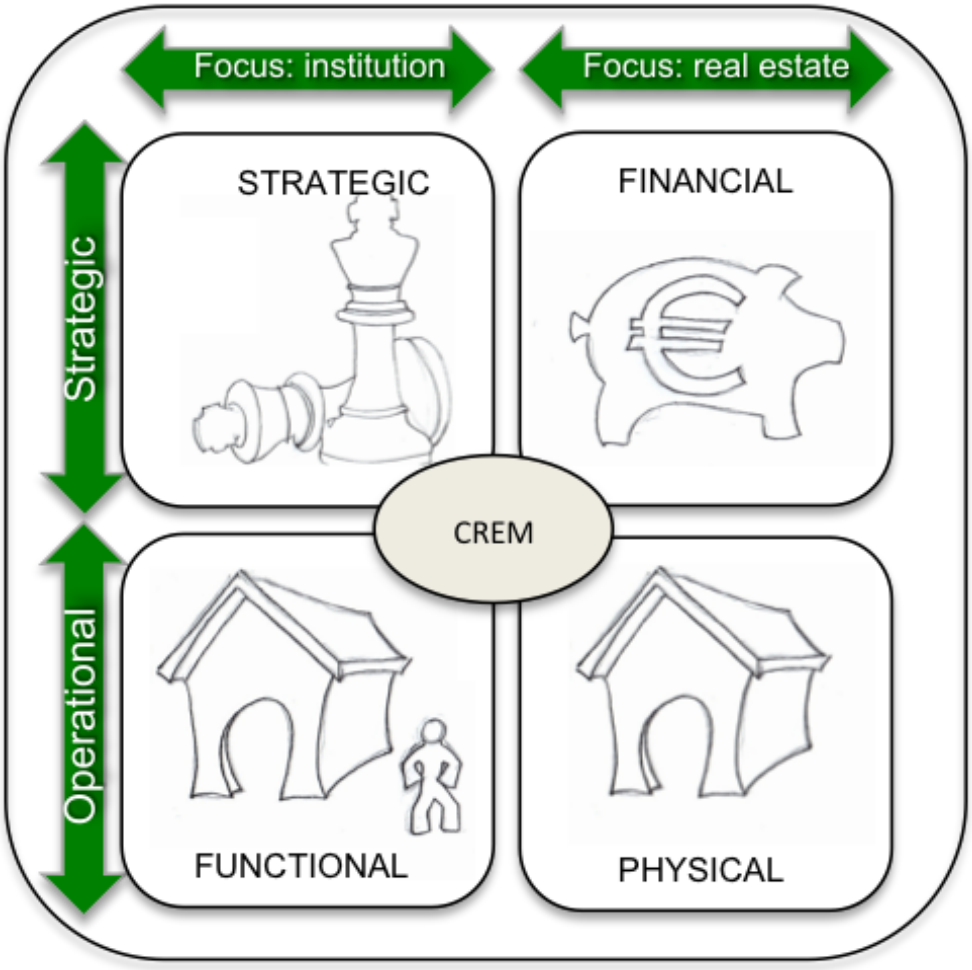


Figure 2 CREM focus areas

According to Alexandra den Heijer's campus management framework (CMFW) (den Heijer 2011) developed for university campuses in Netherlands, one should take four aspects of corporate real estate management into account in all the decision making considering campus: physical, functional, financial and strategic. The model is visualized in _Figures 3,4 and 5.

The aspects mentioned cover all the stakeholders in a university community from the aspect of real estate management as follows: physical for technical managers, functional for users, financial for controllers and strategic for policy makers. In that sense, it is a very holistic framework looking at the university institutionally, spatially, operationally and strategically. The framework is based on four tasks in practice:

1. Assessing the current campus,

2. Exploring changing demand,

3. Generating future models and

4. Defining projects to transformThe practical benchmarking section of this study is structured accordingly. The aim of the framework is to define the (mis)match between the current supply and demand in order to develop the spaces towards the future supply and demand (den Heijer, 2011).

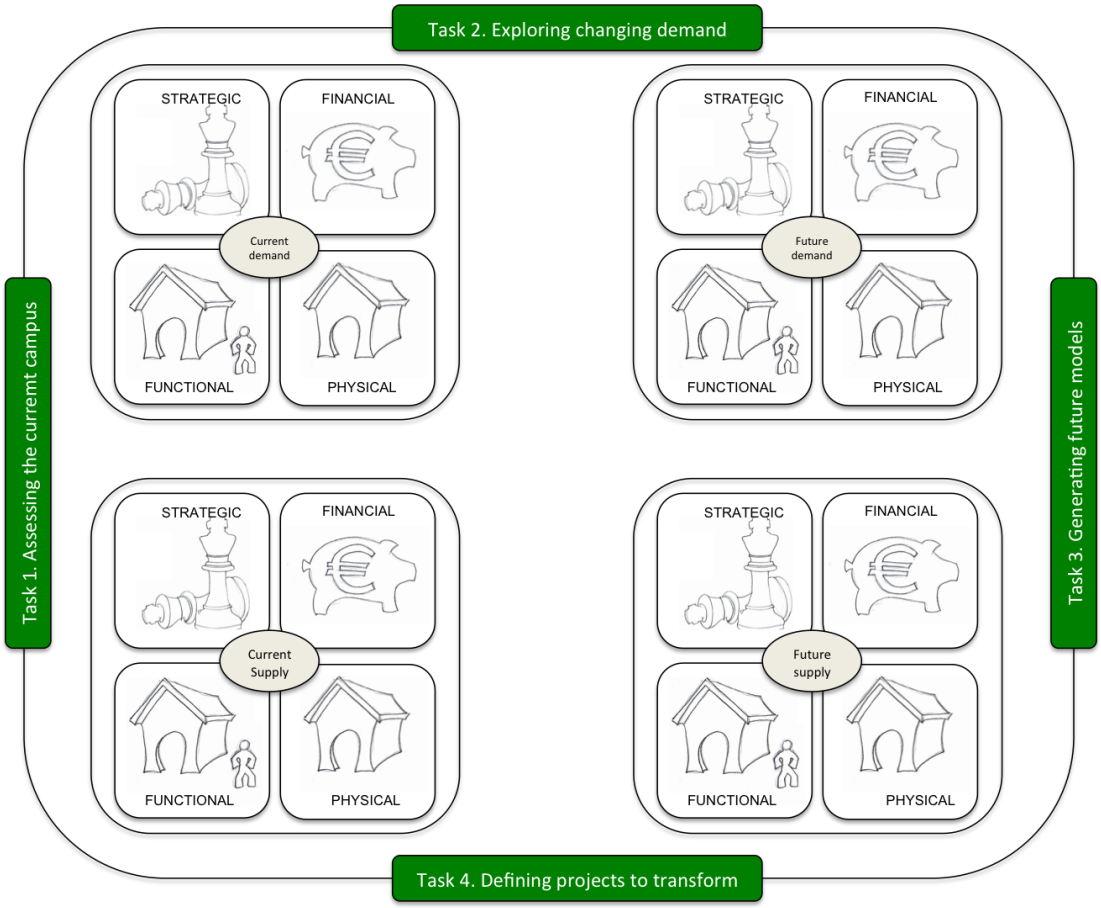


Figure 3 den Heijer's framework tasks

As such, den Heijer's Campus Management framework seems to be a good tool for creating a basic understanding in numbers of what elements a university's buildings consist of. However, it does not take into account differences between CREM and PREM, nor the virtual aspect or the development of the nature of the learning landscape. Therefore, it should be developed further. Applying it to the specific needs of Aalto University in order to compare it with other universities creates a good basis for deepening the study in each of the aspects. The most important idea of the model is, however, that each aspect must be considered for each of the decision made and that everything relates to everything (den Heijer 2011). The application of the framework for this study's purpose is introduced in the chapter on the applied benchmarking framework.

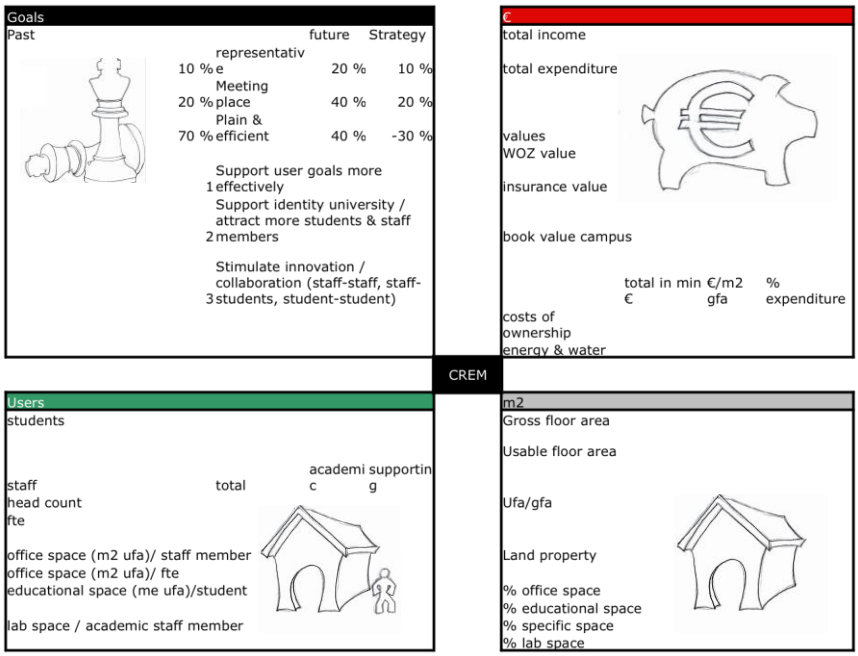


Figure 4 den Heijer's model's numbers to be identified

2.4 Learning landscape trends

2.4.1 Mobility through technology

Nowadays, the development of virtual tools, wi-fi and internet tend to transform almost every space to a working, studying, teaching and leisure environment depending on what people do there. The actual learning can happen both virtually and physically, which makes it more complicated to plan the physical spaces (Dugdale 2009). Dugdale talks about the learning landscape and states that the whole variety of learning settings in different spaces has to be taken into account: physical and virtual aspects, informal and formal aspects, specialized and multipurpose spaces, and everything in between. Also, according to Long & Ehrmann (2005, p. 46), ”the place is becoming irrelevant” because of connectivity.

In addition, it is difficult to define the real use of space based on these measures because of mobility and the varying working methods of people enabled by the fast development of technology. We are living in the 21st century where it is possible to work from anywhere, anytime in various ways and that is why it is important for spaces to follow this development (Albers, 2010).

Therefore, it is hard to determine whether it is more or less efficient to have more or less space per person. After having estimated the rough numbers of staff and space, one should really observe how much each member of staff or students is present during the weeks, where they spend their time and how much time is spent elsewhere. As some people move a lot and work in trains and cafeterias, give lectures

all around the world or do research in their home office, this type of measurement is increasingly becoming irrelevant regarding the possibilities of benchmarking the efficiency of space use. That is why a set of typical identities should be created based on their ways of working in a university environment. This idea of people themselves creating their ways of working is manifested by Albers (2010). Accordingly, when it comes to measuring the efficiency of space use, the effectiveness of spaces should be taken into account because people are increasingly choosing themselves the places they work in.

2.4.2 Informal and formal environments

There are studies revealing that informal interactive spaces are usually actually very effective in enhancing learning compared to the traditionally forced and formal uninteractive spaces such as classrooms (Long & Ehrmann 2005). Spaces cannot be divided as easily as earlier regarding, for example, teaching, studying and researching facilities. Students, researchers and staff have become mobile and organisations are becoming flatter. Even informal cafés or buzzing corridors can be learning and researching spaces nowadays. Dugdale states that the space between the traditional units is ”as important as the traditional formal learning spaces” (Dugdale 2009, p. 54).

Andrew J. Milne points out the following trends speaking for the tendency of unspecific learning environments in learning space design: (1)”Classrooms are not the only form of learning space” but the majority of learning takes place outside the classrooms, (2) ”Social interaction is a growing part of learning” and pedagogy is shifting towards collaborative methods, as students are motivated by social interaction, (3) ”Learning can occur out of sequence”, as students are comfortable with overlapping discussions and new learning tools with respect to the traditional tools, (4) ”Students construct rather than just consuming it”, which is partly because of easy-access technological tools and easy-to-spread on-line platforms (Milne 2006, p. 11.2).

In addition, as knowledge workers of today have the possibility of working basically everywhere, the quality of the actual working environment is given more importance (Vartiainen et al 2007). According to Santamäki (2008), as the generation born in the technology era wants to work in more casual places, the physical, virtual and social spaces are to be designed for a multitude of different needs and users. Therefore, the type of categorization where a specific space is named as a lecture hall and another space as an office or as a lobby in the traditional sense might be a bit old-fashioned. Categorizing the spaces like this on the administrative level does not enhance creativity, nor does it attract people.

2.4.3 Multi-use learning environments

So, there is a big trend speaking for a multitude of new learning methods, which leads to the need of multi-use learning environments. Their purpose is not to allocate the spaces too strictly under any category but to give the user the possibility of discovering what the room is applicable for. This is also emphasized in DEGW's learning landscape model, which is an approach highlighting the connections between the spaces and how much they support encounters and informal learning (Dugdale 2009). Accordingly, there is no one room that can be shown to be good or bad in terms of learning, but as the learning landscape should support all the different ways of learning, it is the network, connections and the urban functions which create a supporting ecosystem for the whole learning cycle. That is why it is increasingly difficult to s spaces as such divided iton small bits and pieces. By only offering the frame and a variety of tools that can be used inside, a customizable and flexible environment is created and responsibility is given to the user. It also stimulates the user's brain to think, moving away from just being passive and taking everything as given.

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 thinking to creating spaces that are more flexible and stimulating, enhancing learning 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"(Long & Ehrmann 2005, p. 48).

They also state four basic ideas that can be identified when imagining a classroom of the future: "Learning by doing matters, Context matters, Interaction matters, Location of learning matters"(Long & Ehrmann 2005, p. 46). It is remarkable that neither the technical solutions nor the furniture is mentioned but the actions taken inside and the location of the space are given great importance. With the furniture and spatial solutions, though, these actions can be supported. For designing a classroom of the future, three elements to be taken into account are: activities and facilities, forms and functions and desired characteristics (Long & Ehrmann 2005).

On the other hand, while there is a trend speaking for multi-use environments, it has to be kept in mind that the so-called traditional learning environments should not be straight away demolished from the way of new multi-use spaces. According to Nenonen (2005), the following four characteristics can be identified in working and learning environments: a connective, structural, formal and reflective place. All of these spaces should exist in a full functioning learning environment in order to support the whole learning cycle. In between these, there are also border zones which, for their part, support sharing and connecting knowledge from one place to

another. Accordingly, also traditional classrooms, offices and lecture halls are needed because people tend to work in different manners and many learning methods need to be supported (Nenonen 2005). The existing spaces could also be modified and used more efficiently by changing the culture with some small alterations (Santamäki 2011).

The three main trends shifting the nature of the learning landscape were recognized in this study: from stable to mobile, from formal to informal and from single-use to multi-use environments. Benchmarking methodology should be developed to support that development in order to better provide information and tools for the managers for managing spaces more meaningfully. The main contradictions between the existing benchmarking practices and learning landscape trends are discussed in the next chapter.

2.5 Summary

According to this overview, the methodology and idea of Corporate Real Estate Management can be expanded from the business world to the public sector's university campus management. Through applying CREM practices in the real estate management of universities, it is possible to create a basis for benchmarking campuses. However, because of the changing nature of the learning landscape, space use and development of technology, the administrative measurement, categorisation and planning tools are out of date. Virtual spaces must be considered as a substitute to physical spaces and this must be taken into account when benchmarking physical spaces. Gaps between the spatial needs of users and the needs of different units of administration do not meet easily, which makes the management of space planning, design and administration difficult. Building on these corner stones, the Campus Management framework introduced by den Heijer is developed further in the next chapter.

3 Physical measures and categorisation in space management

An important thing in benchmarking is to find the right terminology, measurement and categorisation tools. As this study is based on comparing national spaces with international spaces, the measures and terms form a complex ecosystem. This part of the literature review looks at challenges related to measurement and the categorisations of benchmarking the learning landscape, and the section aims to define the (mis)match between the existing benchmarking practices and development of the nature of the learning landscape.

3.1.1 International measurements

The most important measurements are defined by TEFMA (2009, p. 10) as follows:

Table 2 TEFMA (2009, p. 10) definitions

Measure	Definition
Gross Floor Area (GFA)	"As defined in the AAPPA Benchmark Survey, i.e. the sum of [a] fully enclosed area and [an] unenclosed covered area."
Useable Floor Area (UFA)	"As defined in the AAPPA Benchmark Survey, i.e. [the] floor area measured from the inside face of the walls and deducting all the common use areas (corridors, etc.) and non-habitable areas (lifts, stairs, service ducts, etc.)."

Useable Floor Area is used as an equivalent to the Dutch national unit 'nuttig oppervlak' (den Heijer 2011). It is translated in the Multilingual dictionary of Real Estate (Van Breugel, Wood, Williams 1993) as 'surface utile brute' in French, and in a free Dutch online translator the result is 'useful area' in English (Mijnwoordenboek, 2011). This leads back to the Finnish translation, 'useful floor area', which is similar to the French 'surface utile brute' (Sénat, 2011). It seems that the definition of the useable floor area according to TEFMA (2009) does not take into account all the common use areas (including all the circulation), whereas in the definitions of the terms 'surface utile brute' and 'useful floor area' no horizontal circulation is included but vertical structures such as elevator channels are decreased from the total surface. Thus, there is a contradiction between these terms.

Accordingly, it seems that the term Net Usable Area is similar to the UFA definition by TEFMA (2009): **"Net Usable Area (NUA)**

The area occupied by functions within the Learning Landscape, i.e. learning and teaching spaces, office areas, specialist spaces, cafes, etc." (DEGW, 2009). This seems to be very close to the definition of useable floor area.

Therefore, the comparison of benchmarking methods in this study uses the definition of Useful Floor Area in comparison with the Dutch university definition and the definition of Net Usable Area in comparison with the TEFMA guidelines. Regarding the other measures used internationally, the most relevant ones in campus development, according to DEGW (2009), include NUA, NIA and GIA, which are explained as follows:

Table 3 DEGW definitions (2009)

Measure	Definition
Gross External Area (GEA)	**"The total building area** including the exterior perimeter; the measure of the outside skin of the building. The internal floor area of a building including the stairs, risers and lift cores. The Building Cores include fire escape stairs, passenger and goods lifts, lobbies, service risers, and plan areas. "
Gross Internal Area (GIA)	**"The total internal** floor area of a building including the stairs, risers and lift cores. The Building Cores include fire escape stairs, passenger and goods lifts, lobbies, service risers, and plan areas."
Net Internal Area (NIA)	"The remaining internal floor area of a building after the stairs, toilets, risers an lift cores have been subtracted (i.e. the space that a tenant would pay rent on within the commercial sector)."
Primary circulation	"Major circulation routes within the NIA which link fire escape routes. This figure is usually expressed as a percentage of the NIA. Within the commercial sector, these are over 1500mm wide. However, in the educational sector, many primary circulation routes are required to be wider to cope with larger volumes of occupancy during class breaks. The Primary Circulation must remain wide enough for use by the disabled and also for fire escape egress."
Fit factor	"A percentage of the NUA to allow for 'left over space' that is invariably generated when space requirements 'don't quite fit'. For example, for unusual space planning conditions, restrictive columns, angles and inefficient spaces which inevitably occur in all buildings."

(DEGW, 2009)

Other measures that TEFMA Inc. advices to use for the purpose of benchmarking space use are EFTSL and FTE, which measure how much space there is per each student and employee at a time.

Table 4 TEFMA (2009, p. 10) workload measures

Measure	Definition
EFTSL (Equivalent full time student load)	”A value representing the student load for a unit of study or part of a unit of study, expressed as a proportion of the workload for a standard annual program for students undertaking a full year of study in a given year of a particular course.”
FTE (Full time equivalent)	”A value for measuring staff resources. Like student EFTSL, it is a measure as compared to a standard full-time workload.”

International gross floor area equals to the Finnish definition of gross floor area. It is probably the most straightforward measure expressing the factual area of the building with all the walls counted in it. No unclarities of what is taken into account occur.

Compared to usable floor area, counted by decreasing the common use areas, useful floor area takes corridors, lobbies and hallways into account, which speaks for the nature of the buzzing trend of multi-usability. If one thinks about the terminology behind it, useful floor area actually by definition means that ’corridors, hallways, stairs and lifts can also be spaces of great importance, action and experience’, whereas useable floor area looks down on these types of spaces. Those spaces are actually informal spaces that create meetings, spaces that people use a lot for moving from place to place, spaces that could be informative and inspiring but are not usually used efficiently to stimulate people. There is a world of possibilities in designing those informal spaces properly with limited resources.

In addition, the UFA definition of the TEFMA space planning guidelines (2009) that deducts the ’common use’ and ’non-habitable’ areas does not relate to the world of university and campus development but more to housing. For campus development, it is more relevant to look at the campus and its buildings as a whole learning complex, as compared to housing, for example, where people pay for their apartment and not the corridors and lifts as such, even though they could be utilized more wisely in housing as well. Therefore, I consider the ’useful floor area’ as a more relevant measure than ’usable floor area’ for campus development in the 21st century. Another good thing about it is that internationally, it would be easily comparable because it takes a holistic view of all the space use – also the corridors, lobbies, toilets and lifts are considered useful space and therefore must be designed properly – there is potential in them.

Going even further, are all the spaces under the useful floor area necessary to take into account when managing spaces or only the circular areas and usable areas? Where to draw the line? This is when the terms net internal area (NIA), net usable area (NUA) and gross internal area (GIA) become useful. As stated in the previous chapter, NUA only takes into consideration the so-called 'usable areas', meaning the areas of spaces 'available to an occupant or a specific use'. On top of NUA, NIA also includes the circular spaces consisting of open spaces and passages (corridors, entries, lobbies, halls, and waiting areas), otherwise referred to as total primary circulation.

GIA is very close to the Finnish term *huoneistoala* (Useful floor area), with the small difference that it does not take into account the area under partition walls. It takes into account NIA and the so-called core facilities (maintenance and machinery halls such as technical maintenance facilities, cleaning facilities, maintenance facilities, ICT rooms, toilets, stairs and elevators). Still, the outside facilities such as garages, machine halls and shelters are left outside the calculations.

The terms mentioned are useful for mapping spaces - each for different kinds of purposes. NUA is relevant in terms of mapping specific room types and when not taking a holistic view of the campus or buildings as such. I find NIA the most relevant for mapping the possibilities of both the formal and informal spaces of a campus because it counts the primary circulation facilities as meaningful spaces – it does not only look at a specific space type but also the connections between them. On the other hand, GIA is useful when considering the total amount of spaces in international benchmarking – the bearing walls in Finland have to be thicker than in, say, Puerto Rico, due to the climate. Therefore, it is a good measure for expressing the total amount of all the spaces inside the walls regardless of the geographical context. The model of how the measures build on each other is visualized in the table below.

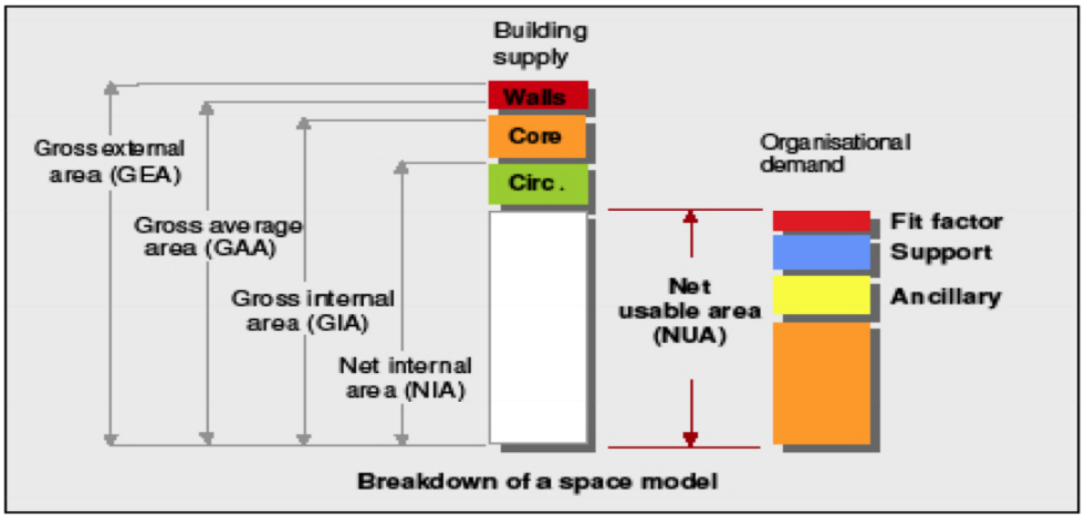


Figure 5 Breakdown of space model, (DEGW 2009)

According to the analysis made, the best purpose of use for each measure is as follows:

Measure	Equation	Purpose
NUA	The area occupied by the functions of the Learning Landscape	zooming to specific space types
NIA	NUA + Primary Circulation	formal and informal mapping of holistic possibilities and connections
GIA	NIA + Core Facilities	studying the total amount of space
GFA	GIA + Structures	studying the total area of the building
TOTAL AREA	GIA+ Outside facilities	Studying the total area of Real Estate

Although the term ’usable’ is misleading in the sense of expressing the usefulness of a space and considering the scope of this study, NUA, NIA and GIA are the most relevant measures to reliably benchmark the campuses of today’s universities around the globe. The space types and the context they are used for are presented in the next chapter, focusing on the categorisation.

3.1.2 Space categorisations

For us, people, it is easier to understand big complex knowledge clouds by categorizing the data under small units and further on creating some models out of them. There are a lot of space type categorisations both on the national and

international level that differ somewhat from each other. Which one is the most suitable for the 21st century?

Traditionally, spaces are categorised according to their functionality. When it comes to observing the functionality of spaces, it can be seen from at least two perspectives: the macro-level where the observation is done on the basis of room listings and existing spaces and their intended use of space, and the micro-level where it is actually observed how people use the spaces in order to develop them to better support their use. As stated by TEFMA: ”In planning, it is often useful to take the macro view of the campus and then drill down to seek more detailed information”(TEFMA 2009, p. 10).

On the macro-level, one can look into different types of spaces and their intended purpose of use and categorize them based on that: Group offices, language laboratories, IT-rooms, meeting rooms, cafeterias, classrooms, auditoriums and so on. One of the risks in this approach is that naming a room for a specific purpose might kill creativity - people might take the purpose of the room as given and they cannot even think of using the room differently. The macro level is an approach tracking how the spaces are designed to be used. This is the approach that the execution part of this study adopts.

On the micro-level, functionality should be observed from a user point-of-view, answering the question of how spaces are actually used. Giving a name to a room by its intended purpose is actually a big statement. Simplified, when naming a room as ’a lecture room’, the statement is: ’This room is not used for anything but lecturing.’ People do not even think what else could be done in there. From this point of view, the categories might be very different compared to macro-level visioning. Micro-level functionality is about how the spaces really support the things people do there.

If spaces are not used as designed, there is a communication breakdown between the two levels. How to overcome this contradiction? Spaces are made to support the actions users take inside the facilities. One option to solve the problem is to teach the users to use the spaces for their intended purpose. This approach, from top to bottom, trusts in the professionals of the administration to know best all the needs of all the different units.

On the other hand, if the space is considered suitable for the purpose it is used for on the grassroots level, should the categorisation of the macro-level approach be applied accordingly? In this bottom-up approach, the professional people who use the spaces and who know how the spaces meet their real needs are trusted. The success in people-centric space planning can be reached when these two aspects meet.

A big task in categorisation is to categorize spaces in order to be able to analyse them. According to TEFMA (2009, p. 20), its ”allocation guides are a ’bottom up’ approach and define the area required to perform a particular function, activity or

position.” The allocation should be relevant for the requirements of the particular activities (TEFMA 2009). The biggest question in choosing the right method is what the aim is in categorizing the spaces. Whether the categorisation is done for the purpose of micro or macro-level tracking, in order to design a new space, to define rents or to track how many of spaces of each kind exist. For planning spaces, there is another set of advices provided by TEFMA, called Space Modelling, which is ”the application of standards to known or planned activities to arrive at an internal benchmark for planning purposes”(TEFMA, 2009, p. 20).

On the national level in Finland, there is a document called Talo 2000 space dictionary which provides a national-level division for different kinds of spaces. Its primary purpose is to be used in official space descriptions and design guidelines (Rakennustieto Oy 2000). It categorizes the spaces as follows:

Table 5 Talo 2000 space type categories

Talo2000 main space types	Sub space types
1 Residential facilities	Apartments, houses, undefined houses, etc.
2 Administrative and retail facilities	Offices, retail, undefined retail, etc.
3 Educational and research facilities	Lecture facilities, auditoriums, labs, undefined teaching facilities
4 Specific special spaces	Production, health care, hospital, day care, cultural, leisure and sports, undefined specific special spaces
5 Storage facilities	Storage, archives, garages, undefined storage space
6 Kitchen and dining facilities	Restaurants, dining, kitchen, public dining, cold facilities of kitchens, undefined kitchen facilities
7 Social and recreational facilities	Dress rooms, locker rooms, toilets, sanitary and washrooms, saunas, break out areas, club rooms, nursery rooms, undefined social and recreational facilities
8 Common use areas	Shelters, storage space per real estate, entrance, public service spaces, laundry spaces, cleaning spaces, maintenance, litter maintenance, special facilities of real estates, undefined common facilities
9 Traffic and technical facilities	Horizontal traffic, vertical traffic, heating and water maintenance, air conditioning, electrical technology, outside, undefined traffic and technical facilities

Institutions tend to make their own categorizations for their own purposes. The spaces of Helsinki University of Technology were in the 1990s roughly applied according to the Talo2000 dictionary in order to allocate different types of rents to different units. This was done to support efficient use of space and to teach that the spaces really are of value. As Aalto University was established, all the spaces of other schools were put on the same platform and applied according to the same database. Nowadays, the Aalto University space resource database includes 78 different themes under which the spaces are divided.

