Strategic Management of University Real Estate supported by BIM

An application to the real estate of the Greek University A.U.Th.

AR3R030 MSc 3 Real Estate Management laboratory
P5 Report

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PREFACE

This is the final research report , prepared for the P5 formal assessment. It is prepared in the AR3R030 MSc 3 Real Estate and Management laboratory by George E. Tzovlas under the supervision of Alexander Koutamanis as the first mentor and Alexandra den Heijer as the second mentor. The research fits in between the research subject of Educational Real Estate Strategies and Briefing and Evaluation of Buildings, associating and connecting two levels; real estate portfolio and building object, in an attempt to provide a complete approach between strategy and its implementation.

The cause of this research lies in the events of the past three years. The outbreak and escalation of a global financial crisis, and its implications as a set of interdependencies, on Greece. The effects of an escalating social, as well as financial crisis of a nation, reflected in the Higher Education sector. A societal sector that has the potential to contribute in the long term development of a nation, adding value to both the society and the economy.

The aim of the research is to provide a rational view on the management process of a university's requirements and available resources during an ongoing crisis; explore the current possibilities and future alternatives, and suggest a plan of action. Therefore, the research objective concerns the examination of a Greek university's real estate property (Aristotle University of Thessaloniki) and the development and application of a method, that will further contribute towards increased professionalization in the organization's decision making process.

Relevant theoretical insights are analyzed in order to develop a conceptual framework that will enable the deduction of hypotheses from theory to practice and the induction of empirical results to theory. In this research, the operational tool that supports the management process based on applied CREM theories is BIM (Building Information Modeling); in this sense, increased information management efficiency will support and enable more effective management.

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ABSTRACT

In this research the case of the Greek university Aristotle University of Thessaloniki is addressed, focusing on the university's real estate property, as one of its corporate resources. In this sense, real estate decision making is related with the performance of the organization. Therefore, the university's real estate should be managed in such a way, that its performance will ultimately support and optimally contribute to the organization's objectives.

The research methodology is twofold; theoretical and empirical. Literature research provided information from applied theories of relevant scientific fields; CREM/PREM and its application in the case of higher education institutions; moreover theories for Building Programming and Information Management through BIM, provide the foundations of the theoretical framework for examining the real case. Research objectives and the means for achieving them have been defined, from a thorough problem analysis to the formulation of the research question. The first chapter of the report, is about the Research Proposal, In which the following question is raised; "*In which ways the decision making for A.U.Th. real estate can further be professionalized?*".

The second chapter of this report presents theoretical input about university real estate management and building programming, connecting two scale levels; real estate portfolio and building object. In addition to that, a tool for information management (BIM) is explored. University real estate management literature research defines a framework (DAS) upon which decisions for real estate should be taken, through four management tasks; different stakeholder perspectives and requirements have to be balanced and incorporated in the decision, matching demand and supply in various time frames. Being able to define general portfolio objectives, Building Programming allows for further elaboration on their degree of applicability in specific building projects and consequently, generates feedback for the decision makers. By using BIM as a tool, building information is not only valid through verification, but it is also integrated into one coherent system for future decision making.

In the third chapter the empirical results of the A.U.Th. analysis are presented, after conducting the first two management tasks. In the first task, the current state of the university's real estate corporate (80% of it on-campus) and investment portfolio(off-campus) is defined, through a quantitative analysis of KPIs. Without any striking differences in the university's real estate and users, the main problem was identified in the organization's reduced budget, raising the issue of cost-efficient accommodation.

In the second task various future demand models are explored. The similarities in the administrative structure of Greek and Dutch Higher Education (public universities) provided the possibility for a comparative analysis. Benchmarking KPIs from the Dutch Higher Education allows for the adoption of new performance standards for A.U.Th.; in this sense, it is possible to assess the degree of fitness between the current supply of real estate and the future demand for it, depicted in a list where each faculty of A.U.Th. is sorted .

The results of this task shows that A.U.Th. finances are considerably lower than that of Dutch Universities of similar physical size. Next to that, A.U.Th. accommodates more than double the students in the same square meters compared to a Dutch University. In general, A.U.Th.'s educational space per student is below the Dutch average, whereas on the other hand, office or administrative space per FTE employee is higher. Finally, the A.U.Th.'s investment level per square meter (€/m2) is naturally identified lower than the Dutch average; still, it is necessary to identify whether the current space quality of A.U.Th. is acceptable, up to which degree it might be raised in the future and what this will mean for the university's decision makers.

Following the previous step with questions regarding the quality of space, the research continues by addressing qualitative aspects of real estate decision making; urban economics provide the theoretical background to explore the relation between location and accommodated functional mix. In a sense, the goal of cost efficiency is tackled from both the demand and supply side, exploring both reduction of costs and increase of revenues, looking for an optimal investment decision. Should A.U.Th. focus on-campus or off-campus and why?

The chapter concludes with aspects that is possible to influence the physical expression of a university, and consequently presents three different universities strategies, as future development models for A.U.Th. and their implications for the university. From the current Classical model, to the Network or Virtual University, strategic and financial decisions for A.U.Th. are explored through brief SWOT analyses for each model.

In the fourth chapter the faculty in which the biggest deviation from the adopted standards was observed, is selected; the School of Journalism and Media. With the research being process oriented, dealing with a management problem, a plan of action for the specific building case is designed. In this sense, the results of the previous stages can be tested and ultimately aligned to the current A.U.Th.'s goals. From a conceptual process framework, in which a generic dual question "*Where and What*" defines its outline, a process that covers both the strategic and operational considerations is developed, connecting the A.U.Th. portfolio requirements to the specific project.

The alignment begins with the development of the project's design brief, which will guide the design phase. The project's quality aspirations is translated into quantifiable requirements that the design should deliver. In the end, the most sustainable design alternative can be selected, in accordance to the university's strategic requirements. The realization of the design should ultimately generate new building performance standards for the university.

Still, besides the main alignment process steps, the designed process also incorporates four preliminary steps; from the top-down decision making about the university's performance, to the project's strategic and operational assessment. Thereafter, the project's related information is integrated into a BIM data-base, which will support the real estate decision (the essence of CREM) with valid information. From this point and on, 4D BIM (time) allows for simulation of different scenarios, enhancing the forecasting capacity of the organization, thus its strategic management.

In the fifth chapter, the end product, the designed process, is assessed, leading to the research results. The research concludes with recommendations for the evolution of the A.U.Th.'s CREM; from a reactive incremental approach of the past, to a rational assessment of today, which will initially tackle the current problem and consequently lay the foundations for a sustainable long-term development.

The designed process is not only suitable for the specific organization examined in the research, but it can be applied in CREM cases in general. In a sense, the research as well as its end product suggest a CREM approach that is about the life-cycle of real estate, in different levels. In fact, the management of consequent cycles of real estate depending on the selected time frame (from short term, 1-2 years to long-term, 10 years or more), in which input and output information should be weighted and assessed, generating strategic insights.

CHAPTER 1

1.1 INTRODUCTION

MOTIVATION

Having spent one year following the curriculum of the master programme Real Estate & housing in the Delft University of technology, I have been faced with the basic domains offered by this programme; Design & Construction Management, Housing Policy, Management & Sustainability, Real Estate Management and Urban Area Development, supported at the same time with basic fundamental knowledge in the field of Building Economics and Building Law. This multi-faceted involvement with different -but at the same time similar- subjects concerning the construction industry was rather beneficial, as it allowed me to develop a broader understanding and familiarize myself with various perspectives.

Following the development of a basic theoretical background in the MSc1, the courses provided in the MSc2 were the first chance to test and apply the knowledge of the previous semester. AR2R025 -Urban (re)Development Game was a first realization of the importance of the various stakeholders and their interests involved in a project, and how these different perspectives should be managed in order to achieve a common goal. At the same time the development of an accommodation strategy for the Rotterdam airport was the moment where the theories of CREM were for the first time combined through the DAS framework, enabling me to test their applicability in a real case.

In the same sense, the course AR2R035- Re design; From Area to Building Block provided me with another opportunity to work again on real cases. It was especially interesting to work on the development of a brief for the TU Delft faculty of Architecture (Bouwkunde); that is because my previous graduation project was also concerned with the architectural design of a higher education faculty. For this project it was necessary to look for programmes of requirements in relevant precedents, in order to develop the new one, that would provide the basic guidelines for the architectural design. However the specific practice was concerned more about the specification of spatial and functional requirements rather than a complete design brief. On the other hand, reflecting back on the case of the brief for Bouwkunde, the considerations about the increased complexity of the building processes, the turbulent real estate market and the huge variety of aspects and actors that had to be taken into account, revealed the hidden potential of a good briefing document in terms of requirements' definition and cost control.

VISION

My vision about the specific research project is to examine the real estate of Aristotle University of Thessaloniki and develop a method which will contribute towards a more rationalized and professionalized decision making for real estate. Real estate will be analyzed quantitatively, in a dual way; portfolio requirements will be linked to object specific requirements, assessing the relation between supply of and demand for real estate, in the present and in the future . The collected data need to be organized in a coherent and comprehensive system employing BIM as a tool. Looking into the long term future of the organization, portfolio assessment will provide useful insights; in order to deepen the research and tackle specific questions raised on portfolio level, selected cases of building objects will be examined. In this sense it will be possible to acquire additional information, which will be evaluated and -if possible- generate generalizations which will be applicable to the portfolio level again.

RELEVANCE

Scientific Relevance

The research is conducted in the Real Estate Management graduation lab. It fits in between the research subject of Educational Real Estate Strategies and Briefing and Evaluation of Buildings, as an attempt to link the strategic and operational level of university real estate. During the research, theories and tools for evidence based decision making will be reviewed. The purpose of a scientific study is to widen and deepen the development of the scientific discipline related to the topic of the research by theory development, new methods and techniques of study, policy instruments and product development (De Jong, Van der Voordt, 2005).

The fundamental theoretical background is that of Corporate Real Estate Management. Moreover, considering the fact that the examined universities are public institutions it would be beneficial to examine in which way Public Real Estate Management theories can be related to the research topic. Finally, regarding the research subject, University Real Estate Management -or Campus Management- theories will be the backbone of the theoretical framework of this research. Considering that, the following scientific fields will also be addressed in order to explore and acquire specific information about;

1. Programming and evaluation of buildings
2. Building Information Modelling -BIM

Social Relevance

Universities are valuable social as well as financial assets of a society. The research addresses the decision makers of a university, with respect to the contribution of university real estate in the overall organization's performance. Campus management should aim at contributing towards the university's objectives, while real estate performance should be monitored and evaluated in order to support and justify managerial actions. According to Jordan et al. (2009) organizations need to develop the ability to collect, analyze and act on data, so that it will be possible to create and communicate clear and substantive performance metrics that link real estate objectives to organizational objectives (Jordan et. al.,2009 in De Jonge et al., 2010). In this sense the research concerns the decision makers in the field of University REM specifically, but also to CRE executives in a broader scope; it is about a method for rationalized and professionalized decision making for an organization's real estate.

1.2 CREM THEORETICAL INSIGHTS

REAL ESTATE

Real estate origin lies in people necessity to be protected, able to perform their activities effectively and efficiently in a pleasant, safe and healthy environment. It reflects society and at the same time facilitates and constitutes society, being a very important economic aspect of a country's economy as its most expensive capital good (De Jonge et al., 2009). Real estate is tangible and immovable (immovable property) and it comprises of land (resources on it or in its subsoil) and constructions erected on it and the rights attached to them (buildings, infrastructure) (De Jonge et al., 2009). Real estate functions are multi faceted; Van der Voordt and Van Wegen in Architecture in Use (2005) suggest that buildings facilitating activities, protecting people against weather and violent actions, expressing special meanings and adding economic value. Their arguments are based on the work of Hillier and Leaman (1976) who provide four main functions of buildings (De Jonge et al., 2009):

1. Spatial Organization of Activities
2. Climate Regulation
3. Symbolic Function
4. Economic Function

The first two functions are defined as utility functions whereas the rest are cultural functions (De Jonge et al., 2009). Following this kind of classification, professional literature by Vijerberg (2003) and De Jonge et al. (2009) distinguishes four types of real estate object life cycles in relation to their function (De Jonge et al., 2009).

1. Technical life – Climate Regulation; the technical life span is the period during which the real estate object meets the technical and building physical performance requirements for enabling the use of the building and guaranteeing its users' health and safety.
2. Functional life – Spatial Organization of Activities; the functional life span is the period during which the real estate object meets the functional requirement s of its users.
3. Economic life – Economic Function; the economic life span is the period during which the income of the real estate object exceeds the expenditure for the owner.
4. Symbolic or Social life – Symbolic function

In general, the life of a building is defined as the period during which it is possible for the owner to realise a positive balance between costs and benefits. At the same time, the ever-changing market circumstances and the type of owner, both influence the economic life of buildings. An owner-occupier would use a broader definition of benefits including often intangible benefits, whereas a commercial real estate owner would focus to the revenues generated by a building, translating income into capital. The required performance level is also increasing over the years, with organizations usually having increasing demands over the functional and structural quality (De Jonge et al., 2009).

MANAGING REAL ESTATE

Real estate management can be distinguished into two main specializations, depending on the management perspective. The first one would be Portfolio management which is also referred as Real Estate Management (REM) or real estate management by investors. In this perspective a more specific view is adopted striving for a return on investment, directly generating income from real estate. The second specialization is twofold, differentiated by the steering authority, which can be either private or public. Thus, Corporate Real Estate management (CREM) refers to real estate management steered by private organizations of businesses, while Public Real Estate Management (PREM) is conducted by public parties (De Jonge et al., 2009).

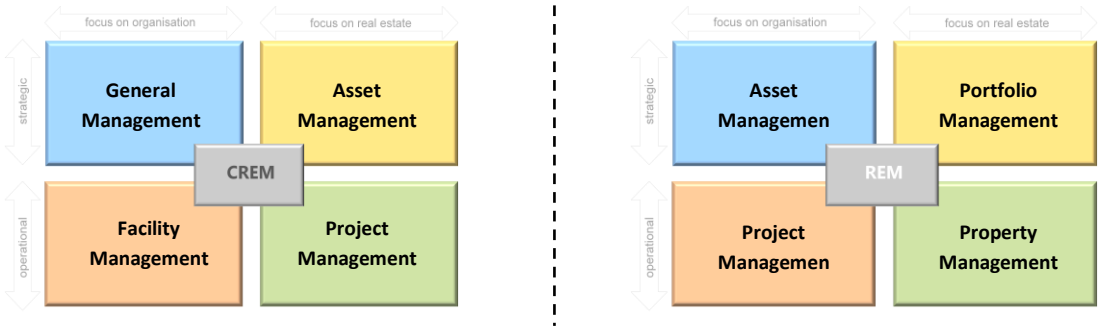


Figure 1. CREM versus Portfolio Management or REM. Source: De Jonge et al., 2009

De Jonge (1994) positions CREM and PREM in terms of a match between business –as the demand side- and real estate –as the supply side, connecting the strategic and operational level. These four perspectives have been translated in four different domains of CREM; General Management, Asset Management, Facility Management and Project Management. CREM/PREM should aim at optimally attune corporate accommodation to organizational performance, adding value to organizational objectives and indirectly generating income (De Jonge,1994 in De Jonge et al., 2009). CREM not only has to meet the organizational technical, functional and financial requirements but also has to contribute to the organizational overall performance.

The existing body of knowledge makes a distinction in Corporate Real Estate Management(CREM) and Public Real Estate Management (PREM). The difference between CREM and PREM is in the steering on real estate by private organizations and companies or by public parties. The external and internal context of organizations determines why organizations behave and act the way they do. Therefore, the content and process of real estate management are also influenced by the context. The corporate and public sector have different internal and external context. Corporate and public organizations have fundamentally different goals; corporations get their income mostly from consumers, while governments get their income from tax-payers. Corporations are mostly operating in a competitive environment while governments can be characterized as monopolies.

At first, these characteristics give different incentives: governments normally do not think about making profit on investments, they focus on the costs of civil services and they do not use the real estate as an investment. Secondly, in public real estate management, governments' political steering and governance can attribute political value to real estate. Thirdly, due to the nature of political steering, public real estate managers have to deal with more external stakeholders than their colleagues in the private sector (Van der Schaaf,2002 in Michielsen, 2009)

Development Stages of Real Estate Management

The current real estate industry focusing on the existing stock rather than on development opportunities operates more like a service rather than a product industry. The transformation of both internal real estate units and external provides reflects a new service orientation, shifting real estate from the “nuts and bolts” toward “strategy”. This orientation places real estate executives in the same relation to broader corporate strategic planning, rethinking and retooling their basic organizational strategies (Joroff et. al., 1993). Corporate real estate managers can either stick to their traditional task or assume new and complex roles that influence the future of their companies. In the later case, the adoption of a new mentality is necessary in order to deal with the new challenges of today (Joroff et. al., 1993). Based on empirical evidence, Joroff (1993) defines five different approaches to real estate management, specifying the role a corporate real estate unit has to fulfil. The five stages are :

1. **Task-manager**: Real estate management has a technical focus, supplying the organization with the required physical space. The specific exercise is to engineer buildings.
2. **Controller**: The primary objective is transparency and cost minimization of real estate. It is an analytical approach, looking for information about real estate and trying to benchmark it in order to control it.
3. **Dealmaker**: The corporate real estate unit solves real estate problems so that it creates financial value for the organization. It no longer specifies that building in the way the organization demands, but works toward a standardized building use in order to get a flexible deal in its internal market.

4. **Entrepreneur**: The corporate real estate unit operates like an internal real estate company, proposing real estate alternatives to the business unites that match those of the firm's competitors. It tries to match the real estate with the business plans of the units and the market options.
5. **Business Strategist**: The corporate real estate unit anticipates business trends: it monitors and measures their impact. It tries to contribute to the value of the company as a whole by focusing on the company's mission rather than on real estate.

Each stage being more complicated than its previous one, adds on a new role in the search for real estate value. The first three stages occur mainly through project-level work related to the internal needs of the organization. In these stages real estate decisions are based on cost-quality considerations, where corporate real estate has to be efficient (De Jonge et al., 2009). The fourth stage – Entrepreneur deals with portfolio-wide needs and focuses outward to trends affecting the corporate units. In the second, third and fourth stage, real estate decisions are based on cost-quality considerations, where corporate real estate has to be efficient (De Jonge et al., 2009). The fifth stage tackles organizational-wide competitiveness, taking into account more stakeholders outside of the traditional organizational bounds (Joroff et al., 1993). It is not only necessary to realise the corporate accommodation and the required quality efficiently but it also needs to be effective for the business as a whole.

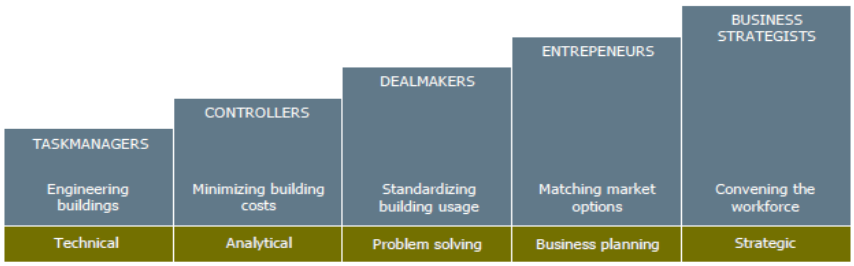


Figure 2. Five development stages of CREM. Source: Joroff et al., 1993

As the organizational stages evolve from Taskmaster to Strategist, the benefits obtained by stakeholders evolve from short-term to long-term. Each successive level brings the real estate unit closer to the senior corporate management, with real estate professionals striving to introduce new sources of value within each of them. The five stages are not mutually exclusive. Most organizations exhibit characteristics of more than one stage at the same time. In most organizations management seems aware of the contradictions between the five stages; layering or accumulating these strategies –of each stage- is one way of resolving the occurring contradictions. When adding each new layer's concern, real estate decision making complexity increases, adding a new element on the one hand but without necessarily eliminating familiar concerns on the other (Joroff et al., 1993).

The Added Value of Real Estate

In the research paper "The Added Value of FM; Different Research Perspectives" (Jensen et al., 2010), various research perspectives and theoretical reflections on the way real estate contributes to an organization core businesses are presented and compared. With the FM Value Map of Jensen (2009) as starting point different definitions and focus points of RE added value were identified, based on the academic field and the area of application (Jensen et al., 2010). The FM Value Map is a conceptual framework to understand and explain the different ways that FM can create value for a core business as well as the surroundings for the benefits of multiple stakeholders: owners, staff, customers and society. It maps which resources FM uses as inputs into the internal processes to produce outputs like space, services, development and relations, and which impacts the provisions from FM can have on core

business in terms of satisfaction, cost, productivity, reliability, adaption, and culture, and on the surroundings in terms of economical, social, spatial and environmental aspects (Jensen et. al, 2010).

The findings from the field of CREM hardly provided a list of performance indicators; the only exceptions are the research of Lindholm et. al (2006) and De Vries et al (2008) (Jensen et al., 2010). Lindholm developed a framework with a set of strategies and performance measurement systems that can be used to evaluate how the real estate strategy can add value to the firm (Figure 3). Following Lindholm's research, De Vries proposed a theoretical model of the impact of real estate interventions on organisational performance and tried to trace quantitative values of the effects. The added value of CRE/FM was defined as the contribution of real estate interventions to productivity, profitability and competitive advantage(Jensen et al., 2010). The two tables bellow summarize the ways real estate contributes to the organizational objectives.

Lindholm et al., 2006, 7RE strategies

Business Approach	RE Strategy Level
Revenue Growth	1.Increase Asset Value
Revenue Growth	2.Promote Marketing & Sale
Revenue Growth	3.Increase innovation
Revenue Growth	4.Increase Employee
Profitability Growth	Satisfaction
Profitability Growth	5.Increase Productivity
Profitability Growth	6.Increase Flexibility
Profitability Growth	7.Reduce Cost

De Vries et al., 2008, 10 RE strategies

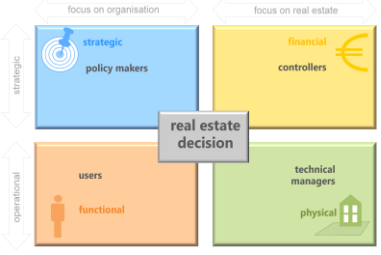
Business Approach	RE Strategy Level
Productivity	1.Stimulate Innovation
Productivity	2.Increase Satisfaction
Productivity	3.Enhance Synergy
Profitability	4.Enhance Flexibility
Profitability	5.Reduce Cost
Profitability	6.Controll Risk
Profitability	7.Expand Funding Possibilities
Distinctiveness	8.Increase Productivity
Distinctiveness	9.Support Image
Distinctiveness	10.Improve Culture

Figure 3. The added value of RE. Lindholm's 7 and De Vries 10 ways of added value. Source: De Jonge et al., 2009

CREM STAKEHOLDERS

Different stakeholders are often after different objectives even in the case where an organizational strategy exists and is explicitly stated. Real estate decision making should always incorporate the interests of various involved stakeholders. These interests should be weighted over time as a result of the ever changing demand and the obsolescence of the supply, where demand is the accommodation requirements and supply the existing accommodation.

According to Den Heijer and De Vries (2004) there are four types of stakeholders; 1.Managers, 2.Financiers, 3.Users and 4.Controllers (De Jonge et al., 2009). Moreover, Den Heijer (2006) combined the development stages of Joroff and aligned them with the four stakeholder perspectives and variables. The fourth stage of Joroff's model, entrepreneur, if examined from a multiple stakeholder perspective, matches that of the second and third stage. Moreover in the fourth stage the real estate function is outsourced or it is organized as that(De Jonge et al., 2009) .



Functions	Dev. Stages	Stakeholder	Adding Value
Technical Life	Taskmanager	Tech. Manager	Productivity
Functional Life	Controller	Controller	Profitability
Economic Function	Dealmaker	User	Productivity & Profitability
Symbolic Function	Strategist	Policy Maker	Distinctiveness

Entrepreneur

Figure 4. Combining the four perspectives of observation, Den Heijer (2006). Source: De Jonge et al., 2009

ACCOMMODATING AN ORGANIZATION

Real estate management is an ongoing process of matching the qualities of real estate and the demands of its users. During this process it is important to look ahead, foreseeing and forecasting possible mismatches between supply and demand. The way occurring mismatches can be tackled can be either proactive -ex ante, preventing them by reflecting on long term changes- or reactive -ex post, correcting them afterwards. However, due to the nature of real estate, a reactive approach has serious disadvantages. One way for providing accommodation for an organization is the DAS framework (Designing an Accommodation Strategy) (De Jonge et al., 2009) .

It is an iterative process with four key steering events, stimulating a structured approach for providing corporate accommodation. This process is suitable for both simple and complex real estate decisions, by examining demand (objectives) and supply (resources) and incorporating the input of various stakeholders. DAS framework can be employed for all types of real estate, on different scale levels and for different time frames; there is not a prescribed starting point, but during the process every stage will be viewed, sometimes even more than once. The four key steering events, presented in the following scheme (Figure 5) are:

1. Determination of the mismatch between current demand (CD) and current supply (CS)
2. Determination of the mismatch between future demand (FD) and current supply (CS)
3. Evaluation and selection of alternative solutions for the mismatch
4. Planning of the transformation of CS into selected future supply (FS) -step by step plan.

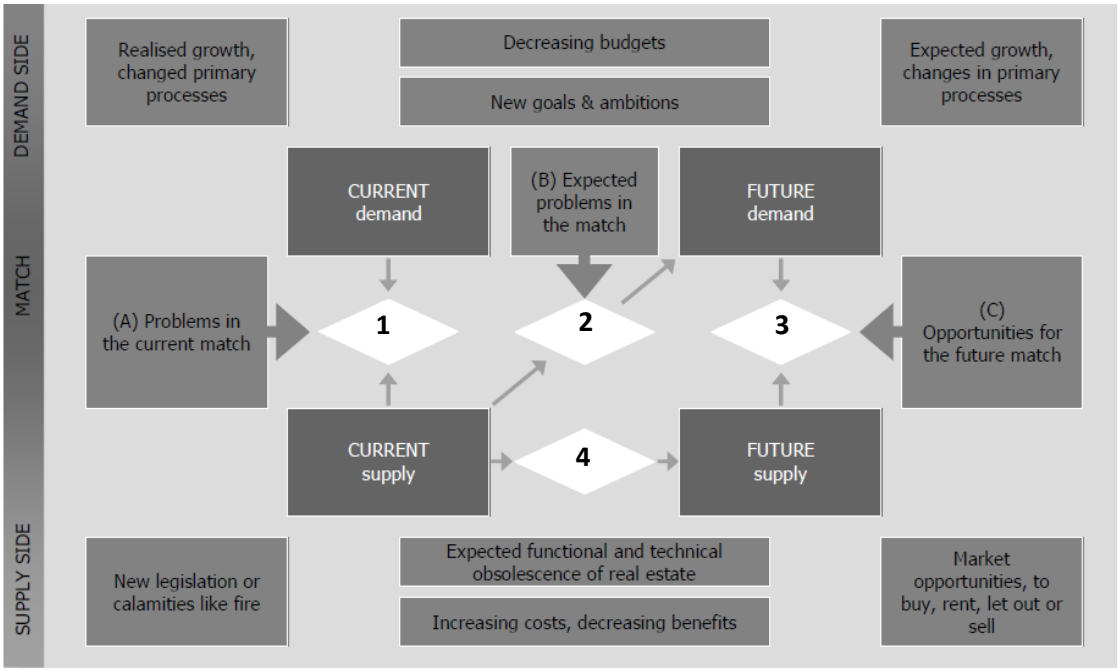


Figure 5. DAS Framework and Starting points. Source: De Jonge et al. 2009

1.3 Research Proposal

The following chapters will briefly present the cause and the underlying drivers behind the selection of this research subject. A more thorough analysis of the problem will follow, which will subsequently lead to the problem statement and ultimately the research questions deriving from it.

Cause of the Research

Besides the academic incentives for conducting a research, social as well as economical drivers co-exist in the shaping of the research context, being the cause of the topic selection. Worldwide, the economy is characterized by the effects of the late-2000s financial crisis, also known as the Global Financial Crisis (GFC) or the "Great Recession", which is considered by many economists to be the worst financial crisis since the Great Depression of the 1930s. (Wikipedia, 2012). In this global financial context many countries have been affected by the GFC, however the Greek Government Debt Crisis is probably the most striking ongoing example of a European sovereign debt crisis.

So far Greece adopted a number of austerity packages since 2010. According to research published on 5 May 2010 by Citibank, the fiscal tightening is "unexpectedly tough". The first 3 austerity packages will amount to a total of €30 billion (equal to 12.5% of the 2009 Greek GDP), and consist of tightening equal to 5% of GDP in 2010, with a further set of tightening equal to 4% of GDP in 2011(Wikipedia, 2012).

Under these circumstances, the required changes in policy and practice can also be reflected in real estate. Real estate property, especially that of the Greek public sector, can be characterized as "asset-rich" but at the same time "income poor"(Koutamanis, 2012), meaning that there is a large amount of real estate holdings, with a lot of potential but currently, poor performance. In the field of CREM, real estate should be managed in such a way that it will comply with the new set objectives, primarily that of cost reduction.

At the same time, Greek universities are public institutions; as such they are heavily dependent on state funding. Currently, universities' management is faced with a new challenging limitation, that of a constantly reduced annual budget, which increases the uncertainty about their continuity prospects. In a report published by the A.U.Th. senate, the problem is presented rather dramatically, concluding with the following statement; "university's future is at stake". Undoubtedly budget cuts affect the performance of organizations and their real estate. In this sense it is necessary to examine how this new challenge can be managed in a rational, professional and efficient way.

Problem Analysis; National and International Context

Higher Education in Greece

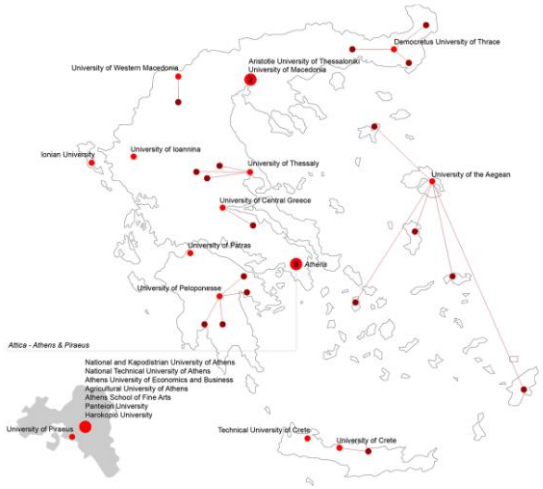
Greece has adopted the international model for higher education suggested by UNESCO, which calls for two main types of institutions for tertiary education—Universities and non-university institutions. In 2012, there are 21 universities in Greece; eight of them in the Athens-Piraeus metropolitan area, two in Thessaloniki and the rest are located in the main county "capital" cities. Athens and Thessaloniki, the two main urban concentrations accommodate half of the Greek universities; the rest of them are organized in a nation-wide network, which in some cases this is also applicable in regional scale; six universities are de-centralized and accommodated in different cities.

Historically the establishment and development of Greek higher education follows the path of the Greek state. The first three higher education institutions were established in Athens in the mid-nineteenth

century, following the establishment of the Greek state. During the interwar period (between WW1 and WW2) four new universities were established in Athens and Thessaloniki. During the redevelopment era after the WW2, higher education institutions' number increased between the 1950s and 1960s, with three new universities.

At this point, the focus shifts from the two main metropolitan areas, to the periphery. The same rate of regional university establishment continued - with only a halt during the dictatorship period (1967-1974) - during the 1970s decade, with two new regional universities. The last two rounds of new universities, followed the European Union path of the Greek state. Right after Greece became a member of the EEU (1981) four new regional universities are established in 1984. Finally, the admission to the Euro zone (2000) marks the last round of universities' establishment, with three new regional universities in 2002.

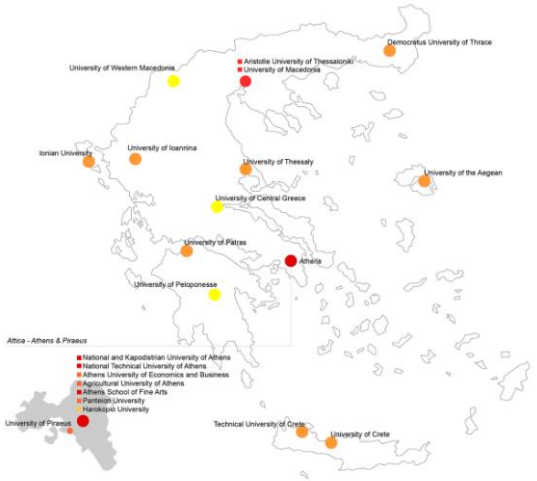
Greece | Higher Education Map



	University
1	National and Kapodistrian University of Athens
2	National Technical University of Athens
3	Aristotle University of Thessaloniki
4	Athens University of Economics and Business
5	Agricultural University of Athens
6	Athens School of Fine Arts
7	Panteion University of Social and Political Sciences
8	University of Piraeus
9	University of Macedonia Social and Economic Sciences
10	University of Patras
11	University of Ioannina
12	Democretus University of Thrace
13	University of Crete
14	Technical University of Crete
15	University of the Aegean
16	Ionian University
17	University of Thessaly
18	University of Peloponesse
19	University of Western Macedonia
20	University of Central Greece
21	Harokopio University

Figure 6. Greek Universities and their location in Greece.

Greece | Higher Education by Age



	University	Year
1	National and Kapodistrian University of Athens	1837
2	National Technical University of Athens	1843
6	Athens School of Fine Arts	1843
4	Athens University of Economics and Business	1920
5	Agricultural University of Athens	1920
3	Aristotle University of Thessaloniki	1925
7	Panteion University of Social and Political Sciences	1930
8	University of Piraeus	1938
9	University of Macedonia Social and Economic Sciences	1957
10	University of Patras	1964
11	University of Ioannina	1964
12	Democretus University of Thrace	1973
13	University of Crete	1973
14	Technical University of Crete	1984
15	University of the Aegean	1984
16	Ionian University	1984
17	University of Thessaly	1985
21	Harokopio University	1990
18	University of Peloponesse	2002
19	University of Western Macedonia	2002
20	University of Central Greece	2002

Figure 7. Greek Universities by age. The table shows the establishment date and the main development periods.

Legend according to QS World University Rankings format.
Source: http://www.topuniversities.com/university-rankings/world-university-rankings

LEGEND

SIZE		FOCUS		RESEARCH INTENSITY		AGE	
XL	: Very Large	FC:	Fully Comprehensive	VH:	Very High	Historic	>100years
L	: Large	CO:	Comprehensive	H:	High	Mature	<100years
M	: Medium	FO:	Focused	M:	Moderate	Established	<50years
S	: Small	SP:	Specialist	LO:	Limited or None	Young	<25years
						New	<10years

Following the timeline of Greek universities' establishment, a relation with their size -in terms of students enrolled- can be observed. In general the oldest universities tend to be bigger in size, especially these which are not focusing in a specific scientific field. Since the 1980s, higher education gradually became more accessible -as shown by the total yearly enrolment(Figure 8), considering the fact of increased state supply of new universities and the economic growth of Greece of the last three decades -reflected in the GDP.

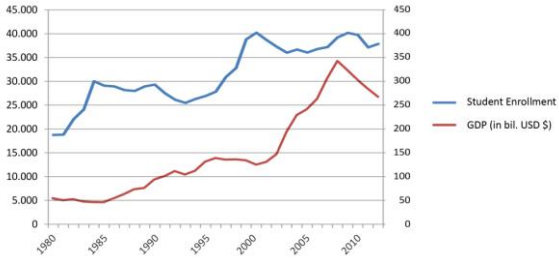


Figure 8. Student Enrollment and GDP development 1980-2011. Source: Data from World Bank Greece's metadata.

The population with higher -or tertiary- education, was experiencing, until the GFC outbreak and Greek Government Debt Crisis escalation, a relatively low percentage of unemployment, as shown in Figure 9. The upward trend of enrolment until 2000 can be related with the oversupply of higher education institutions and the attractiveness of a relatively certain professional future. However, this trend was stabilized and most recently, a decline inyearly enrolment was observed, affected by the economical circumstances and maybe because of the fact that the current national higher education model reached its limits. Following the peak of total enrolment at 2000, three individually different trends can be observed; decline, relative stability and growth. Annual student enrolment decline can be observed in the biggest and oldest universities, in Athens and Thessaloniki. The oldest regional universities (1950s-1970s) and the focused -in terms of scientific field- universities are characterized by relative stability, whereas the youngest universities are still growing.

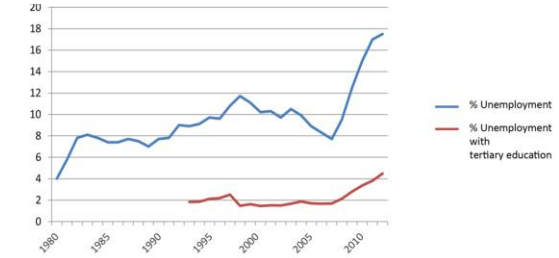
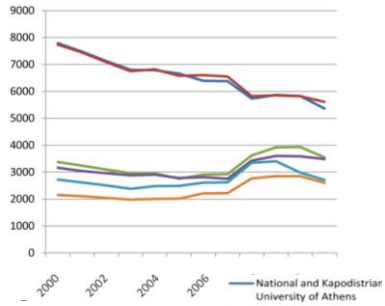


Figure 9. Unemployment and Unemployment with tertiary education 1980-2011 . Source: Data from World Bank Greece's metadata.