The problem in Talo2000 is that it is made for the purpose of categorising all spaces – and not specifically for campus development. For example, the labs and other specific spaces in Helsinki University of Technology are under normal educational and research facilities in the Talo2000 dictionary. Den Heijer introduces at least two categorisations in her book on campus management: one which is made for the purpose of benchmarking Dutch Universities (den Heijer 2011) and another one reflecting the space use from Berlageweg to BK city (den Heijer 2011). Both aim to reflect the same things but are not easily comparable because of small differences:

Dutch Universities	Berlageweg
Residential	Laboratories
Specific including laboratories	Lecture halls
Education	Educational facilities
Restaurant	Studio space
Support	Conference
Office	Restaurants
Special storage	Public functions
Storage	Office space
Sanitary	Storage
	Library

Table 6 Dutch examples of space type categorisations

Now by finding the similarities between the different clusters in the Aalto Space Resource Database, which was based on the Talo2000 allocation, and based on the clusterings introduced by Den Heijer, a new clustering was made. For this study's purpose, the 78 space types were divided into 15 clusters combining the two categorizations in den Heijer's book in order to compare them with other universities. The new clustering for Aalto University's spaces looked like this:

Aalto University space division alteration 1
Specific, incl. laboratories
Auditoriums and lecture halls
Computer rooms and workspaces
Workshops and group facilities
Library
Offices
Meeting rooms

Storage
Kitchen and dining
Sanitary and wash
Lounge and Rest rooms
Open spaces and passages
Maintenance and machinery halls
Residential
Extras

Table 7 Talo 2000 categorisation applied to Aalto University

All the spaces were categorized accordingly. There were still problems in this categorization, however, because a team of British consultants having conducted many campus development projects and working on the development of Aalto Campus wanted to have another categorization for their own needs. The model they use is an application of the TEFMA space planning guidelines (2009) and it is built on the calculational model of NUA, NIA and GIA as introduced in the measurement section of this literature review. Therefore, the clustering was changed once again and finally the calculational model introduced in the previous chapter was taken as the categorisational basis for this study's purpose.

Calculational model	**Sub space types**	
Generic learning and teaching spaces	Auditoriums, lecture halls, computer rooms, group facilities and workshops, supporting spaces for teaching	
Specialist learning and teaching spaces	Technical special spaces, handicraft, labs, other special spaces, nearby storage	
Faculty and administration office spaces	Enclosed offices, group offices, open offices, reprographics, meeting rooms, kitchens, entries and support areas	
Student spaces	Cafes, restaurants, student union, student clubs	
Registry	Other storage	
Lounge and rest rooms	Break out areas, shower and changing room, cloakrooms, first aid	
Library	Library, reading rooms, storage	
Residential	Apartments for staff, apartments for visitors	NUA
Open spaces and passages	Corridors, entries, halls, lobbies, waiting areas	NIA
Core facilities	Maintenance and machinery halls, all toilets	GIA

Other facilities	Shelters, garages and machine halls, Extra	TOTAL

Table 8 Categorisation introduced by British consultants, applied based on TEFMA

The main purpose of choosing this clustering as the final one was that it has been used in the field by professional consultants and considered to be well working around the globe (Harrison 2011). It is applied based on RICS standards. As the area of each space is gathered on the basis of the raw area from the point of view of the building, it can be trusted that all the spaces are in the database as they exist – not with some unit erroneously allocated to corridors or toilets, making the data trustworthy. Plus, the clusters are not too specific and they are mainly based on the user group. On the other hand, the idea of multi-purpose spaces is not manifested in this listing which makes it a bit out-of-date. On the other hand, I consider it the most valid categorisation because of the calculational possibilities and its specific use for university campuses.

3.1.3 Need for categorisation

Is there a need for categorizing spaces? What are we aiming at when categorizing? Are we trying to find out how much space is used for teaching and how much for researching? But what if there would be only raw space with tools inside, not telling that a space is for a specific purpose but can be used for a myriad of purposes?

On a concrete level, does it really mean anything if there is 400 000 sqm of space, 20 % of which is office space? In TEFMA's guidelines (2009), different types of academic members using office spaces and their need for space are defined. The hypothesis is that in an office space, there is someone working for a particular amount of time and therefore they need a particular amount of space. Accordingly, it is assumed that in each of those office spaces, there is someone working in a particular manner.

Challenging the idea, what if one visited each of those 20% and there would be empty rooms, lectures, parties and sleeping going on in those rooms? Would they still be offices? Would they be used efficiently? Would they support the core business? I claim that it is not the intended, administrative use that tells how spaces really are used or whether they are used at all. Today, as there is a world of possibilities for individual working environments because of the development of technology, many assumptions have to be made in order to define the functionality of a space. Moreover, categorizing academic workspaces is a very difficult task because the actual work can be done anywhere, and therefore the data gathered through the benchmarking of the facilities might not have any substance behind it.

The purpose of a room is defined by doing something there. If there is nothing happening in a room, it is just walls, a floor and a roof. If it is argued that it is a classroom but someone is having a party there, is it still a classroom? Personally, I

think it is a party cage in that case. I claim it is the people inside the room and the actions taken there that form the purpose of the room, not the purpose forced by the administration or the designers.

Accordingly, the TEFMA space planning guidelines are a bit out-of-date because the individual needs and working customs vary in today's universities so much that it is almost impossible to make reliable approximations of how efficiently a space is really used – the numbers depend on the individual. This trend is forecasted to increase in the future (Albers 2010). The space type allocations are also getting harder and harder to define because of multi-use spaces and technological abilities. As Einstein has put it, "My mind is my laboratory", and this statement is actually becoming increasingly true, as a specific physical space is not needed as much as before.

3.1.4 Aalto's internal space management system

In this study's current campus assessment chapter, information on physical spaces is collected from Aalto University's Facility Services' space resource database, created by Ramboll. In order to be able to map reliably, it is necessary to point out some of the main principles of the database.

During the process of using the database, I identified four main problems: (1) the unit and building aspect, (2) lack of a planning module, (3) out-of-date space categories, and (4) all the information is scattered around in different administrative units. These are discussed in the following:

(1) The aspects of the nit and the building

Briefly said, the system provides information from two main perspectives: units and buildings. The point of view of units provides information on what different units pay their rent for, whereas the point of view of buildings expresses locational and raw area data. From the unit's aspect, the area of each space is announced in beneficial areas and net floor areas. By the Finnish standards, they are explained as follows:

Table 9 Key measures of Aalto Facility management space resource database (Suomen standardisoimislautakunta, SFS 5139, 1985).

Measure	Finnish equivalent	Explanation
Beneficial area	Hyötyala	is used in buildings where a space program is composed. Reflects the area of spaces being a part of the space program. It is the sum of living spaces (huoneala). Circular areas such as corridors, stairs, stairways, entries, lobbies and technical maintenance

		facilities are left outside the space program and the calculative sum of the beneficial area.
Net floor area / useful floor area	Huoneistoala (htm2)	the horizontal area of a floor which is covered by, on the one hand, the inner surfaces of the bearing walls of dwellings, and on the other hand, the inner surfaces of the bearing structures of the building. The area under the walls of dwellings is not counted in the useful floor area. If, though, there is an unbearing and undividing wall between two dwellings, the area under it is divided in half and allocated to the useful areas of these two dwellings. The useful area can also be calculated by decreasing the bearing structures of the stairways, technical maintenance areas and the building structures (meaning bearing and dividing structures, outer walls, elevator channels) from the gross floor area.

The building point of view provides information about the location of spaces and it shows two numbers: the gross floor area and the living space area. They are explained, by Finnish standards, as follows:

Table 10 Key measures of Aalto Facility Services space resource database (Suomen standardisoimislautakunta, SFS 5139, 1985) translated by Viitanen & Huuhtanen, 2007.

Measure	Finnish equivalent	Explanation
Gross floor area	Bruttokerrosala	the area of a floor covered by the outer surface of the building's outer walls.
Living area / space	Huoneala (hum2)	The living space is covered by the inner surfaces of the walls of a room or their understood extension. The living area is only counted in those spaces that are part of the space program. The sum of the living spaces equals to the beneficial area.

As these two aspects are used mainly for the purpose of defining rents, it is complicated to make them support planning and difficult to define the actual existing areas of spaces through them.

(2) Lack of a planning module

According to TEFMA, a space management system is recommended to consist of three linked modules: inventory, reporting and planning. The inventory module is to be used for a space inventory, the reporting module is to be used for taking reports and charts from the inventory module, and the planning module is to be used for planning different kinds of spaces based on the reports and certain parameters of each space category and, ideally, the head counts of students and staff. Through each of the modules, the user should be able to map and determine the space resources, categories, staff and student head counts on the academic organisational unit level. Ideally, the modules should also be linked to CAD or a similar application in order to alter the spaces easily in real time (TEFMA 2009).

The system does not support the purpose of planning new spaces, and therefore the third module recommended by TEFMA (2009) is lacking from the system. In practice, the reports have to be converted to Excel format and modified because one cannot report from the system straight away, for example, a pie chart of how the spaces are divided into categories. As the old universities have only been united a little while ago, a user cannot define exactly what kind of report one wants to get out of the database: school level allocation is only given from the unit point of view and only the old school allocations can be found from the building perspective, providing the raw existing areas under space types.

(3) Out-of-date space categorisation

Problems of categorisation from the administrative aspect can be reflected through the space resource database of Aalto University. It works well for the purpose of defining rents – a laboratory space is not on the same price level as a lobby and therefore there have to be various categories for different spaces. Accordingly, the technical needs of a wood workshop are more demanding than those of a normal lecture room and the prices for them have to be different. The problem is that this type of categorization in the administrative wing with the money leads to a similar kind of categorization when designing new spaces.

This problem could be partly managed by separating two different viewpoints in the categorization: there is (1) the follow-up categorization which observes how the spaces created are used and (2) the lead-front categorization observing how to create a functional space meeting the real needs of a community. The latter defines what the first one observes. If a designer creates a multi-use room, the observer will categorize it as a multi-use room and not the other way around.

(4) The information is scattered around in different administrative units

Another big issue is that the headcounts, investment costs, maintenance costs and rental costs are not administrated by the same unit but they are all scattered around in different administrative units around the campus. This makes management difficult, considering all the aspects of CREM. There should be one database for the needs of managers.

4 Applied benchmarking framework

4.1 Process

In this paper, the benchmarking process will be conducted in four steps based on the CMFW model as follows:

Table 11 Benchmarking steps

Step in CMFW (den Heijer 2011)	Step in this study
1 Assessing the current campus	1 Aalto space resource evaluation
2 Exploring changing demand	2 Campus trends and international cases evaluation
3 Generating future models	3 Comparing internal and international results
4 Defining projects to transform	4 Generating a future scenario

In the first step the current campus is analysed based on relevant numbers, in the step the changing demand is explored through cutting edge campus design examples and trends in campus design, in the third step the results of the second and first steps are compared and in the fourth step, the next steps in the development are recommended.

4.2 Alterations to the model

To deepen den Heijer's model, it is useful to identify the process between the aspects – they are not just individual aspects but they create an ecosystem where everything relates to everything. To identify the pattern of relations, an application inspired by a 4D design thinking framework introduced by Peter McGrory (2010) is used and bundled with the CMFW model.

In addition to the aspects of den Heijer's model, to be discussed in the literature review, it is useful to include a virtual aspect on the side of the physical aspect. In this study's context, it cannot be deeply studied, but as it is becoming more and more important in the context of the physical environment and as they should be developed in symbiosis with each other, it is taken a look at.

To simplify, I see the physical & virtual and financial aspects as resources for the campus manager to work with. Functionality and the strategic viewpoints, on the other hand, are possibilities and drivers: by making the physical & virtual aspects well-functioning, it is possible to save a lot of money and find a path to the strategic aims. The financial aspect, on the other hand, creates another boundary for making spaces functional for the user and for fulfilling the strategic aims.

Therefore, taking the sum of the physical & virtual, functional and financial aspects should equal to the strategic aspect. So each and every aspect is basically building on the previous one: functionality creates another layer on the physical & virtual aspects by involving a human centric approach and the financial aspect makes the whole equation possible, equalling to fulfilling the strategic aims. After all the aspects have been studied, another round starts by iterating whether or not the new physical and virtual resources respond to the current strategy. The process is iterative, as the needs develop constantly, so whenever the round reaches its end, a second round begins. The idea is visualized in the three figures underneath.

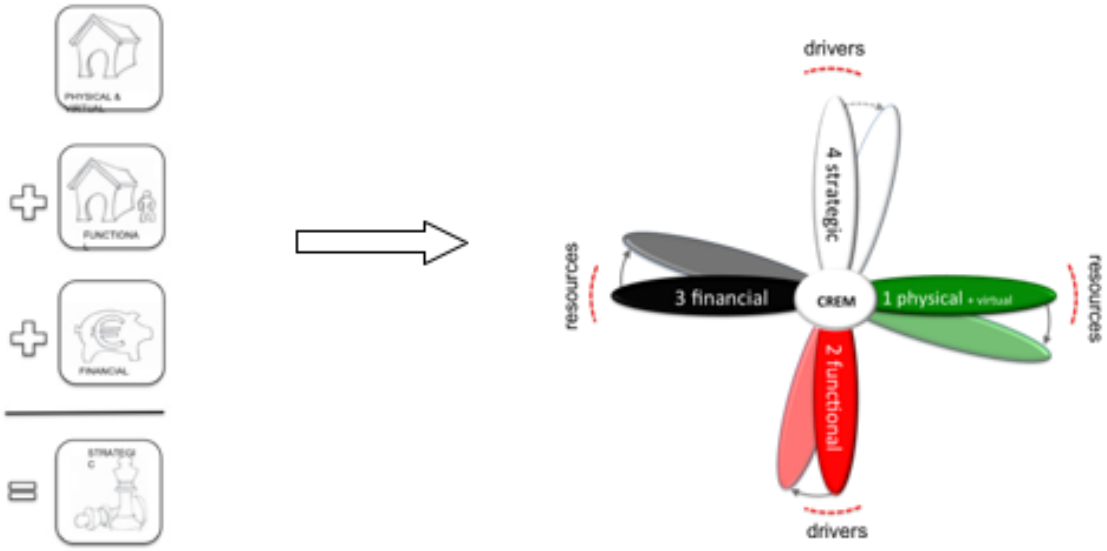


Figure 6 Benchmarking frame for developing existing facilities

However, thinking about how each aspect builds on one another, it should be thought of differently in terms of developing new and existing spaces. In developing totally new spatial solutions, the pattern should be different. As benchmarking old spaces starts from the tangible and leads to the abstract, the newly developed spaces should be built the other way around from abstract to tangible, resulting in modifications to the model as follows: The round starts from strategic aims, and by taking them as the starting point, the actual functionalities and user needs are mapped, the budget for the spaces is defined, and these points should result in a physical and virtual tangible infrastructure.

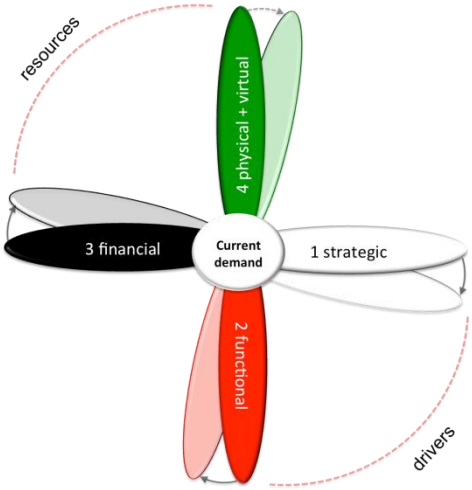


Figure 7 Benchmarking frame for developing new facilities

When developing new spaces, it is more relevant to approach their design from the abstract point of view first and consider the more tangible aspect at the end because new spaces need to fundamentally support the strategic ideology behind new facilities. Theoretically, new developments should start from strategic decisions and continue through functionality and user-centric thinking to map the needs that users have regarding future spaces. Based on those defined needs, it should be estimated how much money there is to finance the spaces and, in the end, the concrete physical and virtual environment should be developed accordingly.

These modifications mentioned result in a benchmarking framework called the Campus Management Mill model:

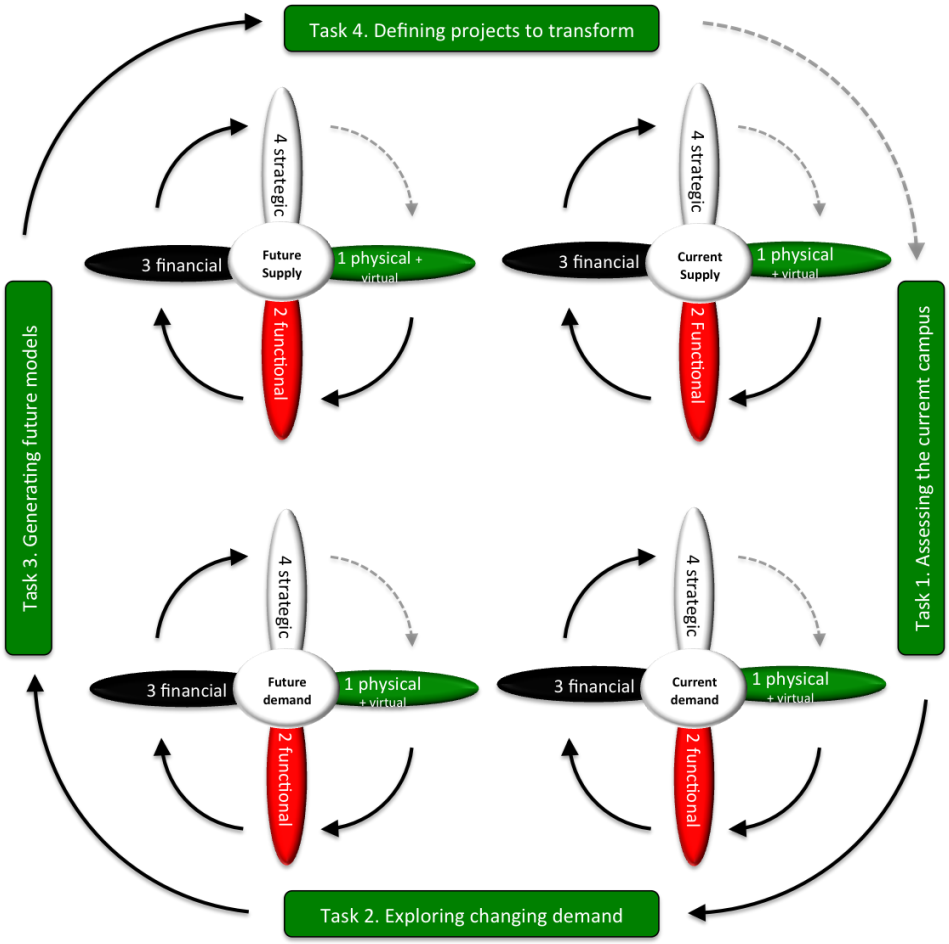


Figure 8 The benchmarking frame CM MILL for benchmarking existing spaces

All in all, CM MILL differs from CMFW by three main points:

1. Virtuality is benchmarked alongside the physical
2. The importance of the strategic aspect is highlighted
3. A pattern is defined according to which aspects should build on one another

4.3 Modifications to the aspects

4.3.1 Physical aspect

When benchmarking the physical aspects of spaces, according to CMFW, the percentages of office and educational spaces should be defined. However, the term ’educational’ already states an intended purpose for a space, while it actually is not an educational space before some teaching and learning takes place in there. These categories already take a stance on the functional aspects of benchmarking. Therefore, the physical aspect is kept very simple and to the point in this study – the big picture of campuses is clustered under the physical aspect of benchmarking and everything else is considered to be covered by the aspect of functionality. As the virtual aspect has been added alongside the physical aspect, a short description of the main virtual tools available is introduced.

According to CMFW, in order to create a campus profile, the necessary physical measures to be defined are the age of a building, gross floor area, useable floor area, number of floors and the percentages of office space, educational space and specific space. However, it is altered in this study as follows:

Table 12 Physical aspect alterations

Physical aspect alterations
1 The figures on the age distribution of buildings are outside the scope of this study
2 Based on the terminology and measure analysis conducted in the literature review of this study, the following measures replace the equivalents of Den Heijer's model: NUA, NIA, GIA and GFA
3 In addition, the spatial categorization under the office, educational and specific spaces, in my opinion, already looks at the functional aspect, and that is why they are moved to the next aspect, that of functionality. This section only looks into the physical and virtual resources as such.
4 Virtuality and virtual tools available are taken a glimpse at because, as proven in the literature review, virtuality has an enormous effect on the physical infrastructure and vice versa nowadays and increasingly in the future.

4.3.2 Functional aspect

According to M. Salimäki (2011), "functionality means the set of attributes characterizing what a product does to fulfil the user's functional needs". In the case of the physical environment, it means how spaces support actions taken within the physical environment by its users. It is sometimes understood as the intended purpose of a building, a room or a connection. However, as stated in the literature review, I am of the opinion that functionality has two sides: On the one side, there is the administrative ideal for the intended purpose of a space and the action the room is designed for, and on the other side is how people actually use the space on the grassroots level. The meeting point of these two factors expresses the functionality of a space. This study only concentrates on the administrative viewpoint, and Konsta Tuokko's Master thesis conducted in close relation to this study is about how people actually use the spaces.

Functionality is going to be observed based on the numbers of Den Heijer's model, with a few alterations:

Table 13 Functional aspect alterations

Functional aspect alterations
1 The figure for the largest user is excluded because in this case, it is not considered

relevant when taking a holistic view of the campus.
2 The space type percentages are moved from the physical section under this section because, in my opinion, they already look at the functionality, not just the physical resources.
3 In addition, functionality is examined closer by comparing the different sizes of lecture halls and offices.
4 A set of pie charts are also provided to visualize the space division of different schools at the moment

4.3.3 Financial aspect

Based on den Heijer's framework, the financial perspective has three dimensions: the budget available for managing the campus, the value of the campus and the costs of managing the campus. According to den Heijer, the numbers that should be provided to create a campus profile include: maintenance, energy & water, cleaning, construction costs and investment costs, with all of these on an annual basis and per sqm for both GFA and UFA (den Heijer 2011).

In Aalto University's case, relevant information is found from the rental aspect – answering how much all the spaces cost on a monthly and an annual basis for each unit. The rental costs defined for departments exist in order to show the value of all the spaces and highlight that they are worth something, so that people would not take spaces as a non-cost self-evident element but would be willing to use the space efficiently. The value of the spaces is reflected through rental values, leading to thinking of it quite vaguely compared to den Heijer's model. Also, the aspect of energy efficiency is covered in the financial section, as financially it might motivate the decision makers to think about the environment as well. All this information is also presented in the benchmarking section.

4.3.4 Strategic aspect

According to Den Heijer, "the strategic perspective is all about adding value to the university goals and accommodating to the primary processes" (den Heijer 2011, p. 143). So, as in any real estate business, the point of real estate management in the university world is adding value to the core business – educating, studying and researching. According to recent studies, the campus planners find it difficult, though, to "translate the institutional goals into real estate goals"(den Heijer 2011).

According to den Heijer, the measures needed to benchmark from the strategic perspective are the following: How much were there plain & efficient meeting and representative spaces in the past, how much are there planned to be in the future and how much is there stated to be in the strategy. As the numbers are, in my opinion,

hard to define from the strategic point of view, the strategy is going to be further discussed and the main facts are taken into account. A vivid stereotype of international benchmarks in relation to Aalto will also be introduced.

The campus profile of Aalto University is based on the alterations mentioned, altering the data to be gathered according to the following formula. However, because the information available is incomplete, the international benchmarks lack some of this information.

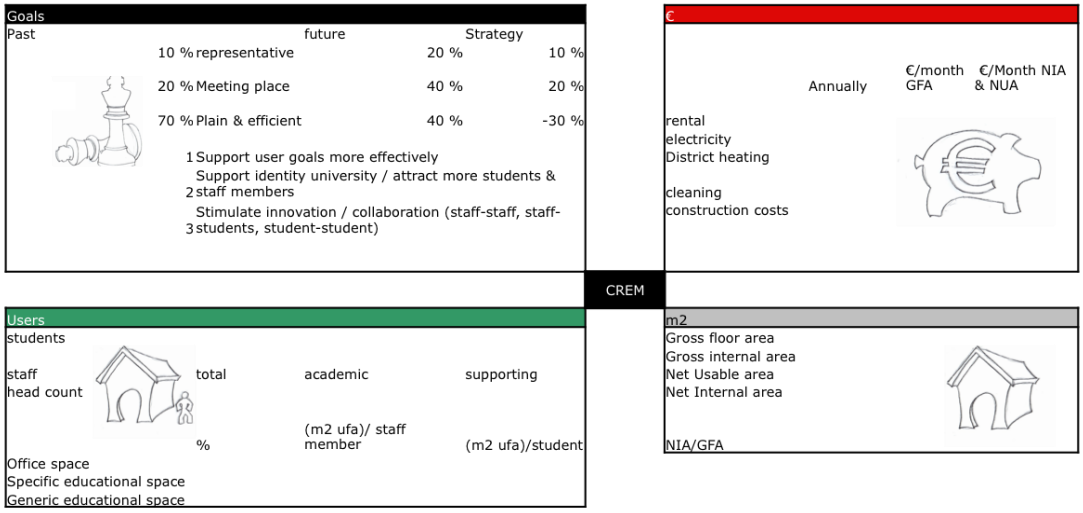


Figure 9 Campus profile numbers to be defined

5 Evaluation of Aalto's space resources

ThecCampus consists not only of the buildings and spaces, but according to Aalto University's vision, increasing importance is laid on the infrastructure, the whole community and people (Aalto University 2011b). It is not only the spaces as such that count but how they are used, how people feel in the spaces and how they contribute to the core business of Aalto University – educating, learning, connecting and researching. That is why also the functional and strategic aspects play an increasingly important role. Benchmarking in this paper is divided into the four categories of corporate real estate management: Physical & virtual, functional, financial and strategic. After taking a look at the university holistically, a case study on the Factories of Aalto University is introduced.

5.1 Aalto University in a nutshell

Aalto University was established on January 1 2010. Its roots derive from three leading Finnish higher education institutes: Helsinki School of Economics situated in Töölö near the city centre of Helsinki, University of Art and Design Helsinki situated in Arabia and Helsinki University of Technology situated in Otaniemi, Espoo. The main idea behind Aalto University is to take advantage of synergies and collaboration between the fields of Art and Design, Technology and Economics in order to educate world-class interdisciplinary pioneers, make state-of-the-art research and create an inspiring learning and teaching environment. As stated in Aalto University's mission statement in 2010:"Aalto University works towards a better world by promoting top-quality research and interdisciplinary collaboration, pioneering education, surpassing traditional boundaries, and embracing renewal" (Aalto University 2011b).

5.2 Aalto University as an organisation

On January 1 2011, Aalto University was divided into six schools representing different fields of technology and science, art and economics as follows: School of Chemical Technology, School of Electrical Engineering, School of Engineering, School of Science, School of Art and Design and School of Economics.

In 2010, there were altogether 19 516 students and 338 professors in Aalto University. Completed master's degrees reached the amount of 2312, and doctoral degrees 184. As the School of Science and Technology covered more than 70% of the total student mass with 13725 students, it was divided into separate units as mentioned earlier. More statistics about the staff and student numbers can be found in attachment 1 (Aalto-www 2011f).

Aalto University's funding is based on foundations. The biggest funder is the state with 500 million €, and 200 million € of the funding is received as donations from private persons, companies and other foundations (Aalto-www 2011f).

In order to understand the wide variety of different spaces, buildings, units and the complicated infrastructure of Aalto, it is necessary to open up Aalto's organizational structure. The organization chart of Aalto University can be found in Appendix 2 (Aalto-www 2011a).

5.2.1 Departments and units

The six schools are divided into altogether 61 different departments and other units. A short description and listing of the departments and units under each school can be found in Appendix 3 (Aalto-www 2011b).

Under Aalto University there are 15 service providers for different fields, ranging from Corporate Relations to Sports Services and from HR to Property and Infrastructure Services. The services are listed in Appendix 4 (Aalto-www 2011c).

5.2.2 Mission, values and goals

In order to understand Aalto University's ideology, its mission, values, vision and goals are introduced in the following pages. As stated in Aalto University's campus vision, February 2011:

"Mission

Aalto University works towards a better world by:

• top-quality and interdisciplinary research,

• pioneering education,

• surpassing traditional boundaries, and

• embracing renewal.

Aalto University educates responsible, broad-minded experts to act as society's visionaries and agents of change" (Aalto University 2011a).

"Values

• Passion for exploration

• Freedom to be creative and critical

• Courage to influence and excel

• Responsibility to accept, care and inspire

• High ethics, openness and equality" (Aalto University 2011a)

"Vision

The best connect and succeed at Aalto University, an institution internationally recognized for the impact of its science, art and learning"(Aalto University 2011a).

"Goals

The main goals of the university are defined as strengthening basic research, focusing on areas of competitive strength, promoting interdisciplinary research and innovation, developing research-based education, enhancing internationalization of faculties, staff and students, rethinking academic leadership and ensuring world class infrastructure, services and working spaces" (Aalto University 2011a).

5.2.3 Aalto University in international rankings

As spaces should support the aim of being a world-class university, it is important to take a glimpse at what Aalto's international ranking is at the moment.

There are plenty of rankings that list universities based on different measures. In this study, the ranking system used is QS World University Rankings which ranks universities based on the following indicators: "academic reputation (worth 40% of the point score used to determine a university's rank), employer reputation (10%), faculty - student ratio (20%), citations per faculty (20%), the number of international faculty members (5%), and the number of international students (5%)" (QS World University rankings 2011).

In the QS World University ranking, Aalto was ranked 232nd of all the Universities in the world at the end of 2011. Cut down to smaller bits and pieces, the natural sciences were ranked as 249th, engineering & IT as 138th and social sciences as 305th. Arts & Humanities were not ranked at all and neither were life sciences. However, in 2007, when the Aalto University did not yet exist, Aalto was ranked as 170th with each of the mentioned fields ranked (QS world University rankings 2011). It seems that as Aalto University is at the moment still so young with such an unclear organizational structure, the rankings are not able to follow its development, and therefore the rankings have to be interpreted vaguely, not as fundamental truths. On the other hand, the Financial Times, for example, ranked Aalto University School of Economics as 22nd in the European Business School ranking in 2011 (Financial Times 2011).

5.3 The campus question

After studying the visionary boundaries within which Aalto University functions, a new question arose: How could these fundamental ideas and core competencies be supported in practice by spatial and campus design? As Aalto University was established by uniting the forces of the three schools with different cultures, locations, administrations and working habits, there was, has been and will be a lot of debate on everything related. However, one of the biggest questions arisen in the media has been the campus question. Should there be only one campus? If, where should it be situated? Or should all the three campuses of Töölö, Arabia and Otaniemi be retained?

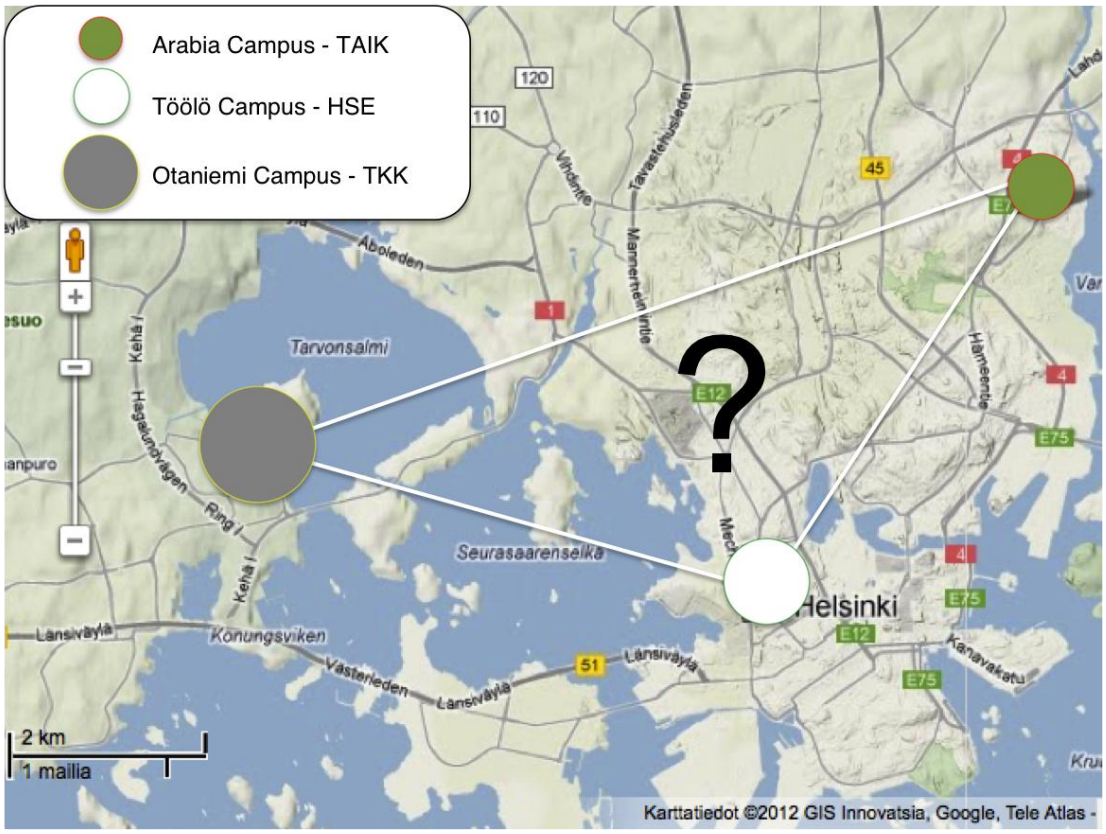


Figure 10 Aalto main campuses map

In the beginning there were basically three options for Aalto University's future campus: one was to create one main campus in Otaniemi and retain some activities in Töölö. The second one was a so-called bipolar campus model suggested by TOKYO (The Student Union of University of Art and Design Helsinki) and KY (The Student Union of Helsinki School of Economics), according to which there would be two main campuses: an existing one in Otaniemi and the other one yet to be built in Töölönlahti next to Kiasma and Musiikkitalo in the City centre of Helsinki. The third one was to retain all the three existing campuses (Aalto University, 2011a).

The School of Art and Design needed new spaces or a massive renovation because the building was in such a bad condition and did not facilitate its purpose. The third option was therefore denied. Due to economic realities, the second option was not considered realistic. After a lot of debate and a study conducted on different campus options, the Aalto University Board decided on June 17 2011 to establish the Aalto main campus in Otaniemi. The model of one main campus was argued for by its contributing nature to Aalto University's mission of being a multidisciplinary and creative university. During the same meeting, the board decided on forming a new school consisting of the School of Art and Design and the Department of Architecture. The new school will start operating at the beginning of 2012 and the current Aalto School of Art and Design's activities will be moved from Arabia to Otaniemi. However, the campus of Aalto School of Economics in Töölö will be

retained and only the bachelor's level activities of economics studies will be moved to Otaniemi. Retaining the Töölö campus was argued for by its central location, which could facilitate possible future development regarding the other schools as well (Aalto-www, 2011d).

Based on the decisions made and the campus vision stated, the negotiations with both of the cities (Helsinki and Espoo) continued and planning for the future campus began. According to the vision for the Aalto University campus, "the aim is to create a vibrant and interactive research and studying environment where work, studying, recreational activities and everyday life will naturally be connected to each other." (Aalto-www, 2011d).

As it can be seen, Aalto's history is short but colourful with a lot of debate involved. A lot has happened in a very short period of time and a lot is going to happen in the near future.

Picture 1 Taik, TKK and HSE main buildings (Aalto-www, 2011)

5.4 Description of the current campuses

Aalto University is, at the time of this study, practically divided into three different campuses in the Metropolitan area of Helsinki and four campuses outside of the Helsinki area in the cities of Lahti, Pori, Vaasa and Mikkeli.

The Technology schools, meaning th eschools of Engineering, Electrical Engineering, Chemical Engineering and Science are, at the time of this study, located in Otaniemi, Espoo about 10 km from th eHelsinki city centre. Otaniemi's campus area consisting of 37 buildings for the activities of Aalto University and various private buildings is referred to as "A unique combination of education, study and business densely packed into a small area" (Aalto-www 2011e). Right next to the campus is situated a vivid Student Village called 'Teekkarikylä', home to more than 2000 technology students. Otaniemi forms the main campus of Aalto University in the future and a map visualizing how the units are scattered around the campus can

be found in Appendix 5. In addition to Otaniemi, School of Engineering has an independent department situated in Lahti which is about 100 km north-east of Helsinki (Aalto-www 2011e).

The School of Economics is, at the time of this study, situated in Töölö, in the city centre of Helsinki. The campus comprises 8 units. It also has a side unit for a specific bachelor's degree program situated in Mikkeli in a consortium established by four Finnish Universities. This is another campus area that is going to be retained in the future (Aalto-www 2011e).

The School of Art and Design is, at the time of this study, situated in Arabia, 6km from the city centre of Helsinki. It is an eight-floor complex building and it used to be used as a factory but was in 1986 taken over by the University. Nowadays the building is in a quite bad condition. Therefore, the School of Art and Design needs new spaces and will be moved to Otaniemi. Like the School of Economics, the School of Art and Design plays an active role in the consortium located in Pori, called the Department of Art and Media, Pori. In addition, it is also running a co-operative research and product development unit called Muova, situated in Vaasa in collaboration with the local University.(Aalto-www 2011e)

5.4.1 Relevant notions of the future campus

A new school will be established by uniting the Department of Architecture and School of Art and Design on January 1 2012. The School of Art and Design will be moved from Arabia to Otaniemi in 2015 to become physically a part of the new school and the Aalto main campus. A new building will be constructed primarily on the basis of the needs of the new school. The design concept for the new building is being developed at the time of conducting this study (Aalto-www 2011b).

Based on the decision made in June 17 2011 by the Board of Aalto University, all the bachelor's level education will be centralized to Otaniemi step by step, beginning in 2013 (Korhonen & Pasanen 2011). A big question arising from this decision is where to fit all the bachelor's level education. Could it be reached by better and more efficient use of space, more customizable spaces or something else?

Another concrete element to be kept in mind while benchmarking the current spaces is the Aalto Campus Vision. It answers the question: "What are we aiming at by developing the campus?" It states four essential basic elements to be encountered in creating a successful, unified campus: "Our students, Our faculties and staff, Our community and Our economy and environment". It is remarkable that much importance is laid on the people, not on the physical facilities as such. The learning landscape is, therefore, supposed to be tailored for the people.

5.5 CM Mill in action

To get a holistic overview of Aalto University's campus profile currently, the CMFW model is applied and spiced up with more specific definitions under each category. The assessment of the current campuses is done based on the three old schools, meaning the School of Economics, the University of Art and Design and the Helsinki University of Technology, because they reflect the current reality of the campuses better than the new division under six schools. However, to get an idea of how spaces are divided into different units in the main campus, a campus map visualizing where each department mainly functions can be found in the Appendices (Appendix 5).

5.5.1 Physical and virtual evaluation

As a result of internal physical and virtual benchmarking, the following questions are answered: "What kind of spaces already exist? How are the spaces divided into different buildings/areas? What kind of problems can be marked in today's campuses? What are the efficient and well working elements of the current situation? How does the virtual infrastructure contribute to spaces and vice versa?" Answering these questions creates an overview of Aalto's space resources today. The numbers are given with the accuracy of 1000 sqm because the database lives from day to day as the spaces are updated and it is not exact.

According to the database, the Real Estate mass of Aalto University altogether today as calculated by the calculational model defined in the literature review of this paper is 256 994 sqm of net usable area. The areas are allocated under the old schools as follows (accuracy of 1000 sqm):

Table 14 Aalto sum areas (Aalto Facility Services, 2011b)

Schools	Net Usable Area sqm	Net Internal Area sqm	Gross Internal Area sqm	Gross Floor Area sqm	NUA/GFA %
The School of Art and Design	30 000	38 000	42 000	48 000	61
The School of Economics	24 000	30 000	40 000	46 000	51
The Schools of Technology	204 000	262 000	318 000	345 000	59
The New School	34 000	44 000	46 000	55 000 (estimate)	61
Aalto University	257 000	330 000	401 000	440 000	59

It is remarkable that already now almost 80% of the total space resource mass is located in Otaniemi. When the School of Art and Design will be united with the Department of Architecture due to the new School, they will be moved into a new building which will be constructed in the Otaniemi area. Then, only about 10 % of the Real Estate mass will be located outside Otaniemi.

As the School of Art and Design is going to be moved from Arabia to Otaniemi and united with the Department of Architecture, a new building will be built according to the needs of these units. The building concept and design is being developed during the time this study is conducted, and therefore the calculations of the current spaces of the buildings are defined in the ”new school”-column.

Because of the recent division of the School of Technology under the four schools, it does not reflect the current reality of them being separated to different units, as multiple units use the spaces across the unit barriers. Therefore, it is not relevant from the point of view of the current campus as a whole to consider the point of view of one specific school. But to get an understanding of how the spaces are divided within the Schools of Technology:

Table 15 The Schools of Technology divided to new schools (Aalto Facility Services, 2011b)

Schools	Net Usable Area	Gross Internal Area
The School of Chemical Technology	21 000	30 000
The School of Engineering	32 000	43 000
The School of Science	28 000	38 000
The School of Electrical Engineering	22 000	30 000

As virtuality is taking over, a separate study should be conducted on how virtual and physical infrastructures support each other in Aalto University in order to create a holistic vision of the functionality of the campus. Within this study’s scope, however, it is too wide a section to be looked at, and therefore it is not included, but in order to highlight the increasing importance of the whole building operating system, it must be analysed at some level.

Virtual tools should support the physical infrastructure inside which learning happens. According to the Aalto campus vision, ”A virtual campus should complement the physical one to secure connections during the evolution of a more unified campus” (Aalto University, 2011b, p. 4). In fact, Long and Ehrmann compare the learning enhancing elements of a building’s infrastructure to computer systems and state that those elements together form a ”building operating system, BOS”.

They find that the BOS should support a set of various activities: ad hoc replaying 'think through', writeable surfaces, real-time blogging, classroom chat-rooms, effective and safe bandwidth to and from rooms, multi-site enabling of videoconference tools, real-time video and data capture and tools for guest lecturers to teach from a distance and still to be able to use the technologies of the classroom (Long & Ehrmann 2005).

On top of these learning enhancing high-tech activities, there should also be the virtual infrastructure telling the story, providing tools for and creating the brand identity of a University. Aalto University has many platforms on-line to be utilized to support learning and to spread knowledge about Aalto which are taken a look at in the following.

Aalto Inside is an on-line intranet for the Aalto staff and students. Its purpose is to inform about everything happening in Aalto and to brand the Aalto identity for the people inside Aalto. In addition to news and other information, Aalto Inside provides links to various tools for the staff and students: e-mail, teaching and researching, logos and documents, HR and economics, space reservation and other tools (Aalto University 2011c). This study only takes a narrow look at the research, studying and teaching tools and the space reservation tool.

There is an *Aalto publication series platform* provided for the researchers through which it is possible to electronically publish academic papers (Aalto University 2011c). I wonder why this kind of system is not provided for the thesis students who need to edit their thesis according to strict editing rules. If the agenda is educational, then in my opinion there should be a freedom of editing – one could think of how the content would look like, as the case is in the School of Art and Design. Now that the code is strict for at least engineering students, there could be something as simple as a Word template provided to make the process more efficient.

Another tool for the staff is *Halli project administration system* used for announcing working hours each month and looking at the cost structures of research projects (Aalto University 2011c). This system seems objectively quite good for its purpose. But the fact that it is again another tool amongst the myriad of other tools makes it difficult to find and utilise.

The library collections are also put on-line (Aalto University 2011c), but the fact that they are still divided under the old schools TaiK, HSE and TKK seems very unpleasant regarding the aim of enhancing interdisciplinarity. is the division according to the old schools makes it more complicated to search for information and one cannot find by coincidence any related research from other fields of study looking at the same subject from a different aspect. This does not support the idea of breaking down the traditional boundaries in research and art as stated in the campus vision.

In addition, there is another hub which informs about everything related to the studies and services for students and it is called *Aalto Into*. This hub includes a whole variety of tools: for instance *Oodi*, which is an application for administrating and registering student, studying and teaching information; *Noppa*, which is a course portal consisting of the course websites; *eAge*, which is an on-line tool for applying to programs; Library platforms for each of the old schools; Onni for the intranet of School of Art and Design; three Optimas; and Studentwiki and Webmail for different purposes. To support on-line learning, there is also a Moodle which some Aalto courses use (Aalto University 2011c).

All these are individual tools disconnected from each other, which seems quite inefficient – everything has to be updated in all the platforms separately one-by-one and all the different platforms have to be observed regularly in order to be on the map about what is happening where. This increases the risk of communication breakdowns.

When it comes to the reservation of spaces, there is also a reservation machine provided to the users to reserve spaces in Aalto University's buildings. An observation study should be conducted in order to find out how well the reservations and real space use match.

It is good that there are hubs like Aalto Into and Aalto Inside through which it is basically possible to find all the tools and information about everything related. The problem is that having many different tools, various databases and forums through which information is spread and tools are used, it is made complicated to search for information, which leads to inefficiency and communication breakdowns. The system is clumsy compared to, for example, Facebook, where everything is under the same umbrella, linked to one another.

5.5.2 Functional evaluation

Now that the physical and virtual spaces are mapped and defined, the next step is to study the use of those spaces. What are they designed to be used for?

At first, the information required to create the campus profile according to CMFW is given in Table 16:

Table 16 Head counts of Schools and the average amount of spaces (Aalto-www, 2011; Aalto Facility Services, 2011a)

Schools	Students	Staff	Educational space/student (NUA) sqm	Office space/staff (NUA) sqm
The School of Art and Design	2 068	402	7,4	20,3

The School of Economics	3 723	524	1,6	21,0
The Schools of Technology	13 725	3 187	6,5	24,0
Aalto University	19 516	4 685	5,6	23,3

As it can be seen, a student in the School of Art and Design and in the Schools of Technology is provided with a lot more space than in the School of Economics. The office space per employee is basically on the same level in each of the schools, which reflects the fact that their work is similar by nature when taken a look at from the facilities' point of view. It is also important to point out the equivalent full time student load, which was 13 797 students in 2010 (Aalto University Board 2010).

To go deeper, let us take a closer look into how the spaces, by today's standards, are divided. The categorization used is based on the calculative model used in the physical aspect benchmarking and the reasons for using it are explained in the literature review. Among the functionality types of the spaces in the campuses as according to CMFW, the most important ones are the following:

Table 17 The space type allocations of the Aalto Schools (Aalto Facility Services, 2011a)

Schools	Office space %	Generic Educational space %	Specific Educational space %
The School of Art and Design	20	19	19
The School of Economics	29	15	1
The Schools of Technology	24	9	19
The New School	20	18	20
Aalto University	24	11	17

As the table indicates, there are big differences between the amounts of office spaces, specific spaces and generic educational spaces of the different campuses. In the school of Art and Design, for example, there is as much specific educational space as there is generic educational space. Because the specific educational spaces consist of e.g. labs, workshops and other spaces supporting practical working methods, the space division indicates that the studying methods are half hands-on and half driven by generic studying. In total, the educational spaces form 38 % of the total space mass of the School of Art and Design, which is 10 % more units than in the Schools of Technology and 22 % more units than in the School of Economics.

This shows that there is more space reserved for an art student than for an economic or an engineer student. In the school of Art and Design, generic and specific educational spaces and office spaces are all three on the same level. Regarding the space use of the New school, the amounts will be more or less the same as in the School of Art and Design.

In the School of Economics, the space division is relatively heavily concentrated on the offices of the staff compared to the educational facilities. However, in the Schools of Technology, more office space is provided per employee. The numbers reflect the fact that only a tiny amount of space in the School of Economics is provided for hands-on working, as the specific educational space covers only 1% of the total space mass. Traditionally, the space use is most efficient in the field of economics compared to other fields of studies, which is due to the characteristics of different fields of studies.

It can be stated that in the Schools of Technology, the studying spaces are designed for more specific, hands-on type of working than in th eSchool of Economics or in th School of Art and Design – in comparison, the Schools of Technology have generic educational space the least and specific educational space the most. Two thirds of the educational spaces are specific. 4 % more units of the total mass are allocated for the educational purposes than for the staff offices.

The points mentioned reflect the fact that the way of studying, teaching and dividing spaces varies a lot in the original three institutions that Aalto emerged from. Simplified, assuming that the space is used as it is divided in the database and according to this analysis, the spaces for art students support both a specific and generic way of studying to the same degree. On the other hand, the spaces for economic students support a generic way of studying, whereas the spaces for engineering students support two thirds specific and one third a generic way of learning. The employees of each of the schools are provided with practically the same amount of space.

On the Aalto University level, faculty and administration office spaces are the biggest single space type, covering 24 % of the total mass. The second biggest is surprisingly open spaces and passages with 18 %, which indicates the importance of utilizing these spaces for some purpose – they should not be thought of as only through passages but as possibilities for creating something valuable. There is a huge potential in the unutilized and undesigned corridors, lobbies and hallways. Generic learning and teaching spaces cover 11 % of the total mass, which is, in the end, quite a small amount compared to the more than double amount of office spaces. On the other hand, generic educational spaces together with specialist learning and teaching spaces and educational facilities cover 28 % of the total mass, which is 4 % more units than with offices. It can be said that there is roughly as much office space as educational space, which is a good balance. Student spaces and lounge and rest

rooms only cover 5 % of the total amount of spaces, which seems to be quite a small number considering that informal spaces are regarded as learning-supporting spaces. Compared with the faculty and administration office spaces, there are approximately 5 students per one employee, so in that sense, the space allocation is not in balance. Could there be more space open to both students and the staff to create meetings and informal interaction?

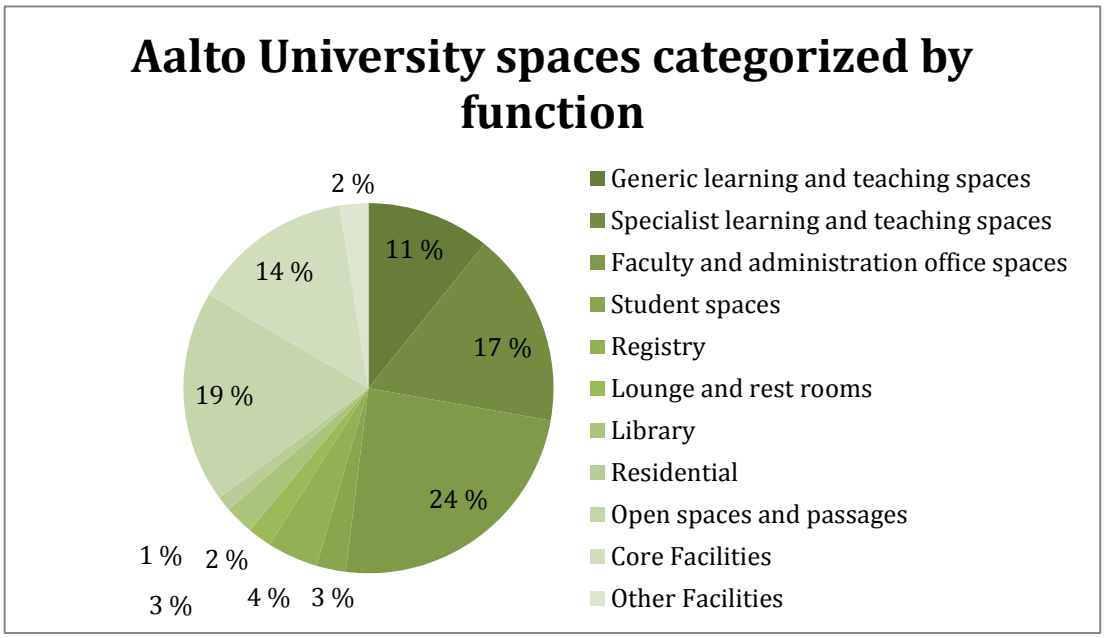


Figure 11 Aalto University Spaces categorized by function (Aalto Facility Services, 2011a)

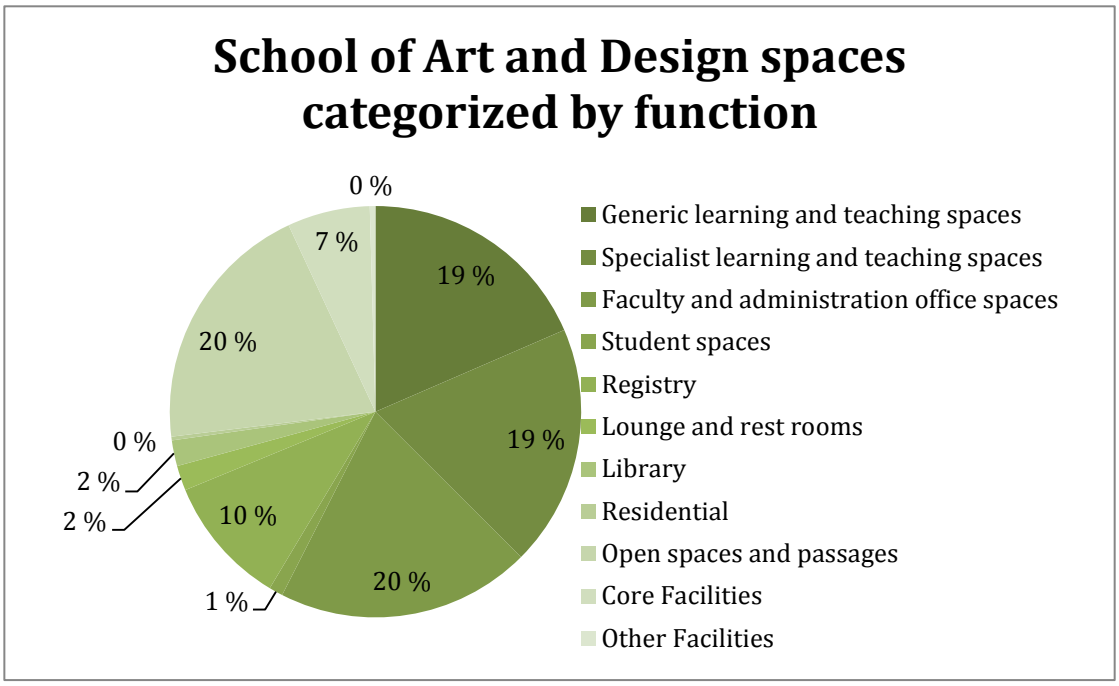


Figure 12 School of Art and Design spaces categorized by function (Aalto Facility Services 2011a)

It is remarkable that in School of Art and Design, the amount of both generic and specialist learning and teaching spaces and faculty and administration office spaces are on the same level, all of them taking about a fifth of the total space mass. The reason for the huge amount of space per an art student is the need of various special spaces. As a lot of studies are conducted by various hands-on work methods, spaces such as workshops, movie studios, glass studios and dress painting studios are needed. The question when talking about the efficient use of space is how to unite these kinds of spaces and make them work in symbiosis? The open spaces and passages are also on the same level as both of the teaching space types. 10 % is covered by the registry. On the other hand, the student spaces only cover 1 % of the mass and lounge and rest rooms 2 %. Could the existing open spaces and passages be used, for example, for the purpose of lounges and rest rooms or the student spaces?

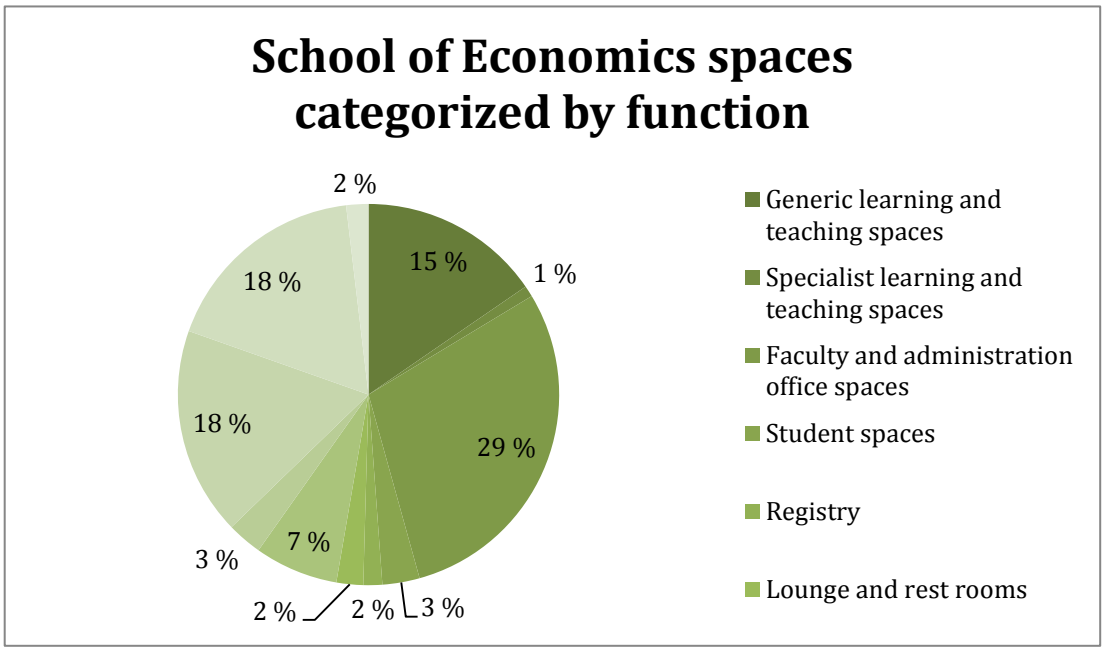


Figure 13 School of Economics spaces categorized by function (Aalto Facility Services 2011a)

Office spaces cover almost a third of all the facilities in the School of Economics. Compared to other schools, it is quite much when the educational facilities only cover 16 % of the total mass. The area of all the offices is almost double compared to the area of teaching facilities in the School of Economics. There are quite comprehensive library facilities, covering 7 % of the total area, and open spaces and passages sum up to 18 %.