Greek universities annual enrolment 2000-2011

	University	2000	Size	Age
1	National and Kapodistrian University of Athens	7790	XL	Historic
3	Aristotle University of Thessaloniki	7735	XL	Mature
12	Democretus University of Thrace	3375	L	Established
10	University of Patras	3160	L	Established
11	University of Ioannina	2720	L	Established
13	University of Crete	2150	L	Established
15	University of the Aegean	2105	L	Young
7	Panteion University of Social and Political Sciences	1850	M	Mature
8	University of Piraeus	1825	M	Mature
2	National Technical University of Athens	1620	M	Historic
4	Athens University of Economics and Business	1570	M	Mature
17	University of Thessaly	1195	M	Young
9	University of Macedonia Social and Economic Sciences	1115	M	Established
19	University of Western Macedonia	510	S	New
5	Agricultural University of Athens	485	S	Mature
16	Ionian University	385	S	Young
14	Technical University of Crete	360	S	Young
21	Harokopio University	150	S	Young
6	Athens School of Fine Arts	105	S	Historic
18	Unive			
	Unive			

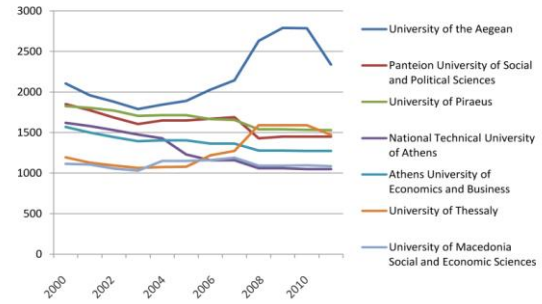


Figure 12. **M** Greek universities annual enrolment 2000-2011

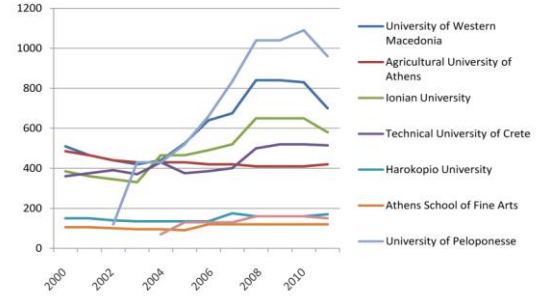


Figure 11.**S** Greek universities annual enrolment 2000-2011

Greek universities are primarily funded by the Greek national government. The majority of the national funding concerns the cost for personnel, being on average seventy percent (70%) of universities' revenues by the year 2009, at the beginning of the Greek Government Debt Crisis. Two years later, the percentage received by the Greek universities' for their payroll increased, as an average of seventy seven percent (77%) of the total revenues. At the same time, their revenues were decreased by twelve percent (12%) in nominal values, a fact that indicates a considerable pressure on the universities' budget.

The annual budget is mainly related to each university's student population. Another influential factor is the scientific focus of each university, with fully comprehensive and comprehensive universities having a relatively lower budget, compared to focused and specified universities of the same size. This is more evident by observing the cost per student of each university which is on average 6.000€, where universities focusing on technical and agricultural sciences as well as fine arts have higher cost,over 10.000€ per student. On the other hand comprehensive universities' cost per student is lower ,between 2.000€ and 8.000€ per student. This variation is related with each university's scientific focus -on a second scale- and at the same time by its age and location (city) and the relevant market conditions.

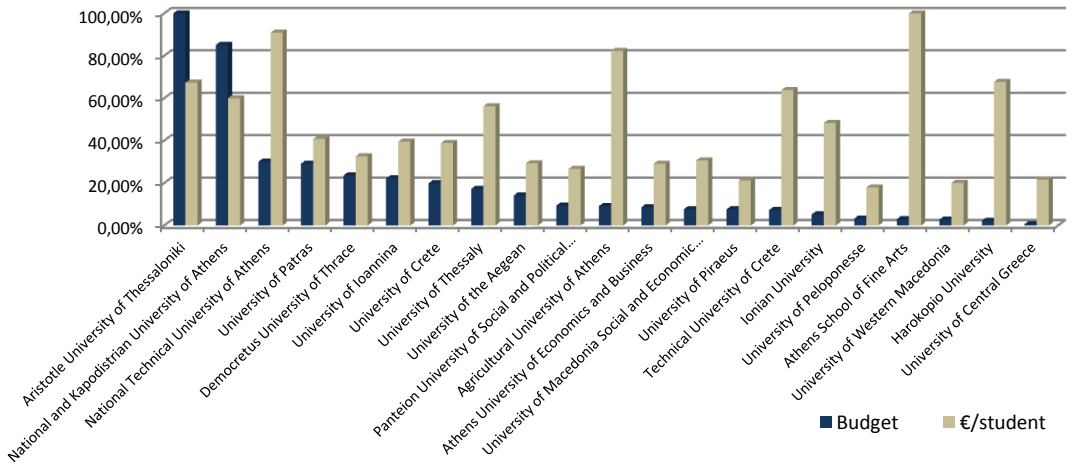


Figure 13. Greek universities Budget versus Student expenses (€/year) overview.

The table below. provides detailed information on financial figures per Greek university for 2009 and 2011

	University	Size	Revenues 2009	€/student	Payroll %	Revenues 2011	Payroll %
3	Aristotle University of Thessaloniki	XL	237.106.217,00 €	8.750,00 €	65,02%	-15,99%	69,86%
1	National and Kapodistrian University of Athens	XL	201.803.145,00 €	7.799,00 €	85,05%	-8,88%	90,54%
2	National Technical University of Athens	L	71.348.000,00 €	11.813,00 €	80,56%	-33,77%	81,21%
10	University of Patras	L	69.067.555,00 €	5.299,00 €	72,64%	-15,94%	75,88%
12	Democretus University of Thrace	L	55.883.039,00 €	4.246,00 €	78,67%	-15,78%	83,02%
11	University of Ioannina	L	52.633.537,00 €	5.137,00 €	54,32%	-17,57%	61,46%
13	University of Crete	L	47.291.417,00 €	5.047,00 €	73,31%	-8,84%	84,76%
17	University of Thessaly	M	40.954.100,00 €	7.300,00 €	68,62%	-14,20%	74,34%
15	University of the Aegean	L	33.583.340,00 €	3.810,00 €	72,99%	-5,34%	77,50%
7	Panteion University of Social and Political Sciences	M	22.311.378,00 €	3.463,00 €	77,14%	-12,97%	81,45%
5	Agricultural University of Athens	S	21.673.000,00 €	10.696,00 €	72,34%	-19,11%	79,80%
4	Athens University of Economics and Business	M	20.471.380,00 €	3.780,00 €	71,47%	-14,54%	78,43%
9	University of Macedonia Social and Economic Sciences	M	18.309.335,00 €	3.989,00 €	78,80%	-9,78%	85,12%
8	University of Piraeus	M	18.166.790,00 €	2.763,00 €	76,54%	-15,03%	82,00%
14	Technical University of Crete	S	17.326.861,00 €	8.290,00 €	73,57%	-21,40%	78,03%
16	Ionian University	S	12.413.200,00 €	6.285,00 €	64,03%	-24,70%	72,18%
18	University of Peloponesse	S	7.751.332,00 €	2.335,00 €	79,60%	-14,13%	82,23%
6	Athens School of Fine Arts	S	7.082.000,00 €	12.994,00 €	69,68%	24,55%	82,91%
19	University of Western Macedonia	S	6.594.912,00 €	2.617,00 €	64,08%	2,27%	76,28%
21	Harokopio University	S	5.325.300,00 €	8.802,00 €	19,00%	-20,11%	51,33%
20	University of Central Greece	S	1.543.115,00 €	2.806,00 €	77,47%	-7,70%	76,60%
			Average:	**6.096,24 €**	**70,23%**	**-12,81%**	**77,38%**

Greek Higher Education in a Global Context

In 2011, the Greek government spent a 2,75% of the country's GDP for education, primary, secondary and tertiary. By examining the OECD countries, it is observed that Greece expenditure for education is low, below both the OECD and the EU average. On average the expenditure for tertiary education equals 0,67% of the Greek GDP, whereas the OECD average for 2009 was 2,4% and the EU 1,9% (OECD,2012). In Greece, higher education is exclusively public funded. The household payment for tertiary education in Greece is zero, meaning the there are no tuition fees for higher education.

There is some relation between tuition fees and graduation times, where lower tuition fees are related with longer study periods, but these associations still need to be treated with considerable caution. In the case of Greece the average duration of higher education studies is according to OECD facts six years. Another remark concerns the foreign students enrolled in Greek universities. The percentage of foreign students in Greece was 2% in the period 1998-2003 (OECD,2005). However, only a small amount of countries are attracting high foreign enrolment; United States attracts 28% of total foreign students, followed by the United Kingdom -12%, Germany -11%, France 10% and Australia -9%, all of them accounting for a 70% in total(OECD, 2005).

In this context, six Greek universities can be found in world-wide rankings, with the two largest universities, ranked in the first two positions. According to QS World Universities Rankings, Greek universities ranked between position 200 and 525 in 2008 - before the GFC- and 387 and 625 in 2011. The ongoing crisis which resulted in a considerable reduction of public funding could be related with this drop in the rankings, however this required additional in-depth research. The following graphs present the six Greek universities' rankings in 2008 and 2011.

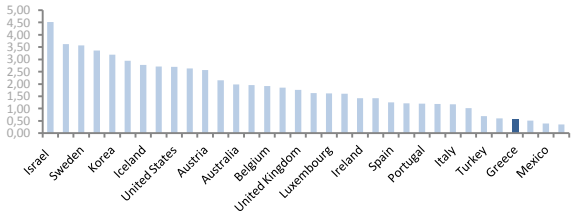


Figure 14. OECD countries' expenses for education as a % of GDP

			2008	2011
1	**National and Kapodistrian University of Athens**			
	Founded:	1837	Place	Place
	Age:	Historic	200- 200	387- 387
	Focus:	FC	Difference 2008 - 2011	
	Research Intensity:	VH	*Place:* ↓	-187
	Size:	XL	%: ↓	-93,50
2	**Aristotle University of Thessaloniki**			
	Founded:	1925	Place	Place
	Age:	Mature	401- 425	451- 475
	Focus:	FC	Difference 2008 - 2011	
	Research Intensity:	H	*Place:* ↓	-50
	Size:	XL	%: ↘	-11,76
3	**University of Crete**			
	Founded:	1973	Place	Place
	Age:	Established	476- 500	476- 500
	Focus:	FC	Difference 2008 - 2011	
	Research Intensity:	H	*Place:* →	0
	Size:	L	%: →	0,00
4	**University of Patras**			
	Founded:	1964	Place	Place
	Age:	Established	576- 600	551- 575
	Focus:	FC	Difference 2008 - 2011	
	Research Intensity:	H	*Place:* ↑	25
	Size:	L	%: ↗	4,17
5	**National Technical University of Athens**			
	Founded:	1836	Place	Place
	Age:	Historic	426- 450	576- 600
	Focus:	FO	Difference 2008 - 2011	
	Research Intensity:	VH	*Place:* ↓	-150
	Size:	L	%: ↓	-33,33
6	**Athens University of Economics and Business**			
	Founded:	1920	Place	Place
	Age:	Established	501- 525	601- 625
	Focus:	FO	Difference 2008 - 2011	
	Research Intensity:	H	*Place:* ↓	-100
	Size:	M	%: ↘	-19,05

LEGEND

SIZE		FOCUS		RESEARCH INTENSITY		AGE	
XL	: Very Large	FC: Fully Comprehensive		VH:	Very High	Historic	>100years
L	: Large	CO: Comprehensive		H:	High	Mature	<100years
M	: Medium	FO: Focused		M:	Moderate	Established	<50years
S	: Small	SP: Specialist		LO:	Limited or None	Young	<25years
						New	<10years

Figure 15. Greek Universities ranked in QS World University Rankings on map.On the right a brief profile of each university and its ranking ; 2008 and 2011

PROBLEM ANALYSIS; FOCUS ORGANIZATION | ARISTOTLE UNIVERSITY OF THESSALONIKI

The research is about the Greek university Aristotle University of Thessaloniki - A.U.Th. Thessaloniki is the second-largest city in Greece and a major economic and industrial centre. The city has suffered following the implementation of national austerity measures with all future real estate development currently on hold. The city is a major transport hub for the Mediterranean and Southeast Europe and home to one of the continent's major ports. The Port of Thessaloniki is set to benefit from ongoing investment with the vision to create a hub transit trade centre for the Balkan region and is also a Freeport with favourable customs regulations. The city's transport infrastructure is also set to be enhanced by the Corridor 10 pan-European highway construction project. The direct highway from Western Europe to Turkey will link Thessaloniki by road to key Balkan area cities including Zagreb, Ljubljana and Skopje. The construction of the Thessaloniki Metropolitan Railway is scheduled for completion in late 2014 and will dramatically increase access within the city boundaries (Cityleaders, 2012). Another key economic driver for the city is Education. Thessaloniki is home to major universities including Aristotle University, the largest in Greece with more than 80,000 students, and several international higher education institutes. The city is also a major conference and events centre (Cityleaders, 2012).

Thessaloniki macro-economic figures

		Office-based employment			Office-based employment		Location-based retail sales		Share of employment in 2011			Location quotients		
Population			GDP						Manufacturing	Fin. & busin. serv.	Public services	Manufacturing	Distribution	Fin. & busin. serv.
2011	'01-'11	2011	'06-'11	'11-'16	'06-'11	'11-'16	'06-'11	'11-'16						
1,175	+0.8	104	–1.7	–0.8	–0.4	+0.6	–5.0	–1.7	0.14	0.12	0.25	–9	–27	10

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Figure 16.Thessaloniki macro-economic figures. source: http://www.cityleaders.info

Facts

While Thessaloniki is the second biggest urban region of Greece, A.U.Th is the largest Greek university, and the largest university in the Balkans. Its campus covers 430,000 square metres in the centre of the city of Thessaloniki. Some educational and administrative facilities are located off campus, for practical and operational reasons. More than 95,000 students study at the Aristotle University, 86,000 in undergraduate programmes and 9,000 in postgraduate programmes.

Furthermore, the Teaching and Research Staff number 2,248 people (716 professors, 506 associate professors, 576 assistant professors, and 450 lecturers), the Scientific Teaching Staff number 84 and the Special Laboratory Teaching Staff 275 people. This is further supported by the 309 members of the Special Technical Laboratory Staff for teaching services and the 1028 members of administrative staff.

Today, the Aristotle University comprises 12 Faculties, 36 Schools and numerous other units (laboratories, study rooms, libraries, clinics, research centres etc.), which make it the largest university in Greece and south-eastern Europe in terms of number of staff, undergraduate and postgraduate students and the facilities offered (Wikipedia, 2012).

The Aristotle University is one of Greece's public Universities and therefore it is a legal entity with full self governance. It is primarily state-funded and functions under the supervision of the Greek Ministry of

National Education and Religious Affairs. Other financial resources for the university are donations from individuals, participation in various EU research programmes and profits generated through management of the university assets. It is important to note that no fees are charged to the students of the university (Wikipedia, 2012).

Administration

The administration of the university consists of collective bodies who take decisions within the framework of the Greek laws. Main objective of the administration's efforts is to ensure the proper function of the university and pursuit the benefit of the academic community as a whole. In the next paragraphs, the administrative structure will be briefly presented hierarchically.

University Senate

The highest administrative authority is the University Senate. It consists of the following members (senators):

- The Rector and the three Vice-rectors.
- The Deans of the various Faculties.
- The Chairman of the various Schools.
- Representatives of the associate professors, assistant professors and lecturers.
- Representatives of the Special Laboratory Teaching Staff and the Administrative Staff.
- Representatives of the undergraduate and postgraduate students of every Faculty.

Rector's Council

The second highest administrative authority is the Rector's Council, which comprises the Rector, the tree Vice-rectors, one student representative and one representative of the administration staff. Each member of the Rector's Council is elected every 3 years.

Rector and three vice-rectors

The Rector is the president of the University Senate and the main representative of the University in various national and international bodies. Moreover, he/she is responsible for developing an overall strategy for the development of the university and for implementing the decisions taken by the Senate and the Rector's Council. Both the Rector and the three Vice-rectors are elected every three years in university-wide elections where all faculty, staff and student representatives vote. Each Vice-rector has different administrative responsibilities, among which are: staff management, financial planning and development, academic affairs.

Faculty, School and Department administrative bodies

Every faculty, school and department has its own administrative body, the members of which are democratically elected on the basis of collective processes. In more detail, decisions on academic, financial and administrative matters within a single department are made by the department's General Assembly, which consists of faculty members and student representatives. The decision making process often involves the creation of ad hoc committees.

Stakeholders

Based on the CREM theory there are four types of stakeholders classified according to their focus (Institution of RE) and their level of involvement (Strategic or Operational) namely; *Decision makers, Controllers, Technical Managers* and *Users* (De Jonge et.al., 2009). The following table summarizes the Stakeholders of A.U.Th.

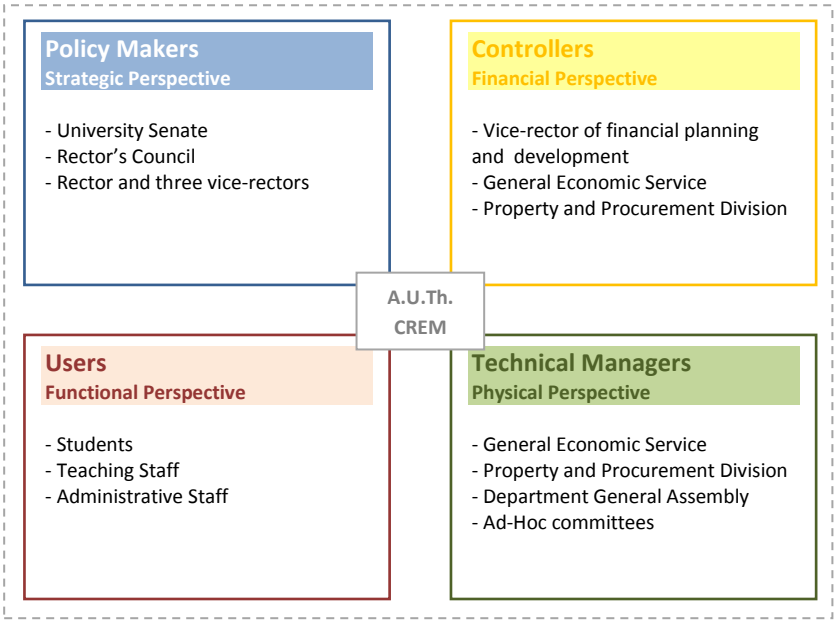


Figure 17. A.U.Th stakeholders linked with the four CREM stakeholders and perspectives

With respect to Real Estate management the General Economic Services and specifically the Property and Procurement Division are operating towards a central management of the university property, being directly related to Rector and the Vice-Rector of financial planning and development. On the other hand the technical and operational management of the university real estate lies mainly within each faculty. More detailed information about the structure and operation of the departments responsible for the technical management of real estate should be found by field research if necessary.

Direct and almost exclusive state financing makes the National Government a key stakeholder, as the existence and continuity of the university depends on it. However this relation is under restructuring, with a new law for higher education introduced by the ministry of education. Described briefly it will link the university performance with state financing while at the same time, it will allow universities to seek PPC in order to support their balance sheets.

Considering that the relation with the state imposes financial limitations for the universities, the potential option for collaboration with private parties could be an opportunity. However this issue is not currently ranked highly in the universities' executive board agendas; it has to be further investigated in terms of threats and opportunities in a strategic level. Having not been applied yet, this new law has many similarities with the case of 1995 where the Dutch universities became owners of their real estate and responsible for their own accommodation while public involvement and funding decreased (Den Heijer, 2011). However, at that time the Netherlands did not have to face an unfolding crisis.

Main Problem to Be Solved

Under the current circumstances the public funding of Greek universities is limited. Due to austerity measures it is necessary for public organizations to minimize their expenses. The real estate of A.U.Th. need to be managed effectively and efficiently not only by reducing costs but also by aiming to increase its added value in the overall organizational performance. After preliminary field research and informal interviews with the Property and Procurement Division staff and the Vice-rector of Financial Planning and Development, corporate real estate (for the primary process, education and research) was regarded

as sufficient in terms of quantity and quality. The focus was put on the potential financial contribution the asset portfolio (endowments) could have in the university's budget.

However, these two different types of real estate need to be in fact managed efficiently and effectively in a proactive manner from the same organization; pursuing the same objectives, real estate performance should optimally support the university's objectives.

A transparent, rational and professional approach and - consequently -decision making process towards university real estate management is necessary. A complete and coherent record of the university real estate is required in order to support the university's real estate management; it will provide the basis for assessing requirements versus available resources at any time, supporting conscious and objective decision making. By registering each building's necessary information in a complete database, it will be possible to connect two different levels of observation; portfolio and object level. In this sense, it will be possible to define plans of action, top-down or bottom-up, towards aligning requirements and available resources between these two levels.

PROBLEM STATEMENT

It is necessary to manage university real estate in such a way, that it will optimally support the organizational objectives. Real estate management needs to be conscious and proactive, providing accommodation efficiently and effectively, supporting the organizational objectives. Moreover, a link for validation and verification should be developed between the real estate decision making and the real estate performance –in terms of costs and benefits-both in the real estate portfolio and the building object level. More insight in physical, functional and financial aspects required, in order to determine in which extent university real estate contributes or could contribute to the organizational goals. A transparent, rational and coherent approach should be adopted for a professional, effective and efficient management of the university's real estate property.

RESEARCH QUESTIONS

Main Research Question

Deriving from the problem statement, the following research question has been formulated;

In which ways the decision making for A.U.Th. real estate can further be professionalized?
Which considerations should be taken into account in A.U.Th. RE decision making, in order to provide optimal accommodation by balancing requirements and available resources, and in which way this task should be managed?

Detailed Research Questions

A. Managing University Real Estate

1. Which stakeholders should be involved in the RE decision making process of a university ?
2. In which way can university RE add value to the institutional objectives?
3. What type of information is necessary for campus management?
4. In which way management information can be employed in order to assess the extent in which real estate meets its performance requirements?

B. Balancing Requirements and Resources in two levels, portfolio and building object

1. How can building requirements be aligned with portfolio objectives and in which way can building requirements be specified?
2. In which way information can be organized in a coherent, comprehensive and usable system?
3. How can different options be explored and how can they generate solutions?

C. Generating Solutions

1. How can these solutions be operational ?
2. How can these solutions be evaluated ?
3. In which way the generated information can be used?

OBJECTIVES AND END PRODUCT

Goals

Throughout my research I would like to suggest a method that will ultimately support and professionalize the real estate of A.U.Th. In addition to that, the method should enhance transparency, organizing information in a coherent system which will allow for its validation and verification. With the research conducted under the Real Estate Management master track, it will be based on relevant theories, applying them and testing their applicability in a real case. The research will be carried out based on the conceptual framework developed by Alexandra den Heijer (2011) in her dissertation *Managing the University Campus; Information to Support Real Estate Decisions.*

In this framework, four management tasks are prescribed, following the iterative process of the DAS framework. Demand for and supply of real estate is assessed from four different stakeholder perspectives in time (past to present and future). Moreover two levels are linked. Assessment of portfolio level will reveal general mis-matches. With these as starting point, the research will proceed by focusing on building object level, specifically tacking them in a more definite context. Finally, the specific generated solutions will be tested for their applicability and suitability on portfolio level, in an attempt to generate generalizations. The four management tasks, which will structure the research are:

Task 1. Assessment of the Current Campus

Task 2. Exploring the Changing Demand

Task 3. Generating Future Models for the Campus

Task 4. Defining Projects to Transform the Campus

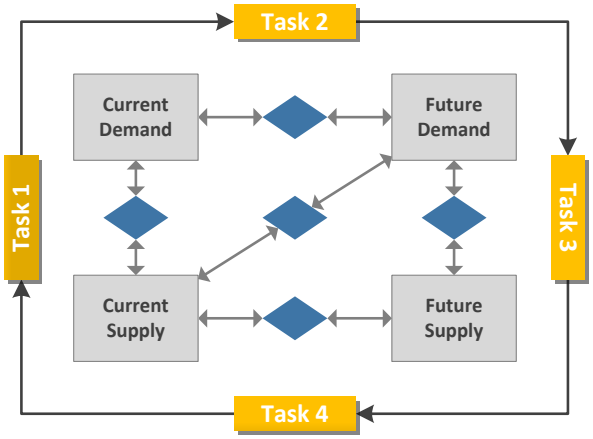
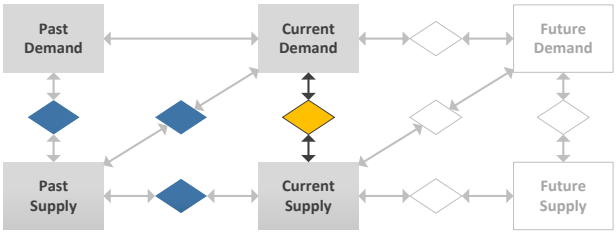


Figure 18. Four campus management tasks in the DAS framework. Source: Den Heijer, 2011

Objectives

1. Assessing the current state of A.U.Th. real estate

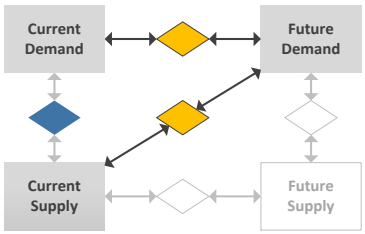


The first research objective aims at assessing the current demand for and supply of A.U.Th. real estate, focusing on key performance indicators from the physical, functional and financial perspective.

In order to identify the current (mis)match, available data from different periods will be examined, analysed and projected from the past to the present. The assessment of CD and CS will provide an overview of the university's real estate on portfolio level, by adding KPIs such as GFA,UFA, Users and related Functions per building.

The result of this stage will be the creation of A.U.Th.'s current supply and demand profiles, concerning the three examined perspectives. Portfolio and building level will be presented in the same detail level, with the first being expressed as the overview (total sum or average) of the latter. Moreover, this information will be the starting point for the next stages. The results of this stage will be of use to the Controllers and Technical managers of A.U.Th. namely; General Economic Service, Property and Procurement Division and each Department's General Assembly and relevant Ad-Hoc Committees.

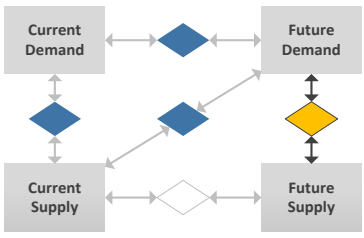
2. Exploring changing Demand



The second objective of the research focuses on the exploration of the potential future requirements of A.U.Th. regarding its real estate. Future developments that can affect the three perspectives (physical, functional and financial) will be examined. Primarily through a quantitative (KPIs)comparative analysis between A.U.Th. and Dutch universities (Den Heijer, 2011) and secondarily be exploring additional relevant qualitative information.

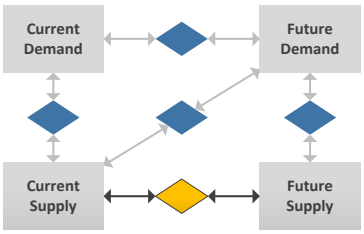
Two systems and their individual characteristics will be compared to identify similarities and differences; in this sense it will be possible to deduct hypotheses and develop criteria for future scenarios for A.U.Th. Analysis focus will remain in the same level as in the first objective and the results will be suitable for the same stakeholder group (Controllers and Technical managers).

3. Generating Future Models for A.U.Th. real estate



The third objective of the research concerns the identification of influences that may shape the future of universities. Influences that have to be considered in order to increase the forecasting capacity of the decision makers and will enable them to proactively manage the organization. In this part of the research already developed strategies for campus management will be adopted and consequently will be related with the case of A.U.TH. In this sense it will be possible to understand which influences may apply in the focus organization and what their related implications will mean for its future development. The outcome should be considered as a basic background for the A.U.Th. policy and decision makers.

4.Defining project to transform A.U.Th. real estate



The fourth objective of the research, following the previously steps, will attempt to align portfolio requirements in specifically selected case on building level. The KPIs of portfolio level should be transferred on building objects and translated into specific building requirements. Building requirements will be stated following the process of building programming and will cope with functional and performance requirements.

Time wise it is the moment where BIM will be employed in the process, initiating the analysis and registration of A.U.Th. real estate in a uniform database. It will provide detailed information about each object's current state in relation with the KPIs. Comparison with the portfolio information will lead to validation of the two systems' consistency of data. Moreover, It will be the basis for future management practice, providing consistent information and a valid link between these two levels (portfolio and building object) in the long term.

The results of this stage will be a process for analysing, registering and programming selected university buildings, aligning them with portfolio set performance requirements. For these buildings alternative solutions will be generated based on the selection criteria and variables. Finally these solutions will be evaluated for their feasibility. The results will be of use for the Controllers and Technical managers as well as the Policy makers (Vice-rector of financial planning and development) of A.U.Th. who are responsible for the definite decision making.

The results of the research will be summarized and will constitute an advice report for the relevant real estate executives, indicating a process for managing the university's real estate. The target group will be that of Policy makers (Rector and three-vice Rectors), who can employ the results of this research to stimulate and support their decision making for A.U.Th., considering the university objectives with respect to the five corporate resources -RE as one of the five resources (Jorroff et al., 1993).

Research Methodology

Following the problem statement the main research question and the detailed research questions were formulated. It is therefore necessary to proceed by selecting the most suitable research design along with the tactics of information gathering and analysis. Moreover It is important to connect the research questions and the research objectives with the research design and methodology.

Literature research findings of the relevant scientific fields will define the theoretical framework upon which the research will be carried out. The literature study will focus on the existing body of knowledge concerning CREM/PREM theories, University REM, Programming and Evaluation of buildings, LCC approach and BIM.

The research will be a case study of the Greek university A.U.Th. The reason for choosing case study as the main research strategy lies in the primary characteristics of it; it focuses in cases studied in their real life context, it has the capacity to explain causal links, theory can be developed in the research design phase, it relies on multiple sources of evidence so data have to converge in a triangulating fashion and it has the power to generalize to theory (Groat L., Wang D., 2002).

Focusing on quantitative data, required KPIs will be extracted in a dual way; by document analysis and archival research and supplementary, with field research and participation in the focus organization. Part of the research will be benchmarking and comparative analysis between A.U.Th. and Dutch

Universities. Dutch universities' KPI will be extracted by literature research in the dissertation of Alexandra den Heijer (2011) Managing the University Campus. If necessary additional unstructured interviews with RE executives will provide additional specific information.

In order to collect and verify information field research is required. it would be necessary to contact people related with decision making and practice of A.U.Th. REM. Action learning by participating in the university relevant departments will provide the opportunity for personal communication and information retreaval. A work session with the decision makers of A.U.Th. can be scheduled so that the research results can be presented to them and consequently provide their feedback, as input for the next steps.

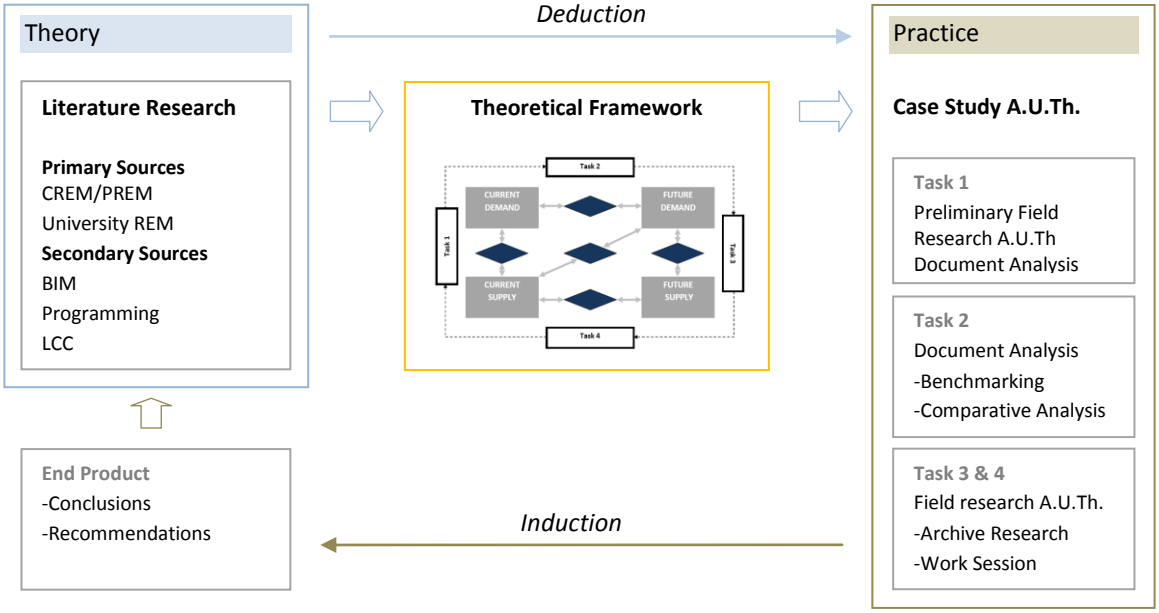


Figure 19. Research conceptual organization ad structure

RESEARCH SCHEDULE

Theoretical | **Empirical**

Preliminary Research Proposal
- Exploring the topic
- Problem analysis
- Problem Statement
- Research Questions
- Research Structure

Preliminary Field Research
- Informal Interviews A.U.Th

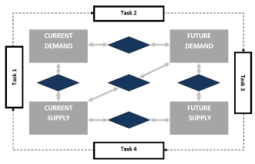
P1

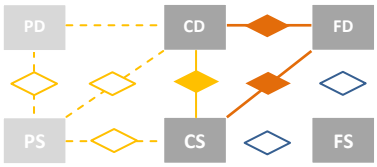
Research Proposal
Theoretical Framework development
- RE management theories
- Programming & BIM

Document Collection & Analysis |KPIs
Comparative Analysis |KPIs
- Task 1: Assessment of the CS vs CD
- Task 2: Exploring changing demand (FD)

Selection criteria-Cases

Portfolio ← *BIM* → Building



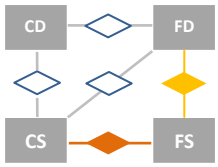


P2: June 22nd, 2012, 7+2 weeks

Theoretical research
- specific additional information

Document Collection & Analysis |KPIs
Field Research
Unstructured Interviews
- Task 3: Generating Future Models for A.U.Th. RE
- Task 4: Defining Projects to Transfor A.U.Th. RE

Focus on building specific cases



Building A,Variable α
Variable β
...
BIM
Programming

P3: November 2012 , 7+2

Concluding Remarks
- Induction from practice to theory

Research Results
- Reflection on theoretical framework with the empirical research results

P4: December 2012, 7 weeks

Final Product
- Answering the main research question

P5: January 2013, 2 weeks

Figure 20. Research Structure related with the four evaluation moments. Scheduling the process and expected products

READERS GUIDE

In the following chapters, the research findings are presented.

Chapter 2 includes the theoretical findings for the relevant scientific fields.

Chapter 2.1 specifically addresses theories of CREM applied in campus management, providing the framework for conducting this research.

Chapter 2.2 provides theoretical input for the next stages of the research, where the focus will turn to building level; Problem seeking (Peña and Parshall, 2001) defines the necessary process for programming a building .

In chapter 2.3 BIM related information is analysed, exploring the applicability of this tool for the purposes of this research.

Chapter 3 includes the results of the case study analysis.

In chapter 3.1 the focus organization is analyzed; past and current demand for and supply for real estate assessed, in order to determine the current situation of its real estate portfolio. The identification of the discrepancies between the two sides is thus reformulated into goals for A.U.Th. CREM.

Chapter 3.2 addresses the changing future demand, through a comparative analysis of same KPIs between A.U.Th. and the Dutch universities. This leads to the identification of future mis-matches in the current A.U.Th. CRE portfolio; specific cases for elaboration on building level will be the end result of this chapter.

Moreover additional supplementary qualitative information concerning the A.U.Th.'s investment decision are presented; urban economics are linked to the range of functions a university can accommodate, exploring the impact of the HBU concept on various locations. Finally, various aspects that influence the physical expression of a university presented as a prelude of the next chapters.

Chapter 3.3 deals with the generation and exploration of future models for the university. What may influence the future of a university should be used in the development of different scenarios. Based on previous research, three strategic models for universities are employed and related with the case of A.U.Th. aiming at exploring the potential future path(s) of action with respect to its current CREM goals. In this sense it becomes possible to test a range of strategic goals for A.U.Th. in selected cases, on building level.

In Chapter 4, a process for aligning portfolio requirements to a selected building project is developed. The research findings are integrated and consequently tested in this process.

The outcome of this part of the research is thereafter critically assessed towards the presentation of the research results and recommendations, in Chapter 5.

CHAPTER 2

The goal of this part of the research is to analyse specific theoretical inputs of relevant scientific fields that will ultimately result in a conceptual framework. In order to accomplish this task, the first two groups of research questions (A and B) will structure the process of approaching the literature; consequently, the way theoretical findings will be combined into a coherent theoretical framework, upon which the research can further proceed.

2.1 MANAGING UNIVERSITY REAL ESTATE

In this sub-chapter, theoretical insights about university real estate management will be presented, by answering the following research questions;

1. Which stakeholders are and should be involved in the RE decision making process of a university ?
2. In which way can university RE add value to the institutional objectives?
3. What type of information is necessary for campus management?
4. In which way management information can be employed in order to assess the extent in which real estate meets its performance requirements?

CAMPUS STAKEHOLDERS

Based on the CREM theory four types of stakeholders have already been identified; 1.Managers, 2.Financiers, 3.Users and 4.Controllers. It is therefore necessary to understand how this categorization is applicable in the case of a university. According to den Heijer (2011) while many CREM theories focus on the level of the organization practice of campus management her research revealed that the organizational level is not necessarily the most dominant level in campus decision making. For the case of a university urban stakeholders have been also introduced in the basic CREM stakeholder model such as Urban Authorities (goals), Economic Department (capital), Spatial Department (m2), and the city population (users) (Den Heijer,2011).

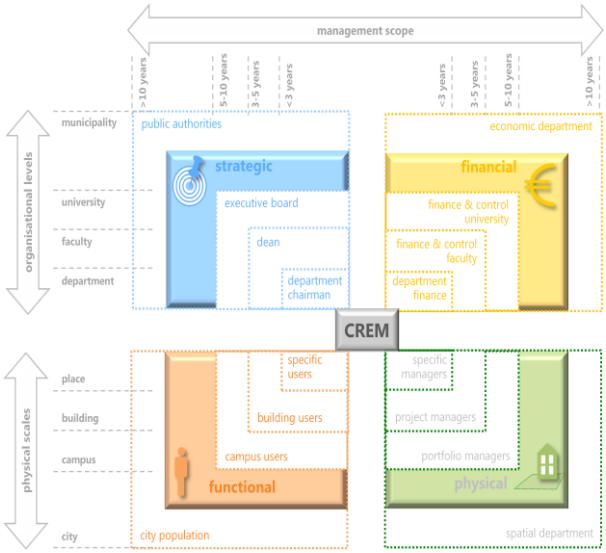


Figure 21. CREM stakeholders, organizational levels, physical scales and management scope. Source: Den Heijer, 2011

From the individual to the societal level, there are many in-between levels of stakeholders such as researchers, sections, departments, faculties and research institutions. The number of stakeholders also depends on the organizational structure of the university as well as the division of power which makes the decision making a very complex process (Den Heijer,2011). The individual level consists of specialized professionals that claim to know best what facilities would support their activities optimally. However, the benefits of these facilities still have to be compared to the cost and benefits in a system of performance criteria (Den Heijer,2011). Because of the large number of parties involved especially on

individual level, decision making can become very complex and managerial actions concerning the campus very slow. Due to the abovementioned facts, a multy-layered analysis of stakeholders involved in campus management is necessary, whereas campus managers -in the middle of CREM model- need to connect these stakeholders' goals, needs and interests in every campus decision (Den Heijer,2011).