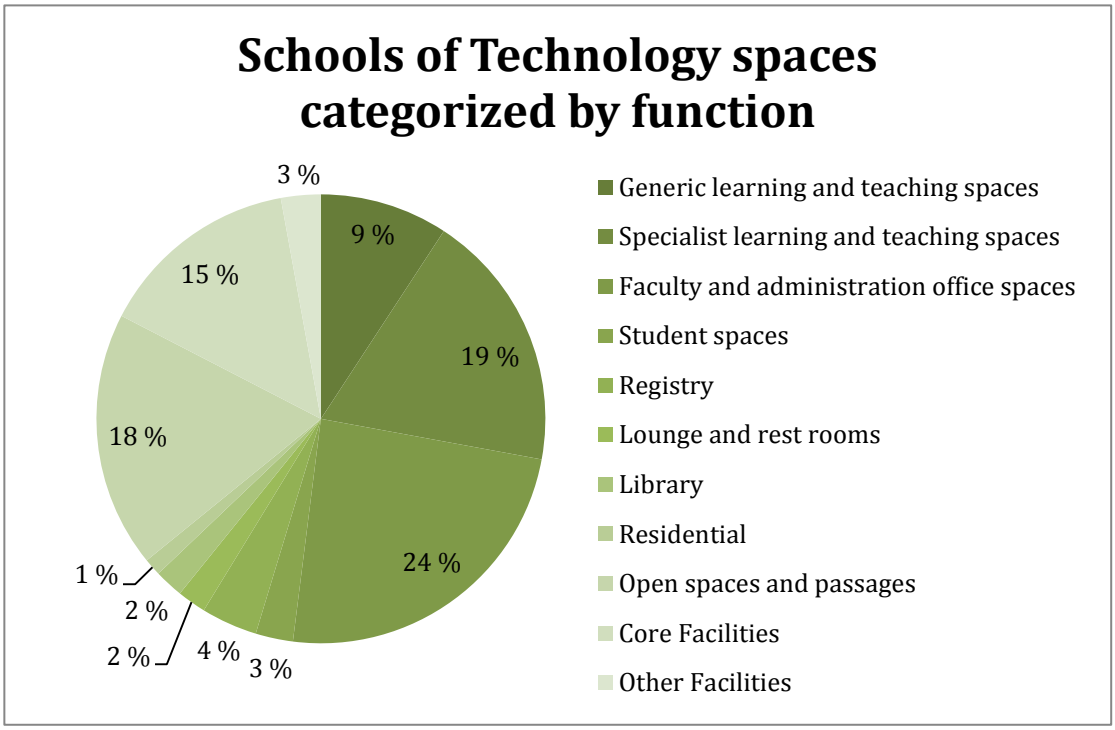


Figure 14 Schools of Technology spaces categorized by function

The most relevant point to note in the spaces of Schools of Technology is that specialist educational facilities is the biggest single category of spaces with almost a third of the total area, whereas faculty and administration office spaces cover about a fourth. Generic educational facilities are relatively the smallest compared to the other units.

An important point from the point of view functionality is also the number of different-sized facilities inside a space type. Lecture halls and offices are the very

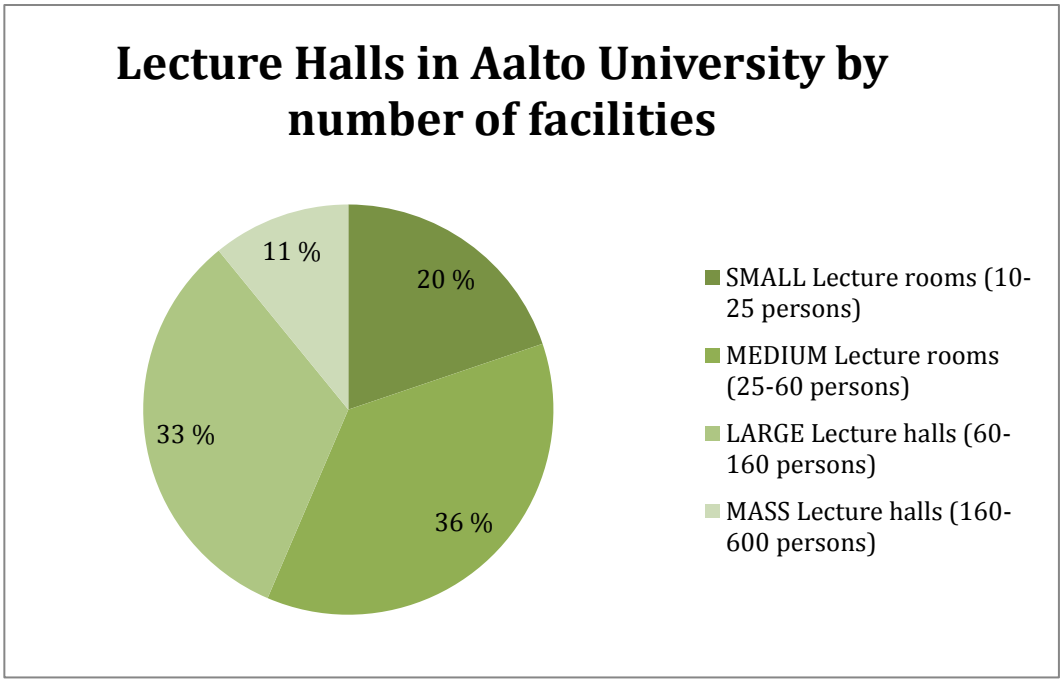


Figure 16 Lecture Halls in Aalto University (Aalto Facility Services, 2011a)

basic types of spaces considering everyone, and therefore they are highlighted here.

As indicated in Figure 16, most of the lecture facilities in Aalto University are medium sized or large. Only 11% of the lecture facilities are huge mass lecture halls and 20 % of the spaces are small lecture rooms. A third of the lecture facilities are designed for groups of 60-160 students. Would it be possible by scheduling efficiently to create flexible larger spaces which could be divided into smaller units?

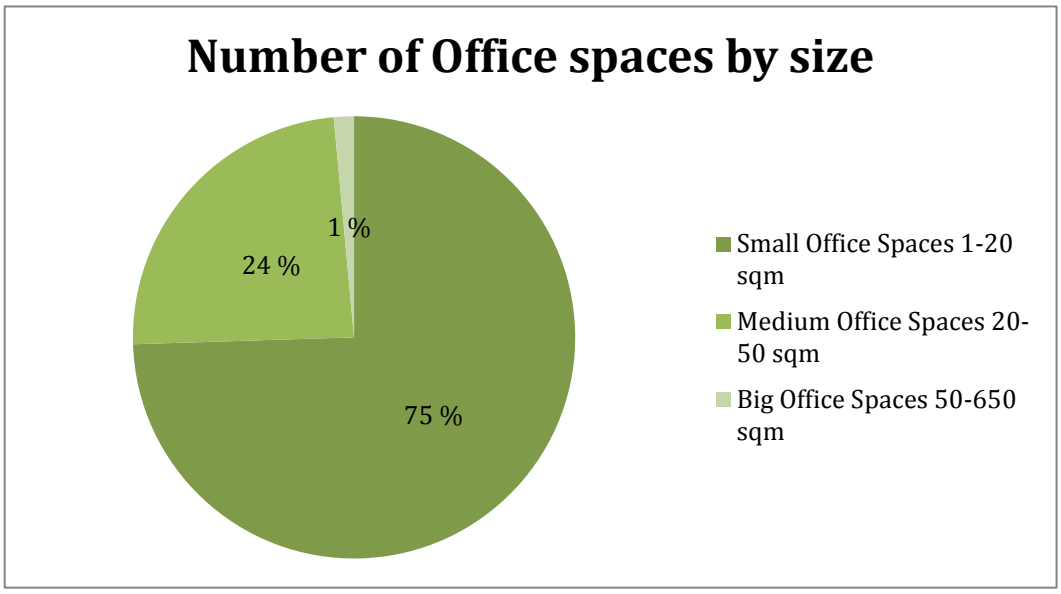


Figure 17 Office spaces by size in Aalto University (Aalto Facility Services, 2011a)

Three fourths of the total amount of offices in Aalto are rooms of smaller than 20 sqm for one researcher. 24 % are team offices for a group of 2-5 people and only 1 % of the offices are open offices between 50-650 sqm for more than 5 people. According to the chart with headcounts and area per employee introduced earlier in this section (Table 16?), there is about 23 sqm office space reserved for each. Simplified, this would mean that about 75% of the staff work in small offices of their own, 24% work in a group of two and only 1 % work in a bigger group of people. In my opinion, it seems that these facilities are quite out-of-date and do not support the ideology of sharing and communicating but enhance more the traditional, individual way of working and research.

5.5.3 Financial evaluation

The financial aspect is covered by looking at Aalto University as a whole. The annual rental costs of Aalto University facilities were 53 million € in 2010. It has been estimated that it will cost 210 million € altogether to renovate the Otaniemi campus. In 2010, the total amount of money spent in university actions was 376 million €, the biggest cost being staff (67 % of the total amount) and the second biggest facilities (17 % of the total amount). In other words, almost 64 million € was spent in facilities in 2010 (Aalto University Board 2010).

In Table 18 below are shown the most important financial figures pertaining to the facilities.

Table 18 Aalto University Real Estate finances

Aalto University	Annually (2011)	€/month /sqm GFA	€/month/sqm NIA	€/month /sqm NUA

Rental (Aalto Facility Services, 2011a)	54 700 000 (including water, energy and maintenance)	10,4	13,8	17,7
Electricity (Aalto-Yliopistokiinteistöt, 2011)	4 509 000 (estimate)	0,9	1,1	1,5
District heating (Aalto-Yliopistokiinteistöt, 2011)	2 689 349 (estimate)	0,5	0,7	0,9
Cleaning	2 775 000 (estimate)	0,5	0,7	0,9
Construction costs (renovation, estimated) (Aalto University Board, 2010)	210 000 000 in the following years			

By showing the costs in gross floor, net internal and net usable areas, I want to highlight the gap between the costs when divided on the basis of net usable area and net internal area. The main idea is to point out that if the rental system's aim is to give value to spaces, then all the spaces should be valued equally. Otherwise the units will not value the other spaces but only the ones they pay their rent for. Almost 4 € per month per square metre is used on maintaining undesigned spaces that could support learning if utilized. It sums up to quite a big number.

Regarding the financial aspect, it is also good to point out the energy efficiency classes of the existing buildings. Throughout the buildings of Aalto University today, the energy efficiencies are low and by improving the efficiencies, money could be saved in the longer view.

Energy efficiency classes of Aalto University buildings	Number of buildings	%
A	0	0,0 %
B	1	3,2 %
C	3	9,7 %
D	3	9,7 %
E	12	38,7 %
F	4	12,9 %
G	8	25,8 %
Total	**31**	1

Table 19 Energy Efficiency classes of Aalto University Buildings (Aalto-Yliopistokiinteistöt, 2011)

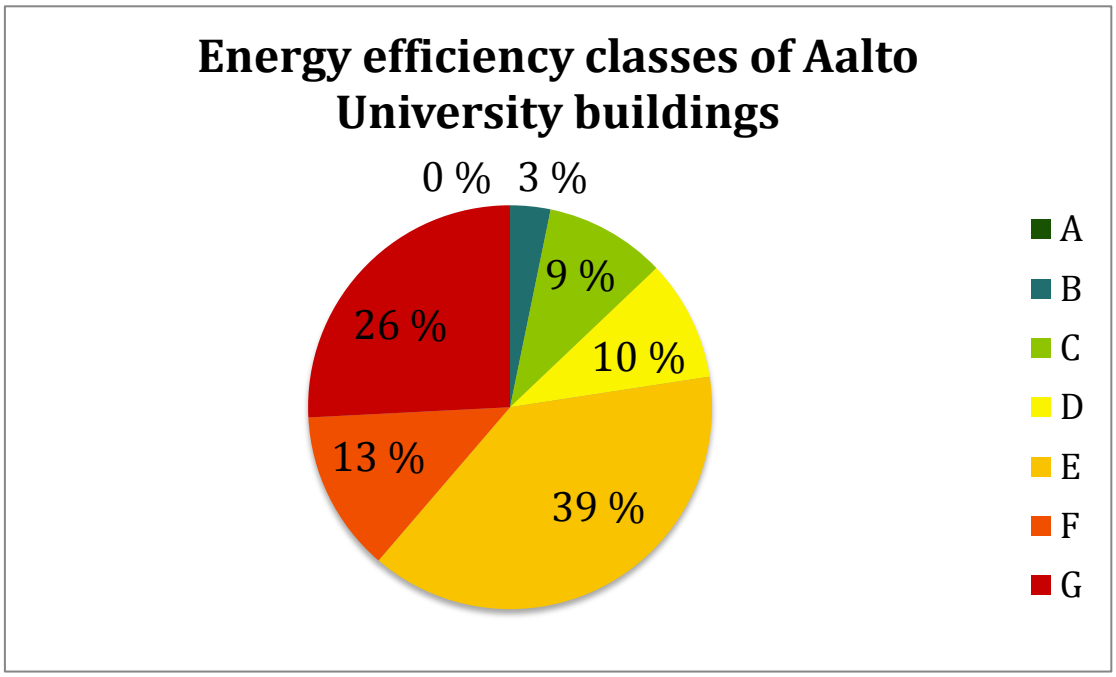


Figure 18 Energy Efficiency classes of Aalto University Buildings (Aalto-Yliopistokiinteistöt, 2011)

5.5.4 Strategic evaluation

The strategy of Aalto University's real estate is stated in the campus vision, which is utilized to benchmark the strategic viewpoint. The aim is to fulfil the vision in 2020. According to the campus vision, four main elements of a successful campus are: "Our students, our faculties and staff, our community and our economy and environment". It is remarkable that only a fourth of the elements refers to the concrete elements being the economy and environment and the three remaining fourths refer to people, whereas den Heijer's framework, for example, emphasizes the concrete elements by three fourths and only one fourth focuses on the people.

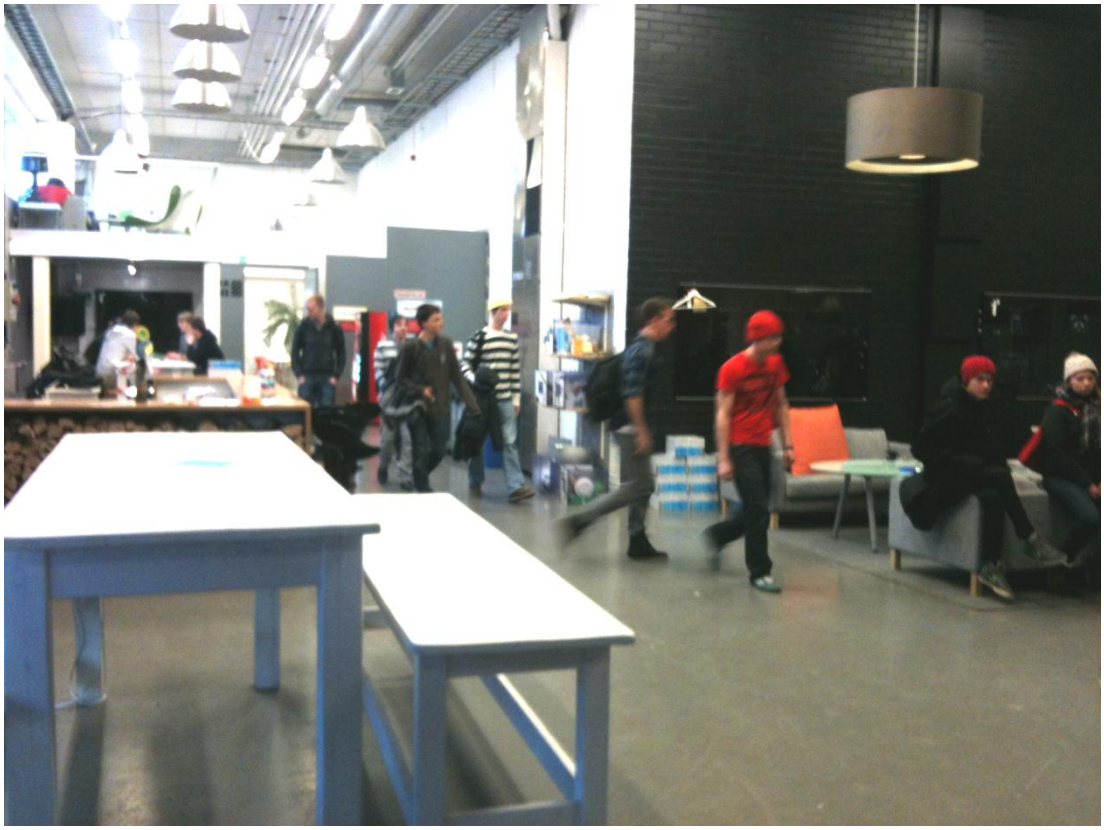
As I understand it, Aalto's campus vision states the campus to be a mirror of Aalto's people. In that sense the vision is very human-centric and people involving, even co-creational. The campus vision also states specific advantages that the campus solution must provide to each element mentioned. For students, the future solution must enable 'a multidisciplinary learning environment' and 'freedom of choice'. For the faculties and staff, it must provide 'the best setting for transcending traditional boundaries in research and art'. For the Aalto community, the campus must enable 'rich connections supporting open innovation and social interaction'. Economically, it must make 'efficient use of limited resources and [a] lower environmental impact' (Aalto University 2011b).

According to the campus vision, put into the frame of den Heijer, the facilities are to be developed from plain and efficient more towards the idea of informal, collaborative meeting places and representative facilities.

5.6 Case Example: Aalto Design Factory

At the time of this study, there is a big hype going on around the Factories of Aalto University. Today, there are officially three of them (Service Factory, Media Factory and Design Factory) but more and more interest is arising all the time in creating factory-minded facilities for a variety of other purposes (Ekman 2010). In this case study the idea behind the Factory way of working is introduced and the short history behind it. Also a short analysis about their importance is provided. The aim of this section is to find answers to:

1. What are the Factories?
2. Why are they highlighted?
3. Is there substance to them?
4. Is the ideology of the Factories the umbrella brand under which Aalto could be built?



Picture 2 Aalto Design Factory's ever-changing lobby (Rytkönen 2011)

5.6.1 Inspired by Design Factory

To understand the fundamental idea behind the Factories, let us first take a look at the first and original factory – Design Factory.

Table 20 ADF fact box

Question	Answer
What is it?	”an experimental co-creation platform for education, research and application of product design – where ’design’ has a broad meaning” (Ekman, Design Factory - Annual Report 2009-2010, 2010, p. 3/42)
What is its mission?	”Design Factory aims to develop a passion-based student-centric learning culture for Aalto University.” (Aalto Design Factory, 2010)
How much space is there?	3926 sqm GFA (Aalto Facility Services, 2011b)
What kind of space is it?	non-sterile, flexible, ever-changing and interactive

Aalto Design Factory, for me, is the first showcase of the physical environment of Aalto University in practice. It has spread the idea of Factory-based spaces around Aalto and the world, leading to the creation of Aalto Venture Garage, Aalto Service Factory, Aalto Media Factory, Tongji Design Factory inspired by Aalto and Swinburne Design Factory inspired by Aalto (Aalto Design Factory 2010). An in-house example of Design Factory inspired spaces can be observed in the Konetekniikka 1 building where students took over an unutilized corridor to develop it into a new studying environment. As a showcase of the Factory mentality, the first step was taken by the students to renovate an unutilized corridor. The initiative was taken from the bottom up, not forced by the administration from the top down. The space was designed to facilitate the identified characteristics of the Design Factory ways of working. There is also a budget in Aalto University for especially these kinds of projects but only a bunch of people seem to know about it.

Table 21 DF ways of working (Aalto Students, 2012 inspired by Björklund et al., 2011)

Design Factory ways of working
Attract people with helpful and proactive attitudes
Be proactive, take initiative
Ensure open knowledge sharing
Provide a physical home base
Inspire by example

At the time of the Shanghai world exhibition, setting up Tongji DF was boosted by a project called Aalto On Tracks, where 82 Aalto people took a private train across Siberia doing workshops, lectures and case study exercises, creating Aalto spirit. As one of the organizers, Heikki Sjöman, describes it: ”The train was like Design Factory on tracks” (Sjöman 2010). A similar kind of project called Aalto On Waves was conducted in November 2011 when a bunch of Aalto people took a private ferry from Finland to Sao Paolo. The idea was very similar to Aalto on Tracks but it took place on the other side of the globe. As a small side project of AOW, it was planned that an ad hoc DF space would be set up in Sao Paolo. Meanwhile in Australia, another Design Factory inspired space was launched in Swinburne University of Technology, Melbourne (Aalto Design Factory 2011).

Looking at the snowball effect that Design Factory, shortly Factory or DF, as a phenomenon has created, there is definitely something fundamentally unique and interesting about it. The amount of buzz, hype and the positive image for Aalto University is unquestionable. But it also raises many questions, such as: What is it all about? How did it all begin? Where did the idea come from? How was it created? How do the spaces function? Is there a pattern to be copied? Is it the spirit the spaces create that makes it so revolutionary? Is this the only kind of academic space we need? Does DF create any value? Do people learn better or do better research there than in ’normal’ spaces? Is it just beautiful words with no substance? Or a revolutionary manifest of a new kind of learning experience in academic circumstances? Or is it all about enjoying learning, work, research, studies and life - not taking everything so seriously?

5.6.2 Short history of Aalto DF

Design Factory’s roots go back to an interdisciplinary research and development project called the Future Lab of Product Design (FLPD) which was conducted in order to develop a better educational facility for the needs of product design to accommodate studying, researching, teaching, learning and interaction between the different stakeholders. The overall aim was to develop a platform which would one day ”educate the world’s best product designer’s [sic]” (Björklund et al. 2011, p. 2).

At first, the FLPD team consisting of roughly ten people, students and professors with different academic backgrounds, prototyped different kinds of spatial solutions and patterns for the varying needs of different phases of a design process on a small scale in the Laboratory of Machine Design. When they saw potential in the most suitable solutions, they started to search for a bigger, unreserved space in order to set up a bigger transformation of the prototypes (Björklund et al. 2011). They heard that there was an empty former wood laboratory building of VTT at the Otaniemi campus. They took over the place and started customizing the building one space at a time and the customizing has been going on ever since. Accordingly, the chief of

Spatial Design in DF actually advices in creating better working environments to ”just do it, apologize later” (Aalto Design Factory 2011).

Of course, in the beginning there is always resistance. When the team started altering the spaces, people were asking: ”What are they doing? Are they out of their minds? This is just another weirdo experiment, right?!” But today, all the visitors of Aalto University are brought to see the Factory. It surely is a phenomenon worth showing. Something uncertain in the beginning became something unique, interesting and worth showing after giving it a chance.

5.6.3 Where is the substance?

Design Factory seems like a physical, tangible showroom reflecting the idea of a different way of working and spirit. At the same time, it is a showroom of what is done in Aalto, a stage for seminars and conferences, a place where to arrange parties, a platform for testing products and spatial designs, a research centre, a wood workshop, a team working hub, a movie theatre, a restaurant for breakfasts, a cafeteria, a bar, a start-up hub, a lecture hall and many others. It has spread the ideology of multi-disciplinarity and a different, non-hierachical mind-set around the world and inside Aalto. But how does it show in numbers from the benchmarking aspect? Where are the results? Are the spaces used efficiently? How much innovation is happening there? Can it really be measured? Is it worthwhile financing these kinds of factories with altogether 3,5 million € annually as in 2010? (Aalto University Board 2010)

Picture 3 ADF Stage. A customizable multi-purpose hall (Rytkönen 2011).

5.6.4 Design Factory evaluated

How does ADF look like in terms of numbers?

Table 22 Aalto Design Factory areas (Aalto Facility Services, 2011a)

Aalto Design Factory	number
NUA sqm	1764
NIA sqm	2284,4
GIA sqm	2799,6
GFA sqm	3926,4
NUA/GFA %	45
NIA/GFA %	58

Aalto Design Factory is physically less efficient on the average when looking at NUA/GFA being 45% as compared to 59% in the whole Aalto University. On the other hand, as all the corridors and hallways are utilized in Design Factory, the NIA/GFA of DF is just one per cent behind the NUA/GFA of Aalto in efficiency. So based on these numbers, there seems to be nothing special about Design Factory as a space. Another interesting thing about the numbers as such is that some references define it to have 3200 sqm of space on one page and 4000 sqm on a different page (Björklund et al 2011). According to the facility services, Design Factory pays rent for 4345,6 sqm (net floor area). The reality seems to be somewhere between 3000 and 4500 sqm. That is another reason why looking at the numbers does not tell the whole truth– the spaces must be looked at from a wider perspective in terms of space use. However, these are problematic factors from the management and decision-making point of view – an extraordinary space looks like just another unefficiently utilized space amongst the others.

As Design Factory is basically an open platform for product development, the exact numbers, headcounts and space categories are hard to define. The functional aspect cannot therefore be applied in Design Factory's case. All the people in Aalto can apply for a tag to get inside the spaces 24/7 but the students participating in the courses organized in DF are prioritized. The premises are behind locks for security reasons. Usually there are also people present to let other people in (Björklund et al. 2011).

It seems that the Design Factory mindset is spread through all the possible channels - the academic year in numbers presented in the DF annual report 2009-2010 includes the following measures:

Table 23 Design Factory in numbers (Aalto Design Factory, 2010)

General Figures		Meals & Memories are made here	
Number of visitors	9 000	Cups of coffee consumed	12 234
Weekly average traffic at main entrance	1 700	Plastic bottles returned per year	3 600
Tours given around premises	303	Breakfasts at DFfany's	32
Languages spoken at Design Factory	33	Working years spent having breakfasts at DFfany's	0,8
Number of different nationalities at Design Factory	42	Ideas produced having breakfasts at DFfany's	252
Number of times the word 'design' is uttered daily	468		
Working like crazy		**Together we can**	
Post-it notes used	18 251	Average number of times a person laughs per working day	13
Hours spent using a CNC turning lathe	350	Hours spent in backyard pool parties	68
Hours spent using a CNC milling machine	1 150	Hugs given and received	65 734
Hours spent using manual hand tools	infinite		

Instead of differentiating the headcounts of each and every group using the premises or the efficiency of space use, a more general, human and humorous view about the year is also provided in the annual report. This might be one of the main substance creators of DF – it is not the space itself but the actions taken, the ideology spread and the atmosphere created that support the idea behind the institution and make it an interesting and unique facility where people feel valuable. Artificial hierarchy barriers are cut down and people are welcome as they are.

How does Design Factory look in terms of the functional space categorisation based on the division applied in this study? First of all, it is very difficult to keep track of the spaces of DF as they are constantly changing. Everybody is welcome to alter the spaces whenever he/she finds something to repair or improve. The lobbies and hallways are also designed to facilitate learning. The data presented in Figure 18 has

been gathered by the Aalto Facility Services at some point in time and may have not been updated on the database afterwards. The spaces might be totally different now than the numbers indicate.

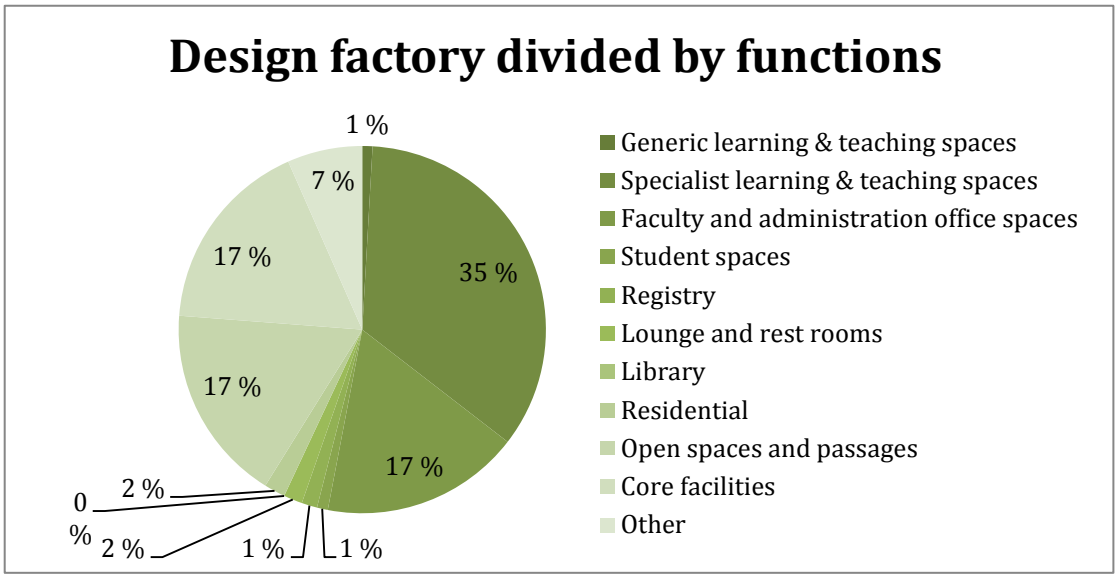


Figure 19 Design Factory categorized (Aalto Facility Services, 2011a)

According to the database, educational spaces cover 36 % of the whole spatial mass, which is two per cent units fewer than in the School University of Art and Design. Specialist learning and teaching spaces cover the majority of the educational spaces, but then again, what is a specialist learning and teaching space? Offices cover 17 % of the spaces, which is six per cent units fewer than on average in Aalto University, library spaces do not exist in DF, and other spaces are roughly divided as general premises in Aalto University. So in short, based on these numbers without knowing the context of Design Factory, it would seem like a typical Aalto building with no library. On the other hand, are the numbers indicated here at all relevant? Does the categorisation match the spaces and their real use? Is it worthwhile to categorize the spaces from the usability point of view or is it just a tool to define rents in the administrative wing more specifically based on the value of different classrooms, their technology, etc.?

There are problems in proving the efficiency and substance of DF numerically or measurably because many things have been proven to work in practice but a theoretical framework and patterns are not easily identified to support the reality. In the academia, it is usually the opposite, so the setting is quite interesting (Ekman 2010).

Financially, in the space resource database, Design Factory is allocated under T2, The School of Engineering. It is true that the initiators come from T2 but now that it

is in use for the whole Aalto community, is it not a bit confusing that one school of the six pays for the rent? Does not this kind of system limit the idea of interdisciplinarity on the mental level? At least it does not enhance the idea of creating a community across the organization. Even though the physical barriers are cut down, the mindset of the space being paid by one unit seems weird. Of course, the University is the one to finance the space renovation and alteration projects but would it not be wiser to allocate the rents of these spaces to facility services, common use facilities or the University as a whole? Or is this done due to the fact that giving money through the school that has been the initiator takes down the levels of bureaucracy in altering the spaces? Never mind the reason, as an objective viewer the setting is a bit confusing.

According to the Aalto Facility Services space resource database (attachment 7), the annual rent paid by unit T210 Design Factory is 650 500 €. Other annual costs equal to about 201 000 € annually. Accordingly, the total amount of money spent per annum equals to roughly 852 000 €. Per square metre this means, based on 4345 sqm, an average of about 16,3 € / sqm / month. To compare on the whole Aalto University level, the average is 17,7 € according to the same listing. This means that cost-effectively Design Factory is cheaper than on average in Aalto University. The listings can be found in Appendix 6.

Strategically, according to the campus vision and reflected through this analysis, Design Factory seems to be in the core of Aalto University. According to the vision, it can be seen as a mirror unit of the ideological Aalto campus. Going back to the campus strategy of Aalto, Design Factory represents all of the corner stones mentioned.

Picture 4 ADF Brainstorming group work space. Results through passion and having fun (Rytkönen 2011).

Firstly, the whole space is a manifest of ’multidisciplinarity’, which is reflected through the courses arranged, the actions taken and the premises designed. ’Freedom of choice’ is answered by allowing anyone to do what one wants around the clock. Secondly, there basically is not just a single faculty operating in Design Factory, but it already fulfils the second aim of ’the best setting for transcending traditional boundaries in research and art’. Thirdly, there is even a bar the functionality of which is based on a ’social tender’ hired and start-up companies located to enable the ’rich connections supporting open innovation and social interaction’. Fourthly, the whole place has been made from an old factory by the people inside the community and partly on a voluntary basis, which makes ’efficient use of limited resources and [has a] lower environmental impact’.

About the efficiency in the traditional sense, there is no approval, but thinking about the amount of different sorts of happenings arranged at the Factory, the brand value DF has already created and the different shareholders working in the community, it must be effective from the aspects of productivity, flexibility and motivation. People feel good inside DF. However, even more than effectiveness, I would highlight the passion that can be sensed in DF compared to any other educational building I have been to. And passion is a value in itself contributing to the motivation and productivity of people working, educating, researching and studying – thus supporting the core competencies of Aalto University. Furthermore, in the future, it

is increasingly passion that is the driver behind people's actions (Albers 2010). Passion is a factor impossible to measure, but as a force, it drives people more than anything else no matter what they are doing. This is a fundamental idea behind the factories and as an ideology, it is concretely supported by the fast-growing interest in applying the Design Factory patterns and concept around the campus and the world, both by educating people in-house and letting them spread the mindset and by developing concrete micro-environments inspired by DF (Björklund et al. 2011).

5.7 Conclusions from the evaluation of Aalto's space resources

To conclude, the internal physical space resources of Aalto University sum up to almost 440 000 sqm GFA, about 256 000 of which are in the net usable area. These are divided for the six schools quite equally, the School of Engineering being the biggest with approximately 33 000 sqm NUA, and the School of Chemical Engineering being the smallest with approximately 21 000 sqm NUA.

Functionally, on the Aalto level, there is about 6 sqm educational space per student and 23 sqm office space per employee. On the other hand, the space reserved per student varies from 1,6 sqm in the School of Economics to 7,4 sqm in the School of Art and Design. Office spaces per employee vary from about 20 sqm in the School of Art and Design to 24 sqm in the Schools of Technology. These variations can be explained to derive from the different needs of specific areas of expertise, their ways of working and their spatial needs. 18 % of the total area in Aalto University consists of open spaces and passages, which indicates that those spaces should be utilized for something, effectively leading to efficiency – they must not be seen as 'unusable' space, usually only considered as empty circulation spaces. A closer look to offices and lecture halls gives the impression of the spatial design being a bit out-of-date. Only 1 % of the office spaces are designed to enhance communicating and group work, whereas 75% are made for working alone. The lecture hall numbers imply that there are mostly large and medium lecture halls, which sounds reasonable. On the other hand, by designing more flexible structures in the spaces, they would be more suitable to facilitate varying sizes of lectures.

64 million euros were spent in facilities in 2010 and a massive renovation project of the main building is going on at the time of this study. It is estimated that the renovation project of the Otaniemi campus will cost altogether approximately 210 million €.

Strategically, the spaces today do not match the campus vision. A lot must be done in order to develop and update the spaces to the 21st century and to meet the needs of the interdisciplinary way of working in an Innovation University. Regarding the future needs and Aalto's campus vision, Design Factory seems to be a space closest to the core of the strategy.

Factories as a case study give rise to the question of whether or not the frameworks and benchmarking methods existing today give relevant information to support the real estate decisions. In Design Factory, we have seen that trusting in people and giving them the freedom of doing what they want and what they are passionate about creates a far bigger scale impact than dictating the truth from the administrative ivory tower. Everything starts from the people of a community creating common rules and a united culture which can then be implemented in a physical space. But the physical space does not work by itself, there must also be the people inside to janitor the space. Without any of that, buildings are just empty walls, ceilings and floors. Giving the people the possibility to create something of their own for the community binds them to a bigger entity.

Based on the traditional benchmarking methods or CMFW, it is very difficult to create a relevant understanding or a profile for people-driven multi-working environments such as the Factories. According to some studies (Dugdale 2009; Long & Ehrmann 2005)), this is the direction where learning spaces are developed to now and increasingly in the future. If the campus profile is made based on the traditional measures, it might not tell the real substance and value of these kinds of multiuse spaces. Therefore, new benchmarking methods should be created for the needs of this spatial design trend.

It seems that it is not all about the money and the square metres, people and strategies as such but also about the whole spectrum of the learning landscape and the relations in between (Dugdale 2009). Increasingly, in this time of great mobility, people want the spaces they work in to have meanings and reflection, atmosphere and attitude, something to experience in the spaces (Santamäki 2011). Otherwise they might not be willing to come to work because they can work from anywhere they want to and that is a huge challenge, but also a great opportunity for the space planners. The development seems to be going from a strict efficiency mindset to a more meaningful ideology where effectiveness counts. The spaces we work and live in will need to increasingly support not only the work we are doing but also the identity and the characteristics of the workplace – the spaces will have to have meanings.

6 Evaluation of campus trends and international cases

This section is about finding the best benchmarks in the university world and comparing their best parts with Aalto University. The biggest questions of this section are: ”What are the big trends in the field today? Which universities represent those trends? What are the most valid benchmarks in Aalto University’s case?” Answering these questions creates an overview of Aalto’s position in comparison to its competitors in the field.

In benchmarking, one of the biggest challenges is to find the relevant benchmarks to be compared. In the university world, for example, it might be actually more interesting to look into other spaces, say in the corporate world, and see how they could be applied to the university context. So benchmarking is not necessarily always about exactly the same products or facilities. It might be of bigger value to get inspiration from completely other contexts.

In this thesis, the aim is to create relevant space use scenarios for the future, and as the strategy is written in the campus vision, there are already some main aims for the campus. The process of international benchmarking goes as follows: first, the standard level of physical and functional factors is mapped according to the TEFMA space planning guidelines. Second, the biggest trends in the field are mapped based on the Aalto University Campus Vision. Third, one benchmark is pointed in each of the trend categories in order to compare Aalto with them. Fourth, through analysing the differences, a basis for the development plan is created to fulfil the campus vision.

6.1 Physical and functional standards

According to the TEFMA standards, academic spaces should cover roughly 46,8 % of the total spaces. Library spaces should cover 8,5 % and student and staff services 5,9%. Functionally, natural and physical sciences as well as architecture are stated to need the most space – 8 sqm UFA/EFTSL, whereas creative arts need about 6, information technology about 4,5, engineering about 6,7 and management and commerce about 1,3 sqm UFA/EFTSL. So the average need per student in the Schools of Technology would be about 6,8. taken from the average of the discipline specific measures of the four schools.

6.2 Trends of cutting edge campus design

In this chapter, the trends of campus design are identified. In the campus vision, February 2011, five big trends were highlighted in cutting edge campus design:

• The Campus of Values: the campus reflects and supports the values of the university

• The Open Campus: the campus engages multiple users and breaks down barriers

• The Commercial Campus: the campus is well managed as an asset and cost centre

• The Sustainable Campus: the campus exists in harmony with nature and enables renewal

• "Off-Campus": the campus is both a physical and virtual environment

(Aalto University 2011a)

These trends are explained in more detail in the following.

6.2.1 The campus of values (strategic)

The University wants to show its values by symbolic buildings and activities taken inside the campus area (Aalto University 2011a). In Aalto University's case, this would practically mean, for example, developing shared open spaces across all the units in order to facilitate interdisciplinary collaboration and interactive working. It would also be a sustainable and economically efficient means of contributing to the whole community (Harrison, A. and Cairns, A. 2008). A good example of an existing campus of values is the University of Manchester (Aalto University 2011a).

6.2.2 The open campus (functional)

This ideology provides space for different organizations also outside of the university itself: the campus is not only seen as a privileged university space from 8 until 4 o'clock but also as an urban, buzzing 24/7 environment possibly including other universities, corporate organizations and social actors and openly inviting people from the outside to its world. This kind of campus should serve more than one purpose and be a manifest of sharing and collaboration. Aalto University's values are stated as "high ethics, openness and equality" and "passion to explore", which are very valid aspects in the development of the future campus. The aim is to create a real campus village, not isolated from the real world but being a strong driver as part of it.Good examples of places where this kind of action have been taken are Dubai's knowledge village and University of Eindhoven (Aalto University 2011a).

6.2.3 The commercial campus (financial)

On average, facilities account for 20% of a university's operational costs (AAPPA 1998). Realizing this, universities now tend to see facilities as assets generating income to the university. In order to show the value of facilities, universities tend to rent space to departments to make the use of space more efficient. Still, the space management of universities is usually very inefficient, with the labs occupancy rate at 8% and that of offices at 25% (DEGW presentation at Aalto 2010). As universities compete for the best people globally, it has also been noticed that the facilities and their attractiveness plays a big role in attracting the best people (Schmitt 2007). The brand and identity can also be spread by investing in an efficient communication

system, both virtual and physical, in order to bring the global academia inside the campus and vice versa. The campus definitely also has commercial value when competing in an ever-intensifying field. A good example of a commercial campus project is Vienna University of Economics and Business (Aalto University 2011a).

This is a very valid point of view when reaching to Aalto University's vision of being an internationally recognized institution where the best connect and succeed (Aalto University 2011b).

6.2.4 The sustainable campus (physical and functional)

The ideology of a sustainable campus consists of two major factors: the campus should be environmentally friendly but also able to renew itself. Environmentally friendly materials now, for example, may not be considered as sustainable in ten years anymore. It is not only the materials and energy efficiency of the buildings that count, however, but also the possibility of flexible working hours, car-sharing schemes and cycle parks that contribute to lowering energy consumption. When it comes to the aspect of renewal, it is wise to create flexible and affordable spaces because universities are made to last for centuries but research and education is under constant renovation. A very good example of an energy efficient campus is the Masdar Institute of Science and Technology, and a good example of a renewable space is Aalto Design factory (Aalto University 2011a).

6.2.5 Off-campus (physical and virtual)

According to den Heijer (2011, p. 68), "…[a] 'third generation university' (termby Wissema, 2005) is a valorization-oriented network University with both physical and virtual spaces to exchange knowledge and increasingly an open market place with various partners." Even though den Heijer says 'both physical and virtual', even more radical actions have been taken. The first campus-free, totally on-line university, the University of the People has been launched with support from the United Nations (Aalto University 2011a). A big trend in campus and university development, as in other real estate areas, is virtuality taking over. Virtual universities and different virtual platforms and tools contributing to the physical environment and vice versa are constantly developed. There are, for example, 450 accredited online business degree programs, a quarter of which are MBA degrees recognized by AACSB (AACSB's website and Geteducated.com cited in Training Magazine May 2003). Also many completely virtual universities have been established, such as the Virtual Global University, University of Phoenix, Intercultural Open University, the Open University of Catalonia and Shiraz University to name a few. An example utilized in this study is the University of Nottingham (Aalto University 2011a).

6.2.6 From trends to action – defining the benchmark cases

All the trends mentioned can be linked to the four aspects highlighted by Den Heijer: the campus of values is a manifest of the strategic viewpoint, whereas the open campus takes a functional aspect. The commercial campus is strictly a financial based trend, and the sustainable and off-campus concepts draw on the physical, functional and virtual viewpoints. Because Aalto University is not aiming to be a world-class university where business, technology and arts meet but a world-class university regardless of the field, it is not so relevant to compare it only with strictly similar universities but also with different ones. Therefore, an example of each campus design trend is analysed according to the Aalto campus vision as follows:

Table 24 Campus trends and example universities

Trends	University	Aspect
Campus of values	The University of Manchester	Strategic
Open Campus	University of Eindhoven	Physical and Functional
Commercial campus	Vienna University of Economics and Business	Financial
Sustainable campus	Masdar Institute of Science and Technology	Physical and functional
Off-campus	the University of Nottingham	Physical, virtual and functional

After looking into these examples highlighting the specific aspect of each university, they are compared with Aalto in order to create an understanding of which actions should be taken to create a campus of the future.

6.3 The University of Manchester

In this study, the University of Manchester represents the Campus of Values and the strategic aspect is emphasized in benchmarking its facilities.

6.3.1 The UM in a nutshell

The University of Manchester was established in 2004 but its roots go all the way to 1824. Its two ancestors, Manchester Mechanics Institute (founded in 1824) and the Victoria University of Manchester (founded as Owens college in 1851) had already co-operated for a 100 years before they united their forces. It nowadays consists of four faculties which are divided into altogether 22 schools. The faculties represented are: Faculty of Engineering and Physical Sciences, Faculty of humanities, Faculty of Medical and Human Sciences and Faculty of Life Sciences (The University of Manchester 2011).

The university's mission is to make the University of Manchester one of the top 25 universities in the world by 2015 with the primary goals of research, higher learning and social responsibility, the enabling goals being quality people, a reputation of excellence, quality management, world-class infrastructure, environmental sustainability and internationally competitive funding. In 2010, the Jiao Tong University Academic Ranking of World Universities ranked them as 44th in the world, 9th in Europe and 5th in the UK (The University of Manchester 2011). In the QS World University Ranking, the UM was ranked as 29th (QS World University Rankings 2011).

6.3.2 The UM Campus

The University of Manchester is a very good example of a campus of values. It reflects its vision and strategy symbolically in the informative physical environment of its campus and makes a great contribution to the life of the city by inviting people inside and opening the campus to the public (Aalto University 2011a). It is also claimed that it has become "both a symbol and creator of a revitalized, knowledge driven and internationally ambitious city" (Aalto University 2011a). They involve students in designing the campus, which is a major thing in committing people in the community – a very relevant thing for Aalto University regarding its campus vision (Aalto University 2011b).

According to the Agenda 2015, which is the vision of the University of Manchester until the year 2015, their vision is stated to be distinguished by the strong emphasis on engaging the wider society across the full range of activities (The University of Manchester 2011). This actually relates to the core of the other trend of an open campus.

The university's real estate portfolio consists of 347 buildings. Funding plans worth 650 million pounds for state-of-the-art buildings by the year 2015 also represent its values of respecting the old but not being afraid of the new – their aim is to sustainably develop the premises and upgrade them to the needs of today. At the same time, as they are constructing a lot of new, they are also developing and maintaining their cultural assets, including the Manchester Museum, the Whitworth Art Gallery, the Jodrell Bank Observatory and the John Rylands Library to name a few (the University of Manchester 2011).

There are about 39 000 students and more than 11 000 employees at the University of Manchester (The University of Manchester 2011).

The majority of the University's income consists of tuition fees and educational contracts (228 million pounds), the total sum being 788 million pounds. Funding council grants are the second biggest income resource (209 million pounds) and

research grants and contracts third with 195 million pounds. In addition, other operating income brings 145 million pounds in the cashier and investments 11 million pounds (The University of Manchester 2011).

6.4 Eindhoven University of Technology

In this study, the Eindhoven University of Technology, briefly TU/e, represents the Open Campus, and the functional aspect is emphasized in benchmarking its facilities.

6.4.1 TU/e in a nutshell

The university was officially opened in 1957. In their strategy, they highlight the knowledge valorization through an entrepreneurial spirit and co-operation with the corporate partners: ”Space has been allocated on campus for new young entrepreneurs” and they aim to be a global leader in ”scientific output produced in co-operation with industry”. Other relevant components differentiating them is that they aim nationally at a leading role in student facilities, not only concerning the purely educational infrastructure but also the sports premises (Eindhoven University Of Technology 2011a). According to den Heijer, it is the main driving force ”behind the region’s internationally oriented knowledge economy” (den Heijer 2011). TU/e was ranked as 146th in the 2011 World University ranking, engineering & IT being 61st and natural sciences 177th (QS World University Rankings 2011).

6.4.2 The TU/e Campus

Green values are highlighted at the campus: it is located near a railway station and it is referred to as the green oasis in the heart of Eindhoven, as its heat-cold storage system saves energy consumption of more than 850 households (Eindhoven University Of Technology 2011a). A new master plan for the campus is being unfolded regarding the Campus2020 project with the aim of emphasizing a more open, contemporary, compact and green campus (den Heijer 2011).

Physically, the campus of Eindhoven University of Technology consists of 337 000 sqm (GFA) and 256 000 sqm (UFA), resulting in 67 % UFA/GFA.

Table 25 TU/e physical and functional measures

Measure	Sqm
GFA	337 000
UFA	256 000
GFA/UFA	67 %
Office spaces	36 %

Specific educational spaces	24 %
Generic educational spaces	16 %

There were 5000 Bachelor's level students and 8900 students in total in 2011. The same year, the amount of employees was 3200.

Table 26 Tu/e head counts (Eindhoven University of Technology, 2011a & b)

Eindhoven University of Technology	Headcount
BSc students	4800
Technological Designers	200
MSc students	2800
Doctoral candidates	1100
Academic staff	2000
Employees	3200

The physical and functional measures allocated per user in numbers are presented in Table 23.

Table 27 TU/e spaces divided by functions per user (den Heijer, 2011)

Eindhoven University of Technology	Office space / employee	Office space / FTE	Educational space / student	Lab space / academic employee
Sqm UFA	28,7	31,6	5,1	10,0

6.4.3 Case: Brainport Eindhoven

As a case study under the Eindhoven University of Technology is used the triangle shaped Brainport area in Eindhoven, consisting of the Eindhoven University of Technology, High Tech Campus and Strijp S. The area refers to itself as "the world's smartest region". The two other hearts of the Brainport area support TU/e by providing a remarkable collaboration network for the academia.

Strijp S used to be the industrial region where Philips grew to become the household brand it is today. In 1990's the site was left empty because of Philips transferring the

production to other locations and moving the headquarters to new facilities in the High Tech Center on the other side of the city. The empty buildings were saved from demolishment and redeveloped into offices and dwellings. A master plan for building new buildings in the region was made and the biggest urban development project in the Netherlands took its first steps with the overall goal of transforming the Strijp S into a ”creative city”, a pioneer in technology and a design innovation centre (De Volkskrant 2010).

Nowadays, there are many young entrepreneurs and a lot of cultural assets and facilities around the area, including the PopEi music institute and a skate park. In addition, redevelopment projects for the Plaza Futura theatre and cultural centre and a side unit for Van Abbemuseum have been initiated. Urban culture is flourishing in the region and, with respect to the cultural heritage assets, new structures and buildings are being developed. Philips is contributing to the massive project by designing a variety of new lighting solutions for the region.

HTC Eindhoven is an open innovation platform where researchers, developers and entrepreneurs co-operate in new product development (High Tech Campus Eindhoven 2011a). The facilities of more than 480 000 sqm consist of: 10,000 m2 social services, 45,000 m2 R&D facilities including labs and clean rooms, 150,000 m2 additional (re)development space, 6,000 m2 reserved for start-up companies (Bèta) and 185,000 m2 office space (High Tech Campus Eindhoven 2011c).

There are altogether 90 companies, 6000 residents and 50 nationalities represented in the campus area. The initiator for the whole project was Philips, and ever since 2004, the campus has been open for other companies. They see themselves as a hotspot for human focused innovation, which is also reflected in the architecture of the buildings (High Tech Campus Eindhoven 2011b).

The whole campus is constructed around ”the Strip” housing shops, restaurants and a conference centre, and its purpose is to serve as a hub of working, interacting and socializing. Also the balance of work and life is emphasized and therefore the sports and childcare facilities are well taken care of. The High Tech Campus aims to attract talents and creative companies (High Tech Campus Eindhoven 2011b) - in addition to the first-class facilities, they provide a low-cost rent and top-edge management and services for the whole campus (High Tech Campus Eindhoven 2011a).

The business model of HTC is based on collaboration with more than 30 industrial companies and shared research methods – all the knowledge generated can be used by the companies. Not everything, though, is necessarily shared amongst the whole community, but the companies co-operating may decide which technologies they want to work together on and which ones they want to keep for themselves (Holland Trade News 2010). In the High Tech Campus, the main principle of sharing the facilities is highlighted. Basically, the infrastructure is provided for the companies,

and they themselves buy in whatever they need. This type of model has been noticed to be very cost-effective and it permits even start-ups and small R&D companies to be situated around the first-class facilities (High Tech Campus Eindhoven 2011a).

6.5 Vienna University of Economics and Business

In this study, the Vienna University of Economics and Business, briefly WU, represents the Commercial Campus with its massive new campus development project, and the financial aspect is emphasized in benchmarking the facilities.

6.5.1 WU in a nutshell

The WU is a university of 27,800 students and about a thousand employees. Its budget was 115 million € and the estate consisting of 6 buildings consisted of 137 000 sqm in 2010. Its massive campus project started in 2007 and once ready, it is supposed to provide the university with a totally new campus in 2013 when the university will move to brand new facilities (Vienna University of Economics and Business 2010). The social sciences of WU were ranked as 164th in the 2011 rankings but the overall ranking was not provided (QS World University Rankings 2011).

6.5.2 WU Campus project

The future campus is referred to as: ”Near the city center but in a green area, an innovative university concept shall be implemented on a modern university campus”(Campus WU 2011).

The campus has been developed as a holistic entity with the aim of creating ”an exciting environment for University life” (Campus WU 2011). It consists of six huge buildings connected to each other with paths, each designed by different architecture agencies, and each supporting a different main function from facilitating the everyday work of the departments through administration to being learning centres. The meeting points in each of the buildings are on the ground level and the outside facilities are along the paths with the purpose of facilitating informal meetings and functioning as a cross-section of the university and the public, teachers, students and researchers. The different functions are scattered around the the campus buildings with the emphasis on the core competence, the Library and Learning centre situated in the middle and other functions supporting it all around (Campus WU 2011).

Approximately 102,000 sqm of space (net floor area) in total will be constructed in the new campus on an area of 88,000 sqm, with a final built-up area of 35 000 sqm. There will be 53,000 sqm open space accessible to the public around the buildings (Campus WU 2011). Workplaces will be provided for 3,000 students. Information was not publicly available considering the financial perspective, other than that the investment will be approximately 250 million euros (WU 2010b). Even a new company was established for the construction and operation of the new Campus

(WU 2010a). On top of accommodating the normal functions of educating, researching and teaching, the campus will offer public facilities such as restaurants and service centres, bookshops, sports facilities and a kindergarten as well as bookable facilities for events of different kinds (Campus WU 2011).

6.6 Masdar Institute of Science and Technology

In this study, Masdar Institute of Technology, briefly MIST, represents the Sustainable Campus, and the physical and functional aspects are emphasized in benchmarking its facilities.

6.6.1 MIST in a nutshell

MIST is a fairly new institute, established in 2009. Nowadays there are only 170 students representing 32 different nationalities between the ages of 20 to 37. The seven Master's programs offered are traditional engineering and technology based programs. A valid corner stone of the University is research – a half of both students' and faculties' time is dedicated to research (Masdar Institute of Science and Technology 2011a).

According to the Institute's vision, they aim to be "a world-class, graduate-level institution, seamlessly integrating research and education to produce future world leaders and critical thinkers in advanced energy and sustainability" (Masdar Institute of Science and Technology 2011b). They see their mission to be educating the students to become innovators and ever evolving interdisciplinary, collaborative research and a development capability in advanced energy and sustainability research (Masdar Institute of Science and Technology 2011b). Masdar Institute of Technology is such a new school that it was not found in the rankings.

6.6.2 The MIST Campus

Physically, the campus is a manifest of sustainability, research and engineering knowledge and it certainly reflects the values of the Institute. The campus has been built "to consume 75 per cent less in cooling demand than a conventional building of its size, as well as 70 per cent less in potable water, 95 per cent less in domestic hot water energy and a 70 per cent less in electricity. The campus offers students a unique opportunity to experience what cutting-edge technology can do for the environment" (Masdar Institute of Science and Technology 2011c).

The technical systems in the buildings have been designed so that natural energy resources are utilized as efficiently as possible. A couple of examples follow. One of the buildings, called Windtower, has been designed to direct the cooling winds to a public square. The water consumption of the Masdar Institute building has been minimized by various inventions. Wastewater and waste management systems enhance reuse in their applicable forms. Fossil-powered vehicles are there to take the user from one place to another. A third of the energy consumption of the buildings is

covered with the photovoltaic Roof Top, and another solar plant constructed by the Institute is the largest grid-connected solar plant in the Middle East. Also linking the Institute to its immediate environment with native plant species and appropriate design considering the regional landscape have been emphasized.(Masdar Institute of Science and Technology 2011a).

6.7 The University of Nottingham

In this study, the side campuses of the University of Nottingham represent the Off-campus idea, and the physical, virtual and functional aspects are emphasized in benchmarking the facilities. More specifically, the University of Nottingham's subcampuses in China and Malaysia represent the ideology behind the Off-campus trend.

6.7.1 The University of Nottingham in a nutshell

The University of Notthingham consists of five faculties: Arts, Engineering, Medicine and Health Sciences, Science and Social Sciences (University of Nottingham 2011). It was ranked as 74th in the World University ranking in 2011 (QS World University Rankings 2011).

The University's mission differentiates four main tasks: "providing a truly international education", "inspiring the students", "producing world-leading research" and "benefiting the communities in all the campuses". The main purpose is stated to be improving life for individuals and societies worldwide,

Their vision outlines three main aspects in being attractive to the stakeholders: "students who want a top quality, international education, researchers who want the best opportunity to make a significant global impact and business[es] that want innovative partners who give them an edge on their competition" (University of Nottingham 2010). They aim to be recognised globally for their "contributions especially in global food security, energy and sustainability and health" (University of Nottingham 2010).

6.7.2 International campuses of the University of Nottingham

In the strategic plan for 2010-2015 of the University of Nottingham, it is stated that the decision of investing in other countries has created a unique platform for the internationalisation of the university education through which the staff and students are helped in positioning themselves for success within the global employment market. The discussion and constant interaction between the three different cultures enhance true collaboration across boundaries and increases the human capital and the ability to cope with truly international cases, resulting in internationality beyond campuses in Asia. Also the amount of global commercial partners reached through the network based on hub-like campuses is bigger than in the traditional setting of one national campus. Through the international campuses, their purpose among

others is ”to provide a new model for an international university, to influence how scholarship, teaching, research and innovation are carried out” (University of Nottingham 2010).

The aims and objectives in the internationalisation are divided into four main ideas: ”Securing achievement in establishing the two campuses in Asia”, ” magnifying the international impact of the research and commercialisation activities”, ”expanding student and staff mobility” and ”developing and enhancing International teaching and research partnerships” (Nottingham University 2010). They are constantly aiming to increase the mobility and student numbers not only in the international campuses but also the other way around (Nottingham University 2010).

In the campuses, the sustainability is highlighted in the campus design and recycling activities (Nottingham University 2010). The setting is somewhat contradictory looking at it from the point of view of internationalisation – enhancing commuting and travelling is not too environmentally sustainable. On the other hand, that is when the sustainable campus design plays even a bigger role from the responsibility aspect.

It is interesting, though, that nothing special about the virtual infrastructure is mentioned in the sustainability part – it could play a significant role in arranging on-line-courses and decreasing the need of travelling back and forth between the campuses – synergies could be stronger. Virtuality is only mentioned in the aims of sustaining excellence: Rolling out an extensive enhancement of the university’s electronic infrastructure (Nottingham University 2010). Surprisingly, the educational perspective is not highlighted from the virtual point of view. The future campus projects include completing the master plans for campuses in Asia by 2012 and planning and delivering a building program in the UK Campus expansion as well.

7 Comparing internal and international evaluation results

In this section, Aalto University space resources are compared with the international benchmarks and the TEFMA planning guidelines. At the end, a vivid stereotypical character of each of the benchmarks is introduced in comparison to Aalto.

7.1 Physical, virtual and functional aspects

The current situation of Aalto University's use of space from the physical and functional perspectives seems to be not as efficient as advised by the TEFMA planning guideline standards. In the following table the differences between Aalto University's use of space and the guidelines of TEFMA are introduced. The terminology used in the University and in the TEFMA guidelines are slightly different as was discussed earlier in this study, but thinking about the result, they do facilitate a relevant enough comparison by the following specifications as discussed in the literature review:

Useful Floor Area (Huoneistoala) (Suomen Standardisoimislautakunta, SFS 5139, 1985) is used in comparison with the Dutch University TU/e and *Net Usable Area* (DEGW, 2009) in comparison with the TEFMA guidelines:

Table 28 Comparison of allocated spaces (Aalto Facility Services 2011a, TEFMA 2009, Aalto University Board 2010, EFTSL/unit estimated by dividing 13797 EFTSL Aalto University Board 2010, into units on the basis of 19516 students, Aalto-www 2011).