The focus of campus management is between university and faculty level but it is also possible that stakeholders outside of the university might affect the real estate decision making. At the same time organizational levels are connected to most common physical scales giving management scopes from three to more than ten years (short-term to long-term) (Den Heijer,2011).

THE ADDED VALUE OF REAL ESTATE

Real Estate Impact on Performance

The basic aim of real estate management is the way real estate contributes to the overall performance of the organization, which can be negative or positive. It is obvious that if there was no impact on the organization, but also on society or individuals, no resources would be spent for it. In a way, performance could be related more in economic goals and results. However it should also be linked to additional aspects, like the way social goals are achieved, non-profit goals or environmental goals of a society, which is also applicable for the case of universities (Den Heijer,2011).

University buildings and the campus should contribute, align or at least not hinder the institutional goals. In the case of a university, the main focus lies in effectively providing its primary processes, whereas financially orientated goals are not primary. Real estate management as well as university real estate management should aim at achieving a positive added value to the organizational performance (Den Heijer,2011).

Considering the functions of real estate different aspects of real estate were recognized: technical, functional, financial, economic, cultural, social and ecological. These aspects can be structured on two levels, in order to examine the impact of real estate in the university performance and make the concept of added value operational (Den Heijer,2011). The two levels are:

1. The impact of real estate on individuals, where psychology theories are linked
2. The impact of real estate on an organization and society, linking business economics theories.

Real estate as the fifth resource of an organization

The real estate of an organization is often referred to as its fifth resource that cannot be separated from the other four, capital, human resources, information and communication and technology. These resources may reinforce each other, but they can also neutralize or in the worst case have a combined negative effect. The organizational model incorporating the five resources can also be applied in the case of a university with specific interpretations of input, output, stakeholders and performance (Den Heijer,2011). In the case of universities the abovementioned resources being interdependent are;

- Capital as the public funding, private funding and the endowment-if applicable.
- Human Resources as are both the academic and supporting staff.
- ICT as the information or knowledge resources
- Technology, where it is closely connected with the campus not only in laboratories but also in every workplace that a computer and a network is needed (Den Heijer,2011).

Added value as Real Estate decisions (input) and performance (output)

Taking into account the four CREM perspectives (strategic, functional, financial and physical) applied also in campus management, the added value of university real estate can be translated as the input on university performance -output. This concept has been operationised in a tool which can be used either ex-post or ex-ante, evaluating or developing a real estate decision (Den Heijer, 2011). The real estate decision can be about a university building (object level) or the whole university real estate (portfolio level).

Input
The CREM variables include the quality ambition, the available budget in euros or the investment per square meter, the number of the university users and the function mix in types of square meters. These input variables, compared to references can help campus managers develop business cases for real estate decision making, relating input to output.

Output
Besides the already mentioned three performance criteria, productivity, profitability and competitive advantage one more output variable was added, that of sustainable development (Den Heijer,2011). Real estate decision making as well every decision related with the five resources of a university should be justified and evaluated by its positive or negative effect on these four criteria (Den Heijer,2011).

Throughput
The ten ways of adding value to the organizational performance provided by De Vries et al. (2008) have been have been reviewed during the research of Alexandra Den Heijer (2011). Some of the existing real estate goals have been renamed and some new goals have been introduced. The real estate goals have been aligned with the four CREM perspectives, defined as Physical, Functional, Financial and Strategic (Den Heijer, 2011). These new real estate goals are the throughput, adding value to the output of a university. The real estate goals are:

1. Controlling risk
2. Increase Real Estate Value
3. Reducing the Footprint
4. Reducing Costs
5. Increasing Flexibility
6. Increasing User Satisfaction
7. Supporting User Activities
8. Improving Quality of Place
9. Supporting Image
10. Supporting Culture
11. Stimulating Innovation
12. Stimulating Collaboration

These twelve real estate goals are related with the four CREM stakeholder perspectives and the related performance criteria (Figure 22).

Stakeholder's related Perspectives

Strategic Perspective
Contributing to the primary goals of the university and the competitive advantage among similar institutions, it focuses at decisions that improve the quality and effectiveness of the primary processes.

Financial Perspective

Universities do not primarily focus on making campus decisions to add to the profitability of the organization. However, other-more commercial- organizations do have financial goals with their real estate strategies. Indirectly by decreasing cost, reducing floor area or controlling financial risks.

Functional perspective

Aiming at improving the productivity of the organization, it focuses at decisions that optimally support the user activities by changing the quality and quantity of space. Decisions related to this criterion are assessed in terms of costs and benefits, as productivity is assessed in terms of output versus input.

Physical perspective

It focuses on technical aspects like maintaining the minimal quality level to allow user activities and by controlling technical risks that could hinder the primary process. The performance criterion that is primarily related to the physical perspective is sustainable development.

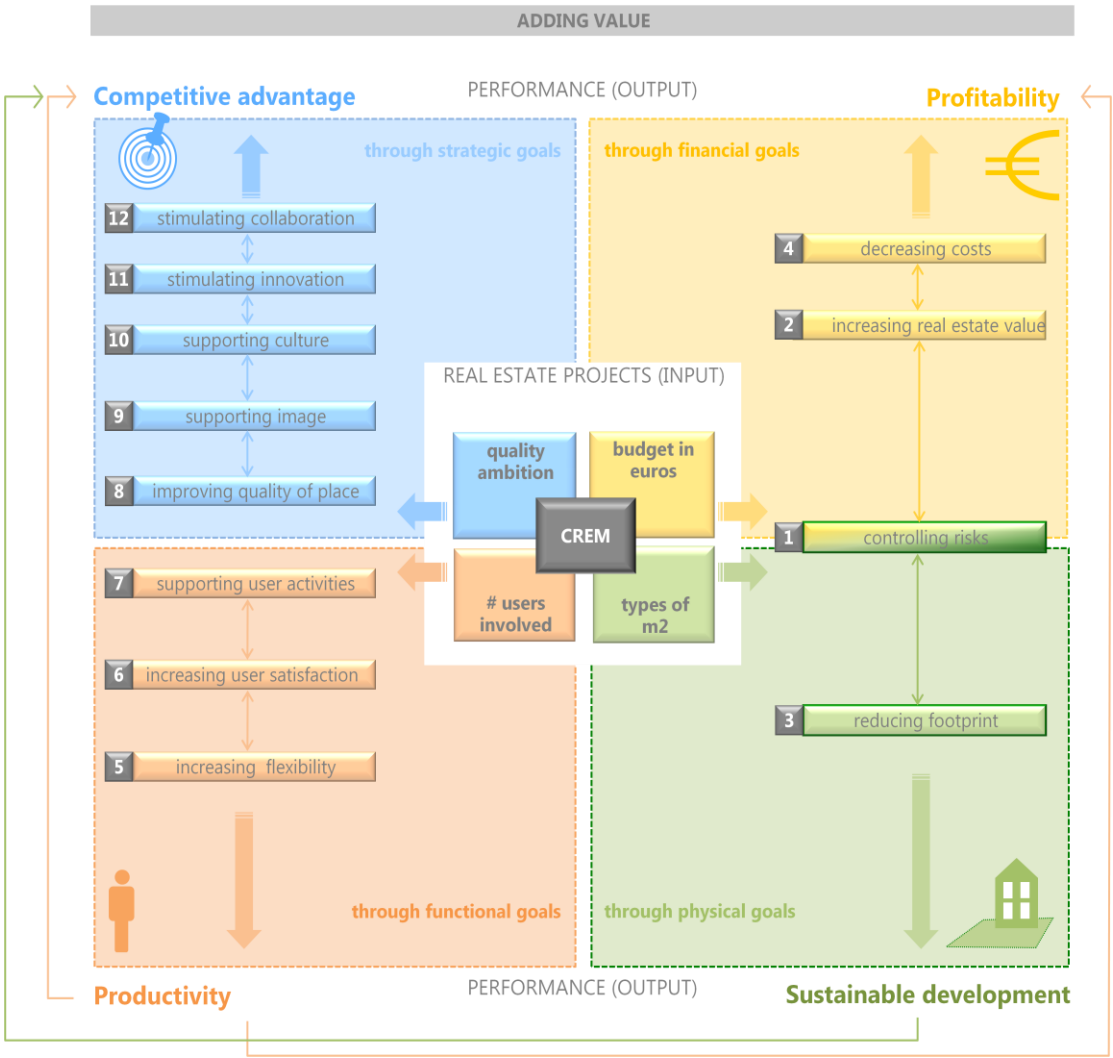


Figure 22. Model to assess the added value of RE decisions- from project (input) to performance (output), ex-ante and ex-post. Source: Den Heijer, 2011

REQUIRED MANAGEMENT INFORMATION

For university management, it is necessary to have enough management information for sound decision making. Key performance indicators (KPIs) related to the performance criteria can be used in order to assess whether set goals have been achieved or not. According to Den Heijer (2011) Campus management connects three dimensions:

- The four performance criteria four expressing the output (x)
- The four stakeholders perspectives that have to be integrated (y)
- The different levels to connect (z) (Den Heijer, 2011).

Campus management information should connect the input variables of the four CREM perspectives and the KPIs of different output criteria on levels within and outside the university (Den Heijer, 2011). Depending on the scale of a project, same KPIs can be used (with a faculty considered as a smaller scale university).

Moreover the KPIs are also applicable to specific projects that may exceed the boundaries of an organizational unit or single buildings for specific users (Den Heijer, 2011). However in this level a difficulty arises when a faculty or a specific user group uses more than one building to produce its output, where performance cannot easily connected to the organizational scale. Even so, this level can be useful in describing the added value of a new type of space, like a laboratory, a learning centre for the university or a new faculty building (Den Heijer, 2011).

Campus management theory provides KPIs (Figure 23) based on a sound set of definitions for benchmarking universities (Den Heijer, 2011). Due to the complexity of the real estate management task (many variables and interdependencies), campus managers need to be able to reference and compare information on all KPIs.

Many organizations tend to share their knowledge, acknowledging that with joining forces enough comparable data can generate managerial information for the whole group (Den Heijer,2011). When benchmarking KPIs with similar organizations it important to use uniform standards and definitions. Moreover KPIs can also be used to measure the performance of an organization at different moments in time. Examining the KPIs over time and looking for patterns and relations can not only help management practice but also management theory on the relation between changes in real estate and performance (Den Heijer,2011).

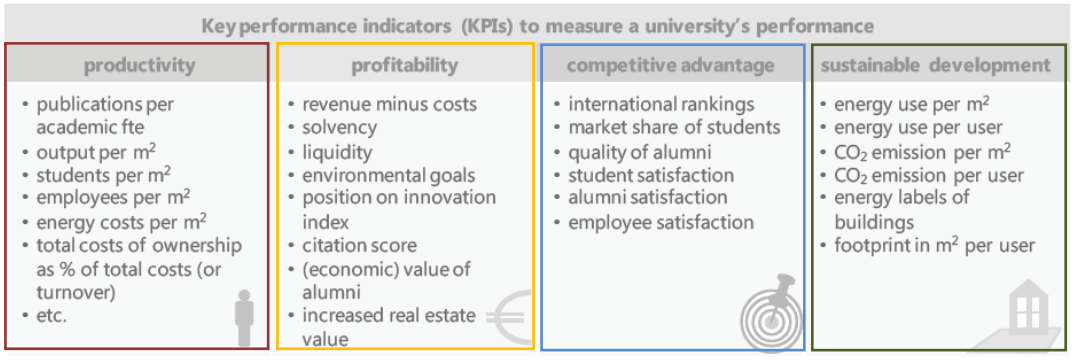


Figure 23. Key performance Indicators (KPIs) for Universities. Source: Den Heijer, 2011

ACCOMMODATING UNIVERSITY NEEDS

As already described in the previous chapter, DAS framework provides the basis for the process of accommodating the needs of an organization. It is therefore required to examine in which way this framework is applicable in the case of a university.

The inherent complexity in the decision making about real estate is determined by the scope – campus, a university building or the floor area of one department- and the various perspectives (four CREM perspectives) involved in the decision making. It is interesting to identify for whom a match between demand and supply is acceptable or satisfactory, keeping in mind that decision making should optimally look for an integrated solution, merging and incorporating every stakeholder's interests as much as possible. Each of the four management tasks (Figure 24) requires different management information, supported by different tools. The four tasks may produce different products, like a master plan or a strategic plan (Den Heijer, 2011). The four management tasks for campus management, already adressed in the research proposal, and their related products are;

Task 1: Assessing the current campus
Product: A real estate assessment on physical, functional, financial and strategic aspects that represents the problem statement of any real estate strategy

Task 2: Exploring changing demand
Product: A list of programmatic requirements or a brief, explicit on physical, functional, financial and strategic aspects

Task 3: Generating future models for the campus
Product: A master plan, real estate vision or strategic plan, including future models on physical, functional, financial and strategic aspects

Task 4: Defining projects to transform the campus
Product: A real estate strategy, investment or maintenance planning, explicit on which physical, functional, financial and strategic aspects will be changed in order to achieve the required future model.

The iterative character of the tool is evident when quality or cost aspects of the real estate strategy as the outcome of this process give reasons to reconsider the future model or when the current situation is changing. Considering that, there is demand for evidence-based managerial information, whether the added value of past decisions is assessed afterwards or the presumed added value of an intended decision is evaluated beforehand, in a network of stakeholders with interfering goals, interests and requirements (Den Heijer, 2011)

2.2 FOCUSING ON THE BUILDING LEVEL: PROGRAMMING

This sub-chapter will cover research aspects related with the scale level of a building object. Based on applied theories about Programming and Building Information Modelling, a background of necessary information will be developed. The following research questions will be answered;

1. How can building requirements be aligned with portfolio objectives and in which way can building requirements be specified?
2. In which way available information can be organized in a coherent, comprehensive and usable system?
3. How can different options be explored and how can they generate solutions?

In order to explore the way building requirements can be stated, the work of William Peña and Steven Parshall, Problem Seeking will be the main source of information. Programming the requirements of a building is one of the most important tasks of an architect, or a programmer. The process of programming concerns five steps: 1.Establish Goals, 2.Collect and Analyze Facts, 3.Uncover and Test Concepts, 4. Determine Needs and 5.State the Problem. The approach is at once simple and comprehensive— simple enough for the process to be repeatable for different building types and comprehensive enough to cover the wide range of factors that influence the design of buildings(Peña and Parshall, 2001). This process can be applicable for many disciplines, but when it is employed by architects, it has its proper content, an architectural product. Four consideration or design determinants exist and indicate the type of information required in order to define a comprehensive architectural problem; 1.Function, 2.Form, 3.Economy and 4.Time. If during the five step process each of these four considerations regarded simultaneously, there are increased chances that the end product will be successful.

Architectural programming involves an organized method of inquiry – a five step process- interacting with these four considerations (Peña and Parshall, 2001). Moreover programming is a process leading to the statement of an architectural problem and the requirements to be met in offering a solution (Peña and Parshall, 2001). Following the statement of an architectural problem, problem solving is implied. There are many different problem-solving methods, but only those few that emphasize goals and concepts (ends and means) can be applied to architectural design problems. Therefore, The concept behind architectural programming concerns the endeavour of searching for sufficient information to clarify, understand and ultimately state the problem.

A Five Step Process

In order to state the problem five steps are structuring the following process:

1. Establish Goals
2. Collect and Analyze Facts
3. Uncover and Test Concepts
4. Determine Needs
5. State the Problem

In the first three steps it is necessary to look for pertinent information (1, 2, 3). The fourth step is a feasibility check (4) The fifth step is the residual results of the research (5). It is interesting that the five steps require alternatively different types of information, qualitative and quantitative. Steps 1.Establish Goals, 3.Uncover and Test Concepts and 5.State the Problem are qualitative, while steps 2.Collect and Analyze Facts and 4. Determine Needs are quantitative. Programming is based on a combination of interviews and work-sessions. Interviews are used for asking questions and data collecting, particularly during the first three steps. Work-sessions are used to verify information and to stimulate client decisions— particularly during the fourth step. For each steps, the following questions are posed;

1. Goals— What does the client want to achieve, and Why?
2. What do we know? What is given?
3. How does the client want to achieve the goals?
4. Needs— How much money and space? What level of quality?
5. Problem— What are the significant conditions affecting the design of the building? What are the general directions the design should take?

The five steps is not necessarily a strict and consistent sequential process as the information many times will not be scrupulously accurate. Information sources will not always be reliable, and predictive capabilities may be limited. The five steps and the available information, then, will not have the rigor or

the accuracy of a mathematical problem, thus programming is a heuristic process but not an algorithm. Programming is not always about a guaranteed process of finding the right problem but it is more about a definition of a feasible solution area, reducing the amount of guesswork (Peña and Parshall, 2001).

The method's success is dependent of the judgment of the people involved. It is preferable to follow the numerical sequence of the prescribed five steps, as theoretically it is the logical order. However all the steps but the last, may be taken in a different order or at the same time. It usually is necessary to work on the first four steps simultaneously, cross-checking among them for the integrity, usefulness, relevance, and congruence of information. The last step may be taken only after gathering all the previous information, extracting, abstracting, and getting to the very essence of the problem (Peña and Parshall, 2001).

STEPS OF THE PROCESS

1.Establish Goals

Project goals indicate what the client wants to achieve, and why. However, goals must be tested for integrity, for usefulness, and for relevance to the design problem. To test them, it is necessary to understand the practical relationship between goals and concepts. If goals indicate what the client wants to achieve, concepts indicate how the client wants to achieve them. In other words, goals are implemented through concepts.

Goals are the ends whereas concepts are the means, the way of achieving goals. The relationship of goals and concepts is one of congruence. The test for the integrity of goals depends on their congruence with concepts. Practical goals have concepts to implement them. On the other hand lip-service goals have no integrity and should be disregarded as regardless of good intentions; it is not always what the client says but what he or she really means (Peña and Parshall, 2001).

Different types of problems call for different types of solutions. A social problem calls for a social solution. After a social solution if identified, then it can be part of a design problem for which there will be a design solution, but not the other way around.

2.Collect and Analyze Facts

Facts are important only if they are appropriate, providing the possibility to describe the existing conditions of the site, including the physical, legal, climatic, and aesthetic aspects. Other important facts include statistical projections, economic data, and descriptions of the user characteristics.

Facts and figures amount can hinder the process of arriving to definite conclusions. Only facts relevant to the problem, pertinent to the goals and concepts should be collected and then organized into categories. After that, facts should be carefully processed to useful information in order to determine further architectural implications. As many facts are numerical information, numbers should be accurate to ensure the impartial allocation of space and money. Predictive parameters have to be just accurate enough to be realistic. While examining the collected data objective bias should be avoided. Programming requires to seek for what is true rather that what it is assumed to be true, separating facts from opinions, by evaluating and testing their validity (Peña and Parshall, 2001).

3.Uncover and Test Concepts

Concepts can be either programmatic or design. Programmatic concepts refer to abstract ideas intended mainly as functional solutions to clients' performance problems without regard to the physical

response. On the other hand, design concepts refer to concrete ideas intended as physical solutions to clients' architectural problems, this being the physical response. The key to comprehension is that programmatic concepts relate to performance problems and design concepts relate to architectural problems (Peña and Parshall, 2001). Programming requires abstract ideas that must have a vague form until the designer will transform them to physical solutions.

4.Determine Needs

Clients' usually have finite resources to achieve what they want, therefore it is important to distinguish needs from wants. In this sense it is usually hard to evaluate the quality and adequacy of space without knowing the available resources. It is also common that a client wants more than he can afford. To deal with this fact, the quality level of the building on a definite space program should be agreed based on the funds available at a specific time. In fact this step is an economic feasibility test, so that a budget can be determined or a fixed budget balanced Peña and Parshall, 2001).

It should be noted that the best balance is achieved when all four elements of cost are to some extent negotiable but it is necessary that at least one of the following elements is negotiable: (1) the space requirements, (2) the quality of construction, (3) the money budget, and (4) time. Thus, if agreement is reached on quality, budget, and time, the adjustment must be made in the amount of space (Peña and Parshall, 2001). If there is a serious imbalance, Goals, Facts, and Concepts should be re-evaluated.

The client's functional needs have a direct bearing on space requirements, which are generated by people and activities. Allowance must be made for a reasonable building efficiency as expressed by the relationship of net areas to gross areas. The proposed quality of construction is expressed in quantitative terms as cost per square foot. A realistic escalation factor must be included to cover the time lag between programming and mid-construction. Phasing of construction may be considered as an alternative:

- When the initial budget is limited.
- When the funds are available over a period of time.
- When the functional needs are expected to grow(Peña and Parshall, 2001).

Cost control begins with programming, and is basic to the whole architectural design problem to be solved. Cost control should not inhibit an architect's creativity as economy is a major consideration, not a constraint. Predicting costs at programming is not too difficult since the total planning proceeds from the general to the specific, from the broad scope to details. During programming, cost estimates can be made by successive approximations from the roughest tally of gross area, testing it with different quality levels of construction, while keeping an eye on building cost and other anticipated expenditures. First-phase programming (for schematic design) requires schematic estimates. Second phase programming (for design development) requires more detailed estimates. As the project advances in refinement, it is possible to test, to rebalance, and to update the budget estimate (Peña and Parshall, 2001).

Cost Estimate Analysis

It is imperative to establish a realistic budget from the very beginning. Realistic budgets are predictive and comprehensive preventing major surprises. They tend to include all the anticipated expenditures as line items in a cost estimate analysis. The architect must look to past experience and published material to derive predictive parameters (Peña and Parshall, 2001).

The budget depends upon three realistic predictions:

1. A reasonable efficiency ratio of net to gross area
2. Cost per square meter (escalated to mid-construction)
3. Other expenditures as percentages of building cost

These predictions are so common in practice that they are not considered as predictions but as planning factors. If cost estimate analysis results in a required budget higher than the available funds, two factors can change:

- Cost per square meter, or
- The Gross area

In other words, the building quality or the amount of space has to be adjusted.

5.State the Problem

Programming is a process leading to an explicit statement of an architectural problem. It's the handoff package— from programmer to designer. Deriving from previous steps, designer and programmer must write down the most salient statements regarding the problem, the kind of statements that will shape the building. These, if skillfully composed, can serve as premises for design, and later as design criteria to evaluate the design solution (Peña and Parshall, 2001).

There should be a minimum of four statements concerning the four major considerations, components of the whole problem: Function, Form, Economy, and Time, covering the functional program, the site, the budget, and the implications of time., representing the essence of the problem (Peña and Parshall, 2001).

FOUR CONSIDERATIONS

It's important to search for and find the whole problem. To accomplish this, the problem must be identified –as already mentioned- in terms of Function, Form, Economy, and Time. Classifying information accordingly simplifies the problem while maintaining a comprehensive approach. Too little information leads to a partial statement of the problem and a premature and partial design solution (Peña and Parshall, 2001).

The appropriate amount of information is broad enough in scope to pertain to the whole design problem, but not so broad as to pertain to some universal problem. Designers should look at the whole problem before starting to solve any of its parts (Peña and Parshall, 2001).

Function

Function implies ''what's going to happen in their building." It concerns activities, relationship of spaces, and people— their number and characteristics. Key words are (1) people, (2) activities, and (3) relationships.

Form

Form relates to the site, the physical environment (psychological, too) and the quality of space and construction. Form is what you will see and feel. It's "what is there now" and "what will be there." Key words are (4) site, (5) environment, and (6) quality.

Economy

Economy concerns the initial budget and quality of construction, but also may include consideration of operating and life cycle costs. Key words are (7) initial budget, (8) operating costs, and (9) life cycle costs.

Time

Time has three classifications— past, present, and future— which deal with the influences of history, the inevitability of changes from the present, and projections into the future. Key words are (10) past, (11) present, and (12) future.

FRAMEWORK

These four considerations should guide each step during programming. By establishing a systematic set of relationships between the steps in problem seeking and these considerations, between process and content, a comprehensive approach is assured (Peña and Parshall, 2001).

The result of the inter-relation between the five steps and the four considerations is a framework for information which covers the whole problem. During the five step process the four considerations interact.

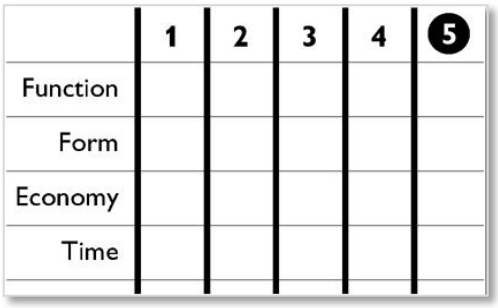


Figure 24. Forming a framework of information
Source: Peña and Parshall, 2001

For example, in the first step when goals are investigated, function goals, form goals, economy goals and time goals should emerge. With each of these having three subcategories, the process includes asking twelve pertinent questions regarding goals alone. Since the first three steps constitute the main search for information, three times twelve provides the basis for thirty-six pertinent questions (Peña and Parshall, 2001).

These should be considered as the main questions while its answers should provide opportunities for further questions. It is not necessary for programmers to know everything the client knows, but they should be able to ask the right questions in order to find out what the client's aspirations, needs, conditions and ideas are.

The considerations interact in the fourth step to test the economic feasibility of the project, and in the last step, they interact to state the whole problem. This interaction provides a framework for classifying and documenting information.

The classification qualities inherent in this framework are particularly useful in preventing information clogs when dealing with massive quantities of information (Peña and Parshall, 2001). At the same time this framework can be used as a checklist for missing information, orderly displayed as a scoreboard, also providing a format for dialogue among the members of the team

Organizing Information

During programming it is necessary to establish orders, so that information can make sense and can be used effectively in discussions and decision making. First, information should be properly organized and classified and then distilled information should be displayed. In this sense, it is possible to stimulate decisions from the client groups, having organized the vast amount of information within a rational framework.

Since the main search for information is made in the first three steps, the largest amount of information will be found in these compartments. Space requirements and their economic feasibility represent a diminished amount of information in the fourth step. The fifth step will contain the most important information, the programming document ; a clear, simple statement of the problem as the epitome of organized, edited information free of irrelevance (Peña and Parshall, 2001).

Data Clog

It is common that the amount of information received from a client can be staggering but this should not be intimidating. Any amount of information can be assimilated as long as it is pertinent, meaningful, and well organized for effective use. Large amounts of highly organized material are required to expand the range of possibilities before a new and useful combination of ideas can be generated by the designer (Peña and Parshall, 2001).

Processing and Discarding

Programming concerns the processing of raw data into useful information. For example, course enrollments at a college are not useful information— until they can be manipulated mathematically with average class size, periods attended per week, total periods available for scheduling, and classroom utilization. Only when the process produces the number and size of classrooms required does the raw data become useful information. Although programming is primarily conscious analysis, intuition has its place— the sensitivity to know what information will be useful and what should be discarded. (Peña and Parshall, 2001).

Abstract to Essence

Abstracting— distilling— to the essence should be an inherent aspect of a good programming process.. There must be a filtering process that brings out only the major aspects of information. This is especially crucial when arriving at the statement of the problem. There is always the risk of oversimplification, but this can be minimized by a thorough analysis and a conscious inclusion of all the complicating factors. It is necessary to amplify in order to view the whole problem, but there is also necessary to abstract in an iterative manner (Peña and Parshall, 2001).

Users

Dealing with users calls for different strategies to determine reasonable requirements; nevertheless, the building should benefit by intensive user participation in the programming process. Trying to integrate users' requirements can however lead to tailor made buildings, which is only favourable in the case where users are usually owners and directly responsible for the outcome. Organizations and institutions with static or dynamic conditions bring up the issue of idiosyncratic versus negotiable requirements. Still, the users' first concern is how their needs will be met when the building is occupied (Peña and Parshall, 2001).

STAKEHOLDER MANAGEMENT

In order to achieve effective group action, it is important to understand how people think. Planning a large, complex building project involves various actors, where multiple views and ideas emerging in the project team, formed by two main groups; the client and the designers. Each of these groups has different but distinct needs, values and objectives.

Acknowledging the differences is as important as reconciling them. According to Peña and Parshall, 2001, the greatest differences exist withing the designers group, usually emerging in the programming phase. Programmers should seek consensus among diverse viewpoints through a series of meetings. The objective is to cope with the multiplicity of perspectives and to lessen the differences of multiple

stakeholders, however without poor compromises. There should be a positive momentum in the team, striving for effective group action, based on the idea collaborating towards an integrating solution.

Project team

The project team should be led by two responsible group leaders— one to represent the client and the other to represent the architect. They must work together toward a successful project. Each leader must be able to:

- Coordinate the individual efforts of his or her group members.
- Make decisions or cause them to be made.
- Establish and maintain communication within, and between, the two groups.

Communication

To achieve effective, clear communication among many people— professionals, clients, and users— information collected must be carefully documented, as undocumented information is not likely to be considered and evaluated by the client and the designer. During programming, information should be organized and displayed for discussion, evaluation, and consensus.

Team effort demands communication; clients and designers require graphic analysis in order to fully comprehend the magnitude of numbers and the implication of ideas. It is necessary to employ appropriate communication techniques to promote thorough understanding, which will facilitate sound decision making.

Participation

Greater client/user participation generates much more information, which can also be conflicting. The users are usually concerned for the greater satisfaction of their needs, whereas the owner is mostly concerned about cost reduction and cost control. Clients have the major responsibility to be creative in programming, as they are responsible for the operational outcome.

Programmers can act as catalysts in seeking new combinations of ideas, by testing new concepts and generating alternatives. Moreover they should keep the client from making premature design decisions during programming. They should raise the client's appreciation and aspiration for better buildings (Peña and Parshall, 2001).

Decision Making

Good programming is characterized by timely and sound decision making by the clients— not the programmer. During programming, clients decide what they want to accomplish and how they want to do it. Programmers may have to evaluate the cost and benefits in order to stimulate a decision, identifying for clients those decisions that need to be made prior to design (Peña and Parshall, 2001).

Even though complete objectivity is not necessary, programming should avoid raising questions based on a preconceived solution. Client's decisions should be stimulated by generating options and testing programmatic concepts, so that it will be possible for the client to understand and evaluate their effects on goals (Peña and Parshall, 2001).

Stimulating client's decisions also prevents reprogramming during the design phase. Moreover, by stimulating decision making, client postponement of deciding on budget issues is minimized, thus the design solution is will most probably to be kept in budget.

Every decision the client makes during programming simplifies the design problem by reducing the number of alternative design solutions to those that meet the program requirements. Organizational and functional decisions produce clear requirements that lead to limited design alternatives.

Finally it is crucial to identify where the authority behind the decision making is vested. It is necessary to contact and interview the person who has the authority to make the decision.

Concluding, it can be said that the process of programming resembles the process for providing accommodation for an organization's needs. Relevant aspects have to be taken into account and the stakeholder management should aim at a solution that integrates various positions. The position that DAS framework is applicable in various scale levels is supported after analysing the Problem Seeking process. It is therefore possible to link and align portfolio and building object requirements, following these two similar methods.

2.3 Focusing on the building level: Building Information Modelling

Considering the increased number of stakeholders and their interests involved in the decision making about real estate as well as the amount of information required to develop a case and the considerations upon which sound decisions can be made, it is necessary to identify a platform that will incorporate these aspects, enhancing transparency and supporting the rational management of this inherent complexity. Nowadays Building Information Modeling (BIM) is an emerging tool that could provide support towards the aforementioned aspects.

What is BIM

BIM origin lies in the Computer Aided Design (CAD) research of the previous decades and is characterized as an "intelligent simulation of architecture" with six key characteristics; it must be digital, spatial (3D), measurable, comprehensive (encapsulating and communicating the design intent, the building performance and constructability and also financial aspects of means and methods), accessible (interoperable) and durable (for the whole life cycle of the building) (Eastman et al., 2008).

BIM provides an accurate digital virtual model of a building, containing information of the geometry and relevant data supporting the construction and fabrication of the building, its procurement activities and many functions related with its whole lifecycle. As such BIM can bring change in the original roles and relationships among a project team, enhancing integration in the design and construction process which potentially can result in buildings of increased quality and lower costs (Eastman et al., 2008).

Managing Information

There are many aspects of the AEC industry where the implementation of BIM can potentially -if properly implemented- bring benefits. BIM can tackle issues related with paper based communication ,transfer and sharing of data as well as information management in a project team. The digital building model can support multiple different views of the data contained within a drawing set, including 2D and 3D. A building model can be described by its content (what objects it describes) or its capabilities (what

kinds of information requirements it can support). It integrates the information in one compatible database which can enable the project team to explore and define further possibilities of the design.

Interoperability, collaboration and integration

With increased interoperability, collaboration within the project team can be enhanced; open interfaces should allow for the import of relevant data (for creating and editing a design) and export of data in various formats (to support integration with other applications and workflows). As BIM technology facilitates simultaneous work by multiple design disciplines, which can shorten the design time, provide earlier insights into design problems and present opportunities for improvements (Eastman et al., 2008).

Employed Ex-ante

In the early stages of a project an approximate or macro building model in BIM can provide useful information about the feasibility of the concept and its design benefits. Linking this model to a cost database can relate the program of requirements to cost and time and assess whether the building can meet the financial requirements of an owner, in other words if the set goals are achievable. In the same sense, a schematic model can be used to evaluate design alternatives -through analysis and simulation- about the functional and sustainability related requirements of the building, resulting in a potentially increased building performance and quality (Eastman et al., 2008). During the design stage of a project, the integration of various types of information (space, cost, energy) into one model can result in accurate cost estimates and improved energy efficiency analyses and assessments, which can be used to support sound decision making about the building, its performance and its quality.

Employed Ex-post

Besides the capabilities offered when the building is designed ex-ante, BIM can also be used in retrospect, after the construction of it, during its operational stage. Previous analyses conducted in order to determine mechanical equipment, control systems, and other purchases can be provided to the owner, as a means for verifying the design decisions once the building is in use.

Verification can enhance transparency and result in more efficient management of the facility. Moreover, an updated building model can also be linked with facility management systems, considering the fact that BIM supports real time monitoring of control systems; being an accurate source of information about the built spaces and systems, it can be a useful starting point for managing and operating the building (Eastman et al., 2008).

After a brief review of the possibilities offered with the implementation of BIM a more thorough analysis will follow, exploring the application of BIM from the perspective of an owner and a facility manager. In this way it will be possible to identify how the organization examined in this research (A.U.Th.) can employ and benefit by using BIM for the management of the university real estate.

BIM FOR OWNERS

It is already mentioned that BIM facilitates collaboration between project participants, reducing errors and field changes and leading to a more efficient and reliable delivery process that reduces project time and cost. From the perspective of the owner, BIM can be employed to:

- Increase the building value, through BIM - based energy design and analysis to improve overall building performance
- Shorten project schedule from approval to completion by using building models to coordinate and prefabricate design with reduced field labor time
- Obtain reliable and accurate cost estimates through automatic quantity take - off from the building model, providing feedback earlier in a project when decisions might have the greater impact
- Assure program compliance through ongoing analysis of the building model against owner and local code requirements
- Produce market - ready facilities by reducing time between procurement decisions and actual construction, allowing for the selection of the latest technologies or trend finishes
- Optimize facility management and maintenance by using the as - built building information model as the database for rooms, spaces, and equipment.

These benefits are available to all types of owners; small and large, serial or one - time builders, private or institutional (Eastman et al., 2008). Various factors can motivate owners to adopt BIM such as cost reliability and management. The accuracy and computability of the building information can provide a reliable source for owners to perform quantitative estimates about costs related to the design. Another factor is that of market timing of the building, where BIM processes can shorten the time frame of a project, resulting in a minimized market (long building cycles increase market risk). It is possible to reduce the schedule by 3D coordination and prefabrication and also have a quick response to unforeseen field conditions with 4D coordinated BIM models.

At the same time BIM tools and processes can support owners' efforts to coordinate the increasingly complex design and approval efforts simultaneously, contributing to a more efficient time management. Another factor is that of sustainability. Sustainable buildings are not only considered a good practice but also have greater marketability. Owners adopting BIM can reduce the energy consumption of their building through energy analyses, improving the operational productivity through modelling and simulation.

Following these factors, it becomes obvious that BIM provides owners with the possibility to manage and evaluate the scope of the design against their requirements at every stage of a project. Due to the fact that requirements can change, it is necessary for the owner to ensure that all requirements are met.

Validation and verification is more efficient within a building model compared to a conventional manual process. Owners can work with the design team to use a building information model to improve program compliance through BIM spatial analyses; thus, the owner can better ensure that the requirements of their organization are met and that operational efficiencies of the program are realized.

Moreover, through visual stimulation relevant stakeholders can provide more useful input for the project. Finally design scenarios can rapidly be reconfigured and explored by simulating the facility's operation, stimulating decisions(Eastman et al., 2008).

BIM FOR FACILITY MANAGERS

Depending on the approach towards the building an owner can not only care about the design, construction and sale of the building (REM or investor perspective) but also for the whole lifecycle of it (CREM perspective, where the organization uses real estate as input for its core business processes). In

this case the owner will also manage the building after its construction, as a facility manager. Whether the facility management is in house or outsourced, a building model can be used in order to develop a facility management database, which can afterwards be used with specific BIM asset management tools.

For example, GIS data and building models can be integrated in a web-based asset management tool (United States Coast Guard case in Eastman et al., 2008), or a 4D financial model that associates each building object with a condition assessment over time, showing the big picture of the facilities' condition periodically. In this way, it is possible to define the required maintenance works and evaluate their impact on the facilities. Finally, as already mentioned, BIM can be employed from the facility manager's perspective in order to check against the program of requirements (spatial, energy, and distance and height requirements for specific spaces or between spaces as well as adjacency requirements) and validate it, in the BIM model.