Educational spaces Discipline	Aalto University NUA/Student sqm	Aalto University NUA/ EFTSL (estimations) sqm	TEFMA space planning guidelines UFA/ EFTSL sqm
Arts	7,4	10,4	6
Technology	6,5	9,1	6,8
Business	1,6	2,3	1,3
Average based on the old schools	5,2	7,3	4,7
Average based on the six schools	5,8	8,2	5,8

Table 29 Comparison of the division of categories (Aalto Facility Services 2011a, TEFMA 2009)

Category space	Aalto University ave % of the total amount of spaces	TEFMA space planning guidelines ave % of the total space on campus
Academic space	52	46,8
Library space	3	8,5
Student and staff services	5	5,9

According to the TEFMA standards, Aalto has on average 2,4 sqm more educational space per student than universities on average and considering the space categorisations, the library spaces seem to be much smaller than the average. On the other hand, when looking at the number of students in relation to the amount of library spaces (not allocated based on EFTSL), the numbers are quite equal to the TEFMA guidelines. Otherwise, from the academic perspective, Aalto's spaces seem to be more or less the average according to TEFMA (2009). It is, however, difficult to say, as discussed in the literature review, what is efficient and what is not because of the development of technology, resulting in changes in working styles and methods. Numbers do not tell the total truth by themselves.

When it comes to the benchmarking cases, from the physical and functional perspective the most relevant comparable information could be found in Eindhoven University of Technology.

7.1.1 Eindhoven University of Technology – Aalto's physical twin

Twins tend to have the same abilities with a little variation in how the abilities are emphasized.

Table 30 Area comparison of TU/e and Aalto (Aalto Facility Services, 2011a; den Heijer, 2011)

Physical	Aalto University	TU/e
Gross floor area sqm	439 000	337 000
Useful floor area (huoneistoala) sqm	257 000	226 000
UsefulFloorArea/GFA %	59	67

From the physical perspective, Aalto's real estate mass is roughly 30 % bigger than that of TU/e's. According to these numbers, Aalto's spaces include about 8 % units less of 'useful' facilities than TU/e's, so it can be argued that Aalto's spatial layout is not as efficient as Eindhoven's. Once again, looking at it critically, savings can be made by improving efficiency, but should we really rely on the numbers only?

Table 31 Headcount and functionality comparison of Tu/e and Aalto (Aalto-www, 2011c; Eindhoven University of Technology, 2011a&b)

Functional	Aalto University	TU/e
Student head count	19516	8900
Staff headcount	4685	3200
Office space per employee sqm	23,3	28,7
Educational space per student sqm	5,6	5,1
Office space %	24	36
Generic educational space %	11	16
Specific educational space %	17	24

The most important point in this table is that in Eindhoven, there are 2,8 students per employee, whereas in Aalto the same number is 4,2. So there are 50% more students per employee in Aalto than in TU/e. There is 5 sqm more office space per employee in TU/e than in Aalto and half a square meter more educational space per student in Aalto than in TU/e. The office spaces cover 36 % in Eindhoven, whereas the equivalent is 24 % in Aalto University. Aalto has 52 % academic space, whereas the same number in Eindhoven is 76 %. So accordingly, there is a half more academic space in Eindhoven compared to Aalto, which is a fairly big difference. On the other hand, the categories of space included in the numbers compared might not be exactly the same. However, do these numbers signify quality or the efficiency of space? No, but they give a good start point to begin looking for the reasons why it is so and afterwards deepening the studies in quality issues.

TU/e belongs to the Brainport Eindhoven region which can be seen as similar to Aalto ideologically. Basically TU/e represents technology, Strijp S represents arts and High Tech Campus represents business. In the future Aalto campus, this could be done more efficiently as the New School will be moved to Otaniemi and Keilaniemi is going to be built even fuller of business parks. During the time of this study, Aalto is scattered roughly as widely as Brainport but the new campus could facilitate even closer collaboration.

7.1.2 Masdar Institute of Science and Technology – Aalto's functional sibling

Sibling is a person admired for what he/she represents in the eyes of a minor/major sibling. From the point of view of sustainability, the physical and functional design of MIST campus is a cutting-edge example. It has various sustainable solutions built in the campus, including, for example, a potable wastewater system, solar panels,

fossil fuel cars, a wind tower, etc., which manifest the knowledge and the core competence of the University. The reflection of the values and the core competence physically through the building operation system (BOS) design is a tangible, physical and functional showcase of what can be done with the research conducted in the university. What would be of better marketing value for any university? This is something that also Aalto could try to do. Reflecting the concrete applications that have emerged through the research in the campus and the learning spaces. This is already the case in Design Factory and that is why it is used as the showroom of Aalto for the visitors. But is one space enough? Does it reflect the myriad of Aalto's different sides? As Aalto university wants to be recognized for its innovativeness, the innovativeness could be shown and reflected in the learning landscape across all the departments.

7.1.3 University of Nottingham– Aalto's cosmopolitan friend

A cosmopolitan is familiar with and at ease in many different countries and cultures. Nottingham's most important physical, virtual and functional factor is the internationalisation through which it aims at global competitive advantage. It is a very well networked university through its two sub-campuses in Asia. Actually, Aalto is doing the same thing differently through spreading Design Factory –inspired spaces to Tongji in Shanghai and Melbourne in Australia. The virtual infrastructure was not emphasized in either of the campus strategies, which could be another infrastructural development factor that could give the University a competitive advantage in the global market.

7.2 Financial

7.2.1 Vienna University of Economics and Business– Aalto's financial 'American cousin'

An American cousin is a wealthy cousin who does everything big. Unlike MIST, WU cannot stand for sustainability. Moving 130 000 sqm to the other side of the city and building six new complex buildings consisting of 102 000 sqm designed by six different appreciated signature architect firms and a totally new campus to host learning is quite a massive load for the environment and costs a lot of money – it does not seem like efficient use of resources.

Then again, an investment of 250 million euros in new buildings is not that different compared to the Otaniemi renovation project estimated at 210 million euros. Adding to this the investment in the new building of the New School, the investment of WU is almost equal to Otaniemi's. On the other hand, in Otaniemi there are over 300 000 sqm to be renovated and WU only builds a 100 000 sqm. The idea in WU, however, of creating an identifiable landmark filled with services is remarkable and may also be seen as a reflection of the attitude of the Business School. They are building six landmarks each constructing the identity of WU. Whatever they do, they do it big.

Functionally, placing the meeting points on the ground level of each building, designing the paths from one building to another and the idea of facilitating commercial players at the campus and keeping the area open to the public are factors Aalto should consider including in its campus design. It is not only the formal learning landscape that matters but also the informal liaisons in between.

7.3 Strategic

7.3.1 Manchester – Aalto's functional and strategic mother

A mother is always saying that everyone should be equal and invited to birthday parties. Relating to the strategic issues, the University of Manchester is a good example. They are said to make a great contribution to the life of the city by inviting the people inside and opening the campus to the public and involving students in the design process of the campus. Involving students in the process also commits them to the area, the buildings and the environment, which again motivates them to be a part of the community. This is something that Aalto could enhance more: involving students in the actual process, getting services on the campus and spreading knowledge about the University and developing the campus towards a vivid and attractive University City. An element distinguishing the Aalto campus, according to the campus vision (2/2011), are the connections enabled "between our different Schools and disciplines – *and the communities beyond*".

The UM wants to be distinguished as stated in their vision by 'engaging the wider society across the full range of activities', which Aalto could emphasize more. Being more open to the public and creating an open atmosphere to the outside community could boost the identity of Aalto.

The massive investment of the UM in state-of-the-art buildings, both constructing new and renovating the old, is worth highlighting. In Aalto, the amounts of money invested are relatively on the same level as in the UM. The difference is that Aalto has decided to cope with its real estate with 'limited resources', which seems to be quite the contrary in the UM's case. Aalto's 210 million € in renovating the Otaniemi campus is nothing compared to the UM's budget of 650 million £ investments in their campus buildings. On the other hand, Aalto does not have an income of 788 million £ with tuition fees and educational contracts worth 220 million £.

7.4 Rankings

To give an idea of how the benchmarked universities are valued, the benchmarked Universities are listed in the following table according to their rankings in 2011. The QS World University ranking takes a student point of view to the universities, ranking them based on the following indicators: "academic reputation (worth 40% of the point score used to determine a university's rank), employer reputation (10%),

faculty - student ratio (20%), citations per faculty (20%), the number of international faculty members (5%), and the number of international students (5%)" (QS World University rankings 2011).

Table 32 Comparison of university rankings (QS World University Ranking 2011)

University	Overall ranking	Arts & Humanities	Natural Sciences	Engineering & IT	Social Sciences	Life Sciences
Manchester	29	42	41	32	29	43
Nottingham	74	143	135	111	101	91
TU/e	146	N/A	177	61	N/A	N/A
Aalto	**232**	**N/A**	**249**	**138**	**305**	**N/A**
WU	N/A	N/A	N/A	N/A	164	N/A
MIST	N/A	N/A	N/A	N/A	N/A	N/A

The rankings are not precise but can give a certain indication of the academic results of each university. For example, Aalto University was ranked in all the disciplines in 2007 in the same rankings. In 2007 it was 170th in the total ranking, even though it did not even exist yet. On the other hand, WU was ranked as 164th in social sciences but did not have an overall ranking, so should it not be the 164th in this case? MIST was not even found on the list. (QS World University Rankings 2011) These facts might signify that the ranking system does not follow the newly developed establishments but is more precise with the traditional, old universities. The ever-changing organizational structures of new universities might as well mix up the whole system and the rankings should be viewed as general indicators, but they do give an idea of how appreciated each university is. However, this study concentrates on space evaluation, but according to real estate consultants worldwide, there should also be a correlation between how well spaces support the core business and how well the company, in this case the university, acts.

7.5 Comparison conclusions

All in all, the benchmarks create a family supporting the whole variety of Aalto University's benchmarking data. *Physically and functionally*, Aalto University provides more space for the students than recommended in the international space planning standards. As a conclusion, it can be said that the efficiency of space use can be improved without much additional effort by utilizing the spaces more efficiently by, for example, schedule arrangements.

However, there are also questions related to the emphasis between the different factors of functionality. The biggest single question arising is: Could the

development of common use spaces and primary circulation areas into informal learning areas and meeting places result in enhancement of communication between the students and the staff, productivity and increasing sharing of knowledge, and more efficient use of space and cost savings regardless of which user group one represents?

Financially, in terms of cost savings, a big challenge is to balance the actions of renovation and new building development to make the spaces effective, energy efficient, functional, sustainable and architecturally and culturally appealing. The spaces need to have meanings and be appealing to the people utilizing them, and therefore the cultural heritage has to be protected and can be seen as an investment – it should be seen as a privilege to be situated in a culturally rich heritage atmosphere such as Otaniemi, but at the same time it must not place too big restrictions on the development of spatial design solutions inside the walls. On the other hand, also the structure and the revenue logic of the spaces could be re-invented to make even more savings and to deepen possible enterprise relationships.

Strategically, the campus area should definitely be more open to the public and offer different kinds of services. This would create the basis for Aalto's development towards an appealing University City. Also internationalisation through Design factory, Aalto On Tracks, Aalto On Waves and similar projects are good ways of contributing to the brand and strategy of Aalto and they should therefore be systematically continued. This is a factor that also creates a sense of belonging to a wider community, which again creates meaning for the spaces, leading to user motivation and productivity and again strengthening the sense of community. These actions could be heavily supported by developing *an effective virtual infrastructure* and spreading the word through interesting communication channels to the whole community of Aalto and the institutions outside.

8 Generating a future scenario of Aalto's campus management practices and benchmarking

In this section, foresight tools, introduced by the Center for Foresight and Innovation at Stanford University and reviewed in the introduction, are applied to imagine the campus of the future based on the study conducted in three phases: perspective, opportunity, solution. At the end, a possible future development scenario is introduced accordingly.

As the main tool, a modification of the Context Map is used. The idea of the Context Map in a nutshell is to gather the most valid factors around a subject to simplify abstract entities into a graphical and understandable format. The Context Map is modified to show the development of the four main factors of CREM in the future. In the opportunity and solution phases, results are built on the perspective.

8.1 Perspective

To build a perspective, den Heijer's forecast (2011) is mapped, and accordingly the meta-level development of Universities can be simplified as follows:

From the point of view of management, according to den Heijer (2011), the campus is becoming a city. From the CREM perspectives, physically there is going to be less private and more public space, functionally there is a shift going on from mono- towards multi-functional spaces, financially the campus should have higher floor productivity, and strategically the campuses have become a market place in knowledge (den Heijer 2011).

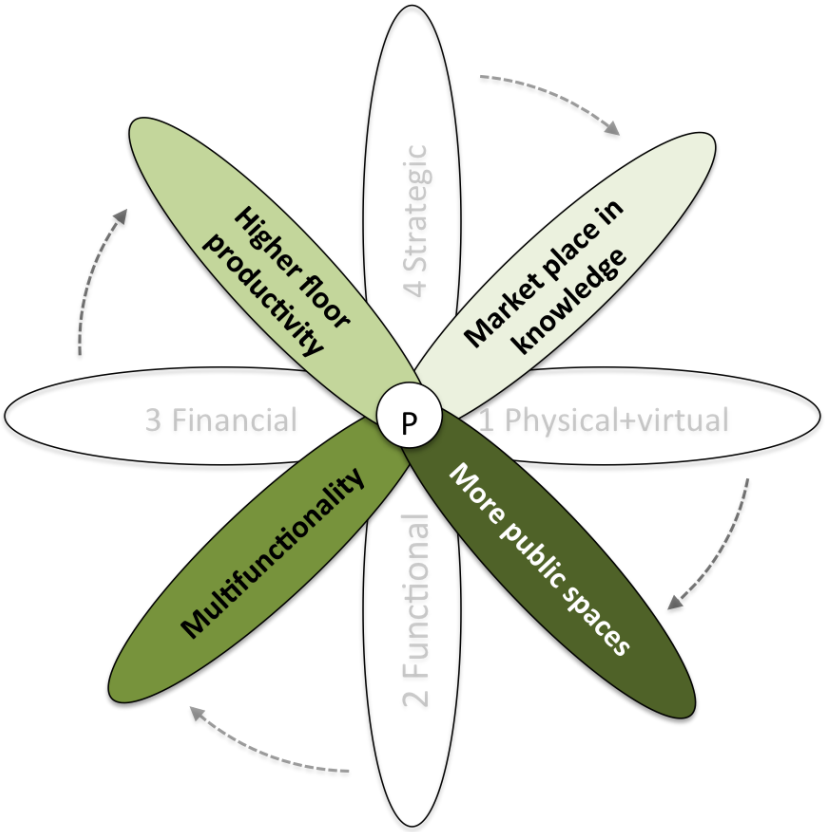


Figure 20 Context Map 1: a Perspective on future development

8.2 Opportunity

The aim of the opportunity phase is to find the possible ways to support the identified characteristics of the future.

Building on this perspective, opportunities are also indicated by the context map, answering what kinds of actions could be taken to find opportunities. The results of this study can be simplified as follows:

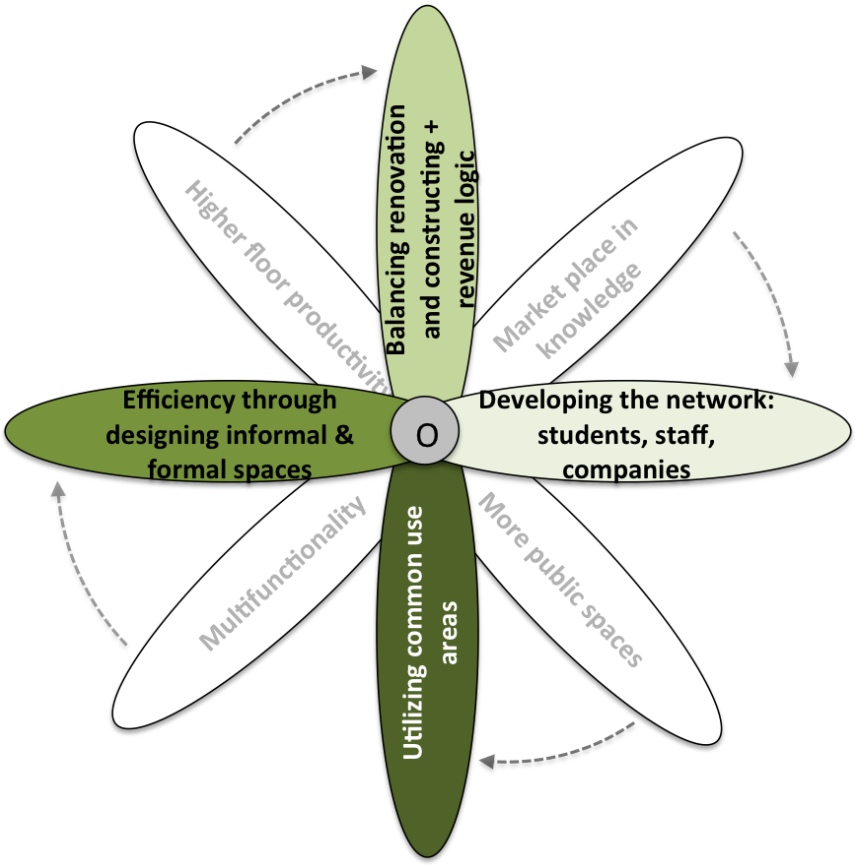


Figure 21 Context Map 2: Opportunities for future development

In the figure above a proposal for developing each of the four main aspects, building on den Heijer's forecast, is introduced.

The development of the *physical* aspect indicates that the undesigned common use areas should be taken into use. Physically, 18 % of Aalto's space resources in total are open spaces and passages and the majority of them are unutilized. There is a space mass of 73 000 sqm that is not thought of as usable space and which is still paid rent for and maintained. This indicates a great opportunity of designing these spaces that would facilitate public and unpredictable meetings, making 'efficient use of limited resources and a lower environmental impact' and providing 'the best setting for transcending traditional boundaries in research and art'. Virtual development that makes wi-fi available all around makes it possible to create even more efficient environments with tools to be utilized and therefore virtual services and their possibilities should also be considered related to the physical environment.

From the benchmarking aspect, this means that spaces should be evaluated based on Net Internal Areas, not based on Net Usable Areas, and as a sibling universe to the physical environment, the virtual environment should be benchmarked in order to be able to better improve and manage the whole Building Operation System.

Functionally, according to this study, effectiveness and efficiency are low in Aalto. Spaces are used inefficiently: on average, there is almost three square metres more

space allocated per EFTSL than TEFMA suggests. As the current situation of space allocation varies from 1,6 sqm per economic student to 7,5 sqm per arts student, there must be some kind of way for compromises and synergies to arise between the different fields of art and science. A more efficient use of space could be gained through designing both formal and informal spaces and also by utilizing the current educational spaces more efficiently. In the context of Aalto, this kind of innovative use of resources can be seen in Design Factory, and it should furthermore be supported by synergies in spatial solutions to facilitate all the different fields of science and art all around the campuses to create ’a freedom of choice’ and ’a multidisciplinary learning environment’. Each field of science and art does not need a specific laboratory to work in, but also by scheduling and thinking about different ways, different users could utilize the same spaces or a variety of spaces under the same roof for a variety of purposes and functionality could be improved efficiently.

In benchmarking, these kinds of multi-functional spaces create a difficulty for categorizing. But, benchmarking is done in order to support space use and not the other way around: people do not use the spaces in order to facilitate benchmarking. Therefore, planning and benchmarking must be based on what best supports what people do, not based on what is easier to follow up.

Financially, adding on higher floor productivity, more cost savings could be reached by implementing physical and functional developments, thinking about the balance between new and old, improving energy efficiency and widely reinventing the revenue logic. A higher floor productivity could be immediately achieved cost-efficiently by realizing the physical and functional developments mentioned – by actually designing the common use areas such as open spaces and passages for the needs of multi-use environments (so basically thinking about Net Internal Areas instead of Net Usable Areas) the average rent drops from 17,7 €/month/sqm (NUA) to 13,8 €/month/sqm (NIA). Annually, this means that 3,4 million € is now used in vain if open spaces and passages are not thought of as usable areas. This would make ’efficient use of limited resources’.

From the benchmarking aspect, this arrangement would create the challenge of to which unit the designed common use areas should be allocated, and that again creates the problem of who would be allowed to use them. If they are all allocated to a common unit, it is a common belief that nobody values nor takes responsibility for them. But creating a new multidisciplinary Aalto insists that also responsibility is taken and shared.

Strategically, according to this study, virtuality and ad hoc underground internationalisation projects, company collaboration and environments similar to Design Factory could build Aalto’s identity and strategic strengths as an innovation university. Going back to the campus strategy discussed in this study, for students the future solution must enable ’a multidisciplinary learning environment’ and

’freedom of choice’. For faculties and staff, it must provide ’the best setting for transcending traditional boundaries in research and art’. Economically, it must make ’efficient use of limited resources and a lower environmental impact’. This all leads to the fourth aim: For the Aalto community, the campus must enable ’rich connections supporting open innovation and social interaction’. As it can be seen, all these four aims are supported by the physical, functional and financial arrangements mentioned that build on each other and fulfil the campus strategy. A vivid market place in knowledge does need recognition, which in Aalto’s case is naturally gained through these kinds of actions in Aalto’s own way.

From the benchmarking point of view, the strategic results indicate that all the information should be collected in one place to make management easier. When everything relates to everything and all the information must be taken into account when making decisions, it is useful to have all the relevant physical, virtual, functional and financial information available in one place linked to one another. If a manager must collect everything from different sources, resulting in unlinked facts and figures, it is not possible to take everything into account.

8.3 Solution

A concrete solution and development scenario is built on the perspective and opportunities identified based on the whole study conducted. The solution proposal is divided into four main elements visualized in Figure 22.

8.3.1 A Valid strategic element: Alternative multi-use learning environments

A big question that has been buzzing in my mind, having conducted this benchmarking survey from the beginning to end is: Could alternative multi-use spaces similar to Design Factory be the core of Aalto University’s spatial strategy? I do not believe that the factories would work as the only learning environment of a university – there still is a need for huge lecture halls, small offices and more formal educational facilities. Those types of spaces are needed for lecturing efficient mass lectures and arranging phenomenal lecture shows, for researching in totally sterile and solitary environments and for concentrating on individual uncollaborative tasks. Some people tend to learn and work better in those types of facilities and cannot work at all in an informal, stimulating environment.

However, for the purpose of giving identity and connecting, creating a sense of belonging and a hands-on atmosphere, spreading the Aalto spirit to the scattered departments and units across all the campuses, and enhancing the inter-disciplinary working by removing the traditional boundaries, the *”factories”* as an element could form a valid liaison. The campus would not be built on singular lecture halls, laboratories and offices but on overlapping modern platforms such as hubs and networks that can offer various choices for the users. Building on that, the

internationalisation should be continued with innovative projects such as Design Factory, Aalto on Waves and Aalto On Tracks to create an international network and all of the actions should be supported as well as possible by virtual tools.

Considering benchmarking activities, the categories should be updated in the space resource database system according to the real functionality of spaces to provide relevant information for the managers.

8.3.2 Enhancing multi-functionality and cross-disciplinarity

Imagine a campus where it is possible for anyone in the university community to go to any department and find a familiar place with a welcoming atmosphere, plug into a hot desk for individual work, agree on a meeting with a group to brainstorm for a group exercise in a place where there actually are the necessary tools for it, just meet people from everywhere in the university or do all of this during the same visit. Welcome to the Factory net. Factory net consists of hubs that create a networked infrastructure, 'a Factory infrastructure', across the whole campus area with a video link and a constant connection between the units. The hubs create a sense of belonging to a bigger academia and enhance collaboration between the units.

Each of the hubs is specifically people-centrically designed by taking advantage of the involvement of the people of the faculty in the design process. The hubs are designed for specific needs of learning, researching, sharing and teaching inside each sub-organization but the guidelines support sense of being networked to other units – the rules are the same in all the units and people coming from other units feel welcome and secure once visiting. Informal and formal spaces are designed to function as an ecosystem offering a spectrum of spaces for different kinds of needs. Each specific hub reflects its own people, studies, research and field, and even though the learning spaces are designed to support that specific unit, the overall aim is to be useful for everyone and design to enhance certain interaction patterns. Spaces are named according to the field they represent, for example Design Factory, Service Factory, Media Factory, Urban Factory, Management Factory, Ship Factory, Electric Factory, Social Factory, etc. The hubs are in constant dialogue to keep the network consistent and to know what is going on where. This supports the initial idea of Aalto's campus crossing traditional boundaries and encouraging the professionals of different fields to discuss and meet informally.

To identify and develop existing spaces that could possibly work as hubs, it would be useful to have a fully functioning planning module in the space resource database. If all the information would be gathered in the same system and it could be dynamically analysed through automatic linkage, it would make efficient planning of these kinds of spaces more manageable.

8.3.3 Innovative funding – utilizing limited resources

Cost savings could be obtained by efficient development of common use and primary circulation areas which would enhance creativity, productivity and motivation and increase the sharing of ideas. More efficient design of specific spaces and a follow-up in the space reservation system could also give more efficiency. Other than that, cost savings can be gained by increasing energy efficiency, utilisation and good caretaking of the existing spaces, which gain value as they get older.

Plus, reinventing the revenue logic could create cost savings. Aalto could try to collaborate with the firms owning buildings in the Keilaniemi region and provide affordable spaces for the growing start-ups after having to leave Venture Garage and Design Factory. The Aalto Entrepreneurship Society could be a relevant player in the process. Through giving opportunities, links to the corporate world would become stronger, and long-lasting sponsorships might be created, revenue of which could also be used for developing and maintaining the spaces. The whole real estate management could be thought of more from the business point of view. Facilitating some commercial services would support the idea of a more open campus.

In terms of benchmarking and the space resource database system, cost savings could be gained through linking the information and not having to always use hours and hours trying to find all the relevant information. On the other hand, an update or change to the space resource database would cost a lot but once done well, it would pay itself back in the long run.

8.3.4 The opportunities of existing undesigned spaces

As 18 % of the total spatial mass of Aalto University consists of open spaces and passages, they could be much better used as real, functional spaces and not just as empty spaces to be walked through. This would make Aalto's use of space more efficient. Cosy cafeterias, sofas, espresso bars, tables for ad hoc work and other informal elements could be located along the paths that people use daily to create meetings and to make spaces more vivid and appealing. The AYY student union or some commercial player could organize freshmen to facilitate possible cafés or pop-up bars. Prototypes created in courses could be tested and ad hoc lectures could be lectured in informal spaces with a good cup of coffee. Also exhibitions of art and research conducted could be set up in the facilities so that the identity of Aalto would be reflected in the physical spaces. Spatial planning and pop-up exhibitions could also be outsourced to the students – why not give credits to students for doing something practical and tangible instead of just producing text on paper before the dreadful deadlines?

Collaboration between students and the staff is a huge resource that should be utilized more. Pioneer examples of this kind of collaboration have been seen in the development of Design Factory and lately in the Konetekniikka 1 building where

students took over a corridor to be developed into a new studying environment. The initiative was taken by the students from bottom up, not forced by the administration from top down (Nurmi 2011).

In the current space resource database, this kind of arrangement might create difficulties in allocating rents and categorizing spaces. Also the boundary between a unit and a building becomes fuzzier and therefore the database should be updated to follow up on these kinds of spaces. The planning module should be included in order to manage these kinds of spaces efficiently.

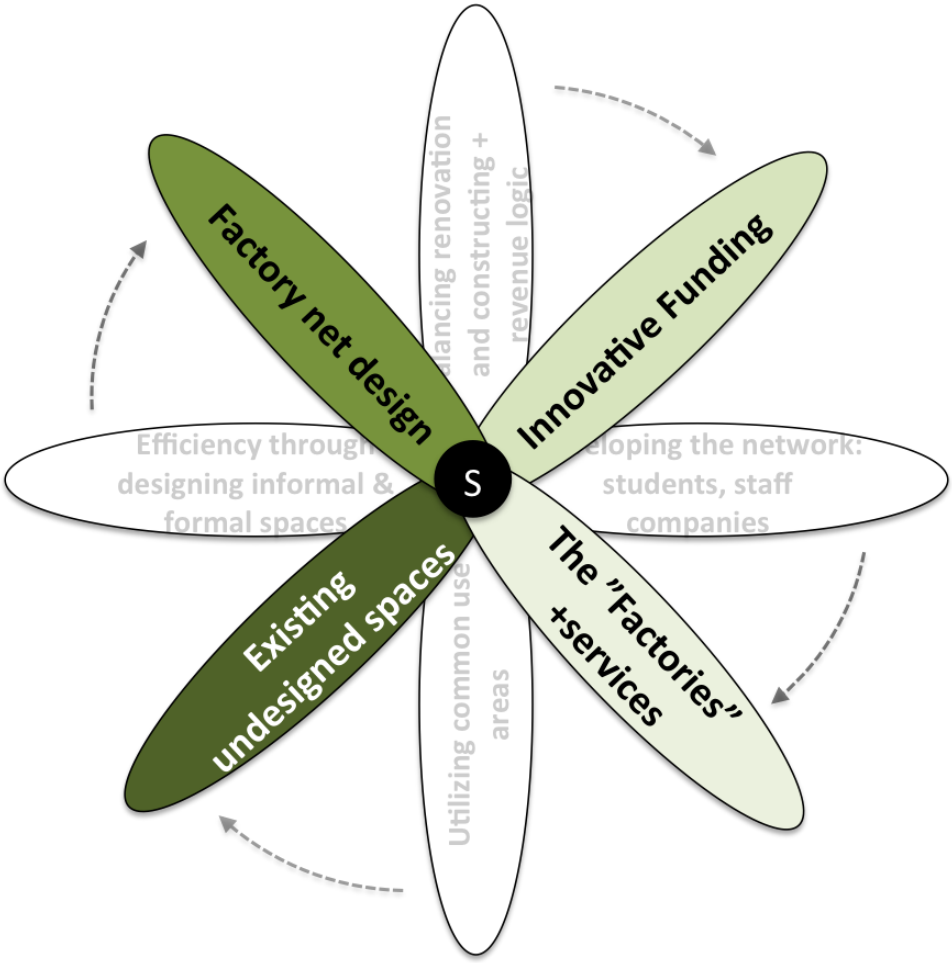


Figure 22 Context Map 3: Solution for future development

9 Conclusions & further research

Going back to the research questions, they are repeated here as follows: (i) How do the existing benchmarking practices support the future development of university campuses *in theory*?, (ii) How do the existing facilities of Aalto University support the current and future demand of university education and related actions *in practice*? and (iii) How could the facilities be modified and developed strategically in order to better and more concretely support the University's core business today and *in the future*?

(i) How do the existing benchmarking practices support the future development of university campuses in general? Based on the theoretical part of this study, the nature of learning spaces is changing. In terms of university campus development, a relevant question to be asked is whether the university works as a learning environment or whether the environment works as a university. As the whole campus should work as a learning landscape with a variety of functions supporting each other, also the campus should be analysed as a whole ecosystem of educating, learning and researching, not just as little individual bits and pieces. Development of technology, globalization and sustainable thinking require more efficiency, more competence in quality and more meanings for the spaces. On the other hand, this change requires a more holistic and systematic observation of facilities.

Theoretically, the benchmarking methods should be developed according to the development of learning spaces, not the other way around. The administrative actions should support the development, not slow it down. Physically, not only usable floor areas and individual units as such are relevant today, but also the whole learning landscape and traditionally unutilized spaces such as corridors, entrances, lobbies and hallways must be taken into account in terms of different measures. Building on the physical aspect, virtuality should also be seen as part of the benchmarking process in university campuses. Combining the virtual and physical aspects and observing how the whole ecosystem works both on micro and macro-levels is relevant in terms of functionality. So now that the nature of learning and teaching is obviously changing, also the administrative categorisations should live accordingly. Financially, it is not all about just hard money as such but also investment in the productivity and effectiveness of spaces motivating people. Strategically, all the relations between the four aspects should be considered as a holistic entity – not as individual units. Everything relates to everything.

Furthermore, the space resource database system of Aalto University does not support the needs of today. In order to make the systematic observation of spaces possible and to support the real estate management practices and space benchmarking of Aalto University, it is necessary to upgrade the administrative system to link also the third module of planning to the existing inventory and reporting modules. However, it would be useful to thoroughly think through the real

needs that the system must be able to answer so that all the stakeholders involved would sit around the same table and in the end know how to use the system to increase communication and sharing between the units. The technology already exists, and actions have to be taken to implement it for the organization's needs.

(ii) How do the existing facilities of Aalto University support the current and future demand of university education and related actions in practice? Physically, the informal areas are not well organized and there are a lot of unutilized spaces such as hallways and corridors that should be designed to facilitate informal unpredictable meetings and a laid-back atmosphere for studying individually and in groups, for meeting across the departments regardless of status, all the Aalto people together.

Functionally, Aalto University's spaces are utilized inefficiently in the traditional sense and there is much space per Aalto member. Effectiveness can be immediately increased by utilizing the spaces more efficiently by course schedule arrangements, sharing the spaces between departments and units and by possible dividing structures between the bigger lecture halls and movable and rearrangable furniture for the demands of different sized courses and different studying methods.

Financially, cost savings could be gained e.g. by designing those spaces which would increase productivity and motivation and by increasing the energy efficiency of the buildings in the long term. Some cost savings could be gained by rethinking the revenue logic and how to value the spaces from both the administrative and single unit point of view. The units and the administration must communicate and support each other – they are not supposed to be enemies.

Strategically, the spaces do not completely match the campus vision. Far more services should be provided on campus and internationalisation should be systematically continued. Services would motivate people to stay on campus and not scatter around to their homes or the city centre for cosier environments. The ad hoc internationalisation projects create a positive buzz around Aalto that spreads the word effectively like a jungle drum. These strategic elements also create an appealing environment for the community around Aalto and can result in facilitating better enterprise co-operation and an open, enthusiastic atmosphere linking Aalto to the outside world. These development plans mentioned would make the Aalto campus a vivid University City.

(iii) How could the facilities be modified and developed strategically in order to better and more concretely support the University's core business today and in the future? Considering the future, it seems that everything we need for the shift from strategic words to practical action is there already, it just needs to be implemented. Going back to the Aalto campus strategy, the four cornerstones to build on are our community, our faculties and staff, our students and our economy. In a nutshell, the purpose of the future campus is to provide a freedom of choice in a multidisciplinary

learning environment transcending traditional boundaries and making efficient use of limited resources and a lower environmental impact. A place that apparently has made all this possible and proven its power as a learning environment is Design Factory. It can be seen as a pioneer example of the kind of space that could work as a catalyst of change in uniting the myriad of Aalto's departments and units, in other words, the people. Applying the characteristics of DF to other physical locations, linking them virtually and creating an atmosphere familiar to all with hub-like overlapping, connective units in strategic locations could work as a cornerstone in campus development. Implementing a united, open culture throughout Aalto and over departmental boundaries is a key thing in fulfilling the campus vision before 2020 and both services and spaces on campus - physical, social and virtual - must support that culture.

9.1 Evaluation of results

This study's aim was to define how the Aalto University campus and benchmarking practices should be developed in order to support fulfilling the campus vision by year 2020. The results indicate the direction to which the facilities of Aalto University could be developed in order to meet the future demands and fulfil the role of the university campus in supporting the core business. The results are indicative and the biggest value of this study is probably the notion of how the nature and meaning of university campuses, the learning landscape and spaces in general have developed. Also, the observation that the benchmarking and management practices are not following that development is an important point in the study.

However, as evaluating all the different aspects was quite a big task, this study should be deepened with a financial and virtual space analysis. All the financial information was not available and the virtual infrastructure was only briefly looked at because of the lack of my expertise in the field and the resources within the scope of this study. From the point of view of functionality, in order to develop the MILL model further, the varying working methods and various space use tendencies of employees and students should had been identified more precisely. Also the key performance indicators could have been more precisely defined.

All the information that would had been useful for this study's purposes considering internal and international case benchmarking was not publicly available, which made it difficult to evaluate them and therefore the analysis of the international cases was quite general.

All in all, these notions mentioned indicate that the study should have been much narrower in scope, because now it feels like everything has been scratched on the surface but nothing has been completely and profoundly studied. However, as a Master's Thesis, I think the process has developed my skills in independent and

logical research, as well as in understanding complex knowledge structures, the importance of frameworks and the use of research methods.

The reliability of the results is based on the data of the constantly developing space management system in Aalto University and international sources publicly available. Therefore, the data is not completely exact for benchmarking purposes, but the results are indicative. The validity of the results is based on the methods, which should be developed even further in order to gain even better comparability.

9.2 A proposal for further research

Further research could be conducted for example on the following:

1. One avenue for further research would be the development of benchmarking methods for the needs of multi-use environments and the building operation system, in other words, how the virtual, physical and social spaces function together and support each other in Aalto University.

2. Functionality - a study should be conducted on the use of space and the behaviour of employees and students to evaluate how the spaces meet the actual demands.

3. Modelling the fundamental idea of Design Factory and how it could be applied to different departments and how the factory network could work in practice would be another interesting research theme.

4. Furthermore, the unutilized spaces such as empty hallways, lobbies and corridors could be mapped and the actual spaces where to set up the informal pop-up areas could be concretely pointed out. Finding out how they would actually look like and be connected would be another interesting theme for further research.

5. Also, the service landscape and business model of the campus as a holistic entity would be an interesting subject to look at from the physical, social and virtual space aspects, both financially and strategically.

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Appendices

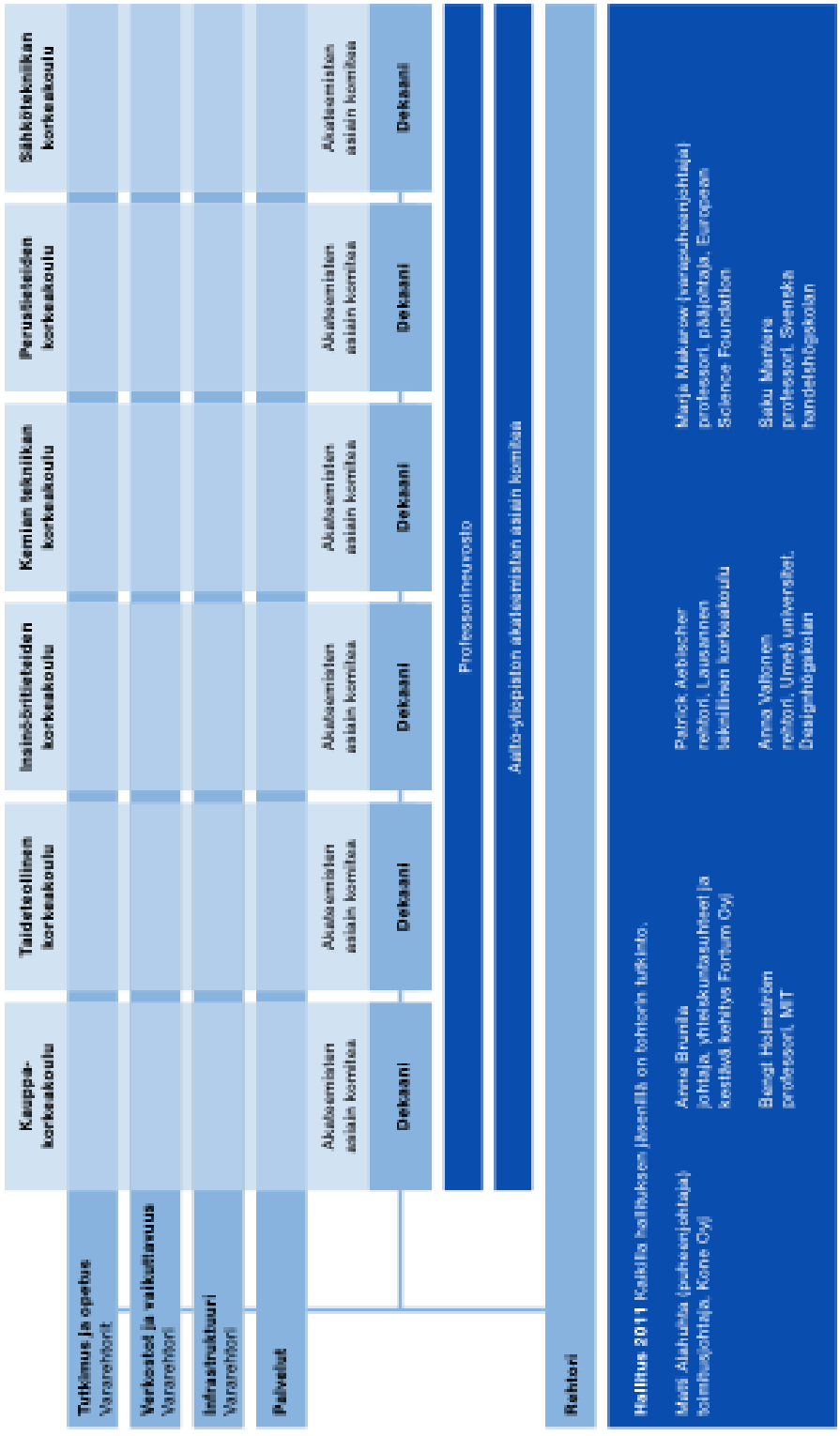
Appendix 1 Staff, students statistics

Aalto University, numbers of staff 31.8.2011 and students 21.11.2011

Department	School	Name in english	Staff (Aalto HR, 2011)	Student/Staff member	Students (oodi-reports, 2011)			
					Post Graduate	Others	Basic students	Foreigners, fixed-te
A800	Aalto SAD	Dean	69					
A801	Aalto SAD	Department of Motion Picture, Television and Production Design	51		30	1	257	9
A802	Aalto SAD	Department of Media	86		69	14	443	9
A803	Aalto SAD	Department of Design	106		62	7	695	23
A804	Aalto SAD	Department of Art and Media Pori	15		12	28	102	
A805	Aalto SAD	Department of Art	52		67	27	370	16
A810	Aalto SAD	Media center Lume	19					
A820	Aalto SAD	Western Finland Design Center Muova	17					
A830	Aalto SAD	Future Home Institute	9					
A840	Aalto SAD	Designium Innovation Center	6	Yht	240	77	1867	57
SUM			430	5,2	2241			
E700	Aalto SE	Dean	81					
E701	Aalto SE	Department of Accounting	24					
E702	Aalto SE	Department of Marketing	60					
E703	Aalto SE	Department of Economics	33					
E704	Aalto SE	Department of Information and Service Economy	42					
E705	Aalto SE	Department of Communication	37					
E706	Aalto SE	Department of Management and International Business	94					
E707	Aalto SE	Department of Finance	27					
E710	Aalto SE	Center for Markets in Transition (CEMAT)	22					
E720	Aalto SE	Center for Knowledge and Innovation Research (CKIR)	35					
E730	Aalto SE	Small Business Center	74					
E740	Aalto SE	ASE Research ?	24					
E770	Aalto SE	Service Factory	4	Yht	259	269	3285	130
SUM			557	7,1	3943			
T100	Aalto CHEM	Dean	48					
T101	Aalto CHEM	Department of Biotechnology and Chemical Technology	137					
T102	Aalto CHEM	Department of Chemistry	86					
T103	Aalto CHEM	Department of Materials Science and Engineering	122					
T104	Aalto CHEM	Department of Forest Products Technology	143	Yht	410	51	1403	20
SUM			536	3,5	1884			
T200	Aalto ENG	Dean	63					
T201	Aalto ENG	Department of Architecture	61					
T202	Aalto ENG	Department of Energy Technology	95					
T203	Aalto ENG	Department of Engineering Design and Production	138					
T204	Aalto ENG	Department of Applied Mechanics	116					
T205	Aalto ENG	Department of Surveying	81					
T206	Aalto ENG	Department of Civil and Structural Engineering	94					
T207	Aalto ENG	Department of Civil and Environmental Engineering	103					
T208	Aalto ENG	Lahti Center	22					
T209	Aalto ENG	Centre for Urban and Regional Studies YTK	60					
T210	Aalto ENG	Design Factory	33	Yht	673	161	3960	128
SUM			866	5,7	4922			
T300	Aalto SCI	Dean	70					
T301	Aalto SCI	Department of Biomedical Engineering and Computation	105					
T302	Aalto SCI	Department of Mathematics and Systems Analysis	109					
T303	Aalto SCI	Department of Media Technology	72					
T304	Aalto SCI	Department of Applied Physics	269					
T305	Aalto SCI	Department of Computer Science and Engineering	188					
T306	Aalto SCI	Department of Information and Computer Science	171					
T307	Aalto SCI	Department of Industrial Engineering and Management	112					
T308	Aalto SCI	BIT Research Centre	179					
T309	Aalto SCI	Language Centre	46					
T310	Aalto SCI	EIT	4					
T311	Aalto SCI	Low Temperature Laboratory	150					
T312	Aalto SCI	Helsinki Institute for Information Technology HIIT	85	Yht	1027	189	2627	92
SUM			1560	2,5	3935			
T400	Aalto ELEC	Dean	58					
T401	Aalto ELEC	Department of Automation and Systems Technology	104					
T402	Aalto ELEC	Department of Electronics	52					
T403	Aalto ELEC	Department of Micro- and Nanosciences	89					
T404	Aalto ELEC	Department of Radio Science and Engineering	96					

T405	Aalto ELEC	Department of Signal Processing and Acoustics	89						
T406	Aalto ELEC	Department of Electrical Engineering	59						
T407	Aalto ELEC	Department of Communications and Networking	152						
T408	Aalto ELEC	Metsähovi Radio Observatory	23		YHI	625	27	2805	85
SUM			723		4,9	3538			
U900	Administration and Services	President	20						
U901	Administration and Services	VP, Academic Affairs	66						
U902	Administration and Services	VP, Education	43						
U903	Administration and Services	VP, Infrastructure	2						
U904	Administration and Services	Knowledge Networks	43						
U905	Administration and Services	Finance	57						
U906	Administration and Services	Human Resources	44						
U907	Administration and Services	Foresight and Policy	20						
U908	Administration and Services	Communications	43						
U909	Administration and Services	IT	150						
U910	Administration and Services	Library	93						
U911	Administration and Services	Aalto PRO	96						
U912	Administration and Services	Facility Services	31						
SUM			714						
SUM			5384		4,8	20463			

Appendix 2 Organisational chart



Appendix 3 Schools, departments,other units and services

”School of Art and Design

The School of Art and Design is the largest of its kind in the Nordic countries and one of the most prestigious in the whole world. The School researches design, digital media, audio-visual presentation, art education and visual culture. The viewpoint of usefulness forms the foundation of artistic activity.

Department of Art

Department of Art and Media Pori

Department of Design

Department of Media

Department of Motion Picture, Television and Production Design

Other units

Media Centre Lume

Western Finland Design Centre Muova

Future Home Institute

Designium Innovation Centre

School of Chemical Technology

The areas of emphasis of the School of Chemical Technology include environment-friendly and energy-efficient processes, the diverse utilisation of wood and other biomaterials, new materials and their application, new engine fuels, the shaping of micro-organisms and enzymes as well as novel pharmaceuticals and biomaterials.

Department of Biotechnology and Chemical Technology

Department of Chemistry

Department of Materials Science and Engineering

Department of Forest Products Technology

Other units

UMK Center for New Materials

School of Economics

The School of Economics is one of the leading business schools in Europe and globally recognized for its management research and education in particular. It is the first Nordic business school to receive all three of the field’s international accreditations (AACSB, AMBA and EQUIS).

Department of Accounting

Department of Communication

Department of Economics

Department of Finance

Department of Information and Service Economy

Department of Management and International Business

Department of Marketing

Other units

Aalto University Executive Education (Aalto EE)

Center for Markets in Transition (CEMAT)

Center for Knowledge and Innovation Research (CKIR)

Mikkeli Campus (BScBA Degree Program)

Small Business Center

Start-Up Center

Service Factory

School of Electrical Engineering

Important research areas at the School of Electrical Engineering include traditional electronics, electrotechnology and telecommunications technology. Microtechnology and nanotechnology have also been emphasised by researchers in recent years. There are almost two dozen research units, which focus on subjects ranging from acoustics to intelligent power electronics.

Department of Automation and Systems Technology

Department of Electronics

Department of Micro- and Nanosciences

Department of Radio Science and Engineering

Department of Signal Processing and Acoustics

Department of Electrical Engineering

Department of Communications and Networking

Metsähovi Radio Observatory

Other units

Micronova

School of Engineering

The School of Engineering researches and teaches fields that encompass all aspects of our built environment. Climate change, energy conservation and the sustainable utilisation of natural resources form the focal areas of both research and education.

Department of Architecture

Department of Energy Technology

Department of Engineering Design and Production

Department of Surveying

Department of Civil and Structural Engineering

Department of Applied Mechanics

Department of Civil and Environmental Engineering

Other units

Lahti Center

Centre for Urban and Regional Studies YTK

Center for Energy Technology (CET)

Institute of Building Services Technology

School of Science

The School of Science engages in world-class fundamental research, the results of which it uses to develop scientific and technological applications. The fields of computation and modelling, materials research as well as ICT and media research account for a large share of the research performed at the School.

Department of Biomedical Engineering and Computational Science

Department of Mathematics and Systems Analysis

Department of Media Technology

Department of Applied Physics

Department of Information and Computer Science

Department of Computer Science and Engineering

Department of Industrial Engineering and Management

BIT Research Centre

Other units

Language Centre

Low Temperature Laboratory

Helsinki Institute for Information Technology HIIT

Other Institutes

Aalto PRO (former Lifelong Learning Institute Dipoli)

Helsinki Institute of Physics (HIP)”

(Aalto-www, 2011b)

Service listings

Aalto University offers a variety of services as listed below:

- Career Services
- Corporate Relations
- Entrepreneurship and Innovation Services
- Financial Services
- HR Services
- IT Services
- International Relations
- Library and Information Services
- Marketing and Communications
- Policy and Foresight
- Property and Infrastructure Services
- Research Support Services
- Strategic Support for Research and Education
- Sports Services
- Student Services

Appendix 4 Main campus map and Schools

Appendix 5 Allocated Areas and rent fees per faculty

Aalto-yliopisto

Tiedekunnat, yhteenveto rakennuksittain (Käyttövuokra)

1.11.2011

Rnro	Rakennuksen nimi	Nro	Koulun nimi	Osuus hyöty-neliöistä	Huoneisto-neliöt	Eur/m²/kk	Yhteensä Eur/kk
03	03 Teknillinen fysiikka	99	Ulkopuoliset	3 774,4	4 825,9	14,02	67 658,90
08	08 Konetekniikka 1	99	Ulkopuoliset	142,4	206,5	14,02	2 895,77
104	104 Economicum	99	Ulkopuoliset	1 438,9	2 041,9	18,38	37 530,36
17	17 Maarintalo	99	Ulkopuoliset	743,4	1 003,3	14,02	14 065,69
19	19 Dipoli	99	Ulkopuoliset	382,9	444,1	14,02	6 225,83
20	20 Ostoskeskus	99	Ulkopuoliset	539,5	542,3	14,02	7 603,27
22	22 Lämpömiehenkuja 2	99	Ulkopuoliset	532,4	716,7	18,38	13 172,33
23	23 Taiteiden talo	99	Ulkopuoliset	239,9	323,9	11,31	3 663,80
25	25 Design Factory	99	Ulkopuoliset	55,7	74,4	14,02	1 043,52
26	26 Betonimiehenkuja 3	99	Ulkopuoliset	934,4	1 072,1	11,31	12 125,40
29	29 Sähkötalo 1	99	Ulkopuoliset	1 758,0	2 373,6	14,02	33 277,54
33	33 Innopoli 2	99	Ulkopuoliset	60,9	83,6	18,38	1 536,69
34	34 Vesilaboratorio	99	Ulkopuoliset	846,0	1 010,1	18,38	18 565,15
36	36 Micronova	99	Ulkopuoliset	10 289,6	12 684,4	18,38	236 479,85
50	50 Lahden tiede- ja yrityspuisto	99	Ulkopuoliset	511,2	627,0	15,12	9 480,08
01	01 Päärakennus	A8	UUSI KOULU	3 597,3	5 290,7	14,02	74 175,72
201	201 Hämeentie 135	A8	UUSI KOULU	25 377,5	34 170,1	11,31	447 864,61
201a	201a Mediafactory	A8	UUSI KOULU	649,0	649,0	14,02	9 098,98
201b	201b Tutkijat	A8	UUSI KOULU	268,0	268,0	14,02	3 757,36
201c	201c 5krs lisätila	A8	UUSI KOULU	2 500,0	2 500,0	11,31	28 275,00
210	210 Vaasa	A8	UUSI KOULU	580,0	580,0	5,65	3 277,00
211	211a Siltapuistokatu 2	A8	UUSI KOULU	371,0	371,0	4,24	1 573,04
211b	211b Pohjoisranta 11	A8	UUSI KOULU	325,0	325,0	3,15	1 023,75
23	23 Taiteiden talo	A8	UUSI KOULU	1 870,8	2 526,2	11,31	28 571,22
27	27 Arkkitehtipaja	A8	UUSI KOULU	952,7	1 159,9	11,31	13 118,24
37	37 TUAS	A8	UUSI KOULU	23,2	31,4	18,38	577,19
101	101 HSE Päärakennus	E7	KAUPPAKORKEAKOULU	3 231,2	4 817,6	14,02	67 542,69
102	102 Arkadia	E7	KAUPPAKORKEAKOULU	2 976,6	4 369,0	14,02	61 253,52
103	103 Chydenia	E7	KAUPPAKORKEAKOULU	2 672,0	4 181,2	14,02	58 620,31
104	104 Economicum	E7	KAUPPAKORKEAKOULU	457,4	649,1	18,38	11 930,22
106	106 Fredrikinkatu 48	E7	KAUPPAKORKEAKOULU	675,7	982,4	18,38	18 056,51
108	108 Arkadiankatu 28	E7	KAUPPAKORKEAKOULU	1 819,9	2 734,3	18,38	50 256,43
109	109 Technopolis	E7	KAUPPAKORKEAKOULU	1 336,0	1 336,0	18,38	24 555,68
110a	110a Lönnrotinkatu 5	E7	KAUPPAKORKEAKOULU	1 025,0	1 025,0	13,04	13 366,00
110b	110b Lönnrotinkatu 7	E7	KAUPPAKORKEAKOULU	1 333,5	1 333,5	13,49	17 988,92
11	11 Kemian tekniikka	T1	KEMIAN TEKNIIKAN KORKEAKOULU	8 612,6	12 534,6	14,02	175 735,77
12	12 Materiaalitekniikka	T1	KEMIAN TEKNIIKAN KORKEAKOULU	6 439,9	8 703,7	14,02	122 025,71
13	13 Puunjalostustekniikka 1	T1	KEMIAN TEKNIIKAN KORKEAKOULU	4 003,3	5 726,6	14,02	80 286,48
14	14 Puunjalostustekniikka 2	T1	KEMIAN TEKNIIKAN KORKEAKOULU	2 311,7	2 984,9	14,02	42 469,01
36	36 Micronova	T1	KEMIAN TEKNIIKAN KORKEAKOULU	14,9	18,4	18,38	337,60
01	01 Päärakennus	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	34,7	51,0	14,02	715,51
02	02 Rakennus- ja ympäristötekn.	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	5 802,9	8 243,6	14,02	115 574,60
03	03 Teknillinen fysiikka	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	599,3	766,2	14,02	10 742,78
05	05 Konetekniikka 4	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	4 198,6	5 429,5	14,02	76 122,28

Tiedekunnat, yhteenveto rakennuksittain (Käyttövuokra)

1.11.2011

Rnro	Rakennuksen nimi	Nro	Koulun nimi	Osuus hyöty-neliöistä	Huoneisto-neliöt	Eur/m²/kk	Yhteensä Eur/kk
06	06 Konetekniikka 3	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	4 995,5	5 695,6	11,31	64 417,56
07	07 Konetekniikka 2	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	2 088,7	2 670,7	11,31	30 205,62
08	08 Konetekniikka 1	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	2 818,5	4 088,1	14,02	57 315,54
12	12 Materiaalitekniikka	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	747,7	1 010,5	14,02	14 167,71
16	16 Meritekniikka	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	5 490,2	7 737,4	11,31	89 535,41
25	25 Design Factory	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	1 904,6	2 545,1	14,02	35 681,87
29	29 Sähkötalo 1	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	252,9	341,5	14,02	4 787,20
30	30 Tietotekniikan talo	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	75,6	106,2	14,02	1 489,39
34	34 Vesilaboratorio	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	1 064,9	1 271,4	18,38	23 368,82
35	35 Falcon Gentti	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	1 367,4	2 227,7	18,38	40 945,33
50	50 Lahden tiede- ja yrityspuisto	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	929,2	1 139,8	15,12	17 233,66
74	74 LVI-koetalo	T2	INSINÖÖRITIETEIDEN KORKEAKOULU	25,0	25,0	11,31	282,75
01	01 Päärakennus	T3	PERUSTIETEIDEN KORKEAKOULU	4 984,4	7 330,8	14,02	102 777,49
03	03 Teknillinen fysiikka	T3	PERUSTIETEIDEN KORKEAKOULU	2 918,3	3 731,3	14,02	52 312,13
04	04 Sähkötekniikka	T3	PERUSTIETEIDEN KORKEAKOULU	445,1	623,3	19,27	11 826,91
08	08 Konetekniikka 1	T3	PERUSTIETEIDEN KORKEAKOULU	977,7	1 418,1	14,02	19 882,00
09	09 Nanotalo	T3	PERUSTIETEIDEN KORKEAKOULU	4 056,2	5 561,2	14,73	95 414,88
30	30 Tietotekniikan talo	T3	PERUSTIETEIDEN KORKEAKOULU	5 956,7	8 376,0	14,02	117 430,94
33	33 Innopoli 2	T3	PERUSTIETEIDEN KORKEAKOULU	1 581,7	2 171,5	18,38	39 911,68
36	36 Micronova	T3	PERUSTIETEIDEN KORKEAKOULU	505,5	623,1	18,38	11 478,55
37	37 TUAS	T3	PERUSTIETEIDEN KORKEAKOULU	6 295,6	8 521,7	18,38	156 628,54
04	04 Sähkötekniikka	T4	SÄHKÖTEKNIIKAN KORKEAKOULU	14 379,7	20 138,2	11,31	234 094,72
09	09 Nanotalo	T4	SÄHKÖTEKNIIKAN KORKEAKOULU	87,4	119,8	14,73	1 754,93
29	29 Sähkötalo 1	T4	SÄHKÖTEKNIIKAN KORKEAKOULU	1 583,0	2 137,3	14,02	29 964,68
30	30 Tietotekniikan talo	T4	SÄHKÖTEKNIIKAN KORKEAKOULU	114,4	160,8	14,02	2 254,49
36	36 Micronova	T4	SÄHKÖTEKNIIKAN KORKEAKOULU	2 936,4	3 619,9	18,38	105 187,79
37	37 TUAS	T4	SÄHKÖTEKNIIKAN KORKEAKOULU	2 545,6	3 445,7	18,38	63 332,11
70	70 Metsähovin radiotutkimusasema	T4	SÄHKÖTEKNIIKAN KORKEAKOULU	841,0	841,0	14,02	11 790,82

Aalto-yliopisto

Tiedekunnat, yhteenveto rakennuksittain (Käyttövuokra)