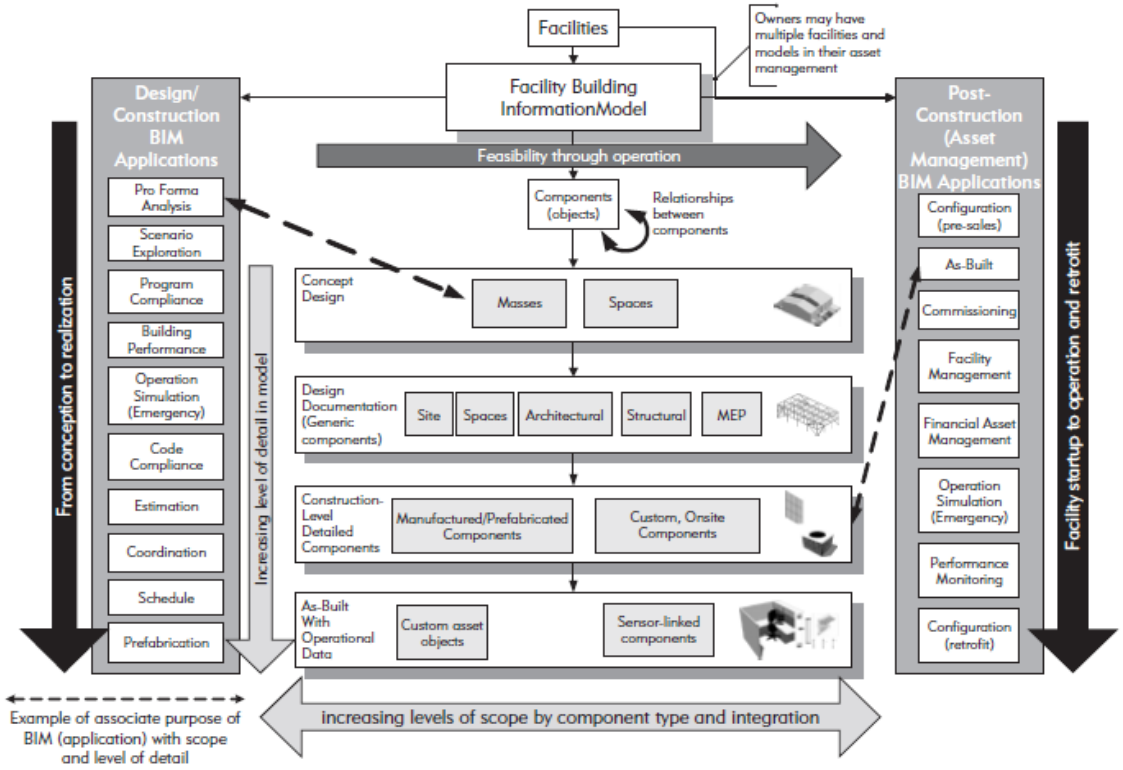


Figure 25. Conceptual diagram showing the relationship between various BIM applications during the facility delivery process; post- construction and their relationship to the level of scope and detail in the model. Source: Eastman et al., 2008

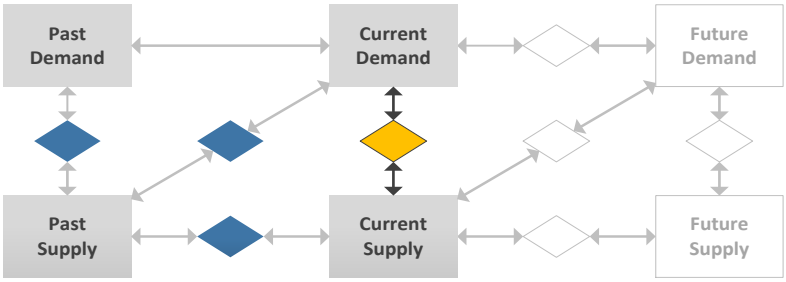
Concluding, it should be mentioned that owners and facility managers have to consider the scope and the level of detail of a project. To take advantage of post - construction BIM applications owners need to work closely with their service providers to ensure that the building model provides adequate scope, level of detail, and information for the purposes intended. In order to present the relationship between the level of detail in a model (masses, spaces, and construction- level detail) as well as the scope of the model, the following framework can be used. Finally Figure 26 presents the key information required for a building model to support post-construction use (Eastman et al, 2008).

Purpose	Type of Model Information
To support program compliance and facility management. In a typical design process, the spatial information is defined to meet program compliance and support code-checking analysis. These are critical for program compliance and use of the BIM for facility management.	Spaces and functions
To support commissioning activities such as performance specifications.	Performance specifications for HVAC and other facility operation equipment
For post-construction analysis and tracking as well as data for future forecasting.	As-built schedule and cost information
To budget and schedule maintenance.	Manufactured product information
For replacement costs and time periods and assessment information (See Coast Guard Facility Planning case study)	Financial asset management data
To plan and prepare for evacuation and other emergency crises.	Emergency information
To monitor and track progress of design, construction, or maintenance activities.	Activity status

Figure 26. Table of an Owner's Building Information Model. Source: Eastman et al., 2008

CHAPTER 3

3.1 Assessing the Current state of A.U.Th. real estate



After developing a basic understanding of the A.U.Th case, exploring its basic figures, organizational structure and the related stakeholders, it is necessary to collect, measure and compare information from the various CREM perspectives. In order to assess the current state between supply and demand, it is necessary to benchmark the current campus. The assessment will focus on quantitative data expressed in KPIs and will focus on the physical, functional and financial perspective. By doing this, it will be possible to provide objective input for decision making in the strategic level. Moreover, by assessing the current situation, it will be possible to continue the process of the DAS framework; in the case of campus management, it will be possible to proceed to the next management tasks (Den Heijer, 2011)

The Physical perspective

The most important variable for assessing the university real estate from the physical perspective is floor area. The real estate of A.U.Th. will be categorized in two clusters; on-campus and off-campus.

On-Campus real estate

The campus of A.U.Th. is located next to the city centre of Thessaloniki and it is the place where this university is historically developed and where it defines its presence. On campus real estate can be characterized as corporate real estate, comprised of thirteen faculty buildings, one building where the central administration is accommodated, and five supportive shared facilities. in addition to that, the academic hospital AHEPA is located in the campus, strongly related with the neighbouring medicine school.

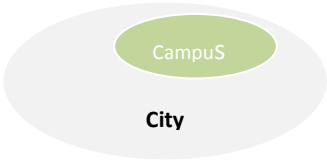


Figure 27. RE location in relation with the city, based on Den Heijer (2011)

According to the Strategic and Operational Development Plan 2006-2015 of the A.U.Th. (A.U.Th.,2005), the total GFA of the on-campus facilities is 340.000 square meters. The efficiency of the portfolio on campus was calculated based on the information found on the research workshop for building registration of 2004 (A.U.Th., 2012).

On Campus A.U.Th. RE	
21 Buildings: E&R, Office, Support	
GFA:	339.216 m2
UFA:	241.317 m2
UFA/GFA:	71%
Owned:	99,8%

Comparing the data of 2005 and 2004 it was assumed that the originally indentified area was the GFA of each building (2005),

whereas the area described as usable on the later documents (2004) would be the UFA. Based on this assumption, the result was logically acceptable; UFA/GFA was between 54% and 78%, with an average of 71%. Considering the fact that most of the campus building were built in the same era (modernist buildings, international style) this data-set will be regarded as valid for the cause of the research. A deeper research on building level may be useful for more detailed and precise results. Assuming an efficiency ratio of 71%, the UFA of the on-campus facilities is 240.000 square meters and the GFA is 340.00 square meters. The total land area of the campus is 430.000 square meters.

The total UFA assigned for Education is 24,3% or 58.500 square meters, 14,4% or 44.000 square meters for Research and 30,4% or 73.000 square meters for Office space. It is not possible to accurately measure the floor area of specific space or laboratories, however at this point it will be covered by the research-assigned floor area. Of the total UFA only 0,2% or 423 square meters are rented; 99,8% of the on-campus facilities are owned and used by the university, so it will be considered as 100% owned by the university.

Off-Campus real estate

On-campus university real estate is almost 80% of the corporate real estate of A.U.Th**.** As already mentioned A.U.Th. accommodates some of its departments outside of the campus. There are two departments located in neighbouring cities (Veroia and Serres) however, it will be assumed that these departments can be managed as individual organizations, in their local context. Moreover, there is ongoing speculation about their future organizational structure; the administration of these departments as well as the Greek Government considering to decentralize them, detaching them from the A.U.Th. central administration and responsibility. Therefore these departments will not be part of the research.

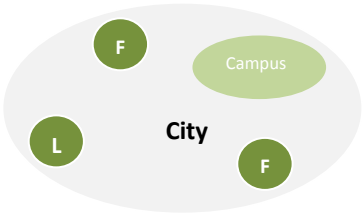


Figure 28. RE location in relation with the city, based on Den Heijer (2011)

The remaining 20%, or 90.000 square meters GFA of A.U.Th. corporate real estate located in the conurbation of Thessaloniki, provides accommodation to four departments; school of Education, Fine Arts, Physical Training and Journalism and Media. These four departments do not have educational space on campus. Moreover, two additional buildings provide practice and laboratory space for departments accommodated on campus; Faculty of Geotechnical Sciences (Veterinary and Agriculture and Forestry) and School of Biology. Due to this fact it is still unknown what is the frequency and occupancy rates of these buildings and the exact number of users, both on and off-campus.

Off campus A.U.Th. RE	
6 Buildings: E&R, Office, Labs	
GFA:	**98.336 m2**
UFA:	**65.028 m2**
UFA/GFA:	**66%**
Owned:	**94%**
Rented:	**6%**

The total GFA of the four schools is 30.400 square meters, with 20.100 square meters UFA. The total UFA assigned for education is 39,7% or 8.000 square meters, 15,0% or 3.000 square meters for research and 34% or 15.300 square meters for office space. The two supportive or laboratory buildings' total GFA is 67.900 square meters, with 44.900 square meters UFA. They can either be regarded as research space in total, or follow the functional ratios used for calculating education, research and office space of the relevant on campus faculties (Faculty of Geotechnical Sciences and School of Biology). The off-campus

real estate is built on 4.427.105 square meters (44,3 hectares), with Faculty of Geotechnical Sciences being located in a farm, 4.172.105 square meters(41,7 hectares).

The densities observed on campus (0,8) and off campus -without considering the farm- (0,11) indicate the differences between the inner-city campus and the recently accommodated faculties -most of them- in the suburbs of Thessaloniki. Of the total UFA , 6% or 4.100 square meters are rented; all rented space is used for the needs of the four departments, where only the school of Journalism and Media renting all of its required space (100% rented, UFA of 1080 square meters).

Off-campus assets; endowments

In addition to the corporate real estate, A.U.Th. is the owner of an investment real estate portfolio, that of the endowments. They are assets donated to the university, the revenues of which should be invested according to the wishes of the legator, most of the times for funding scholarships. Under the current legal framework, the way endowments can be managed is prescribed by a law enacted back in 1939, considered to be outdated. One assumption for this research will be that endowments will be possible to be managed as an investment real estate portfolio parallel to a corporate real estate portfolio, without the complications imposed by the current legislation.

After having a personal meeting with the endowments department, it was possible to obtain up to date data, as per April 2012, in terms of each asset's address, LFA, floors, rents and vacancy. The received data base was addressing each premises as an asset, counting 135 premises in total (apartments, offices, retail stores, basements and land parcels). In order to have a better overview of this portfolio, these premises were categorized by their address, assuming that more than one premises in the same address and in more than one floor, comprise a building owned by A.U.Th. There is still the need to verify this assumption with further research.

The aforementioned categorization resulted in a new portfolio of 13 buildings and 15premises, out of which 2 buildings and 3 premises were in Athens and one building in the city of Kavala. The rest of the assets were all in the city of Thessaloniki. The total LFA of the portfolio is 9.400 square meters, out of which 5.200 square meters are currently let out to external parties. The vacant square meters are 4.250 or 45% of the total LFA. The average vacancy rate of the portfolio is 43%.

Under the current lease contracts, the total yearly gross income of the portfolio (100% ownership) is 319.000€. Due to ownership rations the gross income for A.U.Th. is 255.300€. The gross rent level of the let out space is 61€ per square meter. The average gross rent level for the whole portfolio (let out and vacant LFA of 9.432 square meters) is 43€ per square meter whereas A.U.Th. receives 27€ per square meter per year from this portfolio (let out and vacant LFA of 9.400 square meters).

As an investment portfolio, its performance - in terms of returns- is highly dependent on the market conditions. From the perspective of an investor, the assessment criterion of an asset's performance is that of the EVA creation (economic value added).

In this sense, one possible action regarding the portfolio could be that of real estate divestment, which will provide liquidity for re-investment. On the other hand, a university is not a for-profit organization. A challenge as well as opportunity exists, in the way a supplementary to the core business investment portfolio, should or would be managed.

It is therefore necessary to further research how these two different perspectives (owner and investor simultaneously in this case) can create synergy and benefit by managing different types of real estate for a common goal.

THE FUNCTIONAL PERSPECTIVE

The assessment of the functional perspective concerns the users of the university and the function of its real estate. It can be performed in different levels such as portfolio, building object or specific spaces; in this case it will be a portfolio assessment. In order to proceed with this task, information found in the Strategic and Operational Development Plan 2006-2015 of the A.U.Th. (A.U.Th.,2005) will be used. In addition to that, various statistical reports created by the Greek ministry of Education will be used.

A.U.Th. Users and Requirements	
UG students:	88,062
PG students:	10.315
Act. Students:	56.465
m2 /student:	2,16 on campus
	2,45 off campus
FTE teaching staff:	2.325
FTE admin. staff:	642
m2/staff:	28,64 on campus
	31,73 off campus

Users

The users of the A.U.Th. are students, teaching staff and administration staff. Students are categorized in undergraduate students (UG) as the total number of undergraduate students enrolled, post-graduate students (PG) and active students (AS), as the sum of PG students and the undergraduate students who are participating in the educational process, according to each faculty's secretariat data provided.

In 2005 there were 88.062 undergraduate students, 10.315 post-graduate students and 56.465 active students. At the same time, there were 2.325 full time employees as teaching staff and 642 as administrative staff.

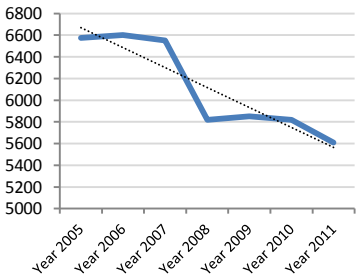


Figure 29. A.U.Th. annual enrolment for the periods 2005 to 2011

Considering the enrollment trend of the A.U.Th. from 2000 to 2011, the total number of students is expected to be slightly lower (-1140 AS in total), assuming the decrease equals the cumulative reduction of 2005-2011 and graduation rates remain constant. However an more accurate estimation cannot be made as the number of students is also influenced by other factors (postponement of graduation due to crisis etc.) (Den Heijer, 2011)).

Following the payroll data of the university, it can be said that between 2004 and 2009 there was a relative increase in personnel (teaching and administrative), estimated as 3%, by compounding 2004 payroll to 2009 and calculating the difference). The ratio for Active plus Post-graduate students / FTE teaching staff stands at 17,5 students per one academic staff, as estimated for 2011.

Functions

Considering that the main functions of the university is education and research, it remains to identify what are the ratios for these core functions as well as which other functions are accommodated in the A.U.Th. facilities.

The basic categorization concerns, four functional types; Education, Research, Office space for teaching and administrative staff and Other functions. Analyzing aggregated data from the research workshop for building registration of 2004 (A.U.Th., 2012), it was possible to extract functional ratios in building level. On average the UFA of the university's facilities comprised of; 36% Office space, 31% space for Education, 12% space for Research, 8% space for Libraries, 7% space for various functions,5% supportive spaces for research and education and 1% for the students' club.

By applying individually these ratios to each faculty building it was possible to determine the portfolio functional composition which was 24% Education, 15% Research, 30% Office and 31% as Other functions.

On portfolio level, the cluster of Other functions refers to specific building such as the Asteroscopeio-Observatory and Meteorology-Weather station, used by a specific user group -students of Applied Sciences- and shared facilities such as the Central Library, the Students Club for dinning and various services and the Student's Gym.

Shared facilities are 20% of the on campus UFA and the majority of them accommodate supportive functions . It should be mentioned that the current campus of the A.U.Th. is rather mono-functional than diverse, accommodating only core educational and relevant supportive functions (lecture halls, classrooms, laboratories, libraries, office space, restaurant and gym).

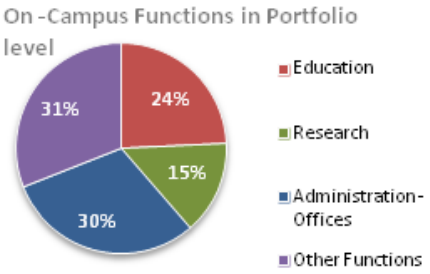


Figure 31. On campus functional breakdown

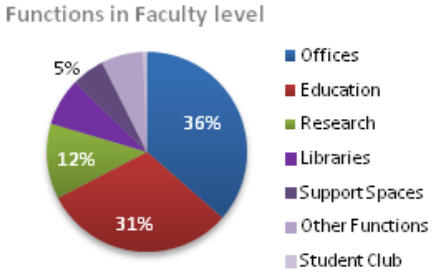


Figure 30. Faculty Functional breakdown

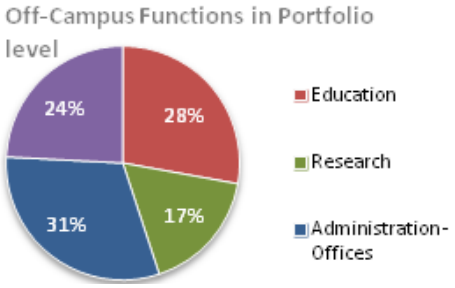


Figure 33. Off campus functional breakdown

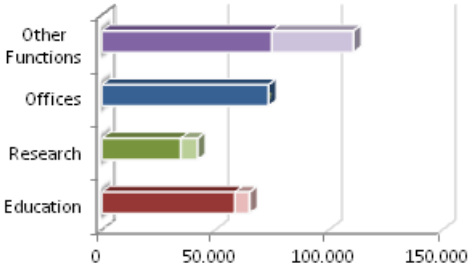


Figure 32. Shared Facilities per Function On-Campus

UFA per User Group

The following KPIs will reflect the floor area assigned per student (Active and Post-Graduate) and the office space assigned for the Teaching and Administrative staff, both on and off-campus.

For Education and Research, the relevant KPI is 1,5 square meter per student in absolute terms, where on average 2,15 square meters per student are available in each faculty building. The average floor area per student offered by the total UFA of the shared facilities is 0,8 square meters per student. Adding the absolute amount of square meters for E&R plus the square meters of shared facilities results in a 2,17 square meter UFA per student on the total facilities offered by the A.U.Th. campus, almost identical with the average R&E UFA per student. In the same sense, the Office Space UFA per FTE employee is 28,7 square meters, indicating the average size of each office workplace.

Following the categorization of the off-campus real estate, the four departments will be analyzed first, followed by the two Practice and Laboratory facilities. The four departments offer 1,7 square meters per student for R&E UFA in absolute terms, where the average stands on 2 square meters per student; being slightly lower than the relevant KPI on-campus.

The average Office UFA per FTE employee in these four departments is 17,1 square meters. This figure can be read in two ways; it either reflects changes in workplace size trends, as these departments are considerably younger than the on-campus faculties, or that by being de-centralized units, part of their administration still lies within the campus. It is still an issue that could be further researched and is still strongly related with the unavailability of exact data of frequency and occupancy rates for these buildings.

The two Practice and Laboratory facilities offer 3,4 square meters per student for R&E UFA in absolute terms, where the average stands on 2,4 square meters per student, reflecting their function. The average Office UFA per FTE employee in these four departments is 30,3 square meters, relatively similar with the on campus relevant KPI. Still the same issue, unavailability of accurate data for the off campus facilities, applies in this case.

Nonetheless, it becomes obvious that it is important to acquire information about two more variables; frequency rate and occupancy rate. Frequency rate indicates hours of use versus hours available, measuring use in time and occupancy rate indicates used capacity versus maximum capacity (Den Heijer, 2011). It is much to gain by increasing both rates and at the same time balancing efficient space use and effectively accommodating the primary process (Den Heijer, 2011).

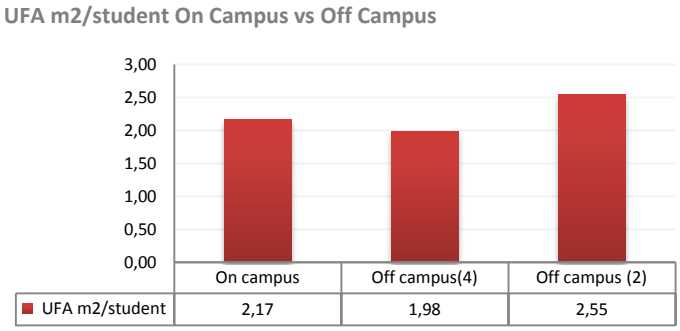


Figure 34. Educational (E&R) Floor area per student On and Off-campus

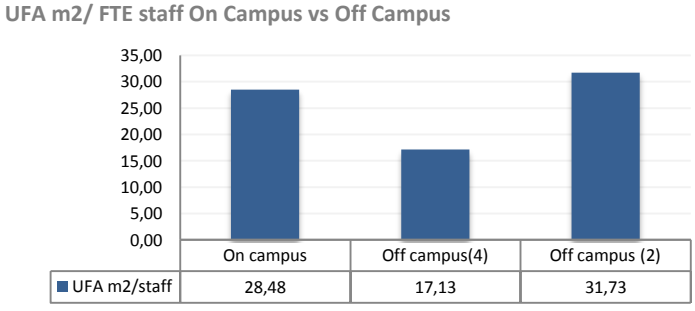


Figure 35. Office Floor area per FTE employee (teaching and administrative staff) On and Off-campus

THE FINANCIAL PERSPECTIVE

The cause of the research lies in the current financial national context resulting in reduced annual budgets, putting pressure in the financial departments -or the controllers- of public organizations. In this sense it was necessary to analyze and develop an understanding of the financial structure of A.U.Th.; in which way is the university financed and how it allocates its financial resources. Two sources of information were used for this analysis; the Strategic and Operational Development Plan 2006-2015 of the A.U.Th. (A.U.Th.,2005), providing data for the organization's funding for the period 1999-2004 and report of the Hellenic Quality Assurance and Accreditation Agency (H.Q.A.,2011), presenting the associated costs of Greek universities for the years 2009 and 2011.

A.U.Th. Financial KPIs in 2004 and 2011

Total Income 2004:	221 min €
Total Income 2011:	155 min €
Total Expenses 2004:	214min €
Total Expenses 2011:	155min €
Cost of Ownership:	5,6% of budget
2004:	12,3min €
2011:	2,3 to 15min €
€/ m2 GFA 2004:	28
€/ m2 GFA 2011:	from 5,60 to 34,00
	Assumed 18,00

Revenues

By analyzing these data it was possible to identify the way A.U.Th. revenues were structured in the period 1999-2004, a period of economic growth for Greece. A brief breakdown of the organization revenues budget shows that on average ; 54% of it, as State funding, covered the cost for personnel - payroll, 18% was the tactical budget for educational and administrative costs, 5,6% was the annual public investment for building infrastructure and equipment. In addition to that, A.U.Th. was generating revenues with its Research Commitee as a 20% of its total revenues budget (RC revenues were 75% of National and 25% of International sources, 15% of the total revenues from private organizations). Finally a 0,7% of A.U.Th. revenues generated by managing its own assets with the Asset Management department.

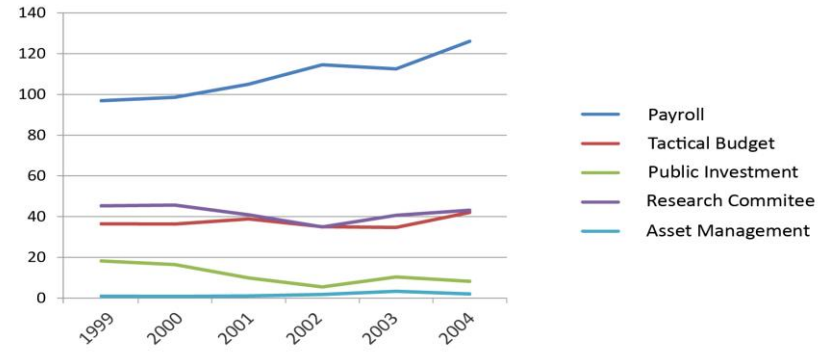


Figure 36. A.U.Th. Revenues development between 1999 and 2004

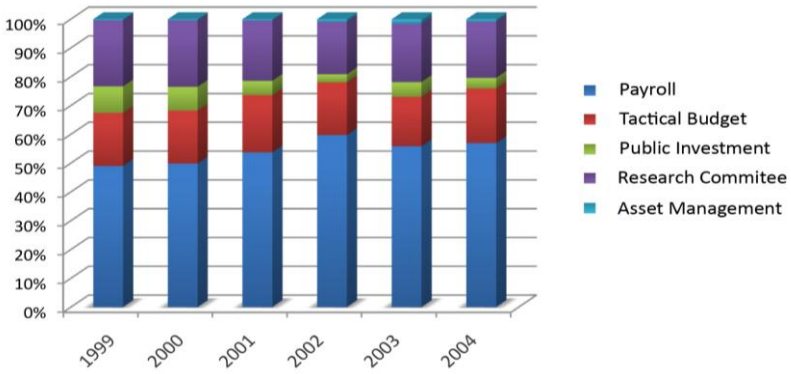


Figure 37. A.U.Th. Revenues breakdown between 1999 and 2004

Expenses

For the period 1999-2004 it was not possible to find definite facts regarding the way A.U.Th. allocated its funds. Considering the fact that non-profit organizations usually have a balanced budget and by referencing A.U.Th. with the financial figures of the Dutch universities (Den Heijer, 2011) the following ratio for Expenses/Revenues will be used; 97%, indicating a slightly positive annual balance for the period 1999-2004 and a 100% ratio for the period 2005-2011.

Rates as per OECD, May 2012	2004	2005	2006	2007	2008	2009	2010	2011
Inflation:	2,90%	3,50%	3,20%	2,90%	4,20%	1,20%	4,70%	3,40%
Salary Growth:	4,90%	4,90%	0,50%	7,70%	6,80%	8,30%	-7,30%	-7,30%

A.U.Th. Budget in million €	2004	2005	2006	2007	2008	2009	2010	2011
Compounded from 2004	**221,00**	228,74	236,05	242,90	253,10	256,14	268,18	277,30
Known by year 2009	221,00	228,74	236,05	242,90	253,10	**237,00**	248,14	256,58
Known by year 2011	221,00	228,74	236,05	242,90	253,10	237,00	196,00	**155,00**

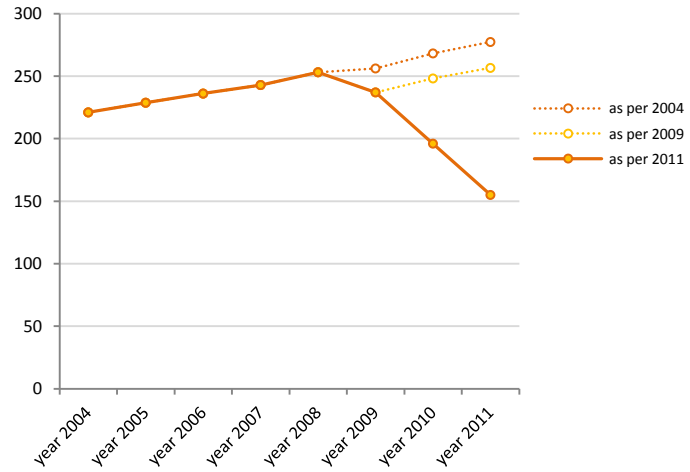
A.U.Th. Payroll in million €	2004	2005	2006	2007	2008	2009	2010	2011
Compounded from 2004	**126,00**	132,17	132,83	143,06	152,79	165,47	153,39	142,20
Known by year 2009	126,00	132,17	132,83	143,06	152,79	**191,00**	177,06	164,13
Known by year 2011	126,00	132,17	132,83	143,06	152,79	191,00	159,25	**127,50**

A.U.Th. Cost of Ownership in million €	2004	2005	2006	2007	2008	2009	2010	2011
Compounded from 2004	**12,38**	12,81	13,22	13,60	14,17	14,34	15,02	15,53
As 5,6% of Budget	12,38	12,81	13,22	13,60	14,17	13,27	13,90	8,68

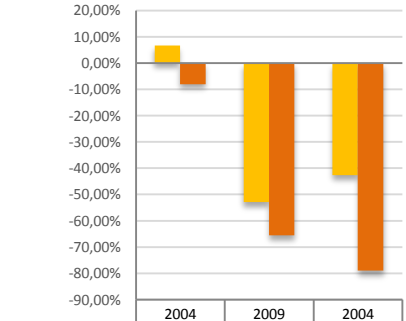
Knowing the cost for personnel and the operating expenses of Greek universities for the years 2009 and 2011 (H.Q.A.,2011) it was possible to identify the annual development of these figures from 1999 to 2004 compounding these two variables with relevant indicators; Salary Growth annual rate (OECD,2012) for the payroll and Annual Inflation Rate (OECD,2012). In this calculations, the cost of ownership could be defined with a constant ratio of 5,6% of the annual budget. The numbers coloured blue, indicate the known figures.

The following graphs provide an overview of the estimated financial figures of A.U.Th. from 2004 to 2011, regarding the annual budget and the cost for personnel. This way it will be possible to define the real and nominal changes of these financial figures and later on, use them to estimate how the current A.U.Th. budget is structured.

A.U.Th. Budget Annual Development between 2004-2011

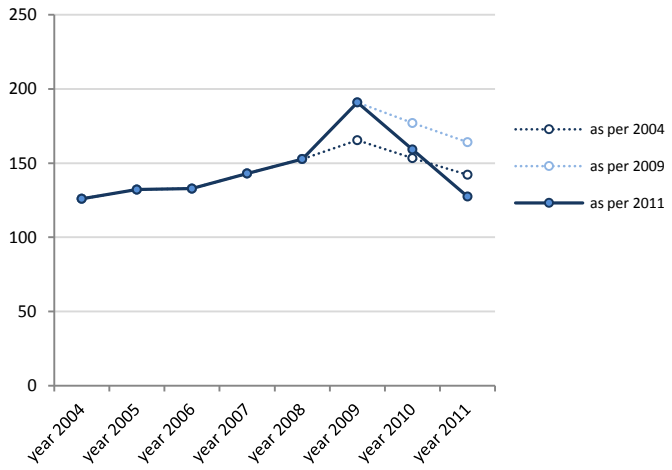


A.U.Th. Budget Changes between 2004-2011

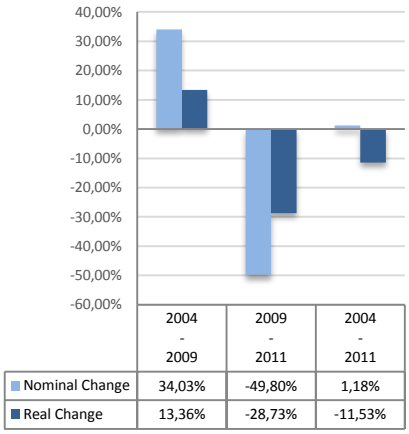


	2004 - 2009	2009 - 2011	2004 - 2011
Nominal Change	6,75%	-52,90%	-42,58%
Real Change	-8,08%	-65,53%	-78,90%

A.U.Th. Payroll Annual Development between 2004-2011



A.U.Th. Payroll Changes between 2004-2011



	2004 - 2009	2009 - 2011	2004 - 2011
Nominal Change	34,03%	-49,80%	1,18%
Real Change	13,36%	-28,73%	-11,53%

It is observed that indeed the financial resources of the university have been diminished, with an observed real decrease of 79% between 2004 and 2011. One interesting finding concerns the employees of the university; between 2004 and 2009, the increase of the payroll is observed to be higher than the OECD salary growth rate for Greece. This can have a dual explanation; there was either an increase in the total employees' numbers or a higher than average salary growth thus the employee's number remained constant. For this research, the first explanation will be used as an assumption.

Having explored the financial figures of the university, a last estimation for the minimum value of the cost of ownership will be attempted. For that, the 2004 budget ratios for each part of the budget will be used along with the annual budget and the payroll, as known variables. The percentage for the public investment will be considered as the resources allocated for the cost of ownership. It is observed that from the year 2009 the percentage of the annual budget allocated for the payroll is dominant, around 80%, compressing the tactical budget of the university.

Considering the decrease of the budget, it can be said that the university is currently under a situation with limited financial resources; in this estimation the cost of ownership is only 2,4 € millions, meaning that there are only 5,6 € per square meter of GFA available every year. Still for the cause of the research this will be considered an extreme scenario, assuming that the KPI expressing the quality of space offered would most probably be around 18 € per square meter of GFA.

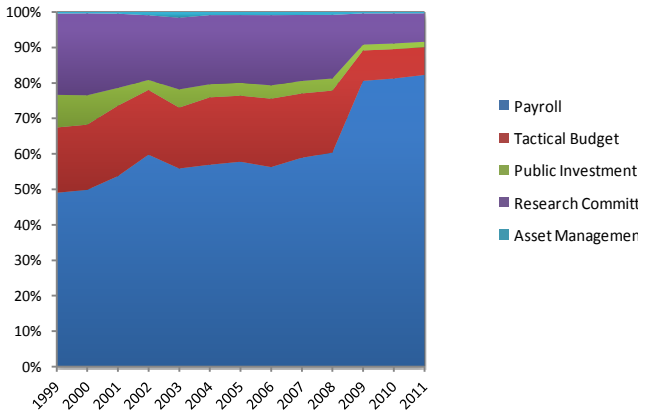


Figure 39. A.U.Th. Budget components development between 1999 and 2011. Since 2009 the university is almost only able to finance the cost for its personnel.

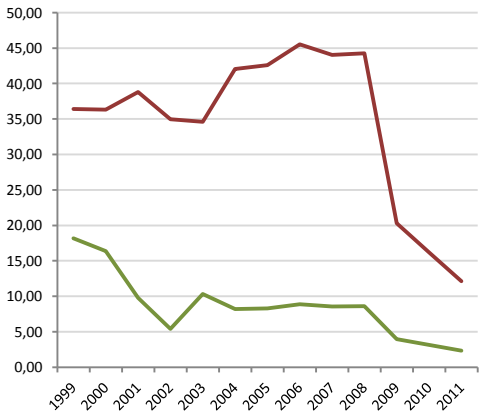


Figure 38. A.U.Th. Tactical and Public Investment Budget development between 1999 and 2011.

IDENTIFYING THE CURRENT MIS-MATCH

After a retrospective analysis of the A.U.Th. through the prism of the three CREM perspectives it is necessary to define the identified mis-matches between the current supply and the current demand.

For the cause of the research, the image of A.U.Th. in 2004-2005 will be considered as the current supply (CS), meaning that this used to be the usual business model of this organization. On the other hand, the image of 2011 will be considered as the current demand (CD), reflecting the new situation in which the university needs to act and provide a response.

The analysis of A.U.Th. allowed the creation of these two profiles (CS and CD) which can be found in the Appendix 3.7. By comparing them it will be possible to identify the discrepancies between the supply and the demand side. In this sense the future goals for A.U.Th.'s CREM could be formulated so that by following the next tasks of campus management (Den Heijer, 2011) solutions would be generated.

Discrepancies between CS-CD

Physical Perspective

Looking at the physical perspective no discrepancies were identified. A.U.Th.'s CREM portfolio footprint (m2) remained the same in terms of quantity. However, as time influences real estate, A.U.Th. is faced with the issue of ageing CRE and the related Technical as well as Financial and Functional obsolescence.

Functional Perspective

Looking at the functional perspective, two discrepancies can be observed; a slight decrease in the number of active students and a slight increase in the number of FTE employees.

This means that the required square meters per each user group will follow an inverse development; slight increase in the square meters per student and slight decrease in the office square meters per FTE employee.

However, It is necessary to develop a point of reference and benchmark the KPIs expressing the current functional fit of A.U.Th. in order to proceed to an evidence based assessment.

Financial perspective

Looking at the financial perspective, it becomes obvious that the available financial resources are considerably reduced, from 221€ million to 155€ million . The reduction has already been described in the previous part, as a 79% decrease in real values.

The reduction in the university's available financial resources is reflected in the decreased budget for real estate, which can be expressed by the cost of ownership, estimated from 12,3€ million in 2005 to 8,7€ million in 2011.

Consequently, the quality of space provided by the university is put under pressure, expressed in the annual cost per square meter of GFA which dropped from 28€ per m2 to 18€ per m2 or even lower.

Concluding remarks

The discrepancies observed between the CS and the CD indicate the mis-matches. The mis-matches and their potential effects can be summarized as:

1. Reduced financial resources: Size reduction (m2) or reduced quality of space (€/m2 GFA).
2. Reduced number of students: Increase in educational space per student (+ E&R m2/AS) or reduced educational space (- total E&R m2).
3. Increased number of FTE staff: Reduced office space per FTE employee (- Office m2/FTE employee) or increased office space (+ total Office m2).
4. Aged-Ageing CRE: Need to deal with Technical, Functional and Economic real estate obsolescence.

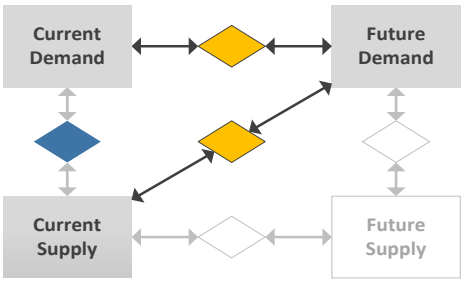
Considering the aforementioned mismatches it becomes clear that A.U.Th. is faced with two challenges:

1. CREM should aim at a cost-efficient accommodation. It is necessary to minimize un-necessary costs due to the limitation of the university's financial resources. Still it is crucial that the decision making about the allocation of available resources will be rational and supported by evidence. Besides cost reduction, cost-efficiency can be also pursued by aiming at increasing the benefits for the related costs. Therefore A.U.Th. should also seek additional ways to increase the value added by its real estate.

2. CREM should cope with the changing functional requirements imposed by its current and future users' population development. The current accommodation has to be assessed in terms of functionality quantitatively and qualitatively. The end goal for A.U.Th. is to provide optimal accommodation, aiming at the best fit per each use or function and the relevant user group.

The next parts of the research will be an elaboration towards answering these challenges.

3.2 Exploring Changing Demand



After developing a clear picture of the A.U.Th. real estate about its physical, functional and financial aspects acquiring the related KPIs the next step is the exploration of the changing context and demand. The essence of this task is the generation of information concerning the way relevant developments may influence the management of the university and its real estate. Following the three stakeholder perspectives researched so far, it is necessary to identify relevant trends, expressed in the same KPIs, so that a list of programmatic requirements - as future demand- can be developed. By setting these requirements it will be possible to compare the current supply of A.U.Th. and determine the current and future match.

Regarding the case of A.U.Th. it is assumed that additional information can be acquired by a comparative benchmark analysis, between the Dutch universities and the Greek Case. This will be possible by comparing available KPIs of the same type from both sides. The KPIs of the Dutch universities are available in the dissertation of Alexandra Den Heijer, *Managing the University Campus; Information to Support Rea Estate Decisions* (2011) and will be used as the source of information for this part of the research.

For this research, the information regarding fourteen Dutch universities has collected and organized with respect to the three explored perspectives, with relevant KPIs per university. In this part of the research the average, maximum and minimum values of these KPIs will be compared with the KPIs of A.U.Th., in 2005 and in 2011.

The Physical Perspective

On average the GFA of a Dutch university is 317.000 square meters, with UFA being 60% of it, as 190.000 square meters. The biggest Dutch university (Utrecht University) uses 683.000 square meters of GFA, with UFA being 67% of it, as 388.000 square meters. The smallest Dutch university (Open University, Heerlen) uses 22.000 square meters of GFA, with UFA being 53% of it, as 14.000 square meters.