1.11.2011

Rnro	Rakennuksen nimi	Nro	Koulun nimi	Osuus hyöty-neliöistä	Huoneisto-neliöt	Eur/m²/kk	Yhteensä Eur/kk
03	03 Teknillinen fysiikka	T98	Aalto-yliopiston alivuokralaiset	22,9	29,3	14,02	410,50
04	04 Sähkötekniikka	T98	Aalto-yliopiston alivuokralaiset	344,3	482,2	18,38	8 278,28
08	08 Konetekniikka 1	T98	Aalto-yliopiston alivuokralaiset	25,8	37,4	14,02	524,66
101	101 HSE Päärakennus	T98	Aalto-yliopiston alivuokralaiset	519,5	774,6	14,02	10 859,24
11	11 Kemian tekniikka	T98	Aalto-yliopiston alivuokralaiset	31,3	45,6	14,02	638,66
16	16 Meritekniikka	T98	Aalto-yliopiston alivuokralaiset	848,9	1 196,4	11,31	13 602,28
17	17 Maarintalo	T98	Aalto-yliopiston alivuokralaiset	32,5	43,9	14,02	614,92
201	201 Hämeentie 135	T98	Aalto-yliopiston alivuokralaiset	329,8	444,1	11,31	5 023,00
22	22 Lämpömiehenkuja 2	T98	Aalto-yliopiston alivuokralaiset	433,8	583,9	18,38	10 732,83
29	29 Sähkötalo 1	T98	Aalto-yliopiston alivuokralaiset	29,1	39,3	14,02	550,84
33	33 Innopoli 2	T98	Aalto-yliopiston alivuokralaiset	28,6	39,2	18,38	720,96
01	01 Päärakennus	U9	U9 Yhteiset Palvelut	9 955,9	14 642,6	14,02	205 288,98
02	02 Rakennus- ja ympäristötekn.	U9	U9 Yhteiset Palvelut	649,2	922,2	14,02	12 929,92
03	03 Teknillinen fysiikka	U9	U9 Yhteiset Palvelut	1 712,1	2 189,0	14,02	30 690,33
04	04 Sähkötekniikka	U9	U9 Yhteiset Palvelut	2 202,3	3 084,2	18,38	37 876,89
05	05 Konetekniikka 4	U9	U9 Yhteiset Palvelut	1 170,1	1 513,2	14,02	21 214,38
06	06 Konetekniikka 3	U9	U9 Yhteiset Palvelut	454,3	518,0	11,31	5 858,25
08	08 Konetekniikka 1	U9	U9 Yhteiset Palvelut	937,9	1 360,4	14,02	19 072,64
09	09 Nanotalo	U9	U9 Yhteiset Palvelut	81,0	111,1	14,02	1 556,99
10	10 Tilapalvelut	U9	U9 Yhteiset Palvelut	416,9	557,8	14,02	7 820,36
101	101 HSE Päärakennus	U9	U9 Yhteiset Palvelut	3 931,0	5 861,0	14,02	82 170,53
102	102 Arkadia	U9	U9 Yhteiset Palvelut	1 058,1	1 553,1	14,02	21 774,32
103	103 Chydenia	U9	U9 Yhteiset Palvelut	1 219,7	1 908,6	14,02	26 758,68
107	107 Helecon tietokeskus	U9	U9 Yhteiset Palvelut	1 777,6	2 182,6	14,02	30 600,05
11	11 Kemian tekniikka	U9	U9 Yhteiset Palvelut	994,1	1 446,8	14,02	20 284,11
12	12 Materiaalitekniikka	U9	U9 Yhteiset Palvelut	577,7	780,8	14,02	10 946,48
120	120 HSEn Asunnot	U9	U9 Yhteiset Palvelut	1 113,0	1 113,0	14,02	15 604,26
121	121 Mikkelin asunnot	U9	U9 Yhteiset Palvelut	360,0	360,0	10,11	3 639,60
13	13 Puunjalostustekniikka 1	U9	U9 Yhteiset Palvelut	115,3	164,9	14,02	2 312,35
14	14 Puunjalostustekniikka 2	U9	U9 Yhteiset Palvelut	256,1	330,7	14,02	4 636,16
15	15 Kirjasto	U9	U9 Yhteiset Palvelut	7 071,0	8 486,5	14,02	118 980,73
16	16 Meritekniikka	U9	U9 Yhteiset Palvelut	1 024,3	1 443,6	11,31	16 326,65
17	17 Maarintalo	U9	U9 Yhteiset Palvelut	1 702,2	2 297,2	14,02	32 206,48
18	18 Saha	U9	U9 Yhteiset Palvelut	333,4	404,0	14,02	5 664,08
19	19 Dipoli	U9	U9 Yhteiset Palvelut	7 991,5	9 268,1	14,02	129 939,21
20	20 Ostoskeskus	U9	U9 Yhteiset Palvelut	111,9	112,5	14,02	1 577,03
201	201 Hämeentie 135	U9	U9 Yhteiset Palvelut	3 397,0	4 574,0	11,31	63 293,53
202	202 Hämeentie 153 B	U9	U9 Yhteiset Palvelut	649,0	649,0	11,31	7 340,19
22	22 Lämpömiehenkuja 2	U9	U9 Yhteiset Palvelut	3 473,2	4 675,3	18,38	85 931,89
220	220 Taik asunnot	U9	U9 Yhteiset Palvelut	119,4	119,4	14,02	1 673,99
23	23 Taiteiden talo	U9	U9 Yhteiset Palvelut	843,4	1 138,9	11,31	12 880,57
26	26 Betonimiehenkuja 3	U9	U9 Yhteiset Palvelut	1 516,7	1 740,2	11,31	19 681,71
27	27 Arkkitehtipaja	U9	U9 Yhteiset Palvelut	734,0	893,6	11,31	10 106,84
28	28 Otahalli	U9	U9 Yhteiset Palvelut	479,5	662,5	14,02	9 288,25
29	29 Sähkötalo 1	U9	U9 Yhteiset Palvelut	3 520,7	4 753,5	14,02	66 643,38
30	30 Tietotekniikan talo	U9	U9 Yhteiset Palvelut	1 545,0	2 172,4	14,02	30 457,09
31	31 Betonimiehenkuja 1	U9	U9 Yhteiset Palvelut	334,3	334,3	11,31	3 780,93
33	33 Innopoli 2	U9	U9 Yhteiset Palvelut	2 396,4	3 289,9	18,38	60 468,27
35	35 Falcon Gentti	U9	U9 Yhteiset Palvelut	2 805,0	4 569,8	18,38	83 992,72
36	36 Micronova	U9	U9 Yhteiset Palvelut	562,9	693,8	18,38	12 752,92

Aalto-yliopisto

Tiedekunnat, yhteenveto rakennuksittain (Käyttövuokra)

1.11.2011

Rnro	Rakennuksen nimi	Nro	Koulun nimi	Osuus hyöty-neliöistä	Huoneisto-neliöt	Eur/m²/kk	Yhteensä Eur/kk
37	37 TUAS	U9	U9 Yhteiset Palvelut	2 290,5	3 100,4	18,38	56 985,46
39	39 Metallimiehenkuja 10	U9	U9 Yhteiset Palvelut	765,0	1 095,3	14,02	15 355,88
50	50 Lahden tiede- ja yrityspuisto	U9	U9 Yhteiset Palvelut	13,1	16,1	15,12	243,70
71	71 Keskusväestönsuoja	U9	U9 Yhteiset Palvelut	500,0	500,0	11,31	5 655,00
72	72 Humaljärven tontti	U9	U9 Yhteiset Palvelut	1,0	1,0	0,00	0,00
73	73 Mäkkylän varasto	U9	U9 Yhteiset Palvelut	110,0	110,0	14,02	1 542,20
75	75 Konalan varasto	U9	U9 Yhteiset Palvelut	4 611,0	4 611,0	11,31	52 150,41
90	90 Asunnot	U9	U9 Yhteiset Palvelut	3 096,5	3 096,5	14,02	43 412,93
Yhteensä				**261 904,7**	**348 590,8**		**5 021 013,29**

Aalto-yliopisto

Laitokset, yhteenveto (Käyttövuokra)

2.9.2011

Nro	Laitoksen nimi	Osuus neliöistä	Huoneisto-neliöt	Vuokra Yhteensä Eur/kk	Vuokra Yhteensä Eur/v	Muut kust Yhteensä Eur/kk	Muut kust Yhteensä Eur/v	ALV 0%	Yhteensä Eur/kk	Yhteensä Eur/v
98	Ulkopuoliset vuokralaiset	4 108,9	6 055,0	48 547,00	582 564,06	13 816,41	165 796,91	0,00	62 363,41	748 360,97
99	Ulkopuoliset	22 162,5	27 892,1	449 709,00	5 396 508,00	106 798,10	1 281 577,16	0,00	556 507,10	6 678 085,16
A800	Deekaani	2 099,0	2 826,3	31 504,06	378 048,69	10 909,34	130 912,14	0,00	42 413,40	508 960,82
A801	Elokuva- ja lavastustaiteet	1 465,2	1 972,9	23 411,14	280 933,71	7 615,20	91 382,43	0,00	31 026,35	372 316,15
A802	Median laitos	3 617,1	4 870,3	59 494,89	713 938,64	18 799,34	225 592,12	0,00	78 294,23	939 530,76
A803	Muotoilun laitos	7 770,5	10 462,8	114 997,35	1 379 968,16	40 386,46	484 637,50	0,00	155 383,80	1 864 605,65
A804	Porin taiteen ja median laitos	709,0	713,5	2 788,29	33 459,42	1 793,65	21 523,75	0,00	4 581,93	54 983,17
A805	Taiteen laitos	6 306,2	8 357,8	101 614,33	1 219 371,99	32 261,13	387 133,57	0,00	133 875,46	1 606 505,57
A810	Mediakeskus Lume	6 082,2	8 189,5	140 404,08	1 684 849,02	31 611,51	379 338,14	0,00	172 015,60	2 064 187,16
A820	Länsi-Suomen muotoilukeskus	580,0	580,0	3 277,00	39 324,00	1 438,40	17 260,80	0,00	4 715,40	56 584,80
A830	Future Home Institute	150,5	202,6	3 460,26	41 523,09	782,21	9 386,47	0,00	4 242,46	50 909,56
E700	Dekaani	5 074,9	7 598,4	104 644,75	1 255 736,99	29 330,01	351 960,09	0,00	133 974,76	1 607 697,08
E701	Laskentatoimen laitos	426,9	668,0	9 058,36	108 700,31	2 578,56	30 942,71	0,00	11 636,92	139 643,02
E702	Markkinoinnin laitos	637,4	932,9	13 839,48	166 073,70	3 600,90	43 210,86	0,00	17 440,38	209 284,56
E703	Taloustieteen laitos	434,9	617,1	10 971,80	131 661,60	2 381,95	28 583,45	0,00	13 353,75	160 245,05
E704	Tieto-ja palvelutalouden laitos	855,7	1 335,9	18 427,37	221 128,39	5 156,75	61 881,00	0,00	23 584,12	283 009,38
E705	Viestinnän laitos	438,4	654,2	8 871,39	106 456,73	2 525,34	30 304,05	0,00	11 396,73	136 760,79
E706	Johtamisen laitos	2 092,7	2 572,2	34 938,04	419 256,45	5 777,31	69 327,77	0,00	40 715,35	488 584,22
E707	Rahoituksen laitos	490,5	767,5	10 407,88	124 894,59	2 962,72	35 552,59	0,00	13 370,60	160 447,18
E710	Center for Markets in Transition	310,6	457,6	6 205,43	74 465,19	1 766,44	21 197,32	0,00	7 971,88	95 662,51
E720	Center for Knowledge and Innovation Research	441,4	641,8	11 410,34	136 924,06	2 477,16	29 725,92	0,00	13 887,50	166 649,98
E730	Pienyrityskeskus	3 704,1	4 249,3	70 048,54	840 582,51	11 449,93	137 399,17	0,00	81 498,47	977 981,67
E740	ASE Research	422,5	633,5	10 976,26	131 715,13	2 445,13	29 341,56	0,00	13 421,39	161 056,69
E770	Service Factory	112,0	166,3	2 392,74	28 712,89	641,82	7 701,87	0,00	3 034,56	36 414,76
T100	T1 Dekaani	165,6	225,5	3 134,89	37 618,63	870,31	10 443,77	0,00	4 005,20	48 062,41
T101	Biotekniikan ja kemian tekniikan laitos	5 071,7	7 381,2	100 089,11	1 201 069,35	28 491,44	341 897,32	0,00	128 580,56	1 542 966,68
T102	Kemian laitos	3 436,5	5 001,4	67 818,41	813 820,90	19 305,24	231 662,88	0,00	87 123,65	1 045 483,78
T103	Materiaalitekniikan laitos	6 337,9	8 565,8	116 152,69	1 393 832,29	33 064,11	396 769,37	0,00	149 216,81	1 790 601,66
T104	Puunjalostustekniikan laitos	6 386,5	8 815,5	120 159,26	1 441 911,14	34 028,01	408 336,08	0,00	154 187,27	1 850 247,22
T200	T2 Dekaani	4 124,7	5 712,3	77 104,74	925 256,86	22 049,47	264 593,69	0,00	99 154,21	1 189 850,54
T201	Arkkitehtuurin laitos	4 446,6	6 293,0	82 426,25	989 114,97	24 290,85	291 490,16	0,00	106 717,09	1 280 605,12
T202	Energiatekniikan laitos	2 925,4	3 723,4	47 853,64	574 243,70	14 372,33	172 467,95	0,00	62 225,97	746 711,64
T203	Koneenrakennustekniikan laitos	5 429,0	6 834,7	80 178,58	962 142,95	26 382,11	316 585,36	0,00	106 560,69	1 278 728,31
T204	Sovelletun mekaniikan laitos	8 186,2	10 869,1	123 629,37	1 483 552,41	41 954,67	503 456,03	0,00	165 584,04	1 987 008,44

Aalto-yliopisto

Laitokset, yhteenveto (Käyttövuokra)

2.9.2011

Nro	Laitoksen nimi	Osuus neliöistä	Huoneisto-neliöt	Vuokra Yhteensä Eur/kk	Vuokra Yhteensä Eur/v	Muut kust Yhteensä Eur/kk	Muut kust Yhteensä Eur/v	ALV 0%	Yhteensä Eur/kk	Yhteensä Eur/v
T205	Maanmittaustieteiden laitos	1 402,1	2 278,7	40 300,35	483 604,21	8 795,85	105 550,20	0,00	49 096,20	589 154,41
T206	Rakenne- ja rakennustuotantotekniikan laitos	3 326,8	4 683,6	63 510,02	762 120,25	18 078,81	216 945,74	0,00	81 588,83	979 065,99
T207	Yhdyskunta- ja ympäristötekniikan laitos	3 722,4	4 992,1	71 326,50	855 918,01	19 269,43	231 233,16	0,00	90 595,93	1 087 151,17
T208	Lahden keskus	915,7	1 123,2	16 983,28	203 799,42	2 785,62	33 427,42	0,00	19 768,90	237 226,84
T209	YTK	599,3	765,9	10 385,21	124 622,58	2 956,26	35 475,16	0,00	13 341,48	160 097,74
T210	Design Factory	3 468,2	4 345,6	54 209,24	650 510,83	16 774,12	201 289,42	0,00	70 983,35	851 800,25
T300	T3 Dekaani	3 155,1	4 408,3	65 184,39	782 212,72	17 015,88	204 190,59	0,00	82 200,28	986 403,30
T301	Lääketieteellisen tekniikan ja laskennallisen tieteen laitos	2 325,7	2 972,1	40 301,84	483 622,11	11 472,35	137 668,24	0,00	51 774,20	621 290,35
T302	Matematiikan ja systeemianalyysin laitos	2 533,8	3 724,5	50 504,30	606 051,57	14 376,59	172 519,11	0,00	64 880,89	778 570,68
T303	Mediatekniikan laitos	1 581,9	2 180,6	34 452,56	413 430,66	8 417,23	101 006,77	0,00	42 869,79	514 437,43
T304	Teknillisen fysiikan laitos	4 964,8	7 029,9	113 013,28	1 356 159,31	27 135,35	325 624,23	0,00	140 148,63	1 681 783,54
T305	Tietotekniikan laitos	1 652,4	2 321,8	31 661,08	379 933,00	8 962,10	107 545,18	0,00	40 623,18	487 478,18
T306	Tietojenkäsittelytieteen laitos	1 789,2	2 515,9	34 114,93	409 379,15	9 711,18	116 534,18	0,00	43 826,11	525 913,33
T307	Tuotantotalouden laitos	3 330,9	4 519,3	80 353,15	964 237,83	17 444,50	209 333,97	0,00	97 797,65	1 173 571,80
T308	BIT-tutkimuskeskus	1 411,8	1 912,3	33 853,89	406 246,62	7 381,55	88 578,65	0,00	41 235,44	494 825,27
T309	Kielikeskus	570,6	729,2	9 887,88	118 654,50	2 814,69	33 776,28	0,00	12 702,57	152 430,78
T310	EIT	294,9	399,2	7 097,33	85 167,92	1 540,81	18 489,77	0,00	8 638,14	103 657,69
T311	Kylmälaboratorio	2 746,9	3 765,2	54 266,35	651 196,18	14 533,83	174 405,99	0,00	68 800,18	825 602,17
T312	HIIT/Tietotekniikan tutkimuslaitos	1 031,7	1 416,4	25 183,03	302 196,31	5 467,18	65 606,17	0,00	30 650,21	367 802,48
T400	T4 Dekaani	6 333,4	8 509,3	157 850,85	1 894 210,20	32 845,74	394 148,83	0,00	190 696,59	2 288 359,03
T401	Automaatio- ja systeemitekniikan laitos	2 211,7	2 993,7	53 228,75	638 744,95	11 555,85	138 670,16	0,00	64 784,59	777 415,11
T402	Elektroniikan laitos	1 432,9	1 925,6	25 792,33	309 507,94	7 432,70	89 192,36	0,00	33 225,02	398 700,29
T403	Mikro- ja nanotekniikan laitos	1 575,6	2 045,7	30 553,47	366 641,62	7 896,27	94 755,27	0,00	38 449,74	461 396,89
T404	Radiotieteen ja -tekniikan laitos	2 210,0	3 101,2	33 926,83	407 122,00	11 970,53	143 646,34	0,00	45 897,36	550 768,34
T405	Signaalinkäsittelyn ja akustiikan laitos	2 376,2	3 334,4	36 478,57	437 742,82	12 870,87	154 450,39	0,00	49 349,43	592 193,21
T406	Sähkötekniikan laitos	3 288,4	4 614,4	50 481,86	605 782,30	17 811,70	213 740,37	0,00	68 293,56	819 522,68
T407	Tietoliikenne- ja tietoverkkotekniikan laitos	2 221,7	3 117,6	34 106,74	409 280,87	12 034,01	144 408,06	0,00	46 140,74	553 688,93
T408	Metsähovin radiotutkimusasema	888,6	907,8	12 134,70	145 616,38	3 504,09	42 049,07	0,00	15 638,79	187 665,44
U900	President	714,6	961,6	17 096,99	205 163,83	3 711,72	44 540,63	0,00	20 808,71	249 704,46
U901	VP, Academic Affairs	1 312,8	1 806,8	25 736,87	308 842,43	6 974,39	83 692,65	0,00	32 711,26	392 535,09
U902	VP, Education	545,2	730,9	10 195,51	122 346,08	2 821,11	33 853,37	0,00	13 016,62	156 199,46
U903	VP, Infrastructure	25,2	33,9	602,92	7 235,00	130,89	1 570,70	0,00	733,81	8 805,70
U904	Knowledge Networks	561,9	777,1	11 136,57	133 638,83	2 999,77	35 997,24	0,00	14 136,34	169 636,07

Aalto-yliopisto

Laitokset, yhteenveto (Käyttövuokra)

2.9.2011

Nro	Laitoksen nimi	Osuus neliöistä	Huoneisto-neliöt	Vuokra Yhteensä Eur/kk	Vuokra Yhteensä Eur/v	Muut kust Yhteensä Eur/kk	Muut kust Yhteensä Eur/v	ALV 0%	Yhteensä Eur/kk	Yhteensä Eur/v
U905	Finance	1 555,4	2 278,8	35 992,98	431 915,78	8 796,29	105 555,47	0,00	44 789,27	537 471,24
U906	Human Resources	161,3	217,0	3 859,14	46 309,72	837,81	10 053,74	0,00	4 696,96	56 363,46
U907	Foresight and Policy	468,1	650,6	9 182,80	110 193,57	2 511,22	30 134,69	0,00	11 694,02	140 328,27
U908	Communications	152,3	204,9	3 643,22	43 718,62	790,93	9 491,22	0,00	4 434,15	53 209,83
U909	IT	3 927,7	5 923,2	91 447,41	1 097 368,90	22 863,45	274 361,39	0,00	114 310,86	1 371 730,29
Yhteensä		**189 790,1**	**257 057,7**	**3 589 983,79**	**43 079 805,54**	**969 407,01**	**11 632 884,15**	**0,00**	**4 559 390,81**	**54 712 689,69**

Aalto-yliopisto

Rakennukset

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Rnro	Rakennus	Osoite	Postinumero	Postitoimip	Omistaja	Bruttoala brm²	Rakennuksen huoneala hum²	Aalto huoneala hum²	Muut käyttäjät huoneala hum²
01	01 Päärakennus	Otakaari 1	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	50 184,4	44 478,5	27 315,1	
02	02 Rakennus- ja ympäristötekn.	Rakentajanaukio 4	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	11 242,2	9 450,1	9 165,8	
03	03 Teknillinen fysiikka	Rakentajanaukio 2 C	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	15 917,3	13 715,4	6 715,8	4 825,9
04	04 Sähkötekniikka	Otakaari 5	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	29 040,5	25 310,4	24 328,0	
05	05 Konetekniikka 4	Sahkomiehentie 4	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	9 389,5	7 760,0	6 942,7	
06	06 Konetekniikka 3	Puumiehenkuja 5	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	8 868,3	8 064,2	6 213,6	
07	07 Konetekniikka 2	Puumiehenkuja 3	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	3 253,2	2 786,2	2 670,7	
08	08 Konetekniikka 1	Otakaari 4	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	8 312,6	7 571,2	6 929,2	181,4
09	09 Nanotalo	Puumiehenkuja 2	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	8 553,2	6 815,0	5 792,0	
10	10 Tilapalvelut	Konemiehentie 4	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	719,8	599,2	557,8	
11	11 Kemian tekniikka	Kemistintie 1	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	19 254,1	17 339,8	14 027,0	
12	12 Materiaalitekniikka	Vuorimiehentie 2	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	12 650,0	11 217,0	10 495,0	
13	13 Puunjalostustekniikka 1	Vuorimiehentie 1	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	6 873,4	6 369,4	5 891,5	
14	14 Puunjalostustekniikka 2	Tekniikantie 3	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	4 465,6	3 681,9	3 315,6	
15	15 Kirjasto	Otaniementie 9	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	9 889,5	8 942,2	8 486,5	
16	16 Meritekniikka	Tietotie 1	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	11 849,5	10 872,9	10 377,4	
17	17 Maarintalo	Sahkomiehentie 3	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	3 770,4	3 403,0	2 341,0	1 003,3
18	18 Saha	Konemiehentie 1	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	469,9	414,4	404,0	
19	19 Dipoli	Otakaari 24	02150	ESPOO	AYY	12 447,8	10 907,4	9 268,1	444,1

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Rnro	Rakennus	Osoite	Postinumero	Postitoimip	Omistaja	Bruttoala brm²	Rakennuksen huoneala hum²	Aalto huoneala hum²	Muut käyttäjät huoneala hum²
20	20 Ostoskeskus	OTAKAARI 11	02150	ESPOO	Rexland Oy	825,2	655,6	112,5	542,3
21	21 Kirjanpito- ja maksuliikepalv	Otakaari 8	02150	ESPOO	Senaatti Kiinteistöt	1 509,6	1 309,4		
22	22 Lämpömiehenkuja 2	Lämpömiehenkuja 2	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	7 632,4	6 631,3	5 259,2	716,7
23	23 Taiteiden talo	Lämpömiehenkuja 3	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	4 762,5	4 200,4	3 665,1	323,9
25	25 Design Factory	Betonimiehenkuja 5	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	3 926,4	2 997,6	2 545,1	74,4
26	26 Betonimiehenkuja 3	Betonimiehenkuja 3	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	3 641,3	3 235,8	1 740,2	1 072,1
27	27 Arkkitehtipaja	Metallimiehenkuja 4	02150	ESPOO	Senaatti Kiinteistöt	2 375,0	2 204,5	2 053,5	
28	28 Otahalli	Luolamiehentie 7	02150	ESPOO	Otahalli Oy	773,5	664,0	662,5	
29	29 Sähkötalo 1	Otakaari 7	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	12 377,5	11 133,7	7 271,5	2 373,6
30	30 Tietotekniikan talo	Konemiehentie 2	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	12 990,5	11 772,6	10 815,4	
31	31 Betonimiehenkuja 1	Betonimiehenkuja 1	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy		334,3	334,3	
33	33 Innopoli 2	Tekniikantie 14	02150	ESPOO	Technopolis Oyj	6 895,0	5 604,0	5 500,6	83,6
34	34 Vesilaboratorio	Tietotie 1 E	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	2 731,5	2 365,5	1 271,4	1 010,1
35	35 Falcon Gentti	Vaisalantie 8	02130	Espoo	Aberdeen Property Fininvest Delta Oy	8 444,0	11 735,0	6 797,5	
36	36 Micronova	Tietotie 3	02150	ESPOO	Senaatti Kiinteistöt	26 380,2	22 444,3	4 955,2	12 684,4
37	37 TUAS	Otaniementie 17	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy	18 112,4	16 357,4	15 099,2	
39	39 Metallimiehenkuja 10	Metallimiehenkuja 10	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy		1 218,7	1 095,3	
50	50 Lahden tiede- ja yrityspuisto	Niemenkatu 73	15110	Lahti	Lahden tiede- ja yrityspuisto Oy	1 372,6	1 786,8	1 155,9	627,0
70	70 Metsähovin radiotutkimusasema	Metsähovintie 114	02540	Kylmälä	Aalto-Yliopistokiinteistöt Oy		841,0	841,0	
71	71 Keskusväestönsuoja	Otakaari 1	02150	ESPOO	Aalto-Yliopistokiinteistöt Oy		500,0	500,0	
72	72 Humaljärven tontti	Humaljärvi	02540	Kylmälä	Senaatti Kiinteistöt		1,0	1,0	
73	73 Mäkkylän varasto	Turuntie	02150	ESPOO	Senaatti Kiinteistöt		110,0	110,0	
74	74 LVI-koetalo	Otaniemi	02150	ESPOO			25,0	25,0	
75	75 Konalan varasto	Honkasuontie 13	00390	Helsinki	Sponda Oyj		4 611,0	4 611,0	

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Rnro	Rakennus	Osoite	Postinumero	Postitoimip	Omistaja	Bruttoala brm²	Rakennuksen huoneala hum²	Aalto huoneala hum²	Muut käyttäjät huoneala hum²
90	90 Asunnot	Otaniemi/Tapiola/Munkkiniemi					3 096,5	3 096,5	
Yhteensä	Espoo					**341 900,8**	**315 533,6**	**240 755,7**	**25 962,7**
101	101 HSE Päärakennus	Runeberginkatu 14-16	00100	Helsinki	Aalto-Yliopistokiinteistöt Oy	16 043,0	12 650,1	11 453,1	
102	102 Arkadia	Arkadiankatu 24 / Lapuankatu 6	00100	Helsinki	Aalto-Yliopistokiinteistöt Oy	7 999,0	6 508,8	5 922,1	
103	103 Chydenia	Runeberginkatu 22-24	00100	Helsinki	Aalto-Yliopistokiinteistöt Oy	8 104,5	6 540,8	6 089,8	
104	104 Economicum	Arkadiankatu 7	00100	Helsinki	HY rahastot	3 592,5	2 921,0	649,1	2 041,9
106	106 Fredrikinkatu 48	Fredrikinkatu 48	00100	Helsinki	Tapiola	1 200,0	985,8	982,4	
107	107 Helecon tietokeskus	Leppäsuonkatu 9	00100	Helsinki	HYY	2 641,5	2 251,8	2 182,6	
108	108 Arkadiankatu 28	Arkadiankatu 28	00100	HELSINKI	AYY	4 229,5	3 207,7	2 734,3	
109	109 Technopolis	Hiilikatu 3	00180	Helsinki	Technopolis Oyj	1 336,0	1 336,0	1 336,0	
110a	110a Lönnrotinkatu 5	Lönnrotinkatu 5	50100	Mikkeli	KOY Mikkelin tietotaitokortteli		1 025,0	1 025,0	
110b	110b Lönnrotinkatu 7	Lönnrotinkatu 7	50100	Mikkeli	KOY Mikkelin tietotaitokortteli	1 333,5	1 333,5	1 333,5	
120	120 HSEn Asunnot						1 113,0	1 113,0	
121	121 Mikkelin asunnot						360,0	360,0	
201	201 Hämeentie 135	Hämeentie 135	00560	Helsinki	Keskinäinen työläkevakuutusyhtiö Varma	46 675,5	40 341,7	39 188,2	
201a	201a Mediafactory					649,0	649,0	649,0	
201b	201b Tutkijat					268,0	268,0	268,0	
201c	201c 5krs lisätila					2 500,0	2 500,0	2 500,0	
202	202 Hämeentie 153 B	Hämeentie 153 B	00560	Helsinki	Arabian yritystalo Holding Oy	649,0	649,0	649,0	
210	210 Vaasa	Wolffintie 36 F 11	65200	Vaasa	Palosaaren Yrityskeskus Oy	580,0	580,0	580,0	
211	211a Siltapuistokatu 2	Siltapuistokatu 2	28100	Pori	Prizztech Oy	371,0	371,0	371,0	
211b	211b Pohjoisranta 11	Pohjoisranta 11	28100	Pori	Renor Oy	325,0	325,0	325,0	
220	220 Taik asunnot						119,4	119,4	
Yhteensä	Helsinki					**98 497,0**	**86 036,6**	**79 830,5**	**2 041,9**

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Rnro	Rakennus	Osoite	Postinumero	Postitoimip	Omistaja	Bruttoala brm²	Rakennuksen huoneala hum²	Aalto huoneala hum²	Muut käyttäjät huoneala hum²
Yhteensä						440 397,8	401 570,2	320 586,2	28 004,6