A.U.Th. floor area is higher that the Dutch average (GFA=437.500 m2., UFA=306.350 m2). The efficiency of A.U.Th. facilities stands at a UFA/GFA ratio of 70%, also higher than the Dutch average. In terms of floor area A.U.Th. can be related with the Utrecht University, with the two universities having similar building efficiency (A.U.Th. 70%, U.U. 67%); their floor area is also similar at least in terms of general size, both above the Dutch average (A.U.Th. UFA=300.350 m2, U.U. UFA=388.000 m2).

Moreover A.U.Th. UFA is also similar with the TU Delft UFA, which is 317.000 square meters. The two universities slightly differ in their building efficiency with TUD having ratio of UFA/GFA of 64%. Finally the A.U.Th. also has similarities with Wageningen University (WU UFA=260.000 m2, UFA/GFA=63%) and the University of Amsterdam (UvA UFA= 252.000 m2, UFA/GFA=62%). At this point, it can be said that A.U.Th. would be comparable with the biggest -in terms of floor area- Dutch universities

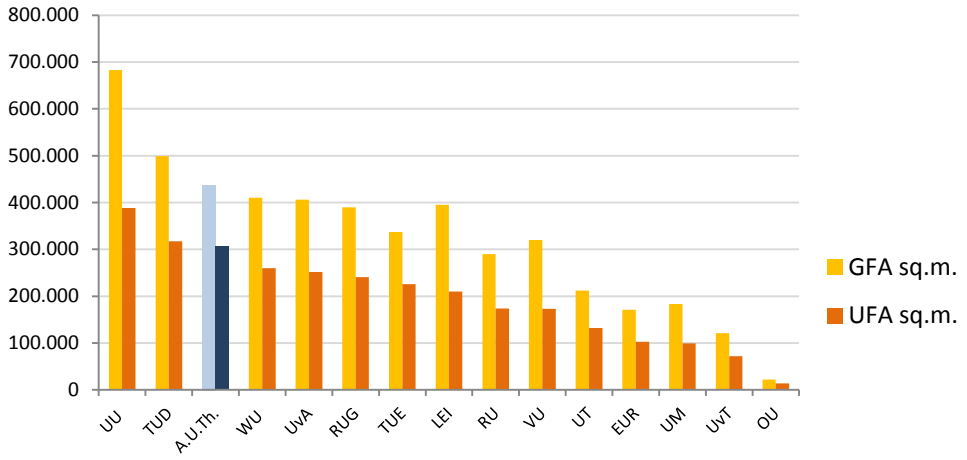


Figure 40. Comparing A.U.Th. and 14 Dutch universities on physical size

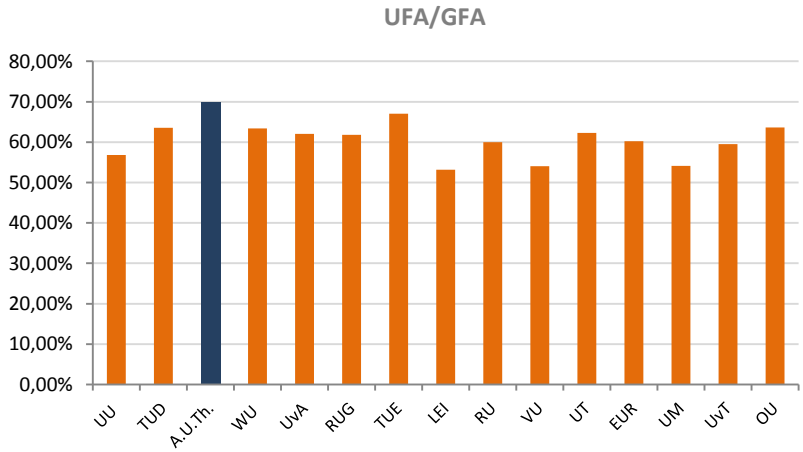


Figure 41. Comparing A.U.Th. and 14 Dutch universities on building efficiency (UFA/GFA)

THE FUNCTIONAL PERSPECTIVE

Students

On average the students enrolled at a Dutch university are 15.899. The biggest Dutch university (Utrecht University) has 29.300 students while the lower number, 5.240 is observed in the Wageningen University. A.U.Th. 62.367 (active student population) is almost four times larger compared with the Dutch average, and almost two times larger than U.U. In this sense it is hard to further compare A.U.Th. as this variable is affected more of social and political developments.

Employees

On average the FTE staff of a Dutch university are 3.625. The biggest number of FTE staff, 6320, is observed in Utrecht University while the lower number, 710, is observed in the Open University. A.U.Th. estimated FTE staff number ranges between 3.400 and 3.500, fitting well in the Dutch average.

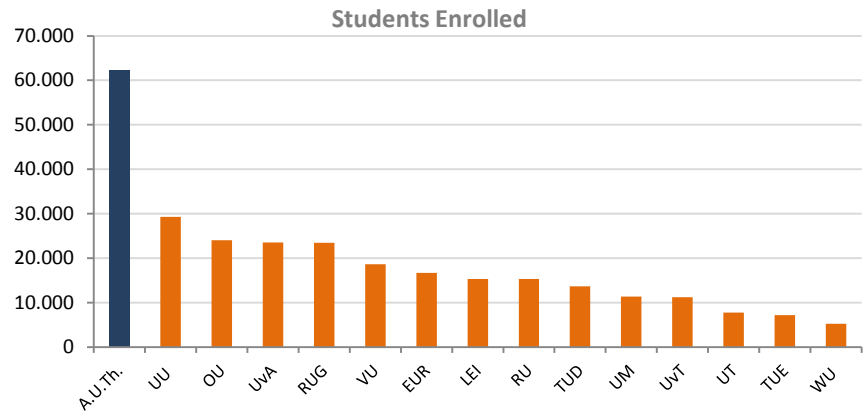


Figure 42. Comparing A.U.Th. and 14 Dutch universities on organizational size; students

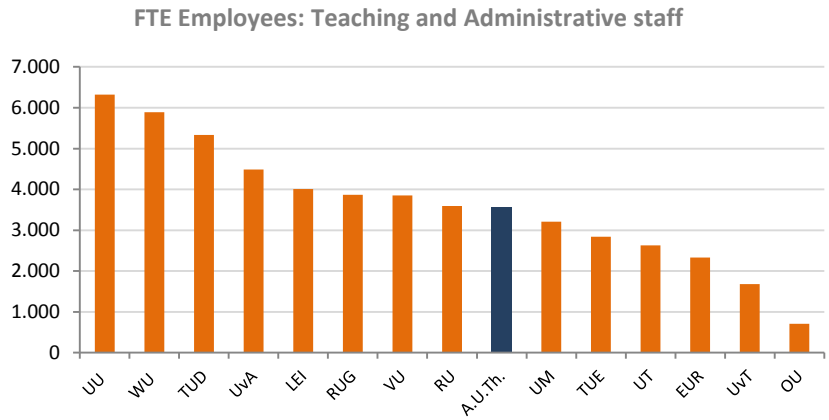


Figure 43. Comparing A.U.Th. and 14 Dutch universities on organizational size; FTE employees

Education UFA square meters per Student

In the Netherlands, the average educational UFA per student is 2,3 square meters. The maximum educational UFA is observed in Eindhoven (TUE) as 5,1 square meters per student while the minimum is observed in University of Tilburg and Erasmus University of Rotterdam as in both cases 1,4 square meter per student. A.U.Th. educational UFA is 1,8 square meters per student (UFA/active student population), while on average each student has 2,2 square meters of the total university UFA. The trend observed in the case of A.U.Th. is that due to the decline in yearly student enrollment, the educational UFA per student increases each year. A.U.Th. is relatively similar with the following universities; University of Groningen 1,8 m2 per student, Utrecht University 1,9 m2 per student, Leiden University 2,1 m2 per student and Maastricht University and University of Twente with 2,3 m2 per student.

Office UFA square meters per FTE staff

In the Netherlands, the average office UFA per FTE staff is 20,9 square meters. The maximum office UFA is observed in Eindhoven (TUE) as 31,6 square meters per FTE staff while the minimum is observed in

Wageningen University as 14,9 square meters per FTE staff. A.U.Th. office UFA is 28,2 square meters per FTE staff. A.U.Th. office workplaces are by 50% bigger that the Dutch average; being closer to the maximum observed Dutch figure (TUE). Besides TUE, A.U.Th. office UFA per FTE staff does not show any significant similarities with any other Dutch university, with the second biggest Dutch figure standing at 24,2 m2 per FTE staff in the University of Groningen followed by the University of Amsterdam with 23,2 m2 per FTE staff.

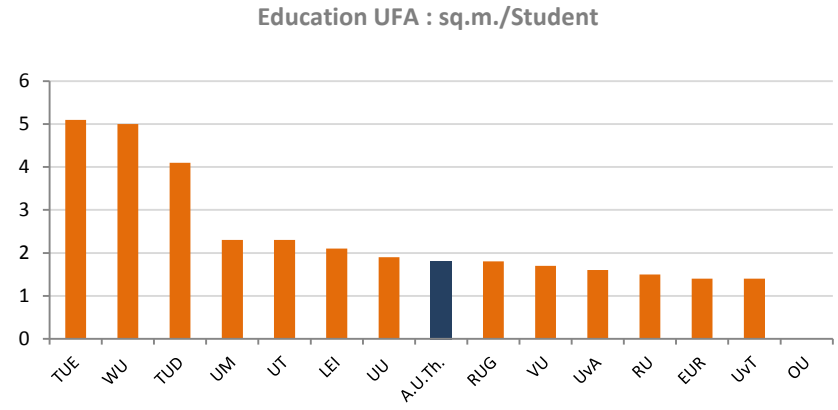


Figure 44. Comparing A.U.Th. and 14 Dutch universities on floor area offered per student

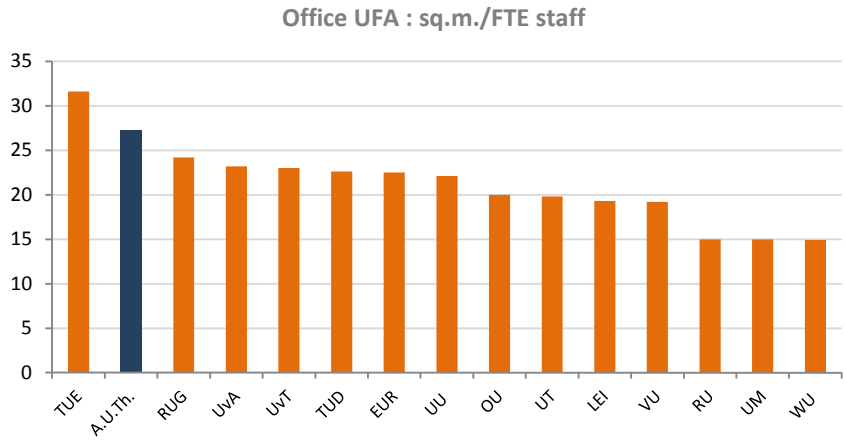


Figure 45. Comparing A.U.Th. and 14 Dutch universities on office workplace size

THE FINANCIAL PERSPECTIVE

Revenues

In the Netherlands, the average income of a university is 380€ million. The university with the highest income is Utrecht University , 695€ million. On the other hand the university with the lowest income is the Open University, 62€ million. A.U.Th. income are estimated at 155€ million, based on the previous analysis of the period 2004-2011. A.U.Th. revenues are considerably low, compared with that of the Dutch universities, being influenced by the different economic dynamic of Greece, compared to the Netherlands.

In an attempt to relate Dutch and Greek university funding system, the four flows of income (Den Heijer,2011) for the Dutch universities were applied to the case of A.U.Th. The main findings are that in the case of A.U.Th. and Greece in general, university income is more dependant of public funding, which is the cause of the financial limitations imposed by the current budget cuts. Compared with the Dutch case, it is observed that tuition fees contribute with 6% of the Dutch university income; by applying a

kind of tuition fees Greek universities could diversify more their income flows reducing their dependency on the public funding. Still, this is an issue of political debate.

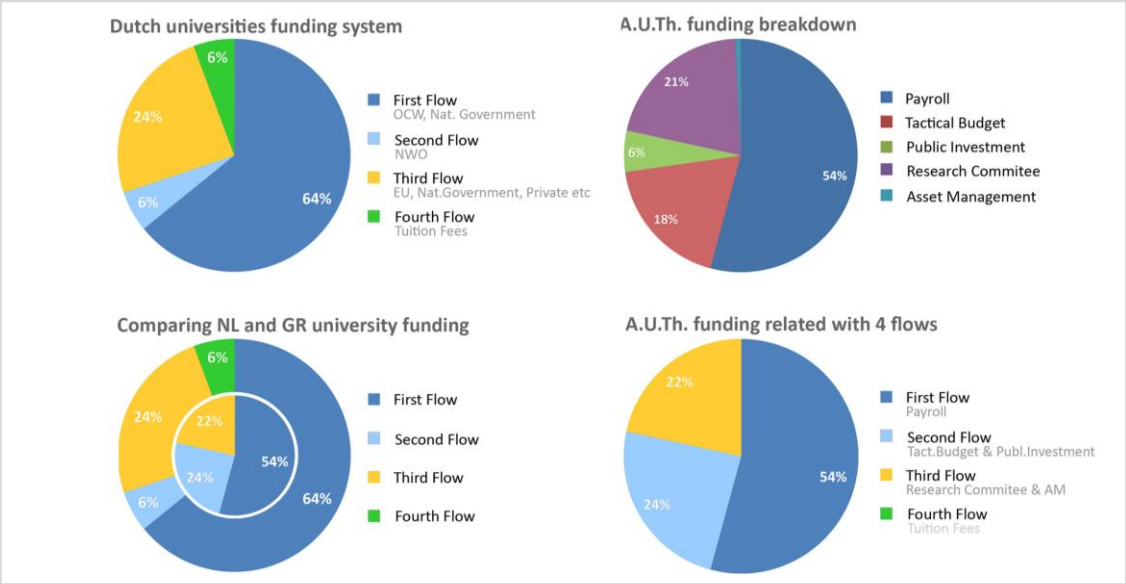


Figure 46. A.U.Th. revenues related with the Dutch university funding system

Expenses

Regarding the expenses, it is observed that on average university budgets are balanced, with annual profits of 3%. The allocation of resources depends on each universities strategic plans, thus for this research it will not be necessary to further investigate this aspect. The observed variation on the balance sheets of Dutch universities is on average 3,5%. In the same sense, the balance of A.U.Th. was estimated with a positive balance for 2004 (expenses 214€ million) and absolutely balanced for 2011 (expenses 155€ million). In the Netherlands the average the cost of ownership is 31€ million as a 8% of the university budget. Utrecht University has the highest cost of ownership 77€ million, while the Open University has the lowest, 10€ million. The estimated cost of ownership for the A.U.Th. was 12€ million for 2004, as 6% of its budget(the part concerning Public Investment for building infrastructure). The current cost of ownership ranges in same the way cost per square meter of GFA is estimated, presented in the following paragraph.

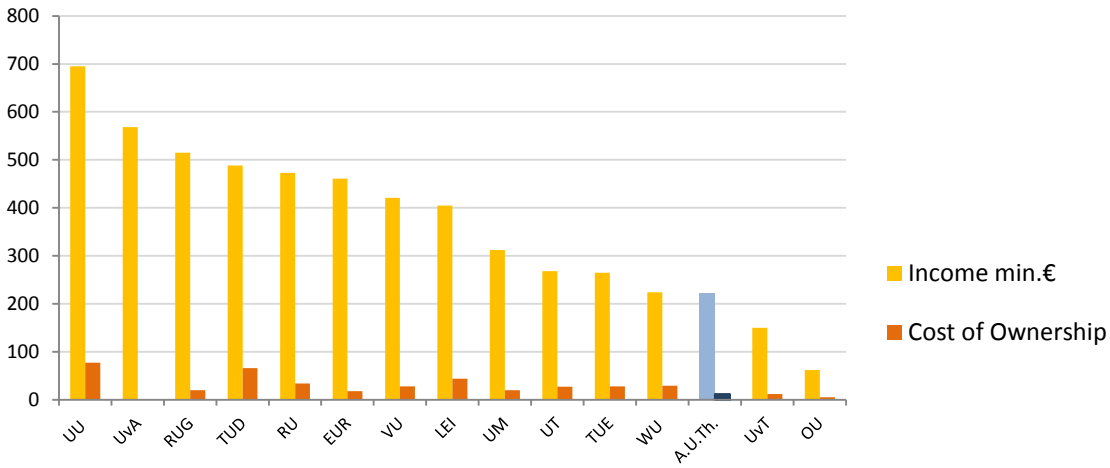


Figure 47. Comparing A.U.Th. and 14 Dutch universities on revenues and cost of ownership

Annual Cost per square meter of GFA

In the Netherlands, the average annual cost per square meter of university GFA is 102€. The highest cost per square meter is observed in the Open University as 227€/m2 , while the lowest cost per square meter is observed in the University of Groningen as 51€/m2. The relevant KPI for the case of A.U.Th. stands at 27€ per square meter of GFA in 2004, while it is assumed as 18€ per square meter of GFA for today. It is obvious that this is also related with the differences between the two countries' economic dynamics. A.U.Th. expenditure for space is 25% of the average Dutch expenditure, and in the best case, almost half of the minimum observed figure.

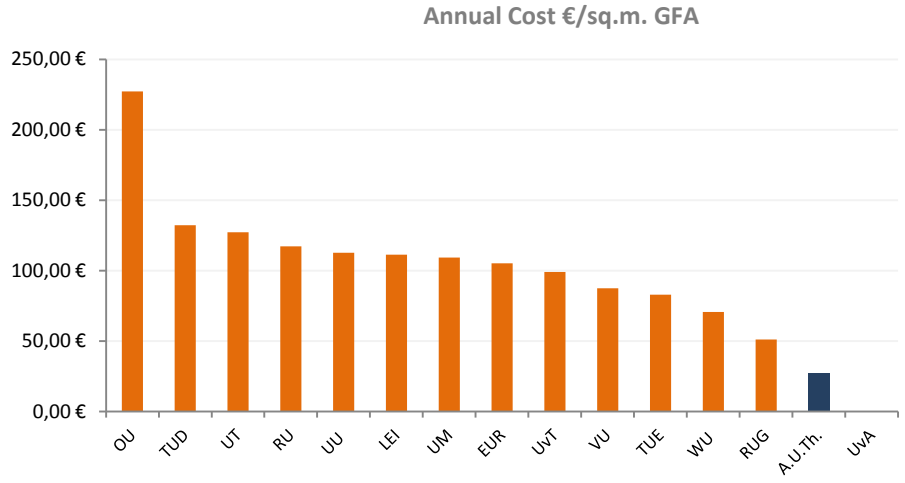


Figure 48. Comparing A.U.Th. and 14 Dutch universities on cost per square meter of institutional space

Setting Selection Criteria

This difference raises the question of space quantity versus space quality and the related requirements (users) and resources (financial) and the way the decision making balances these variables. The next table will summarize in which aspects A.U.Th. shares similar characteristics with Dutch Universities. With the research focusing on supporting decision making about real estate, KPIs related with the physical perspective will define the selection criteria for the Dutch cases, that will be used as input information. Physical aspects will be treated as dependent variables. In this sense, it will be possible to further research how universities with similar size of real estate(GFA and UFA) accommodate different users and their related functions (requirements) and in which way finance this cause (available resources). Functional and Financial aspects will be the independent variables.

Based on the comparative analysis and looking at the physical aspects, four Dutch universities share similar floor area with A.U.Th. These universities are; Utrecht University, Delft, Wageningen University (Agricultural) and the University of Amsterdam. Further research will be based on exploring what kind of functional requirements are imposed by the four Dutch cases in relation with A.U.Th. and how these requirements can be translated in physical space (square meters). The threshold for selecting and comparing will be that of total GFA equal of

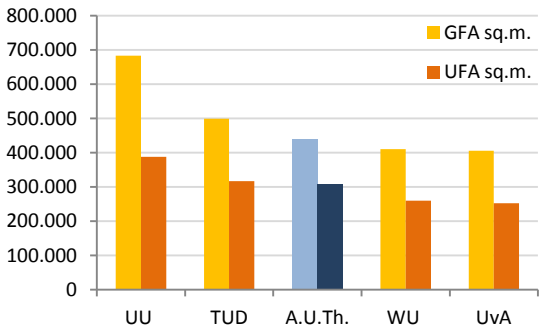


Figure 49. A.U.Th. related with Dutch universities of similar physical size

higher than 400.000 square meters. Considering the differences observed on the building efficiency, the related UFA will vary from 250.000 to 388.000 square meters, with an accepted variation of 20% (UU +26% as an accepted case).

Examining the four Dutch universities it is observed that the can be categorized in pairs according to their dominant profile (Den Heijer, 2011). Based on the relevant categorization provided by Alexandra den Heijer (2011), Utrecht University and University of Amsterdam fall under the α-β-γ profile (arts, social sciences and theoretical and medical sciences). On the other hand, Delft University of Technology and Agricultural University of Wageningen fall under the β profile (technical and agricultural sciences). A.U.Th. accommodates all the above mentioned study fields, so it is possible to examine in which faculty (building level) requirements imposed by the Dutch examples match or do not match.

For the cause of this research the aforementioned profiles will translated into two basic categories for the A.U.Th. case: Type A (α-β-γ profile) and Type B (β profile). Following this classification, the assumptions of Alexandra den Heijer (2011) will be used as a starting point:

- gamma (γ) profiles - Type, require the least specific space whereas beta (β) profiles -Type B, require the most specific spaces
- gamma (γ) profiles - Type, have the smallest footprint per student whereas beta (β) profiles - Type B, have the biggest
- gamma (γ) profiles - Type A, have the smallest footprint per staff due to desk research whereas beta (β) profiles -Type B, have the largest footprint due to specific laboratory research.

From the Dutch cases the following standards (average footprint) will be used for benchmarking:

Type A: Utrecht University and University of Amsterdam

Square meters per student:	1,75
Square meters per staff:	22,65

Type B: Delft University of Technology and Agricultural University of Wageningen

Square meters per student:	4,50
Square meters per staff:	18,75

A.U.Th. portfolio will be examined based on this functional categorization in order to identify which faculty buildings fit within each category (Type A or Type B) and match with the Dutch standards per type.

Following this analysis, the last criterion will reflect the financial aspect, considering the cost per square meter associated with each faculty building of A.U.Th. introducing the aspect of facilities' quality. This will be the starting point of further research on specific cases on building level; nonetheless it will provide useful indicators.

Determining the Future Match

Method

Based on the selection criteria each faculty building, being part of A.U.Th. RE portfolio will be assessed based on the aforementioned Dutch standards. This will indicate which faculty is necessary to be aligned with these standards and at which extent its current characteristics do not match them. In this way it will be possible to identify a list of specific cases which should be further researched in another scale (building level), and would provide results that could be generalized to the portfolio level.

The method used to determine in which extent faculty buildings fit the set standards would based on examining the variance of each faculty KPI from the standard. Positive values indicate that the KPI exceeds the value of the standard, whereas negative values indicate that opposite; in other words, regarding the square meters per user group, it indicates whether additional space is required or not. The results of this analysis will provide two percentages for each faculty that will express; the % variation of educational space per student and the % variation of office space per staff with respect to the set standard.

Considering the financial perspective or the cost per square meter associated with each faculty building, a total cost is determined according to the Owned/Rent ratio. Based on the report Greece Research and Forecast Report, Mid Year 2011 (Colliers, 2011), market rent level of 200€ per square meter of office UFA will be used for this point of the research. Doing so, it will be possible to estimate the total cost per square meter for each faculty.

Finally, the three percentages will be weighted (30% education, 30% office, 40% cost) in order to acquire a final score per faculty. The later, would express at which extent the observed building will or will not fit its future requirements, according to the selected Dutch standards.

Results

Type A

The faculties of A profile provide on average less than half square meters of UFA per student, compared to the similar Dutch universities. However, considering the fact that A.U.Th. enrolled students are considerably higher, this issue is possible to be tackled by more efficient use of space; frequency and occupancy rates are required in order to determine the extent of space use intensification. In addition to that, the decreasing annual enrollment, will gradually improve this KPI. Besides that, if this additional considerations have been taken into account, a new assessment can be made.

On the other hand, office UFA per FTE staff are on average equal with the relevant standard KPI. Moreover, half of the Greek faculties of profile A provide bigger office workplaces. Contemporary trends of office layout and the way each staff carries out his work could influence this KPI. Finally, one option could be that of re-assessing the allocation of space for these two functions; territorial offices, sharing office space for educational purposes etcetera.

Figure 51. Type A education student place size per faculty

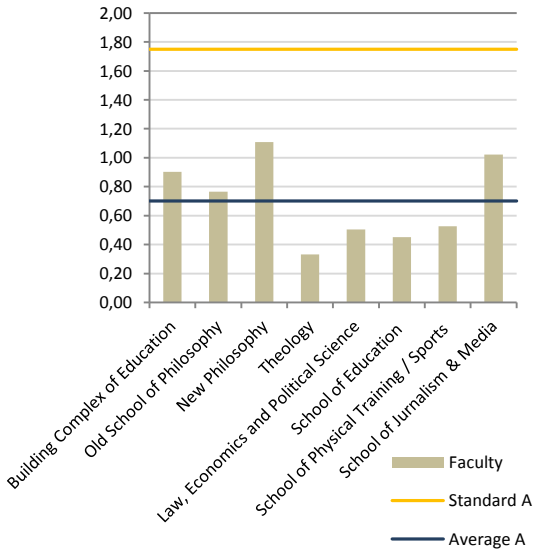
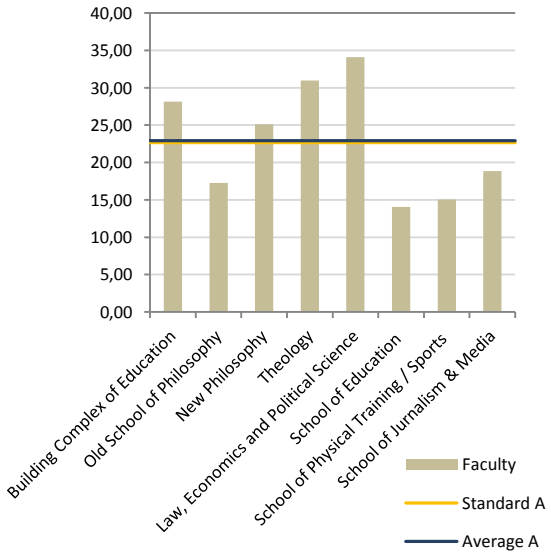


Figure 50. Type A office workplace size per faculty



Type B

The faculties of B profile provide on average similar square meters of UFA per student, compared to the similar Dutch universities. What seems interesting is the fact that half of the Greek faculties of this profile, offer educational space of size similar to the one required for laboratories. On the other hand, the remaining faculties educational space is similar to profile A; non-specific educational space. Frequency and occupancy rates should be examined, however the aforementioned difference introduces a new aspect; that of sharing specific laboratory space among faculties, wherever this is possible to happen. Finally student enrollment trends affect this profile in the same way as already mentioned. Office UFA per FTE staff is on average 50% higher than the relevant standard KPI. Moreover, half of the Greek faculties of profile A provide bigger office workplaces. The same options for profile A faculties should be examined in this category as well.

Figure 53. Type B education student place size per faculty

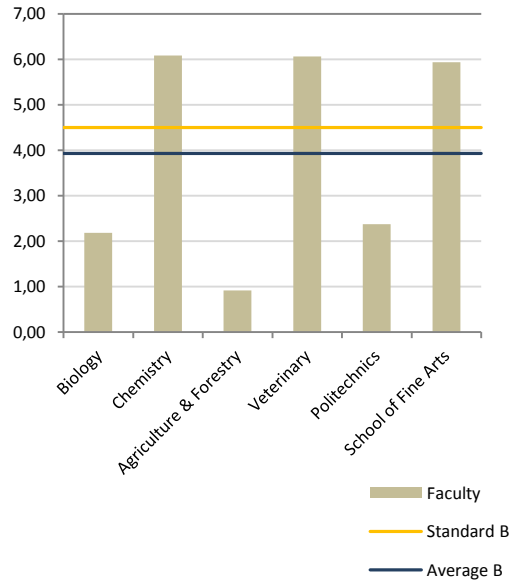
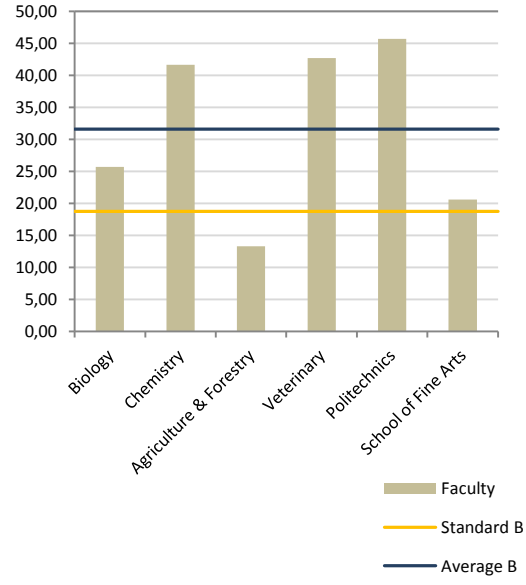


Figure 52. Type B office workplace size per faculty



Three faculties can fit between profile A or profile B. These faculties should be assessed by the A.U.Th. decision makers in relation with the options associated with each profile, and managed accordingly. The next graphs briefly present the characteristics of these faculties.

Figure 55. Assessing three faculties for educational space

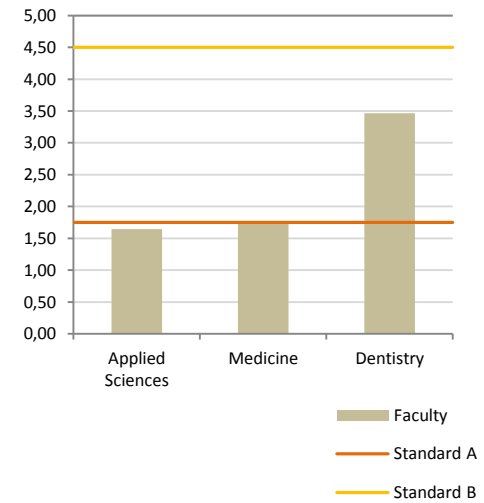
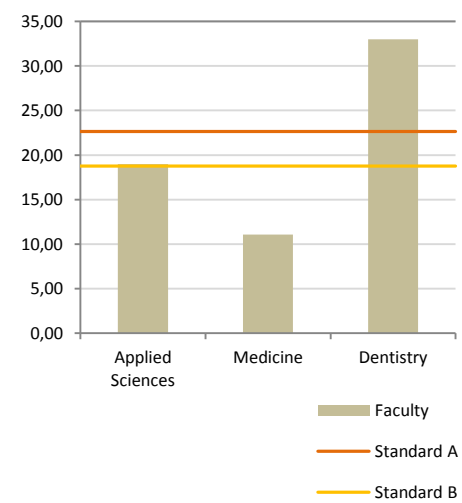


Figure 54. Assessing three faculties for office space



IDENTIFYING THE FUTURE MIS-MATCH

Based on the three KPIs explored during the comparative analysis, it is possible to sort out every faculty building of the A.U.Th. CREM portfolio, and indentify the extent of the mis-match with respect to the compared standards. Appendix 3 contains the relevant information of this part of the research; the educational facilities future fit, each faculty's general score and the three individual sub-scores (Appendix 3.8). The assessment deriving from the comparative analysis addresses two CREM perspectives; Functional and Financial. Therefore the findings of the assessment (figure 56) are hereby presented.

Type	Campus	Code	Faculty building	Total Score	Scores and Weights							
					Education	30%	Office	30%	Cost per m2	40%		
				Mismatch	Mismatch	Current Supply	Mismatch	Current Supply	Mismatch	Current Supply		
A	OFF	29	School of Jurnalism & Media	418%	42%	Less m2	17%	Less m2	1000%	More		
A	OFF	28	School of Physical Training / Sports	137%	70%	Less m2	34%	Less m2	265%	More		
B	OFF	27	School of Fine Arts	80%	32%	Less m2	10%	More m2	168%	More		
B	ON	24	Polytechnics	57%	47%	Less m2	144%	More m2	0%	Equal		
B	ON	4	Veterinary	49%	35%	More m2	128%	More m2	0%	Equal		
A	ON	21	Law, Economics and Political ..	48%	71%	Less m2	50%	More m2	28%	More		
B	ON	15	Chemistry	47%	35%	More m2	122%	More m2	0%	Equal		
A & B	ON	7	Dentistry	36%	60%	More m2	61%	More m2	0%	Equal		
A	ON	20	Theology	35%	81%	Less m2	37%	More m2	0%	Equal		
A	OFF	26	School of Education	34%	74%	Less m2	38%	More m2	0%	Equal		
B	ON	3	Agriculture & Forestry	33%	80%	Less m2	29%	Less m2	0%	Equal		
B	ON	2	Biology	27%	51%	Less m2	37%	More m2	0%	Equal		
A	ON	18	Old School of Philosophy	24%	56%	Less m2	24%	Less m2	0%	Equal		
A & B	ON	6	Medicine	23%	31%	Less m2	46%	Less m2	0%	Equal		
A	ON	9	Building Complex of Education	22%	48%	Less m2	24%	More m2	0%	Equal		
A	ON	19	New Philosophy	14%	37%	Less m2	11%	More m2	0%	Equal		
A & B	ON	1	Applied Sciences	13%	35%	Less m2	9%	Less m2	0%	Equal		

Figure 56. A.U.Th. Educational facilities assessment according to the selected KPIs as standards from Dutch universities.

Discrepancies between CS-FD

Physical Perspective

Looking at the physical perspective, there is no direct connection with the assessment results. However, an assumption about the quality and physical condition of A.U.Th. CRE can be made. This assumption derives from the difference observed in the financial perspective's comparison between the investment level per square meters of A.U.Th. (CS: 27€/m2 , CD: 18€/m2) and the Dutch universities (on average 102€/m2). Thus it is necessary to explore on the building level to which extent the current financial resources effect the quality of the university's facilities.

Functional Perspective

Looking at the functional perspective, two discrepancies can be observed looking at the KPIs describing the functional requirements for Educational and Office space.

The A.U.Th.'s Educational space per AS is on average 52% lower than the tested standards. On the other hand, A.U.Th.'s Office space per each FTE employee is on average 48% higher than the tested standards. Figure 55 provides more explicit information per faculty.

Financial perspective

Looking at the financial perspective it becomes obvious that there is a striking difference in the cost per square meter between the owned and rented CRE. Rented space, which is located off-campus, is 10 times more expensive for A.U.Th. (Market Rent:200€/m2 Vs. A.U.Th. Av.Cost:18€/m2).

Concluding Remarks

The anaysis of the Current state of A.U.Th.'s RE showed that the university should cope with two challenges; cost-efficient accommodation which at the same time should fit techincal and functional requirements that will optimally support the university's core business.

Considering the identified discrepancies and the challenges A.U.Th. is faced with, a set of goals to be pursued, will be formulated.

1. **Aiming at a Cost-Efficient Accommodation weighting costs and benefits.**

   It is necessary to examine how the available resources are allocated and the relevant benefits. As already mentioned, this goal will ultimately be assessed by the KPI expressing the quality of space, thus the Euros per square meter (€/m2). The focus should be in minimizing the expensess and maximizing the revenues of the university. One example already identified is that of the cost for rented space off-campus.

   Therefore it is necessary to decide on the university's accommodation model (owned versus rented space) in a supply driven approach by the university. Moreover, this decision is also related to the location of the real estate and its function or functional mix. Finally, the function of real estate can also influence -besides the related costs- the revenues generated by it. Thus, with a demand driven approach, the university should aim at increased revenues by its real estate. These decisions should be taken on the portfolio level.

2. **Providing accommodation effectively, optimally supporting the university's core business.**

   After the university's decisions on portfolio level have been taken, considering the aspects imposed by the financial perspecitve, A.U.Th. should consequently translate them to specific project requirements. These requirements should aim at the best achievable fitness for use, expressed in a design brief document for each case. In this point, building specific cases should be elaborated in order to match the physical space to user requirements.Finally, techincal, functional and economic aspects of a project's life-cycle, should be adressed, in order to estimate, test and assess the adequacy of the selected real estate premises.

Additional Need for Qualitative Information

After the quantitative comparative analysis, the following parts of this chapter will elaborate on the issues addressed by the two-fold set of goals. Qualitative theoretical input will be employed next to the case study, in order to further explore possibilities related with cost-efficient accommodation as directly related with A.U.Th.'s investment decisions. Thereafter, with respect to the effectiveness of the university's accommodation, the potential future functional mix and the physical expression of the university will be explored.

EXPLORING QUALITATIVE ASPECTS OF CHANGING DEMAND

The aim of this part of the research will is a qualitative analysis of university real estate decisions anticipating the future demand for real estate, considering the four CREM perspectives. In this sense it will be possible to identify ways in which real estate decisions contribute to the university objectives; moreover with real estate decisions regarded as investment decisions it will be necessary to investigate the related costs and benefits of each decision, aiming at optimal investments by the side of the university.

Example of a sub-optimal investment

There exists one building located on A.U.Th. campus that is vacant. There was not possible to retrieve any data concerning this building, however examining aerial photographs of the campus it is observed that it could provide accommodation for one faculty, by roughly comparing its footprint with other faculties. Discussing with administration employees of A.U.Th. (July 2012) it was not possible to get a conclusive opinion about the state of ownership of the specific building. It was mentioned that the construction was halted due to structural inadequacies and miss-calculations and that from this moment, the project's stakeholders abandoned it.

Being vacant, not even finished, it generates the need for researching its investment cost as it currently has zero returns on it. Being located in the land plot of the university's campus this example provides an opportunity for A.U.Th. if effort will be put in the determination of its state of ownership. This building, and most importantly the land where it is currently erected can be a parallel alternative; a potential space buffer for long term developments for A.U.Th. or a valuable land parcel that can potentially generate revenues for the university in the case of a future sale.

Figure 57. Vacant construction in the north-east side of A.U.Th. campus , also in Appendix 3.
Source: http://www.bing.com/maps

For the purposes of the research the financial perspective will be addressed as the starting point; from financial related issues, the research will further be carried on to functional aspects which will be reflected in the physical perspective of the university's real estate. Analysing qualitative information for real estate decisions will ultimately generate the need to address the strategic perspective, which will be elaborated in the next chapters of this research.

FROM A FINANCIAL PERSPECTIVE

The first goal of cost-efficient accommodation for the A.U.Th. can be approached by either reducing accommodation related costs or by increasing the revenues generated by its real estate. Urban economics and specifically the Central Place Theory (Geltner, 2007) can provide a basic comprehension background, linked with the case of A.U.Th. through an analogy.

Location

Even if CPT seem rather academic and far from the real world, it underlies the most basic decision making in real estate development and the functioning of the space market. CTP provides the general conceptual background that explains where it is reasonable to locate certain sites, in which sufficient demand for real estate may exist. Combined with urban hierarchy, these concepts can be employed in various scale levels, explaining the location decision; what matters is *location*, one of the oldest cliché in the real estate business (Geltner, 2007).

Because of the tendency of markets to move towards an equilibrium state between demand and supply and the fact that in a sufficient well functioning land market , competition will drive the price of each land parcel to equal the value of its marginal contribution to the production process, results in each location being used at its highest and best use - HBU. In other words, there will be competition between various production processes-functions for the most appropriate location. In this sense after determining where to build, what the building will be needs to be determined.

Reflected in the case of A.U.Th.

Currently, A.U.Th. accommodates its CRE on-campus and off-campus while its RE portfolio comprised of premises mostly found in the city centre of Thessaloniki. A brief analysis of A.U.Th. presence in different scale levels will provide a better understanding of the current situation.

Looking at the County of Thessaloniki, at the level of Thessaloniki conurbation it can be said that the university is accommodated primarily in the municipality of Thessaloniki and secondarily in the neighbouring municipalities which serve as the suburbs of the city. Thessaloniki's suburbs used to be rural areas, which following the population development over the years served as the available urban expansion area.

Zooming in the municipality level, the way A.U.Th. is located in the municipality of Thessaloniki and the surrounding suburban municipalities becomes even clearer. Looking specifically at the municipality of Thessaloniki, it becomes obvious that A.U.Th. is mostly concentrated on its campus with only a few locations outside of it, in the city's suburbs.

These locations accommodate new departments, such as the School of Fine Arts and the School of Physical training and were constructed in the last decade (municipality of Thermi). This fact can be justified by the lower value of the suburban land as well as the urban land scarcity , especially in a period when financial resources were following an upward trend and could support decisions for new construction.

Moreover, practice and laboratory space , for faculties such as Forestry and Veterinary exist in the suburbs of Thessaloniki. In this case, these facilities were developed in previously rural areas, where the population increase gradually transformed to suburban. Still, the boundaries of each zone, Urban, Suburban and Rural, cannot be clearly defined, but they will provide a basic understanding of the A.U.Th. location.

Therefore it is necessary to continue the research looking for the ways a university has been established and can be identified in a city; which universities' typologies exist that relate and explain the location conditions and relations for a university in its city. Appendix 3.10 contains the relevant theoretical information. The results of this sub-research are hereby briefly presented.

Universities' Location Typologies

The current university real estate portfolios comprised of buildings that reflect the university's development through time, being for example single historical buildings or university campuses. Dependent on each university's establishment date and related with the aforementioned timeline three basic types of universities and their positioning in a city, can be identified;

1. Following the first generation of universities, it is possible to have buildings in and around the city centre. The buildings housing the university would be expected to be of historical value, if they used to accommodate it since that period. The first type will refer to a university integrated in the city, as "Univer-city" (den Heijer, 2011).

   In the case of A.U.Th. this type can be related with the way university real estate can be identified mostly in the city centre of Thessaloniki with the majority of its RE assets and some of the university's departments located there.

2. With respect to the second generation universities, and the modern American paradigm, universities can be located in a campus. Initially university campuses were intentionally developed outside cities as already mentioned, however urban growth sometimes exceeded the initial urban boundaries. Still, the second type will be describing a campus outside of the city, as a "Village" (den Heijer, 2011).

   In the case of A.U.Th. this type can be related with the way university real estate can be identified mostly in the suburbs of Thessaloniki, where some of its laboratories and youngest departments are located.

3. Finally, a university campus can be found concentrated within the city, being a 'gated' campus, or a "Park" (den Heijer, 2011).

   This type is directly related with the current conditions identified in the case of A.U.Th. campus, where 80% of the university's CRE exists.

The campus of A.U.Th.

As already mentioned universities' campuses reflect influences from the past that developed their image. Since the last decades of the twentieth century, the changing profile of the Humbolt University (den Heijer, 2011) led to various developments. One of the effects was that campuses originally developed on the edge of the cities (between the sixties and the seventies) were over time integrated by the urban fabric.

The way A.U.Th. campus was developed has many similarities; since its establishment 1927, the first land parcel was in the edge of the city of Thessaloniki, in the expropriated Jewish cemetery. With accumulative land acquisitions, the final campus area took its final shape in 1955. The development of the faculty buildings followed a similar path; the first university building was that of the School of Philosophy (built on 1887 and accommodating A.U.Th. since 1927), while the vast majority of the building stock was developed between 1953 and 1980. Today the university campus is integrated in the

city that expanded beyond its early twentieth century borders. Still, the historic city centre should be considered a the CBD of Thessaloniki.

The Highest Best Use of a Location

Continuing the urban economics analysis, in CPT, various functions compete for the most appropriate location in the city landscape, already faced in the perspective of the residual theory of land value (Geltner, 2007). Following that, it can be said that a land site, a location, is usually most appropriate for a specific function, expressed in the notion of *Highest and Best Use* of a location (HBU). Nowadays, the HBU of a locations concerns more than one specific functions but rather a combination of functions. Due to the synergy developed between these functions, the positive result are multiplied, expressed in the concept of mixed use, that will be elaborated later on. The HBU notion, can be described in a generic urban model of a mono-centric city, where the centre is considered to be the Central Business District (CBD) (Geltner, 2007).

Reflected in the case of A.U.Th.

Being on the supply side, maximum economic returns for a given location will occur when a functional synergy with the highest demand for that location will be accommodated there ; on the other hand, being on the demand side, accommodating another set of functions in the same location will not be cost efficient.

In this sense A.U.Th. CRE rented space in the city centre (Thessaloniki CBD) does not contribute to the goal of cost-efficient accommodation, because academic related functions competing with functions predominantly observed in the city centre of a city, such as Offices and Retail. On the other hand, the same reasons generate the opportunity for A.U.Th. -being on the supply side- to identify and select its target group on the demand side, when it comes to managing its RE portfolio (endowments).

It is still necessary to explore which mix of functions supports or even enhances the core academic related functions, that can be supplied or demanded by the university in the the city centre of Thessaloniki and its impact on the A.U.Th.'s accommodation model.

The Bid-Rent Curve

Considering the CPT and the abovementioned HBU theory, one basic concept in classical urban economics evolves, that of the bid-rent curve, where transportation costs are a determinant factor for HBU and land value (Geltner, 2007). Each potential land use has a bid-rent curve which relates the user's bid-rent (Figure 59) to the location of the land site. moreover, this curve shows how the bid-rent changes as a function of the user's distance from some central point. Thus the central point is defined as the location at which the transportation costs are minimized (Geltner, 2007).

In this sense, each potential land use will have its own bid-rent function. These basic economic principles and concepts regarding land value and use, are combined in a model of urban form, that of the mono-centric city.

In the mono-centric city model, the central point is considered to be the Central Business District - CBD, whereas the city is developed in circles of different radius around it. The outer boundaries of the city, define the space of the city- residential and production (inside) and the agricultural land (outside). The real property rent of this model consists of the Agricultural rent A, the Construction rent C and the Location rent L.

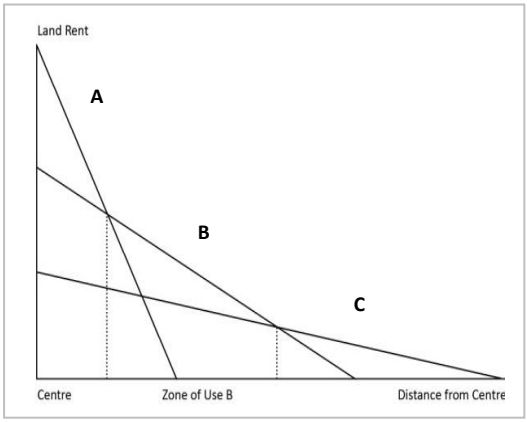


Figure 59. Bid-rent functions of different land uses A , B & C. Source: Geltner, 2007

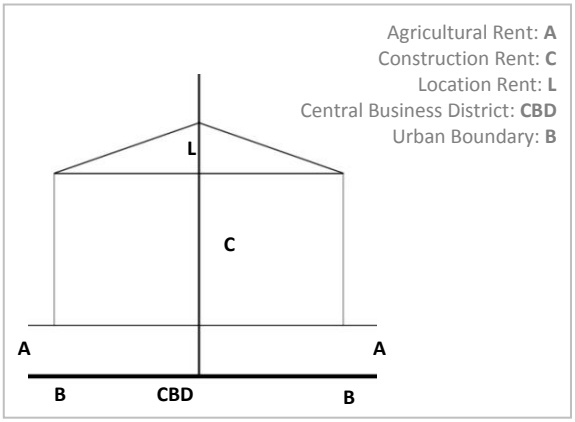


Figure 58. Real Property Rent components in a monocentric city. Source: Geltner, 2007

Knowing the components of the real property rent (Figure 58) , CBT as the centre and the Urban boundary radius known, the monocentric city model can be briefly summarized in the following four principles (Geltner, 2007) :

Principle 1: Other things being equal, larger cities will have higher average location rents

Principle 2: If a city grows by increasing area rather than density, property rent growth will be higher closer to the periphery. If a city grows by increasing density instead of area, property rent will be higher closer to the city centre.

Principle 3: Declining transport costs holding population and income constant, will always reduce the value of location rent in the city centre; the effect on the location rent near the periphery is generally ambiguous, depending on changes in density.

Principle 4: Increasing real income per capita will tend to decrease rent gradients, with a possible result of absolute reductions in land rent at the centre of the city, although a secondary transport cost increase effect due to higher incomes might mitigate this result or even reverse it, especially if the spatial expansion of the city is constrained.

Reflected in the case of A.U.Th.

In order to identify the location-related options for A.U.Th. it is first necessary to examine the current supply of real estate in the scale level of portfolio. The location of each portfolio object in the city should be analyzed. For the cause of this research and consistent with the basic urban economics location theory , the assessment will focus on the relation inner city versus A.U.Th. campus; in other words, the market conditions influencing accommodation in the CBD of Thessaloniki and the established university campus, right next to it.

A.**U.Th. in Thessaloniki's CBD**

As already introduced in the analysis of the HBU notion, the hypothesis concerning this assessment is that off-campus accommodation in the city centre , is characterized by considerably higher rents due to market conditions whereas in the case of on-campus accommodation, the cost of space is lower. This assumption is based on the comparison between the average cost per square meter for the university, 20 €/m2 and the rent paid for accommodating 100% of School of Journalism and Media in the city centre, 220 €/m2. It is obvious that the cost per square meter off-campus is almost ten times higher than the one on-campus.

Looking at Thessaloniki's inner-city or CBD, sixteen premises can be found. Five of them, coloured blue, are part of the CREM RE portfolio and eleven of them are part of the REM portfolio (endowments, coloured yellow). The eleven endowments located in the inner-city of Thessaloniki can be summarized in figure 62, which provides an brief overview of their basic attributes.

The five CREM buildings provide space for the School of Journalism in two locations and for the School of Fine Arts in three locations , all for the department of Theatre. Finally, there is one more building which accommodates some of the School of Fine Arts space, coded E18 in the map.

It is interesting that this specific building (E18) has already been identified as an endowment, where up to date data from A.U.Th. (www.auth.gr/map, 2012) also define it as a CREM university space, for the School of Fine Arts . Due to this first indication of merging the two RE managerial perspectives (CREM and REM), the specific building is coloured green . Therefore it becomes clear that it is possible for the university to use its endowments for accommodating some of its core-business space demand.

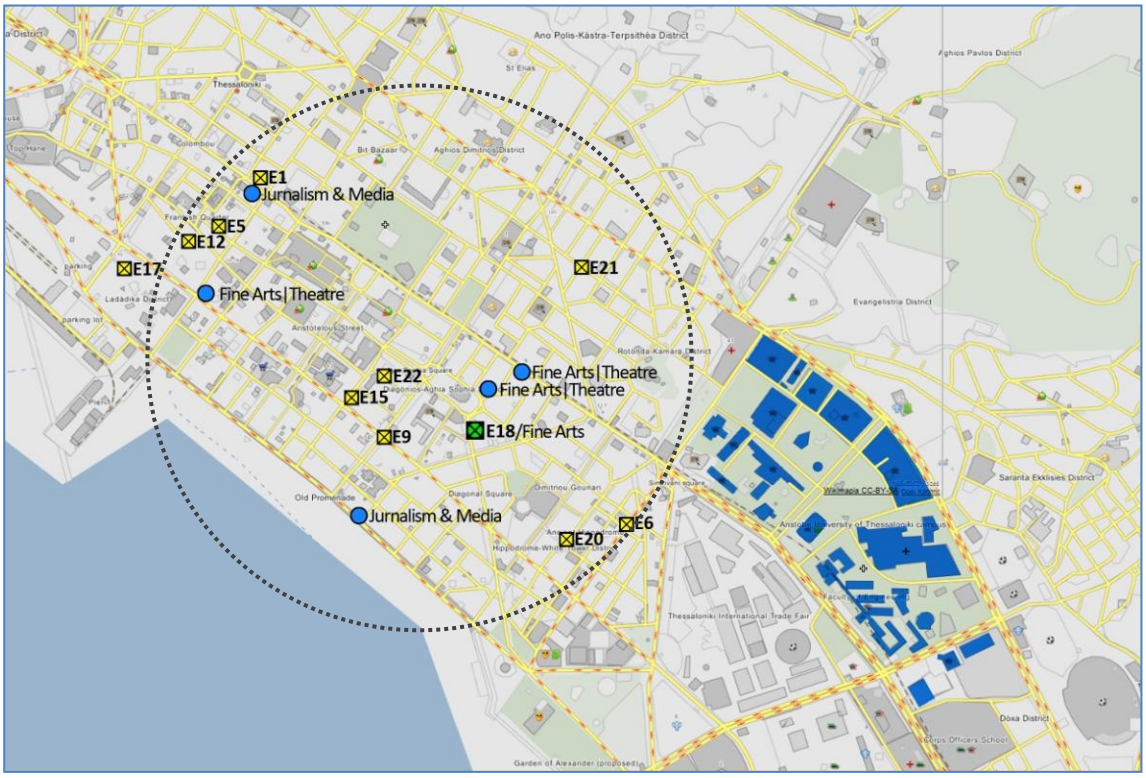


Figure 60. Thessaloniki inner-city, A.U.Th. on-campus and off-campus real estate.

Identifying the state of ownership

Acknowledging that, it is necessary to identify which of the CREM space accommodated in the inner city is rented by an external party and which is owned by the university. By doing that it will be possible to identify where the current accommodation costs are higher than the average accommodation costs of A.U.Th, which does not contribute to the current requirement of a cost-efficient accommodation.

A.U.Th.Endowments in Thessaloniki CBD

Code	City	Address	LFA m2	Vacancy	PGI	€/m2/year
E 1	Thessaloniki	Εγνατίας 43 - Συγγρού 14	1.381	22%	8.362 €	24 €
E 5	Thessaloniki	ΕΡΜΟΥ 5- ΚΑΠΟΔΙΣΤΡΙΟΥ 5	310	0%	4.853 €	63 €
E 6	Thessaloniki	ΕΘ. ΑΜΥΝΗΣ 34	421	53%	38.083 €	90 €
E 9	Thessaloniki	ΑΓ. ΣΟΦΙΑΣ 4	49	100%	0 €	0 €
E 12	Thessaloniki	ΚΑΤΟΥΝΗ 43	712	80%	2.835 €	4 €
E 15	Thessaloniki	Κ. ΝΤΗΛ 20	72	0%	181 €	10 €
E 17	Thessaloniki	ΛΥΚΟΥΡΓΟΥ 6	160	100%	0 €	0 €
E 18	Thessaloniki	Π. ΜΕΛΑ 40	1.169	32%	19.843 €	34 €
E 20	Thessaloniki	ΙΠΠΟΔΡΟΜΙΟΥ 3	72	0%	3.925 €	55 €
E 21	Thessaloniki	ΟΛΥΜΠΟΥ 119	63	0%	4.080 €	65 €
E 22	Thessaloniki	ΑΓ. ΘΕΟΔΩΡΑΣ 4	67	0%	13.560 €	202 €

Figure 61. Overview of A.U.Th.'s Endowments in Thessaloniki CBD.

It is known that the School of Journalism and Media is exclusively accommodated in a rented building, opposite of E1, Egnatias 43 as showed in the map (figure 62). A.U.Th.'s data also show that some of its required space is accommodated in a building owned by the university, in the sea front of Thessaloniki. That building is known to be owned by A.U.Th. as it is an endowed property which was under renovation for several years. Therefore, the space demand for the accommodation of the School of Journalism and Media is supplied by renting space at the building located in Egnatias 46 .

Knowing already that the space for School of Fine Arts space accommodated in E18 is owned, it is only necessary to explore whether the department of Theatre is accommodated in owned or rented space. Considering the fact that the rest of the space for the School of Fine Arts is accommodated in recently constructed facilities in the outskirts of Thessaloniki (www.auth.gr/map, 2012) , the three locations for the Theatre department should be rented by an external party. This is further supported by the A.U.Th. CREM portfolio analysis.

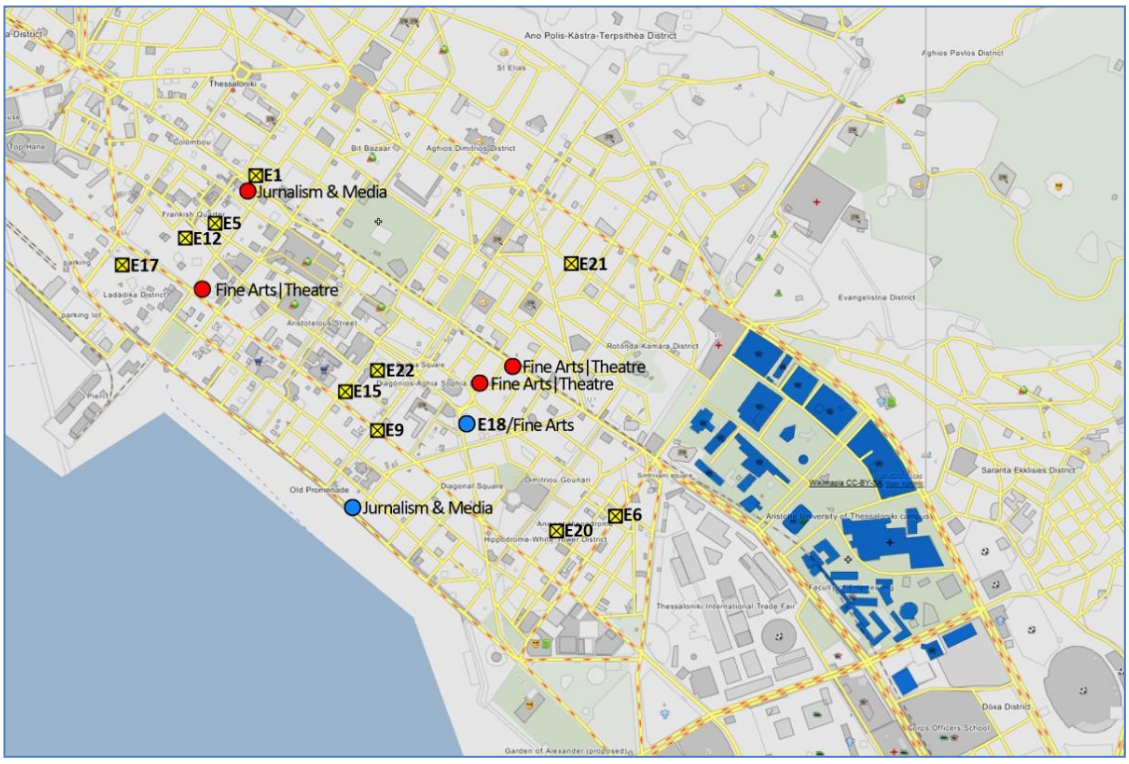


Figure 62. A.U.Th. real estate in Thessaloniki CBD. Owned CRE in blue, rented CRE in red and endowments in yellow.

The analysis of the CREM portfolio shows that for the School of Fine Arts, 17% of the space is rented from an external party. The total GFA of the School of Fine Arts is 20.690 square meters and the

UFA/GFA ratio for the Fine Arts cluster is 66%. Moreover, the GFA of the Theatre department is 1.770 square meters. Therefore, the total rented space for the School of Fine Arts should be 2.291 square meters, which supports that assumption (2.291>1.770). Figure 62 shows the definite current image of the A.U.Th. inner city real estate. The rented space is coloured red, the owned CREM space blue and the endowments yellow.

Summarizing

There are two main findings concerning this level of analysis. The first one, derives from the formulated hypothesis which was based on the CREM portfolio analysis; that accommodating space off-campus in the inner city is more expensive that on-campus accommodation. However, what makes this way of accommodation a burden in the A.U.Th. budget is the fact that CREM off-campus accommodation in the inner city is achieved by renting space from external parties. This leads to the second finding.

Considering the fact that at the same time A.U.Th. owns space in the inner city, within its endowments, the first decision towards a more cost-efficient accommodation should be made by re-examining the relation between the owned and rented space. In this case, the rented CREM off-campus portfolio objects should be tested with the owned REM endowments, in order to identify if it is possible to have a match. Consequently, if no match was possible to be achieved, the second decision should be about moving back on-campus.

A.U.Th On-Campus

From a financial perspective, the university should look for ways to increase the value of its owned assets in the city centre (REM-endowments) and at the same time minimize its exposure in the market rents when leasing extra space (CREM-primary process space). In this sense, A.U.Th. should probably concentrate in providing space for its primary process on campus, which is an observed trend; more efficient use of space and footprint reduction, when concentrating on the campus are some of the relevant trends.

Still, it is required to treat this assumption as background information that will stimulate the formulation of goals and strategies by the side of A.U.Th. Moreover, it would also be beneficial for the university's decision makers examine paradigms of universities that did or currently follow a different strategy.

A.U.Th. Off-campus?

Literature research shows that while some universities sell their inner-city buildings Utrecht University did the opposite, acquiring property around their historical heritage (den Heijer, 2011). Utrecht University projects in the city centre concern two faculties, the International Campus Utrecht and the University Library (uu.nl, 2012) .

Next to that, another example comes from the University of Amsterdam, reinvesting in the cultural heritage in the case of Agnietenkapel (den Heijer, 2011) and currently being spread across many locations in the city centre (uva.nl, 2012). With campus heritage contributing to the competitive advantage of a university, in other words being one aspect of adding value to its objectives, it would be interesting to explore these universities' (UU and UvA) strategy and real estate management, in order to identify more of these aspects .

Therefore, interviews with real estate executives of the two aforementioned universities or strategic documents analysis would be recommended, in order to thoroughly explore the managerial approach, the decision making process, and the aspects and their related weights that influenced these decisions.

UNIVERSITIES' FUNCTIONS

Besides the obvious core business related functions (education, research and administration), contemporary universities accommodate a broad range of space types. This contributes to an anticipated function mix by the university, as universities tend to be increasingly dependent on functions other than the traditional academic ones. Based on the research of den Heijer and de Vries (2006) five space types for campuses were identified (den Heijer,2011).

1	**ACADEMIC FUNCTIONS**	Education & Research
2	**RESIDENTIAL FUNCTIONS**	Housing for students and staff, hotels
3	**RELATED BUSINESS FUNCTIONS**	Space for partners linked to academic goals and supporting process
4	**RETAIL AND LEISURE**	Sports, Cultural and Catering Facilities
5	**INFRASTRUCTURE**	From Parking to Accessibility

Universities both on the demand and the supply side

These types of space are not necessarily to be provided on the university campus. Again, the location of the university in the city can provide various possibilities for the functional mix; the functions provided in the campus can be complemented by functions provided by the urban web, in the city. Considering the different ways of a university urban setting, different advantages and disadvantages can be expected. Besides the location functional supply, it is possible that these functions are not exclusively developed for university use (den Heijer, 2011). A university can be positioned both in the demand and the supply side of shared functions (or facilities) with stakeholders outside of the institution , such as the municipality, private parties or the population of the city.

Ownership, Management and Use

Moreover, a university can be affected by the city it is located on, in terms of the perceived quality of life, as one variable of the its competitive advantage. This consideration can shape the decision about the extent campus functions are merged with urban functions within the city. It becomes clear that sharing functions with a different set of stakeholders raises the issues of ownership, management and use and possibly investment. Therefore this kind of decision has to be weighed by the side of the university in terms of costs and benefits. The following table, based on the research results "building Knowledge Cities" (den Heijer and de Vries, 2007) provide an overview of the required university function mix and the ownership , use and management scope (den Heijer, 2011).

FUNCTIONS	Who manages / own / uses?			Similar City function
	University	Municipality	3rd Party	Alternative in the city
ACADEMIC. EDUCATION & RESEARCH				
Class rooms and studio spaces (small groups)	X			
Lecture halls (large groups)	X			Cinema, theatre
Office space academic staff	X			
Office space support staff	X			
Laboratories	X		X	R&D facilities or businesses
Study places for individual use (small groups)	X			Inner city coffee bars
Library	X			Community library
Special places for ceremonies	X	X		City halls, churches
Special conference facilities	X		X	Conference centre
Special educational facilities (dance, media, arts)	X	X		Theatre, studios, museum

Academic hospital			X	Other hospital
Medical school			X	
RESIDENTIAL				
Student housing / national			X	Social housing
Student housing / international-short stay	X		X	Hotels or apartments
Alumni housing / young potentials, creative class			X	Housing supply in the city
Faculty housing			X	Housing for expats
Hotel facilities			X	Housing supply in the city
Short stay apartments for visiting professors	X		X	Hotels in the city
RETAIL & LEISURE				
Sport facilities	X		X	Sport facilities in city
Book stores			X	Book stores in city
Coffee bars	X		X	Coffee bars in city
Student associations and societies			X	
Restaurant (lunch or dinner)	X		X	Restaurants
Bars	X		X	Bars
Theatre			X	Theatre
Jazz clubs			X	Jazz clubs
Cultural centre, museum	X		X	Cultural centre
Dry cleaning, day care centre, supermarkets			X	Existing city facilities
RELATED BUSINESS				
Incubators (academic spin-off)	X		X	Office supply in city
R&D facilities of large companies			X	Business campuses
Related services (services spin-off)			X	Office parks in city
Business combining learning and working			X	
Artists and creative professions			X	Vacant industrial buildings
INFRASTRUCTURE				
Parking space	X	X		Existing parking facilities
Transport on campus	X			
Accessibility by car	X	X		Car transport network city
Accessibility by public transport	X	X		Public transport network city
Public space (bicycles, pedestrians)	X	X		Bicycle paths in the city

Figure 63. Required university function mix, specified by campus managers and supplied and managed by university, municipality or a third party. Source: den Heijer, 2011.

Another consideration derives from Worthington's programmatic requirements for the learning landscape (den Heijer, 2011), where again a question for the decision makers is posed; to what extend the university functions and users are merged with similar urban function and user groups. moreover the importance of interaction in the educational process in highlighted; interaction between the academic society and business as well as spontaneous and informal incidents of interaction. For Worthington, the learning landscape is: Holistic, Loosely-coupled, On and Off campus, Formal and Informal, Virtual and Physical.

With respect to functionality, space demand can be categorized in specialized, generic and informal space types, with less distinct boundaries and a more intensified space use (higher occupancy and frequency rates). Considering the issue of ownership, Worthington makes a distinction between three types; core space, flexible space and space on demand, on different levels (den Heijer, 2011). Finally, Worthington advice can be summarized as:

1. Improve the quality of the learning experience
2. Expand academic expectations of amenity
3. increase the range of learning settings
4. Intensify the use of space and time
5. Blur boundaries by sharing with partners
6. Reconsider the business model
7. Maximise the value of the brand

After examining the basic urban economics and the location of universities in the city followed by an analysis of the possible functional mix and its consequent implications for the organization and the external stakeholders (city, business, population), it is necessary to explore and identify what may shape the physical form of the university and in which ways. The next chapter will elaborate more on various forces that may shape universities' characteristics, aiming at identifying variables characterizing the physical perspective.

SHAPING FORCES FOR THE FUTURE UNIVERSITY

In this part of the research, various forces that may shape the future university will be explored. It is possible that some of them have been already faced during the research, still at this point an attempt to summarize and categorize them will be made. Undoubtedly, having a multi-perspective approach in developing a business case means that there will always be overlaps and connections between different fields, adding to the complexity of the management task, that however has to be tamed and manipulated in an efficient way.

It has already been mentioned that until today, universities' are the only institutions in society offering education, research, professional training and intellectual criticism (Delanty, 2001 in Hashimshony and Haina, 2006). The combination of these four activities is what attaches to the university its special role in society. However, nowadays societal changing demand requires that the role of each activity should be re-evaluated. Decisions made about balancing these activities will have a critical impact on the distribution of spaces within the university. The following factors are particularly important in defining the nature of the future university (Hashimshony and Haina, 2006):

- Financial Challenges
- Collaboration with Industry
- Increasing Student Population and Greater Diversity
- New Patterns of Teaching and Learning
- Growth of Interdisciplinary Fields of Knowledge
- Openness to the Community

Financial Challenges

With government support for universities declining, these institutions have to look for new ways of revenues. One way to achieve that is by commercializing knowledge. Some examples could be filing patents, designing and providing non-credit, cutting-edge educational programs for private and public sector employers. Another way is by cutting expenses by privatizing some of the services offered to students and staff alike, such as residence halls. As a consequence, universities should be more open to the market demand, recognize the need for change and consequently reconsider their dependency relations (State, Business) and act more efficiently (Jarvis, 2000 in Hashimshony and Haina, 2006).

Collaboration with Industry

Nowadays, industry's role is changing in a context of a globalized economy with competitive forces. In this context, knowledge is at the heart of today's economy while at the same time information-based and high-technology industries' role and importance increases. Universities can provide scientific knowledge that can be critical for the success of these industries and it becomes a factor which supports their collaboration. The commercialization of knowledge adds revenues to the university budget; on the other hand, university's monopoly over the creation of knowledge is reduced, since more research can be performed outside of the university's walls (Hashimshony and Haina, 2006).

Increasing student population and greater diversity

In recent years student population is characterized by an increase in numbers as well as diversity and heterogeneity. It can be said that higher education has long ago been democratized, no longer reserved for the elite, partly due to the increased importance of knowledge in the society, thus an increased demand for white-collar workers. The growth of the university population and the increase of its composition's diversification may increase the demand for more higher education institutions, both in numbers and types, and will affect, in turn, decisions about the missions and physical requirements of universities. Still, considering this trend, more factors can be expected to be influential related to the national context of each university.

New Patterns of Teaching and Learning

The recent and ongoing changes in ICT have increased access to digital knowledge resources. Moreover, communication between individuals in different places at different times is increasingly easier. Terms like “distance learning” and “electronic learning” represent the possibility of learning activities unrelated to time and place. These technological improvements have created the option of a virtual university in which virtual spaces replace the existing physical ones (Hashimshony and Haina, 2006). However, these virtual universities generally do not offer students the kinds of informal interactions found in the traditional face-to-face campus learning experience that stimulate learning beyond the formal educational experience. The task of universities to bring people together and allow for cross-fertilization of minds is considered by some researchers as the main reason for their existence (Hashimshony and Haina, 2006). Thus, the challenge for universities is to find a balance between virtual and physical space, that will be in line with the organizational objectives.

Considering the ICT developments and next to the changes in teaching and learning patterns, similar effects can apply in the administration space of universities, specifically in their office layout through the concept of New Ways of Working. Tele-working, sharing offices, new spatial arrangements promise reduced accommodation costs and more efficient space usage. Depending on the current office layout of an organization, implementation of New Ways of Working may result in thirty percent reduced integral costs for housing and facilities (Syaranamual et.al. 2010 in Deloitte, 2011). Still, the implementation of New Ways of Working is not always a panacea and requires a-priory critical consideration by the side of the organization.

Growth of Interdisciplinary Fields of Knowledge

The classical university was based on a hierarchical structure of major disciplines that were then divided into sub-disciplines. The faculties and departments, represented by the vertical elements, usually are located in a defined physical space. Interactions across disciplines, shown by horizontal elements(Figure 64.A), occur sporadically and often reflect only the interests of individual faculty working together in an interdisciplinary project (Hashimshony and Haina, 2006).

In contrast, today's structure of knowledge is increasingly interdisciplinary in character. In the future university (figure 64.B), the horizontal elements containing the evolving interdisciplinary frameworks, which were secondary in the classical organization may become primary elements. In time, these elements might also need defined physical spaces (Hashimshony and Haina, 2006).

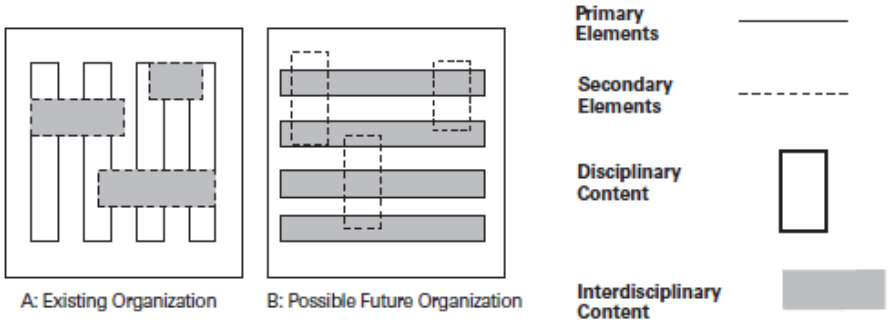


Image 64. Changes in the University Organizational Structure. Source: Hashimshony and Haina, 2006.

Openness to the Community

As a result of increasing standards of living and life expectancy, more people around the world have more leisure time. There is a large public seeking meaningful activities to fill its free time, and the university can be just the right framework for this population. The public opportunity to attend lectures, special courses, and evening activities may strengthen the image of the university as a central institution, responding to the needs of society. The implication is an increasing interaction between the university and the "outside world." As a result, the boundaries of the university campus will become more penetrable and its facilities will be used more efficiently for mixed activities (Hashimshony and Haina, 2006).

INFLUENCES REFLECTED IN THE PHYSICAL PERSPECTIVE

The basic architectural prototypes of university design should be re-examined with respect to the shaping forces that are affecting the missions of higher education institutions. The design of a future university should be related to the expected changes in the activities of that institution.

Five variables are typically are identified in the physical structure of existing universities and can be used to conceptualize the future university: size, spatial configuration, boundaries and accessibility, functional organization, and location (Hashimshony and Haina, 2006).

By analysing the impact of these five variables, it would be possible to acquire greater insight into the possible spatial characteristics of the future university. These characteristics can serve as a point of reference for planners and policymakers and should also be examined with regard to considerations such as values-financial perspective, institutional goals-strategic perspective, and pragmatic constraints-functional perspective (Hashimshony and Haina, 2006).

Size | Small vs. Large

Size refers to the total built area, exclusive of open spaces between buildings. Three forces for change that may affect the size of the future university (Hashimshony and Haina, 2006). Firstly, due to contemporary ICT developments, moving activities into the virtual space may reduce or eliminate the need for large lecture halls, library study areas, and related spaces. In addition to that, it should be

mentioned that also storage may be affected by ICT developments, as nowadays, large physical archives can soon turn to digital, meaning that less physical space for that function will be necessary (Den Heijer, 2011)

Secondly, privatization may cause some of the classic functions of the university, such as dormitories and sport facilities, to be located elsewhere, thus decreasing the area of the university. This is also related with the way a university decides to manage its required functional mix, exclusively or by sharing space with another party, as already mentioned in the functional perspective analysis.

Thirdly, strengthening relations with industry may affect the size of the university in two opposing ways: new functions may be imported and located within the university compound, thereby increasing its size, while other functions may be exported and attached to existing industries, resulting in a decrease in the size of the university. In the following scheme a graphical representations of the forces that may affect the size of the university is given.

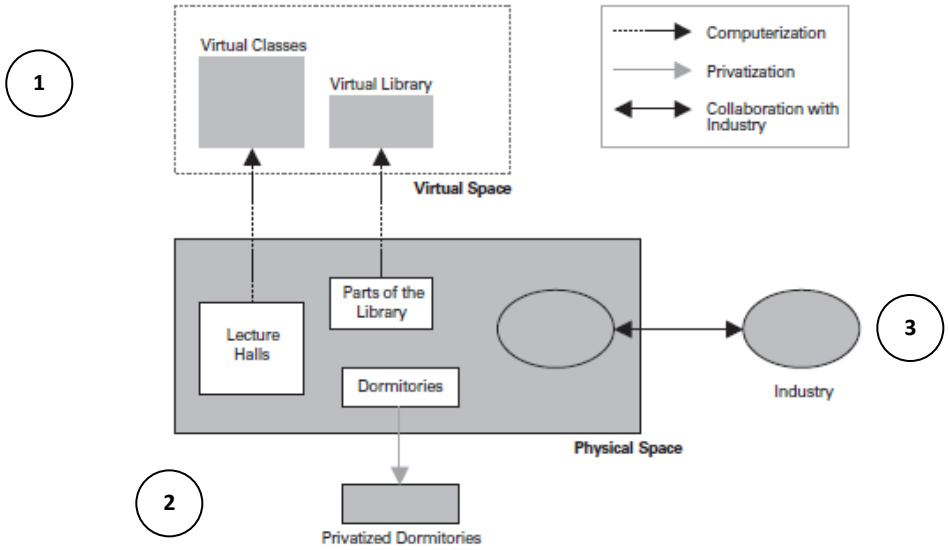


Image 65. Three forces shaping the physical size of universities. Source: Hashimshony and Haina, 2006.

Spatial configuration | Compact vs. Decentralized

The concept of the confined university, as in the campus and/or mega-structure facilities, should be reconsidered since contradictory forces co-exist. On the one hand, the need for internal cohesion regarding new modes of knowledge production, the growing need for collaboration, and the importance of linking different fields of knowledge may contribute in the continuation of a centralized-focused spatial development.

On the other hand, some institutional trends indicate a tendency towards a higher degree of decentralization due to privatization and the option to study and work at home or elsewhere off campus (Hashimshony and Haina, 2006). However, diffused spatial patterns may decrease possibilities for interpersonal interaction and harm the valuable sense of a university's community. The social quality of the university and the options it creates for diverse formal and informal interactions therefore also need to be considered. Again, the relation with Worthington's considerations for the learning landscape is clear.

Boundaries and accessibility | Open vs. Closed

The boundaries of the university are both physical and conceptual, defining the degree of accessibility to the university by determining its 'openness' to different populations that are not part of the university community. The historical notion of the Ivory Tower embodies the isolated and closed character of many universities (Hashimshony and Haina, 2006). This “closed-ness” is also typical of the previously-described spatial typologies.

The growing need for collaboration with industry, the new openness to the community, and the changes in the organizational structure of the university may well result in the blurring of its physical boundaries, again mentioned by Worthington. The integration of students and academic staff in the life of the city or community and the emerging social role of the university as a bridge to the public could and would become highly important.

Functional organization | Zoning vs. Mixed Uses

Rigid functional organization or spatial zoning used to be a more appropriate model for when departments were isolated and knowledge was divided into discrete disciplines. Considering the anticipated, actually ongoing change in the universities' character -collaborative research and interdisciplinary knowledge - major influences will shape the spatial structure of the university.

The need for an environment of mixed uses is enhanced by the existing possibility of studying and working from different places and by collaboration with industry. These changes can be implemented through the university’s emerging interdisciplinary physical frameworks. Based on the new communication technologies, multifunctional buildings may also appear, mixing different knowledge operations (production, distribution, and preservation) with leisure activities and even residence. The mixed-uses strategy, with shorter physical distances between different functions, supports more flexible and spontaneous activities suited to current dynamic lifestyles (Hashimshony and Haina, 2006).

Location | Integrated vs. Isolated

Little can be said about the location of the future university relative to city environs. The concept of the university as a site of interconnectivity, epitomized by its increasing collaboration with industry and other knowledge institutions and by its growing openness to the community, can be considered conducive to a specific location inside a city or near industry or a community. Developments in communication technologies and transportation, on the other hand, minimize the importance of physical location (Hashimshony and Haina, 2006). Still, this perspective refers mostly in the physical setting of the university and is related with the supply side, from the university's perspective. As already analysed, location decisions may be mostly influenced by financial-related drivers.

Summarizing the basic insights

Keeping in mind the previously elaborated consideration, such as the location decision, the campuses' typologies and the campus' functions, the basic spatial variables' values will be summarized . Next to that, the main shaping forces that may influence the physical expression of the university (of the future) and the basic spatial variables will be opposed to each other, in order to identify which force influences or affects each spatial variable and in which way.

The next figure provides a graphical representation of the values each spatial variable may take in the future. The spatial variables can be related to the basic four CREM perspectives, as a range of possible 'output' , all considered to be part of -and integrated in- the strategic perspective. The spatial variables may describe the future university on different levels thus they can be used to describe the future

university in the two selected scale levels, portfolio and building. The potential future models of a university's development will be elaborated in the next chapter.

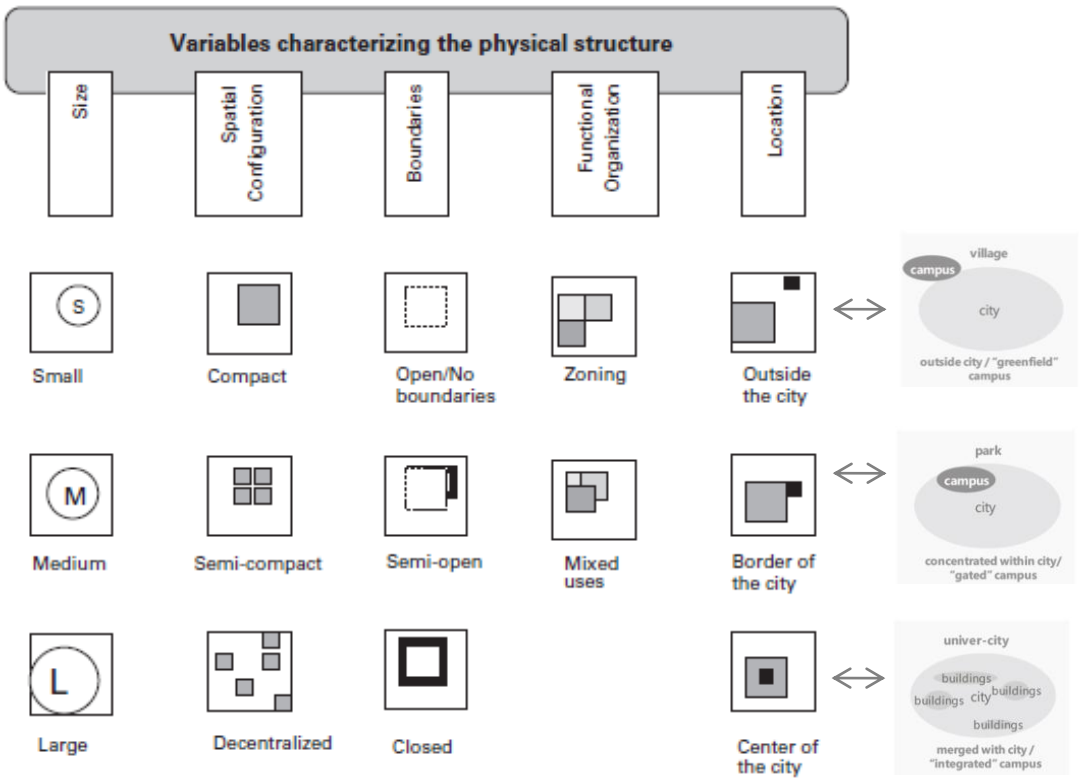
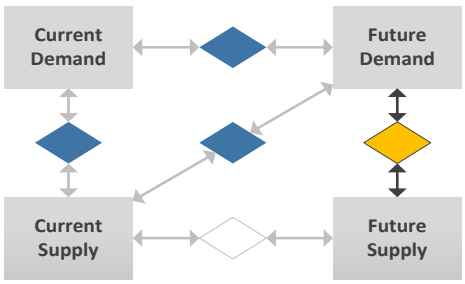


Figure 66. Physical Variables of a university and their values. Source: Hashimshony and Haina, 2006 and Den Heijer, 2011

3.3 Generating Future Models for A.U.Th.



In the previous chapter the future demand and the forces that can influence it was analysed. In this part of the research, an attempt to project different versions of it will be made. The purpose of this chapter is to first identify a set of possible ways, or strategies, that will un-cover the future development of universities. Consequently, these strategies will be related with A.U.Th. In this way it will be possible to realize what are the options and the related strategic goals for its future. The information used will be based on Den Heijer's (2011) dissertation, where different scenarios concerning the universities of the future were developed.

Shaping Forces of the future Universities

On the previous chapter six forces that can influence the physical structure of the university (Hashimshony and Haina, 2006) have been identified:

- **Financial Challenges**
- **Collaboration with Industry**
- **Increasing Student Population and Greater Diversity**
- **New Patterns of Teaching and Learning**
- **Growth of Interdisciplinary Fields of Knowledge**
- **Openness to the Community**

By oposing these six shaping forces next to the developments that can influence campus management provided by Den Heijer (2011), it is observed that a strong relation between them exists.

1. **Economics**: transition to a knowledge economy, sharing goals with national, regional and locat government.
2. **Network economy**: Collaborate global and act local, enhanced collaboration with partners outside of the university, as a consequence of the network university
3. **Globalization**: globalization of individuals and increased international students
4. **Green Campus**: Focus on sustainability goals
5. **New ways of working**: Changing the academic workplace and new learning concepts
6. **Rising expectations of students and researchers**: more competition among universities
7. **More strict legal and technical requirements**
8. **More simulation in research processes**
9. **More ICT in working processes**.

SCENARIO PLANNING

Having identified influences for the future development of universities, it is possible to develop scenarios that describe possible futures for the universities. Scenario planning has been used in previous researches to provide these kind of scenarios. Scenario planning is a the tool for developing these sets of potential futures for the universities.

The first step in towards scenarios is the alignment of all developments in a diagram where two variables are expressed; the first variable concerns the effect of these developments on campus (axis X) and the second variable concerns the extent of influence campus management can have on these developments (axis Y) (Den Heijer, 2011).

The developments that cannot or are not easily influenced by campus management are moved on the right diagram, adding predictability to the assessment(Den Heijer, 2011) Applying the diagram the strategic choices will be determined by developments that are influenceable by campus managers and have a substantial impact on campus (Den Heijer, 2011).

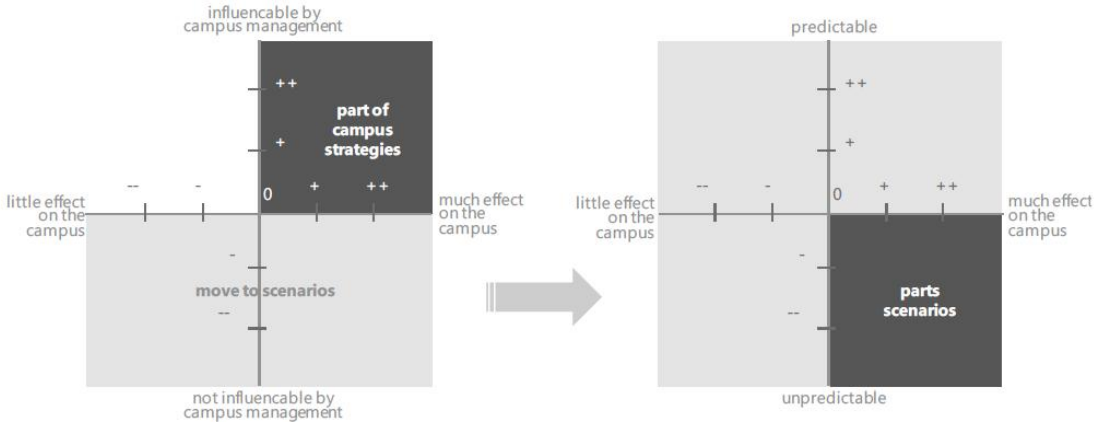


Figure 67. Scenario Planning as a tool to explore changing demand. The place of all relevant developments in these diagrams will determine if they are part of campus strategies or scenarios.
Source: Dewulf et al., 1999 in Den Heijer, 2011

After a brief elaboration on the scenario planning tool, the next part of the research will be a presentation of scenarios that have already been developed and concern the future of higher education related with various socio-economic developments.

THREE SCENARIOS FOR HIGHER EDUCATION IN 2020

One set of scenarios was developed by the Centre of Higher Education Policy (CHEPS) in the report "*The European Higher Education and Research Landscape 2020; Scenarios and Strategic Debates*", in 2005. Three scenarios concerning the future of higher education were developed using as main variable the way universities are coordinated. In this research, Universities' coordination could be threefold;

1. Hierarchical, from Brussels
2. In a network, or
3. From the market

Under this perspective, CHEPS elaborated on the following three scenarios, summarized by Den Heijer (2011);

1. **Scenario 1, Centrali**a**:** will Brussels implement the Lisbon agenda top down?

2. **Scenario 2, Octavia:** will the current 'network university' trend continue?

3. **Scenario 3, Vitis Vinifera:** will the market exert more influence on the courses offered and the research conducted?

In the scenarios developed by CHEPS it is possible to choose between competition and collaboration. According to Den Heijer (2011) it is not easy to deduce the universities' future demand for space from these three scenarios.

However it is possible to attach "values" on these scenarios; *Centralia* can be characterized as traditional and relatively closed, *Octavia* as open and collective and *Vitis Vinifera* as individual and commercial (Den Heijer, 2011).

In this sense, these values can be used by universities that identify themselves in one of these three scenarios and further develop their decision making process and practices, with this as a starting point. Moreover, that different scenarios' attributes exist or may happen in different parts of one university at the same time (Den Heijer, 2011). The following table provides a summary each scenario's characteristics

A. *Centralia*	**B. *Octavia***	**C. *Vitis Vinifera***
Scenario Foundations		
• Hierarchical co-ordination. • Centralized power; Muscles from Brussels.	• Network co-ordination. • Power spread throughout the network.	• Market co-ordination. • Power lies within individual institutions.
Scenario Characteristics		
• Top universities in N-W EU. • Transnational co-ordination. • Large universities with many campuses. • Students have an international study path. • HEI students in demand because of ageing population.	• Social dynamics forces universities to find new stakeholders. • Hybrid form of HEI. • Crossing borders in partnerships • International-changing groups for research. • Academic "gypsies". • Network and social skills more important than a diploma. • Diverse student population. • Mobility between countries & disciplines. • Combination of face-to-face and online contact.	• Higher education is very diverse • A university is what it does; EU universities do different things. • Ranking is important. • Applied research & finance perspective. • >30% of HEI is private. • Continuous competition for resources. • Every academic is an entrepreneur. • Student loans are accepted to a great extent.
References		
• One "European" university • Classical university	• Pen academic network • Network university	• Commercial degree courses • Virtual university

Figure 68. CHEPS three scenarios for higher education in 2020. Source: CHEPS, 2004 in Den Heijer, 2011

VISIONS FOR THE FUTURE OF HIGHER EDUCATION

Following the CHEPS three scenarios for higher education, another research conducted in TU Delft about the future of higher education, provides a set of scenarios. The results of the research "*Towards a Sustainable Campus; Visions for the future of higher education*", (Den Heijer, Teeuw and Aalbers, 2010) integrate three university strategies and four scenarios towards the development of sustainable

university models. The three strategies elaborated in this research will be adopted and used as the starting point for the case of A.U.Th.

Three University Strategies

The three campus strategies are based on literature on the future of the campus (Chapman, 2006 in Den Heijer, Teeuw and Aalbers, 2010) translated into similar issues - purpose, meters, users and funds - and used as a framework within real estate research strategies of the Dutch universities (Den Heijer 2007 in Den Heijer, Teeuw and Aalbers, 2010).

Strategy A, *"Back to the Future"*
It is most similar to the present situation or to the past traditional, closed university model. A university wants to keep a relatively large portfolio of university buildings, most of which are exclusively used by the institution itself. The so-called "exclusive campus" can add to the image or identity of the university, but is also quite expensive and has a relatively large footprint per user. However, in this strategy, the campus is exclusively for the university (Den Heijer, Teeuw and Aalbers, 2010)

Strategy B, *"Intellectual Agora"*
It represents an open market place for the creation and exchange of knowledge, with the campus as an integral component of the city, where many spaces are shared with other users. This strategy can be characterised as a network campus: the campus is shared with partners of the university (Den Heijer, Teeuw and Aalbers, 2010).

Strategy C, *"Clicks & Mortar"*
It assumes there will be a much smaller campus with a great deal of inspiring space for social and intellectual encounters, an important trend in campus design. However, in this last strategy, students and employees will spend most of their time off campus, while the campus does not supply a fulltime workplace for these user groups. The workplace can be anywhere, but consequently, the workforce is also spread around the world or region. This strategy is also referred at as a virtual campus: part of the university is virtual (Den Heijer, Teeuw and Aalbers, 2010).

For these three strategies, the strategic choices to make are:

1. ***What will be shared with other parties and what will be exclusively used by the university?***
2. ***What part of the floor area could or would be possible to be replaced with virtual workspace?***

In essence, these choices have to be made in relation to the strategic vision of the university: what are the university values and how can the campus add to these? (Den Heijer, Teeuw and Aalbers, 2010).

Scenario Characteristics		
A. *Centralia*	**B. *Octavia***	**C. *Vitis Vinifera***
Traditional Relatively closed Classical University	Open Collective Network University	Individual Commercial Virtual University
A. *Back to the Future*	**B. *Intellectual Agora***	**C. *Clicks & Mortar***
Traditional Closed model Exclusive university use Classical University	Open market place Creation and Exchange of Knowledge Sharing with partners Network University	Smaller Campus Meeting place More time off-campus Work anywhere Virtual University

Looking at these three university strategies it becomes clear that there is a strong relation with the three university futures developed by CHEPS. Finally, the three strategies basic aspects are presented in the following table.

Classical Model ***Back to the Future (A)***	Network University ***Intellectual Agora (B)***	Virtual University ***Clicks & Mortar (C)***
Purpose		
The campus does not change much in comparison with today's campus. The physical campus is gradually adapted to new quality requirements.	The campus operates as an open market place for the creation and exchange of knowledge. The physical campus increasingly becomes part of the urban fabric, other users are welcome	Much smaller campus due to more working/ learning from home: 'clicks' replace some of the square meters (bricks)'. The physical campus is above all a meeting place: 'creative, stimulating and with a focus on intellectual and social exchange'
Euros - €		
Same amount of resources available	More resources due to shared usage – external users pay	Same amount of resources available
Square meters - m2		
-Same number of m2	-Same number of m2 -Higher occupancy & usage	-Less m2 -Campus is partly virtual
Quality - €/m2		
Same money for the same m2 Only enough money for "healthy and safe"	More money for the same m2 more quality differentiation possible. From "healthy and safe" to 'inspiring'	More money for fewer m2 - Higher quality per m2 - Up to '"Inspiring"
Users		
Largely exclusive use of buildings by their own users, also at faculty level	Knowledge institutions make use of each other's facilities and are no longer the exclusive users of their buildings.	Students and lecturers spend less time at the campus, come to the campus to meet others.

Figure 69. The three university-campus strategies Source: Den Heijer, Teeuw and Aalbers, 2010

Four Scenarios for the Future

For the academic purposes of this research, the next part shows in which way it is possible to further increase the forecasting capacity for a university. An example of the way external influences can be employed in order to enhance the alternative future's development is presented.

In 2009 Agentschap NL published a document describing four different scenarios for the future in 2030. With "Agentschap NL" promoting sustainable development and innovation, these scenarios not only describe the future in terms of demography, economy, technology, culture, political choices and sociological developments, but also in terms of sustainability issues or – at least – influences on how sustainable the world will be in each of these futures (Den Heijer, Teeuw and Aalbers, 2010).

The main scenario variables that distinguish the four scenarios are (I) globalisation versus regionalisation and (II) individualisation versus social integration. Combining these two variables results in the four scenarios.

1. **Scenario 1, *Global Market*:** combining globalisation with individualisation: the world as the playing field for competitive organisations and individuals.

2. **Scenario 2, *Global Solidarity*:** combining globalisation with social integration: the world as the collective playing field to collaborate for mutual growth.

3. **Scenario 3, *Transatlantic Region*:** combining regionalisation with individualisation: the region or own country as a habitat to compete with other.

4. **Scenario 4, *Regional Community*:** combining regionalisation with social integration: the region as a community to collaborate for mutual growth.

For higher education, the research team translated these scenarios in five main variables:

1. The number of Higher Education Institutes, the size and their profile, compared to 2010;
2. The funding of higher education, both private and public;
3. The use of ICT, for education, research and valorisation of knowledge;
4. The type of students;
5. The type of scientists – professors and researchers.

Additional aspects for each of the scenarios are the partners for collaboration, the changing in student population and community, the changing space demand, function mix and quality requirements, the increased demand for related university functions: residential, related businesses, retail & leisure and infrastructure, the feasibility of environmental goals and sustainable ambitions (Den Heijer, Teeuw and Aalbers, 2010).

Twelve models for Higher Education

Combining these three strategies with the four scenarios results in twelve future models for higher education institutions. Therefore, it possible for a university to identify its current state in one of these models and consequently test its desired and potential future development. By analysing the variables of each scenario it would be possible to test alternative options which will facilitate its decision making for its future. It is possible that these models could be used by the A.U.Th. decision makers by relating and attaching specific Greek context-related values to the scenarios' variables.

	SC. 1 ***Global Market*** Global Competition	SC. 2 ***Global solidarity*** Global Collaboration	SC. 3 ***Transatlantic Region*** Regional Competition	SC. 4 ***Regional Community*** Regional Collaboration
	Knowledge for Sale	**Knowledge to Share**	**Knowledge for Yourself**	**Knowledge Applied Locally**
Strategy A. *Back to the Future*	**A1** University college. Closed Campus. Members only.	**A2** Traditional University. Open Campus. For University's exclusive use.	**A3** National University. Gated, Safe campus for group individuals	**A4** Community College. Our Campus village.
Strategy B. *Intellectual Agora*	**B1** Closed Network University. Campus to share with invited guests.	**B2** Open Network University. Campus to Share with many partners.	**B3** University as local market place. Campus as "shopping Centre" for individual growth.	**B4** University as local place for knowledge exchange. Campus as town centre with social function.
Strategy C. *Clicks & Mortar*	**C1** Virtual University. Pay to Study Online	**C2** Open Source Virtual network.	**C3** Gaming Setting. Play with peers to win.	**C4** Our virtual community (in low density areas).

Figure 70. Linking the three University Strategies (A, B, C) and four Scenarios (1, 2, 3, 4) in twelve University-Campus Models. Source: Den Heijer, 2011

THE CASE OF A.U.TH.

In this part of the research, the focus shifts to the case of A.U.Th., in the strategic perspective. The three adopted strategies will be related with the case study in order to identify how the deriving goals from the analysis (chapters 3.1 and 3.2) should be tackled in the short-term and most important, in the long-run. The first step is to explore each strategy's aspects and related consequences in order to identify in which strategic model the current situation of A.U.Th. is most accurately described. In this point it is necessary to examine each strategy's aspects , summarized in the following table and consequently conclude on the current A.U.Th. strategic model.

Identifying A.U.Th.'s Current Strategic Model; Classical University (A)

Currently A.U.Th. can identify itself almost exclusively in the Classical University strategic model, *Back to the future*. Due to A.U.Th.'s presence in the inner-city of Thessaloniki, its current business model also shares some characteristics of the Network University strategic model, *Intellectuall Agora*. However, it was hard to retrieve any proof that the university's decisions of the past were consciously planned or intentionally related with any strategic vision by the side of the university.

Looking at the university's inner city accommodation practice of today, that it is currently achieved through a mixed model of ownership (both in owned and rented space), location characteristics (infrastructure and city amenities), and building characteristics (physical size, age and condition and architectural quality). One can say that diversification of an organization's portfolio is beneficial, if consciously planned and executed.

However in the case of A.U.Th. there is hardly any connection between the organization's vision and actions. Its controversial accommodation practice can be related with an incremental accommodation strategy (O'Mara, 1999), as the result of a constantly reactive CREM approach by the side of the university. Briefly considering the advantages of this strategy, it shortens the forecast horizon and it symbolizes a flexible attitude, especially when am emergent demand for real estate occurs (Singer et. al., 2007).

These strategic advantages can probably be identified in the case of A.U.Th. during the last decades (1990-2005), after a boom in the student population and the expansion of the university in terms of size, organizational goals and expectations. With abundant financial resources from the state, at least compared with the current situation (2009 and on), strategic CREM must have been a lower priority's issue in the university's agenda.

Incremental accommodation suited the organization, as accommodation cost was not of the highest importance. However, with the situation being radically changed, currently the university has to deal with the disadvantages of this approach; a sub-optima financial investment followed by an ambiguous collection of buildings, and with the location still being a long-term commitment.

Consolidation of the Current Model

Before endeavouring for the selection of a new future model it is first necessary to consolidate the current practices related with the strategic or business model of A.U.Th. It is the time for the university to change, and lay solid foundations for its future. The consolidation of the classical model should focus on the following aspects:

- **Professionalization:** increased transparency in the university's operations is necessary; collect, analyse and use, as well as benchmark and share data concerning the management of the organization in the form of relevant KPIs.

- **Rationalization:** Evidence based decision making on KPIs, weighting costs and benefits. At this point A.U.Th. main purpose is to decide on the costs and benefits of its current accommodation model so that the goal of cost-efficiency is achieved.

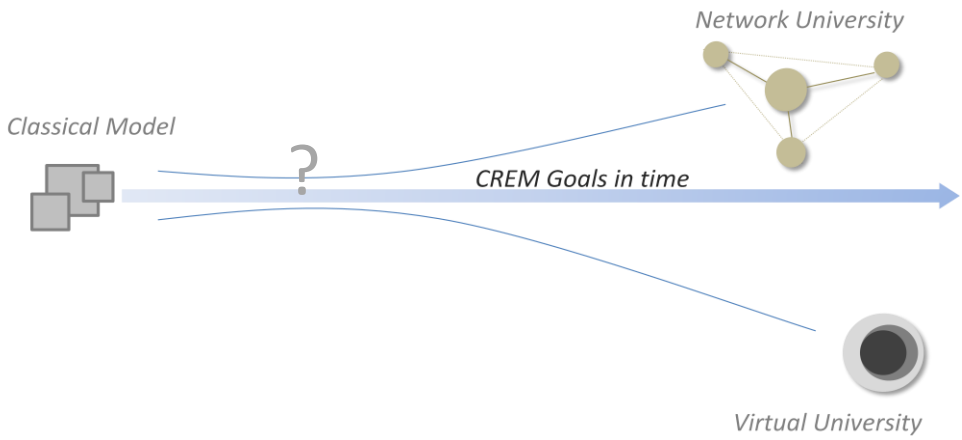
- **Proactive Management:** The decision making should follow a sound management process for example the DAS framework with its four management tasks as presented in this research.A shift from reaction to pro-action, thus anticipation of future developments should be launched.

By adopting these structural but most important cultural changes, A.U.Th.'s management would gradually evolve towards increased effectiveness and efficiency. It will be possible to rationally face and act on the current issues and at the same time begin to prepare a future plan of action, by anticipating future developments. The next paragraphs will further elaborate on the potential future models for A.U.Th.

Relating A.U.Th. to the three Strategic Models

Considering the four CREM perspectives, It becomes clear that the *Purpose* of each strategic model, in other words the university's strategic goals, as well as the *Euros*, thus its budget, are related with the strategic level of the organization. On the other hand, on the operational side, *Square Meters* and *Users*; two groups where the effects of each strategy will be reflected. The link between the two levels is expressed by the aspect of Quality.

In this part of the research, the strategy-related aspects (*Purpose* and *Euros*) per model (Classical, Network and Virtual) are analysed, ultimately reflected in the *Quality* ratio. Doing so it will be possible to identify the ways A.U.Th. CREM strategy could be developed, which goals should be pursued and what their implications will be for every perspective.



The next table provides the analysis' information related to each strategic aspect , assuming that the classical model (A) reflects the university's current business model, as the basis for exploring its potential future development.

Classical Model	Network University	Virtual University
Back to the Future (A)	***Intellectual Agora (B)***	***Clicks & Mortar (C)***
Purpose		
Business Model		
Consolidation of current business model through professionalization and rationalization of processes and practices. From reactive to proactive management; anticipation of the future.	Evolution to a new business model based on increased Professionalism and Rationality of processes and practices. Anticipation of future developments.	Evolution to a new business model based on increased Professionalism and Rationality on processes and practices. Anticipation of future developments.
Goals		
1.Cost-efficient accommodation 2. Optimal accommodation supporting A.U.Th. core business	1.Cost-efficient accommodation 2. Optimal accommodation supporting A.U.Th. core business	1.Cost-efficient accommodation 2. Optimal accommodation supporting A.U.Th. core business 3. CRE communicating A.U.Th.'s image.
Actions		
From Consolidation towards Restructuring. Rationalization of Financial Management Meet Health and Safety requirements.	Trade quantity for quality. Intensification of CRE space utilization for increased cost-efficiency, resulting in residual space. A.U.Th. part of a network; open to market demand for knowledge creation and exchange. Look for and collaborate with strategic partners; Sharing use, management and ownership responsibilities. A.U.Th. supplies space on demand both on-campus and off-campus. Integration within the city's urban landscape and with city's population, with A.U.Th. campus an important node of the urban network. Primarily focus on letting out residual space to partners. Selling space as an alternative	Trade quantity for quality. Compact A.U.Th., primarily through increased ICT capacity; More operations virtual, resulting in residual space. Densification supported by intensification of CRE space utilization. Focus on the supply side. Existing On-Campus facilities designed for A.U.Th.'s Core Business. Invest & Improve CRE Functional value. A.U.Th. Campus the core element of the university's identity. Focus on CRE Symbolic value. A.U.Th.' Campus location competitive advantage, generating demand from external parties. Primarily focus on selling residual space. Let out space as an alternative
Accommodation Focus		
On-Campus: -/+ **Off-Campus: -/+**	**On-Campus: -/+** **Off-Campus: +**	**On-Campus: ++** **Off-Campus: -**
Euros - €		
Actions		
1.Cost-efficient accommodation: Minimize Costs From Rented to Owned space; -Disengage from lease contracts. -Match space demand in owned	1.Cost-efficient accommodation: Minimize Costs Sharing space with partners & less CRE m2: sharing fixed costs, lower operation and maintenance cost.	1.Cost-efficient accommodation: Minimize Costs Less CRE m2: lower operation and maintenance cost.

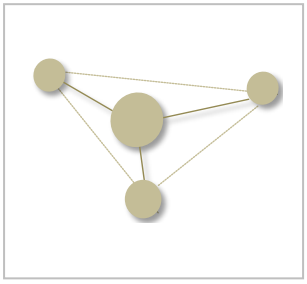
premises. -Owned space Off-Campus versus On-Campus.	Increased revenues Let out space to partners, additional annual revenues	Increased revenues Selling RE (building or land) increases the liquidity of A.U.Th.
Effect		
Lower Cost of Ownership	Lower Cost of Ownership Increased Revenues	Lower Cost of Ownership Increased Revenues
SWOT Analysis		
Strengths		
Market independent State as the main source of income adds certainty to forecasting.	Less Dependent on State funding. Diversification of income. Long term contractual commitment adds certainty to forecasting.	Less Dependent on State funding. Increased liquidity Capital available for direct re-investment.
Weaknesses		
Dependent on national economy and developments not directly influenced by A.U.Th. management. Lower Revenues	A.U.Th. increased responsibilities and management capacity.	A.U.Th. increased responsibilities and management capacity. Stagnation without market demand.
Opportunities		
Introduce Tuition fees	A.U.Th. attractive to partners, increased revenues in the long run because of lease contracts	Location potential for different functions >NPV. A.U.Th. budget boost.
Threats		
Further decrease of state funding, A.U.Th.'s future at stake	Dependent on Market Demand Market Fluctuations versus contractual commitment. Objections about the institutional role of A.U.Th.	Dependent on Market Demand Sale timing. Objections about the institutional role of A.U.Th.

Quality - €/m2					
Actions					
Meet requirements and regulations for Health and Safety. Align CRE cost per m2 with available resources.		Trade quantity for quality. Intensification of space utilization through the implementation of new concepts of learning and working, with ICT developments supporting this process.		Trade quantity for quality From a physical to a virtual university. Invest in ICT infrastructure, to support virtual operations in teaching, working, administration and storage. Supplementary increased space utilization.	
Expected Effect					
Revenues (€):	- or -/+	Revenues (€):	+	Revenues (€):	+ or ++
Cost of Ownership (€):	-	Cost of Ownership (€):	- or -/+	Cost of Ownership (€):	- or --
Investment level (€):	-/+	Investment level (€):	-/+ or +	Investment level (€):	++
CRE space(m2):	-/+	CRE space(m2):	-	CRE space(m2):	- or --
Quality (€/m2):	- or -/+	Quality (€/m2):	-/+ or +	Quality (€/m2):	+
SWOT Analysis					
Strengths					
Allows A.U.Th. to accommodate its core business without compromising user's safety and health.		Space utilization intensification through planning and scheduling not dependent on heavy financial investment.		Direct investment on CRE space Direct impact on quality Internal decision making	
Weaknesses					
Minimal level of quality might be reflected in users' satisfaction. Potential negative impact on A.U.Th. productivity.		Increased number of stakeholders, various interests and requirements to be managed.		Requires considerable financial investment for ICT infrastructure. Employees's adaptation to ICT use.	
Opportunities					
Quality proportional with available financial resources.		Increased quality, above Health and Safety requirements.		Considerably Increased quality, above Health and Safety requirements.	

	From sharing space to sharing quality requirements, as an incentive for quality improvement.	Quality of CRE can be proportionally related to A.U.Th. aspiration.
Threats		
Quality proportional with available financial resources.	Reactions of users due to the implementation of new layout concepts and more tight schedules. Intensification of space utilization reflected on operational and maintenance costs.	What you wish is what u (can) get? Reality checks. Heavy ICT energy requirements impact on Sustainability goals. Users' familiarity with new ICT developments.

Legend	
- -	**Very low**
-	**Low**
-/+	**Unchanged**
+	**High**
+ +	**Very High**

A.U.Th. in the Network University Model (B)



In the case of the Network University model, A.U.Th. needs to be market orientated and seek strategic partners for collaboration. In this model, networking can be identified in two ways. Firstly, within the urban landscape of Thessaloniki, where the university is present in nodes that facilitate collaboration with partners; the university is integrated within the city's urban, social and economic network. Secondly, by developing an internal network between its academic units where relevant disciplines are clustered as new distinct nodes.

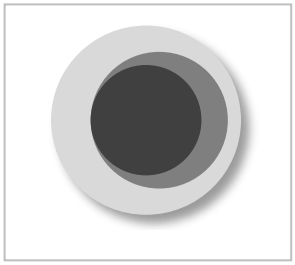
A.U.Th. accommodation is necessary to focus on reduced space demand, trading quantity for potentially increased quality. which in this case can be materialized by intensified space usage. Increased space utilization and the implementation of new teaching and working concepts should be considered as useful tools to achieve this goal.

In this model, the benefits of collaboration resulting from the increased synergy developed through partnerships. From a financial perspective benefits are capitalized through the increased revenues generated by leasing residual space to partners. Moreover, internal clustering of similar academic disciplines may result in cost reduction through increased sharing of expensive space, most probably laboratory space.

Following this model provides A.U.Th. the opportunity to evolve to a more sustainable future with adjustments of not necessarily high impact on available resources. However in this case A.U.Th. will be faced with increased management responsibilities, mainly in the field of stakeholder management.

Externally, stakeholders reflected in Market demand as well as social demand for collaboration will be factors that will influence the implementation and success of this model. Internally, the implementation of changes aiming at space usage intensification may be reflected on A.U.Th. users; dissatisfaction and reduced productivity as well as the need for change of culture should be considered as future effects and actions respectively.

A.U.Th. in the Virtual University Model (C)



In the case of the Virtual University, A.U.Th. needs to raise its consciousness and knowledge levels about its own advantages. Analyse and realize what is already and what could possibly be contributor factors to its competitive advantage. In the Virtual University model, it is possible to achieve lower space demand offered by the implementation of ICT and the shift to virtual practices. Therefore a rational assessment of the current real estate supply will result in the space to be kept and the not required space.

Knowing that its real estate on-campus is 80% of its total CRE generates a question; what is the current value of A.U.Th. campus and how can this value be increased?

From a financial perspective the location of A.U.Th. campus and its proximity to the city centre predisposes the opportunities lying there. Considering the fact that the current CRE building stock on-campus is characterized by obsolescence, it should be expected that the value mainly lies within the land of the university's campus.

Still, many of the on-campus buildings have architectural or iconic value, as they are some of the best Greek Modernist designs. There is where the implementation of the Virtual University model raises an opportunity to combine these two advantages for A.U.Th. Raise the quality of its iconic campus buildings and exploit the not required residual space.

The difficulties for this strategy exist in the required investment. Financial and technical Investment related with the ICT infrastructure capacity primarily of the university's demand but also of the city's supply. Financial investment related with the buildings' functional and physical obsolescence and sustainability related issues. Finally, investment in the human factor, Teaching and Administrative staff, that it will be necessary for these groups to perform under a new "virtual" organizational structure.

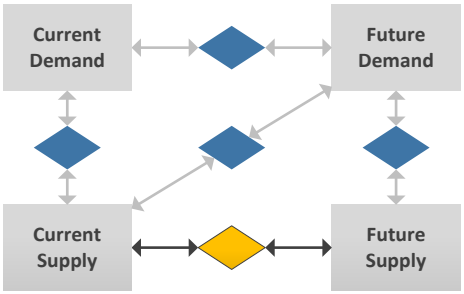
Considering the resources required for the implementation of this strategy, the opportunity to exploit the residual space should primarily related with sale transactions, that will provide A.U.Th. the necessary liquidity. However, the effectiveness of such a decision depends on the market demand, that will by its turn influence the timing decision of the transaction.

The Virtual University model applied in the case of A.U.Th. may deliver increased value and quality of real estate, the chance for the university to express its values through its real estate, but naturaly this comes with increased risks; risks that have to be handled with increased managerial awareness and capacity by the A.U.Th. decision makers.

The final step of the research concerns the definition of a project for A.U.Th. in order to transform a desired future supply into current supply. Having explored the strategic possibilities for the university's future from a top-down perspective, it remains to see what project specific information will be generated, in a bottom-up approach. In this sense, various aspects of each strategic model can be either supported or rejected, adding to the decision making process of the university by providing operational feedback.

CHAPTER 4

4.1 Defining Projects to Transform A.U.Th. Campus



Having previously developed a basic understanding about the ways a university can be developed in the future as well as the shaping forces that may influence these developments, this part of the research will focus in the ways A.U.Th. should act towards materializing a desired future supply into current supply.

So far, the analysis focused on the portfolio level, following a top-down approach. Based on the empirical results of the case study, it is well acknowledged that a response or re-action to the identified problems is required. Moving to the building level, and specifically addressing a building case of the A.U.Th. portfolio, will further enrich the research with aspects and information deriving from a bottom-up approach. Ultimately, the goal is to link these two levels, identifying the way in which they can be connected.

First, an introductory theoretical connection with the nature of this task will provide the background upon which consequently, a generic operational model concerning the process of a project will be developed. In this sense, it will be possible to examine and determine the constraints, affordances and goals, all together in a system that will be the basis of generating a solution for A.U.Th.'s current discrepancies between real estate supply and demand, examined in a selected building case.

Theoretical Background

This management task requires information about the current campus and future campus, expressed in the same variables. However, as it is possible to take this step without conducting the previous three management tasks, defining projects to transform the university campus, can be distinguished into two types of approach:

1. Proactively, conducting the fourth management task after the first three tasks, having assessed the current campus, explored changing demand and generated future modesl.

2. Reactively, reacting on an occurring problem on the current campus (Den Heijer, 2011).

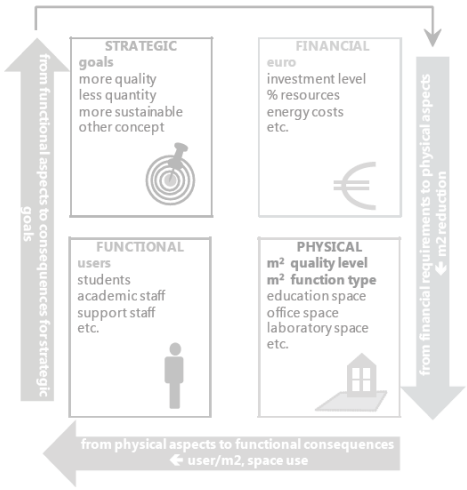


Figure 71. Defining projects; from Financial problems to Physical, Functional and Strategic Consequences. Source: Den Heijer, 2011.

Still for both approaches it is necessary that the project is defined in the same CREM variables, considering the four CREM perspectives. For a proactive approach it is necessary to connect the current and the future campus. For a reactive approach it is necessary to compare projects with each other, to benchmark and optimally learn from successful or less successful projects of the past (Den Heijer, 2011).

While many projects are defined as a result of changing demand or goals, another range of projects initiate as a response to occurring problems, for example physical or financial (Den Heijer, 2011). In fact regarding the second type of projects (figure 71), they begin with specific goals as a response to the problem, for example reduce the total cost of ownership by reducing the total floor area.

Developing a Process for A.U.Th.

With respect to the four CREM perspectives, the starting point for this part of the research lies within the financial perspective. The response will follow the path presented in figure 71; the current financial constraints will be translated to goals and requirements that will define the physical and functional perspective of the university's real estate. Therefore, in this equation, the financial perspective will be the independent variable as the cause or the input, and the physical and functional perspective will be the dependent variables, whose output will be first assessed and thereafter serve as conclusions.

Concept; Asking Where and What?

The conceptual framework of the alignment process will be based on the following question; Where and what? This dual question addresses in a generic way both the strategic and the operational level of real estate decision making.

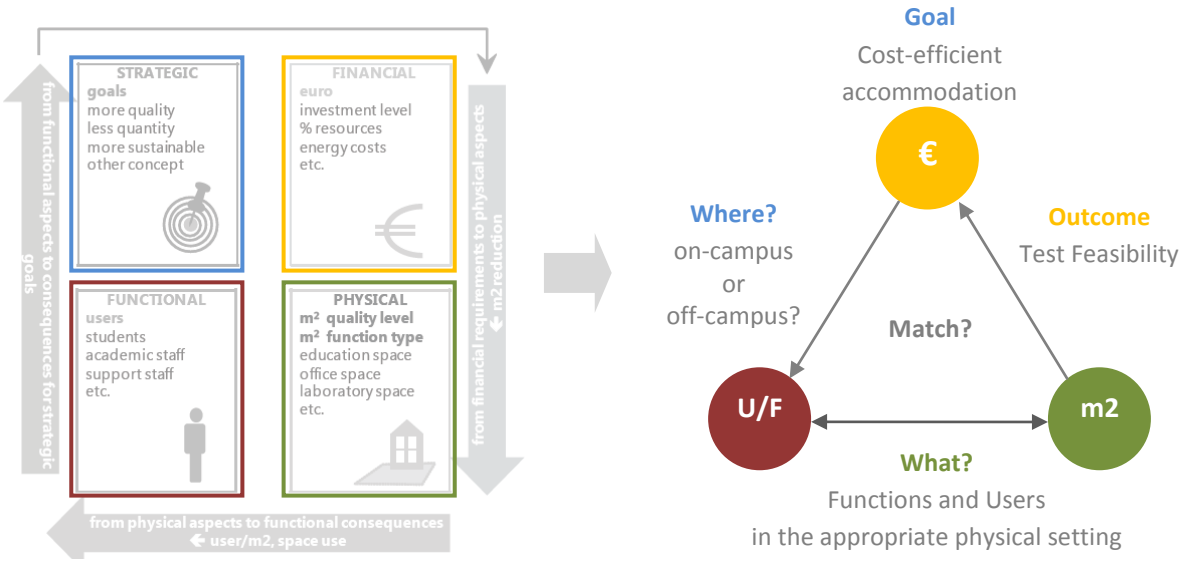


Figure 72. From theoretical insights (left) to the development of a generic concept for real estate decision making (right) for A.U.Th.

Developing the project's business case

Asking "where", is related with the location decision and the investment's feasibility, deriving from the university's strategic decisions. Market demand for specific functions is necessary to be assessed in order to support the decision making for the project's feasibility. The analysis of these issues and the related results would comprise the project's business case.

Focusing on the building level

Asking "what" is related with functional and physical perspective, thus referring to the t building stock. What kind of functions is possible to be accommodated in the existing real estate object. Keeping in mind the financial perspective as a constraint, it becomes obvious that this issue should be primarily addressed by first looking at the current supply of real estate.

Expressing the Future Demand: Brief

The first step is to state the functional and physical requirements in a brief document. The required future supply should be clearly stated in that document, as already been found in the literature research by Pena. The brief would be the outcome of the programming as it is mentioned by Pena.

Programming is a process leading to an explicit statement of an architectural problem. It's the handoff package— from programmer to designer. After pondering information derived from previous steps, designer and programmer must write down the most salient statements regarding the problem, the kind of statements that will shape the building. These, if skillfully composed, can serve as premises for design, and later as design criteria to evaluate the design solution(Peña and Parshall, 2001).

There should be a minimum of four statements concerning the four major considerations, components of the whole problem: Function, Form, Economy, and Time. Typically, they cover the functional program, the site, the budget, and the implications of time.

Designing the Future Supply: Design

Following the Brief the next step is the Design phase. it is necessary to examine whether the available buildings can match the brief requirements. In order to do that, it is necessary to test the information of the supply side. In this step it is the time to employ BIM.

A building model of the existing building object should be developed, which will facilitate the design's fit assessment, as the design brief's outcome. The design assessment will either result in new additional adaptations for the design brief, or further design elaboration will be required. This is the stage where the future demand should be translated into concepts about the future building's physical expression - and eventually during the technical design phase- its performance.

The design of the future supply of real estate, and specifically the design of the project can be provided internally from the university or by collaborating with external designers of the required specializations, such as Architects and Engineers. The engagement of each specialization should occur with respect to each stage of the design, from concept design to technical design and should be managed by the project's leader.

Providing the Future Supply: Construction

In order to acquire the desired future building, this stage is about its realization. The construction of the project would be carried out by an external contractor. Still it is necessary that the university will be in position to provide all the necessary information from the previous stages. The construction management of the projects will not be part of this research. Finally after the completion of the construction, the aligned building object will be ready to be part of the university's portfolio, where its post construction phase will signal its use and management phase again, providing new performance standards. Appendix 4.1 contains a detailed description of this process; from Brief development to the Construction and Use & Management stage supported by information related with the implementation of BIM for each stage. The following figure presents the conceptual framework for this process.

Developing a process structure

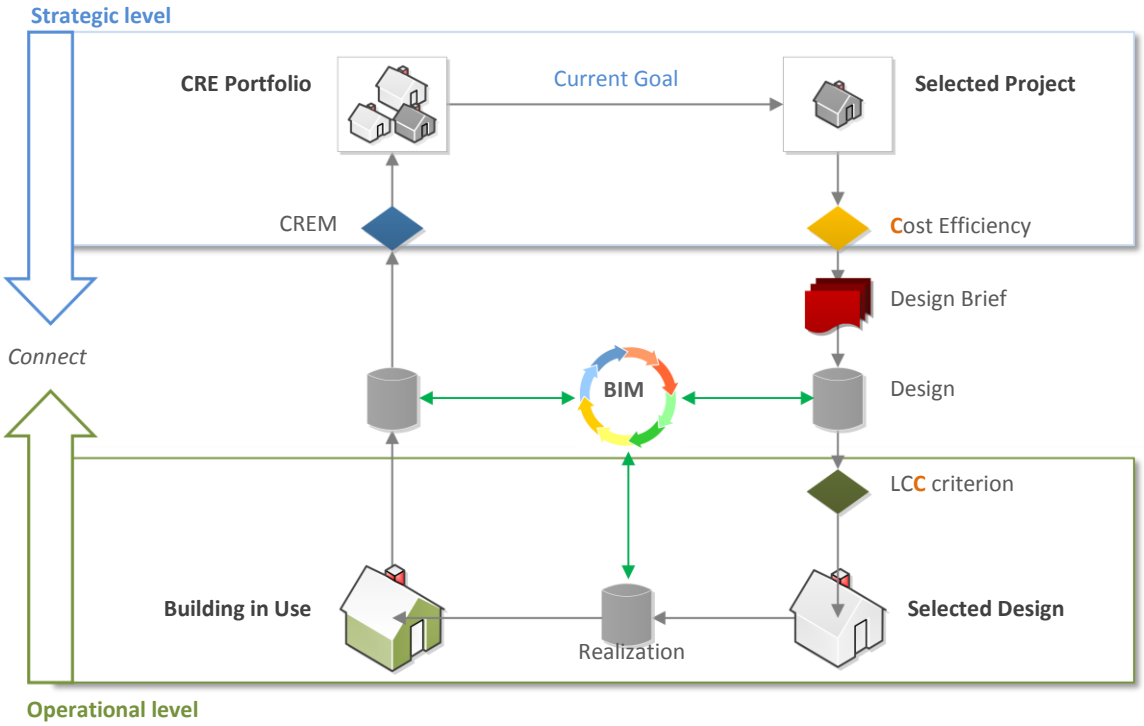


Figure 73. Generic sequence of operations for the alignment process

The combination of the initial generic concept and the necessary steps of the project's life cycle, result in a conceptual process framework, where the aforementioned considerations are structured in a logical order. It begins from the analysis of the university's CREM perspectives, the assessment of which revealed the current problems. In this case, as a response, A.U.Th.'s current goal of cost efficiency is examined in a specific project. The selected project has already been identified, as the result of the university's CRE portfolio evaluation (comparative analysis and benchmarking).

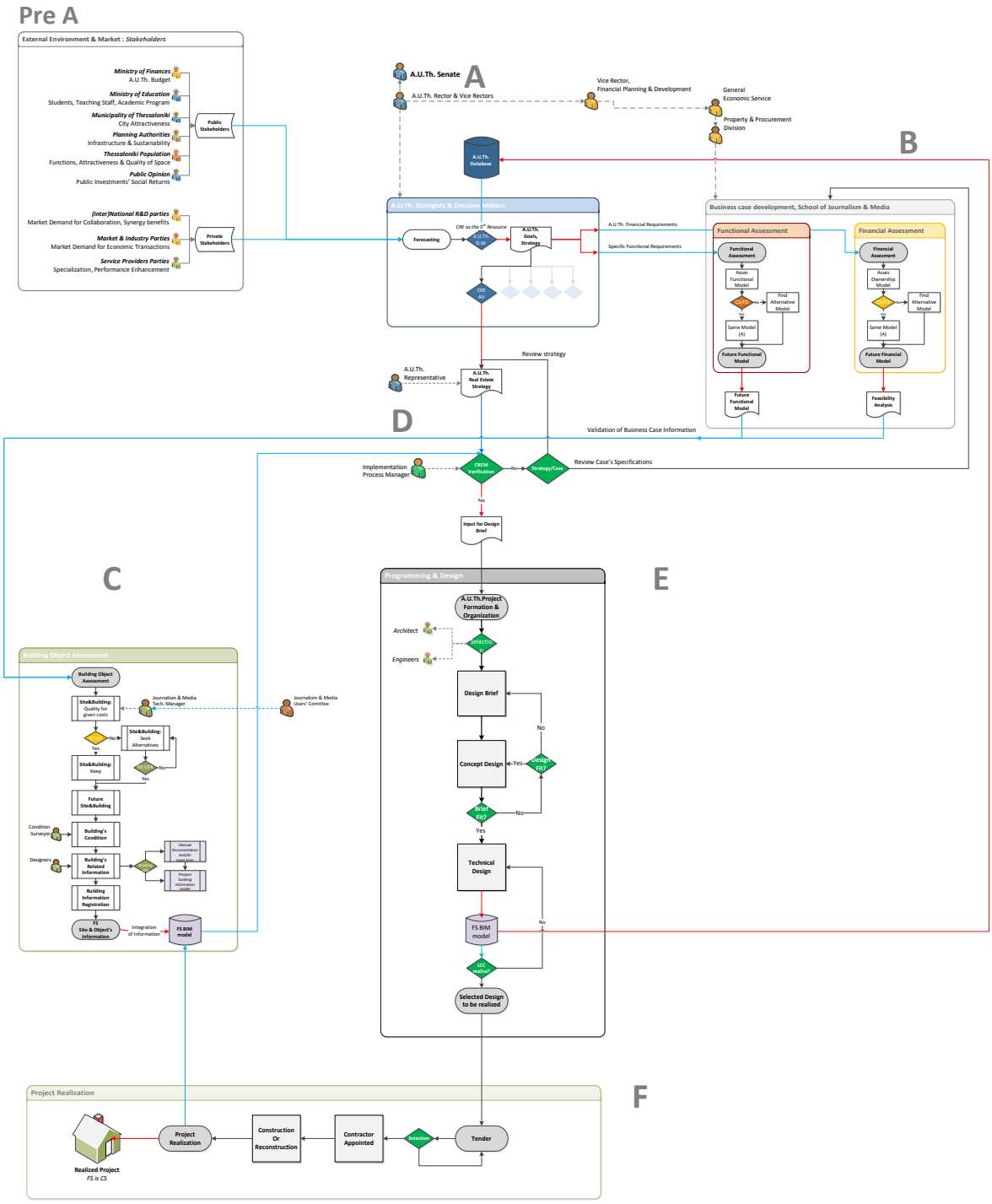
Consequently it is important to develop a proper design brief, that will eventually guide the design stages. The university's requirements should be translated into tangible goals, that should be achieved through the design development. In the end of the design stage, the generated design alternatives will be weighted based on their LCC, resulting in the selection of the design to be realized. The selection of the design, being the outcome of the technical design elaboration, should reflect in the project's LCC, its financial as well as environmental sustainability.

Finally, the realization of the project will provide a new building for use, generating new management information for future decision making, having been again part of the university's CRE portfolio.

From this process, it becomes clear that it is important to connect the Strategic and Operational levels, by improving the management of the project's LC information; and there is the first contribution of BIM as a tool. It enables the development of a complete and coherent data-base of the project, by integrating its life-cycle information from every stage. Thus, by the end of that cycle, decision makers would have a new systematic source of information, which will enable them to acquire specific building related information when required, getting the right information at the right time. Obviously, for the purpose of CREM, it is -ideally- necessary to develop BIM models for every building object.

4.2 Case of School of Journalism & Media

The aforementioned conceptual framework will be applied in the case of the school of Journalism and Media, which was the case where the highest mis-match was in the A.U.Th. CRE portfolio analysis was identified (418%). With the university acting on its problems by commencing a project, the main goal is to identify what actions are necessary to be taken in order to align A.U.Th.'s portfolio goals and requirements to the selected case.



The necessary actions will be structured in a process designed for the specific case in order to optimise the university's CREM, aiming at improving the link between the strategic decision making and operational planning and practice. Moreover, it will aim at identifying the necessary decisions to be taken, process's bottlenecks that will ultimately stimulate and support decision making.

The process' conceptual framework is based on current designs, but its design will focus at describing a desired new practice; the analysis of its design will provide a comparison between the current and designed practices wherever applicable. the following figure presents the design of the process for the case of the School of Journalism and Media.

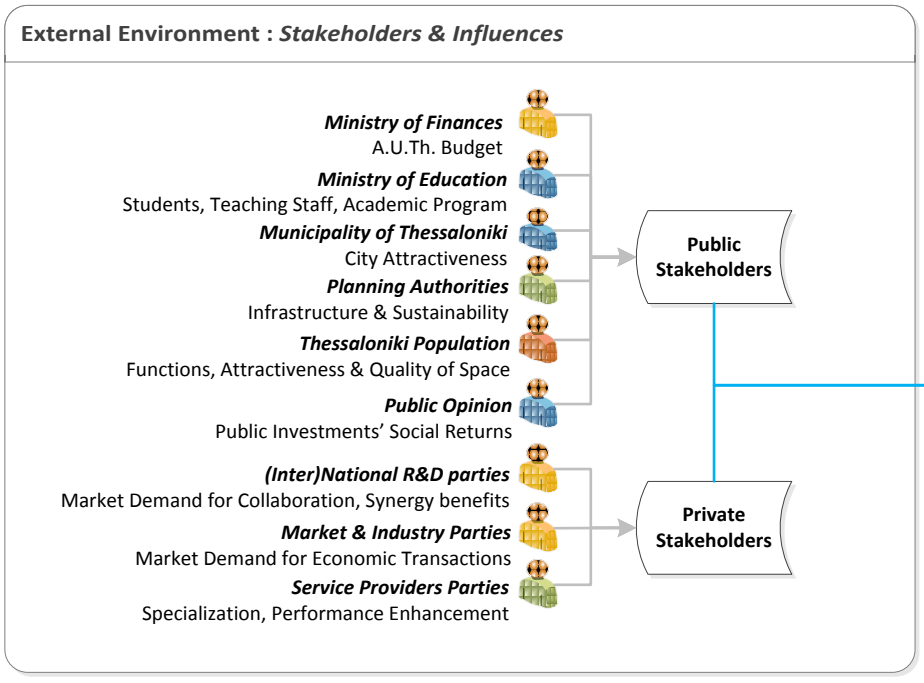
Process Description

The core objective of the designed process for the School of Journalism and Media is its alignment with the portfolio requirement of A.U.Th. , expressed in the two goals of cost efficiency and optimal accommodation. Therefore the process for achieving this objective, concerns the programming of the FD into a design of the FS, as the core process *Programming and Design*, considered to be the zero point. Still it is necessary to examine the sequence of each step of the process, in order to realize what steps are preliminary and what would the output of the core process be. Looking at the complete process, a brief description of it follows.

External Environment: Stakeholders & Influences

Step Code **Pre A**

Step Timing **t -5**



Order/ Importance

Prerequisite for Strategic Management.

Adds to forecasting and managerial capacity, both for the management of A.U.Th. and its CREM.

Process Purpose / Description

External Public and Private Stakeholders' analysis.

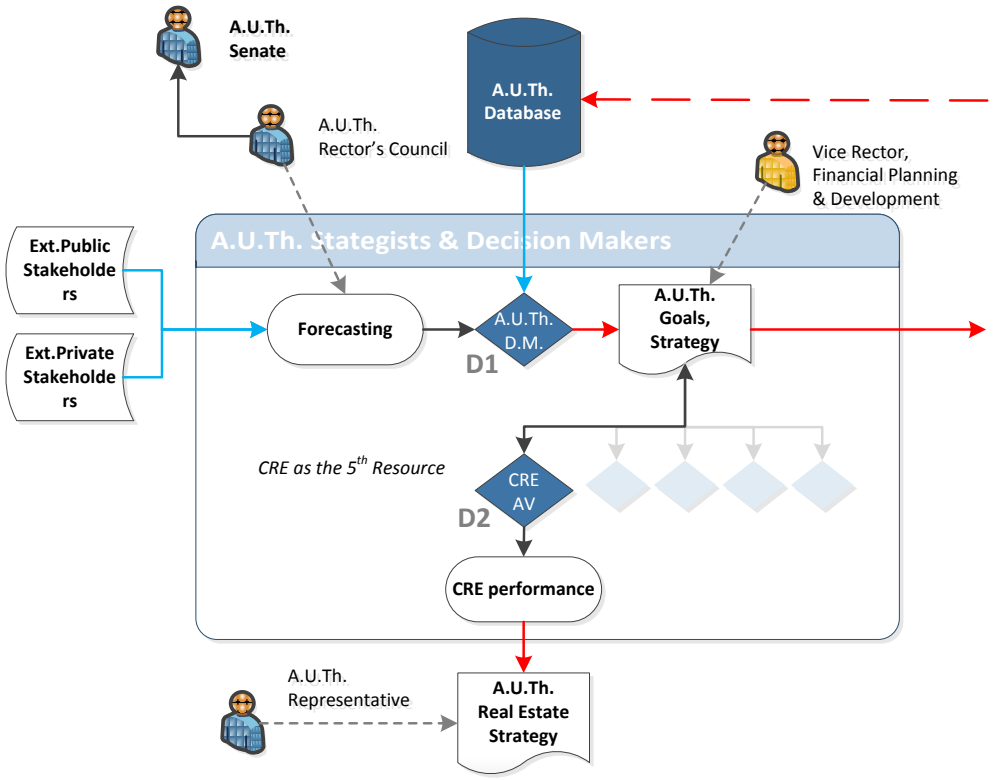
Stakeholders' interests, Power and Influence from the perspective of A.U.Th.

Decisions
-
Responsible stakeholder
Information manager Market Researcher A.U.Th. Decision Makers
Related Stakeholders
A.U.Th. Senate A.U.Th. Rector's Council A.U.Th. Decision Makers
Input
Analysis of Trends and Developments in the external environment of the organization. -Knowledge workers -City population facts & demographics -University Rankings & Reputations -Attractiveness of City, to public and private stakeholders -Market Analysis, Stakeholders in Demand & Supply -Laws, Regulations, Planning & Sustainability directives -Infrastructure
Output
Environmental Analysis, influences and trends from the external environment, used for scenario planning, as in Chapter 3.3

A.U.Th. Strategists & Decision Makers

Step Code **A**

Step Timing **t -4**



Order/ Importance
Decision making on the University's Organizational Goals and related Strategy. Decision making on the AV of the University's RE on the organization's performance.

Process Purpose / Description

Strategic management through evidence based decision making.

Proactive approach, by forecasting and anticipating future developments.

Weighting Stakeholders' interests, Power and Influence from the perspective of A.U.Th.

Decisions

D1. Decide on the organizational goals, weighting costs and benefits.

D2. Decide on the way CRE contributes to the organizational goals.

Responsible stakeholder

A.U.Th. Senate

A.U.Th. Rector's Council

Vice Rector of Financial Planning & Development

Related Stakeholders

Information manager

Market Researcher

A.U.Th. Administration Units

Input

Environmental Analysis, influences and trends from the external environment as in Chapter 3.3.

A.U.Th. performance-related KPIs (chapter 2.1, Figure 23, pp.28)

Scenarios primarily for D1, consequently reflected on D2.

Output

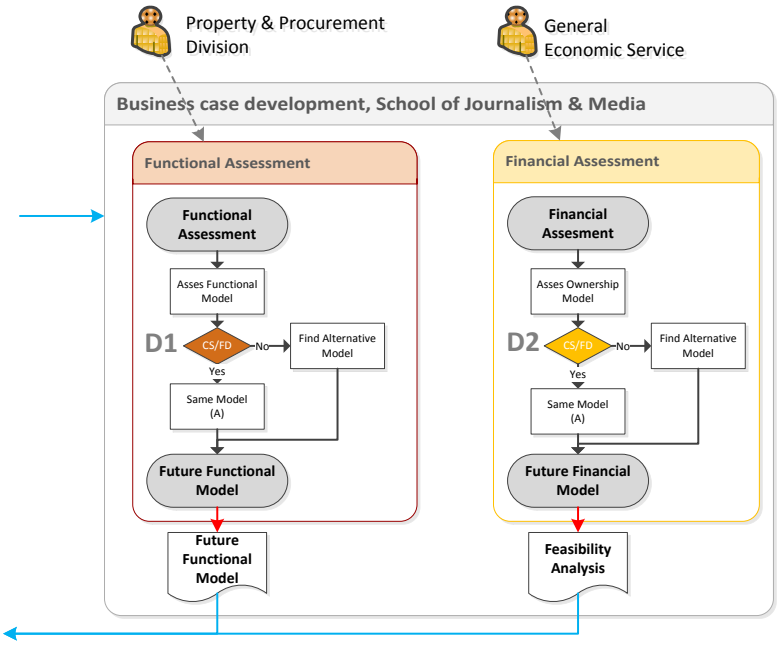
A.U.Th.'s organizational performance Goals, Requirements & related Strategy

A.U.Th.'s Real Estate Strategy

Business Case Development, School of Journalism & Media

Step Code **B**

Step Timing **t -3**



Order/ Importance

Assessment of Strategic-related information, before decisions for the specific case can be taken.

Process Purpose / Description

Assessment of the match between the case's aspects of CS and the organizational A.U.Th.

relevant requirements, considered as FD.

On the specific case's scale level, the methodology is similar to that presented in chapters 3.1 and 3.2 related with portfolio assessment.

The Assessment should end with the identification of alternative future options, if necessary.

Decisions

D1. Functional Match between case's CS aspects and A.U.Th.'s FD requirements. Related information, and assessment criteria are presented in chapter 3.2/Universities' Functions.

D2. Financial Match between case's CS aspects and A.U.Th.'s FD requirements. Decisions about the cost/revenues plan, ownership model, market analysis for land prices & rent levels, land value and replacement costs.

In order to provide a future model it is still necessary for the responsible stakeholder to have knowledge and ability to select between alternative options.

Responsible stakeholder

A.U.Th. Administration Units

A.U.Th. General Economic Service, Property and Procurement Division

Related Stakeholders

A.U.Th. Decision makers

External Stakeholders related with the required management information.

Input

Organizational goals, Budget, Users and Functions.

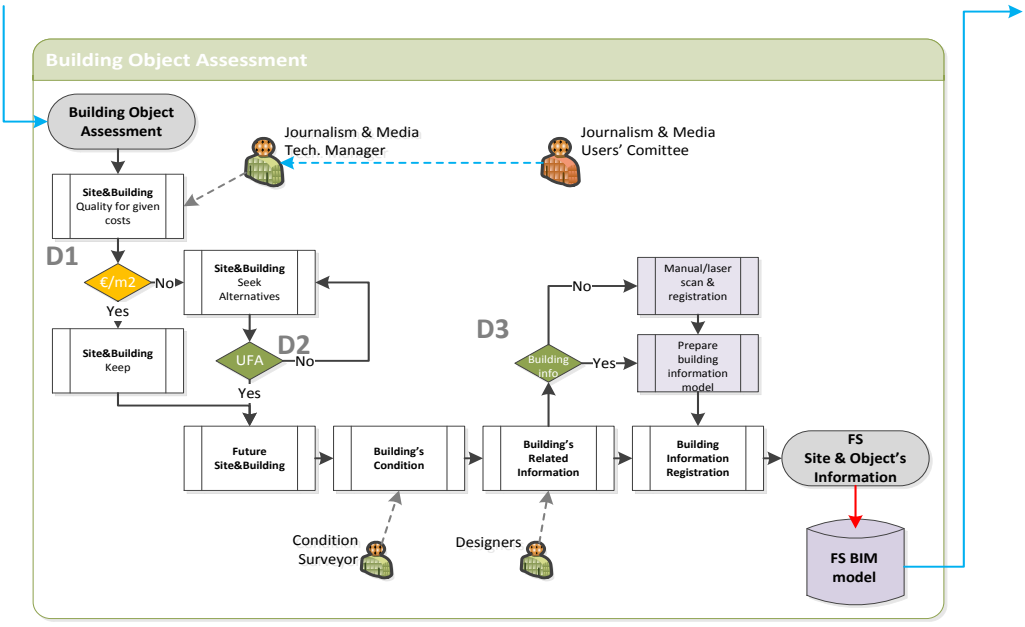
Output

Future Functions, Users, Cost & Revenues plan, Strategic implications for the current model of the project.

Building Object Assessment

Step Code **C**

Step Timing **t -2**



Order/ Importance

Follows the project's Business Case Development, providing the grounds for validation of the strategic information. Prerequisite for the verification of the project's business case and the match-test to the A.U.Th.'s real estate strategy.

Process Purpose / Description

Assessment of the CS on the building level. This step begins with testing the business case's information to the case of School of Journalism and Media; assessing the accommodation costs for the obtained building quality.

In this point information of the Users' opinion would be recommended.

The process continues with the decision about the future site and building, which consequently its related building information has to be registered.

In the end of the process, the FS on the building level as well as its related information should be available.

This is the first moment where BIM is employed; available building information is integrated into one data-base.

Decisions

D1. Decide on the Costs and benefits of the current building. It can be reflected in the accommodation costs per square meter, thus the current quality (€/m2) of the School of Journalism and Media , validating the input from the Business case with the specific building related information.

Next to the accommodation costs, operational and maintenance costs as the sustainability assessment of the building should be taken into consideration. This decision is will influence the location decision, on-campus or off-campus.

D2. With the UFA as a criterion, decide on the suitability of available buildings from the A.U.Th. portfolio, off-campus and/or on campus.

D3. Decide on the available building information, whether it meets the required level of detail or not and consequently on the way to obtain it.

The necessary information can be collected by manual measurements or by laser scanning

Responsible stakeholder

Technical Manager of the School of Journalism and Media

Related Stakeholders

Condition Surveyor

BIM operator/designer

School of Journalism and Media Users' committee

Input

Business Case, Functional and Financial Assessment Results

Output

First BIM model of the FS building.

Integration of the Input information and building specific information about:

-Spatial relations, Architectural information

-Total GFA, UFA, UFA per space type

-Technical Condition,

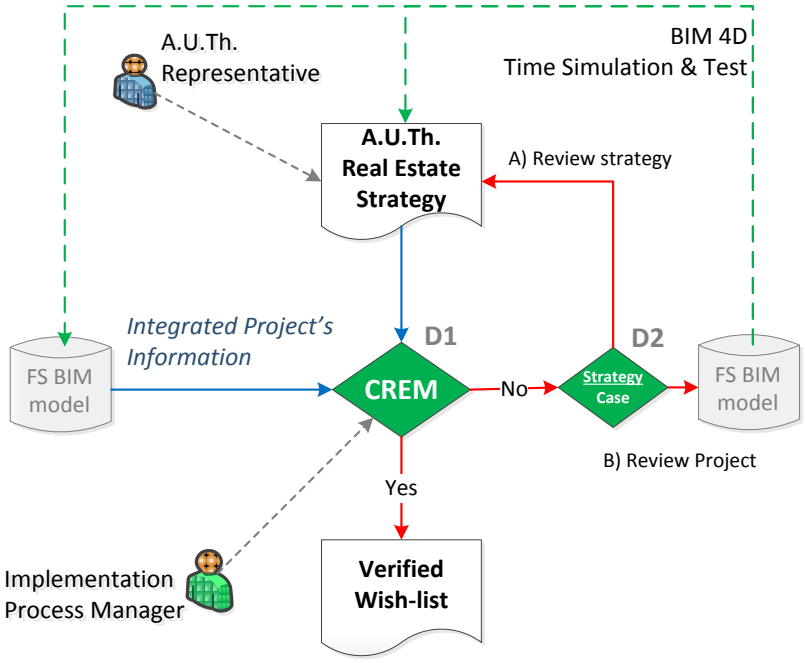
-Users and Space Utilization, Frequency and Occupancy rates

-UFA per User and User group
-Carbon Footprint, Carbon Footprint per User
-Energy Use, Energy Use per User
-Infrastructure & accessibility information

CREM verification

Step Code **D**

Step Timing **t -1**



Order/ Importance

It is the verification moment between the portfolio and building object levels. It is an assessment of the strategy's implementation potential into a specific building case. It is the moment when top-down requirements and bottom-up results and affordances confronted and weighted, resulting in managerial stimuli for both organizational levels.

In this point, it is where BIM further contributes to this process; 4D BIM, allowing simulation and testing of different options in time, increasing the forecasting capacity of the university. Therefore, BIM not only provides complete and coherent information but also enhances the strategic managerial potential.

Process Purpose / Description

This step is characterized by the importance of the necessary decision making. In fact it is a moment characterized by increased complexity when actually all the CREM perspectives need to be weighted and consequently composed into an integrated result. The BIM model developed in the previous stage, contributes by providing a complete data-base of the project, allowing for objective decision making on valid information.

It is about the link between strategic imperatives and the organization's operational capacity, implemented in the most effective and efficient manner.

The task requires knowledge of the strategic as well as operational aspects of CREM.

Chapter 2 and 3of this research can be considered as an indication of the required theoretical as well as empirical background.

Decisions

D1. It is related with the essence of CRE decision making. Test, evaluate and decide on the strategic as well as operational information, from RE portfolio requirements to the specific project.

D2. Decide on which real estate as well organizational level adaptation are required; on the real estate strategy or on the specific project. In both cases, the results stimulated decision making in the relevant level.

Responsible stakeholder

Implementation process manager

Related Stakeholders

A.U.Th. representative

A.U.Th. decision makers

A.U.Th. controllers/administration units

Input

A.U.Th. Real Estate Strategy, for the whole university's portfolio.

FS BIM model, with integrated Strategic as well as Operational project specific information.

Output

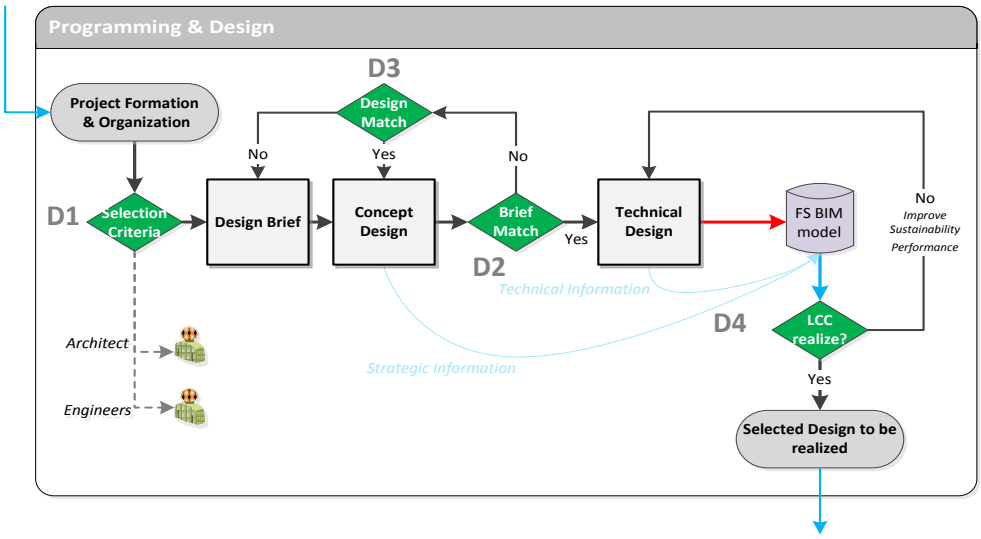
Verification of implement-ability of real estate strategy to the specific project, bottom-up results stimulating top-down decision making.

CRE information regarding the development of the project's Design Brief.

Programming and Design

Step Code **E**

Step Timing **t 0**



Order/ Importance

It is the programming and design of the CRE decision making process's outcome.

Appendix 4 describes the process for Step E and Step F.

Process Purpose / Description

The process begins with the formation and organization of the project team for the School of Journalism and Media, by appointing the stakeholders for the design phases, the Architect team for

the concept design and the Engineers' team for the technical design.

The first step of the process concerns the development of the Design Brief with the university's requirements, objectives and constraints.

The second step of the core process concerns the Design phase, where the Brief will be translated into design alternatives for the project. Strategic-related information should first be incorporated and consequently tested in the concept designs.

The final step of the process is the technical design where the performance of the building will be designed. Appendix 4 contains the relevant information for these stages.

Decisions

D1. The first decision concerns the project's stakeholders selection and necessary selection criteria by A.U.Th.

D2. The second decision concerns the fit of the concept design to the design brief, that has to be evaluated by the project team.

D3. The third decision concerns the field which needs to be adapted; it could either be the Brief's input or the Brief's output, the design. D3 is related with the step of the design development (appendix 4).

D4. The final decision concerns the LCC evaluation of the design. If it meets the A.U.Th.'s budget requirements it should enable the process to proceed to its realization. If not, the buildings sustainability performance has to be adapted, in order to balance the required investment and the expected returns in the project's life cycle

Responsible stakeholder

Implementation process manager or Project leader

Related Stakeholders

Project team

A.U.Th. representative

Architect

Engineers

Input

RE Goals & Concepts

FS BIM model and related information , for the development of the Design Brief.

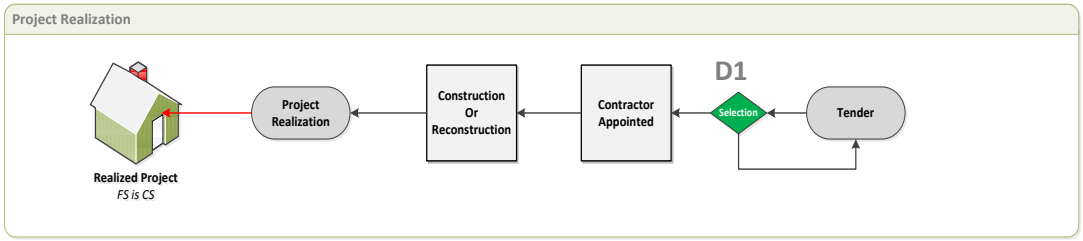
Output

Project's information (BIM) for the tender as well as for the A.U.Th. decision makers' database

Project Realization

Step Code **C**

Step Timing **t 1**



Order/ Importance
It follows the programming and design stage, towards the realization of the project Appendix 4 describes the process for Step E and Step F.
Process Purpose / Description
It is the end result of the CREM process, the project aligned to the requirements set. The project should be ready to optimally contribute to the university's objectives.
Decisions
D1. It concerns the selection of the appropriate contractor for the realization of the project.
Responsible stakeholder
Contractor
Related Stakeholders
Project Team A.U.Th. decision makers
Input
Project's BIM model from the project team.
Output
Realized Building for A.U.Th. use and management phase. Project's BIM model updated by the contractor.

CHAPTER 5

5.1 Research Results

End Product

In this research, decision making for A.U.Th. real estate has been addressed by following the DAS process with its four campus management tasks (Den Heijer, 2011). Having conducted all the campus management tasks, the end product of the research is the process designed for the case of the School of Journalism and Media (Chapter 4.2).

It is an operational step-by-step plan, that connects the strategic and operational level of CREM, incorporating necessary actions to be taken as well as their implications, in the decisions concerning the life cycle of a real estate project; from initiation, brief and design to construction, ultimately providing a new project for use and management, in accordance to A.U.Th. requirements (Chapter 2.1 and Chapter 2.2).

Considering the holistic character of this management process, covering the whole life-cycle of real estate management in two scale levels, thus both portfolio and building, BIM actually supports this process by integrating all relevant information (Chapter 2.3).

Assessment of the End Product

In order to assess the end product of the research it is necessary to review the main issues described in the problem statement and assess to which extent these issues have been successfully tackled.

1. Real estate management should optimally support the organization's goals and objectives.
2. Proactive real estate management, providing accommodation effectively and efficiently.
3. Conscious decision making, based on evidence; valid information is necessary.
4. Rationality, coherence and transparency in the decision making process

Input for the Process' Design

Considering the first and second issue of the problem statement, they concern the added value of real estate to the organizational performance and the ways real estate management should be practiced. Chapter 2.1 showed twelve ways and the related process, in which CRE could add value to a university's objectives and performance.

The analysis of A.U.Th. in chapters 3.1 and 3.2 revealed its current problems, observed in the discrepancies between demand and supply, which by their turn framed the current and future CREM goals. In chapter 3.3 the importance of strategic planning was stressed out, as a way to proactively prevent the occurrence of mis-matches. Moreover, potential future models for A.U.Th. , with additional goals and related consequences were explored, in order to expand the range of options for decision making.

The ways the required accommodation can be obtained in the form of a building project, resulting from the aforementioned management processes, has been addressed in chapter 2.2 and 2.3. In these chapters the research identified the process to and plan and consequently design the future building object (programming) and the tool to support this process (BIM) which is explicitly described in Appendix 4.

Operating the process

In Chapter 4.2 the end-product of the research was presented. Each step of the process designed for the School of Journalism and Media was described. By operating the process it becomes possible to assess and identify what has been achieved in each step.

Step	Pre-A & A
Organizational Level	**Strategic**
RE Level	**Portfolio**
Achievements: ***- Strategic Management*** ***- Evidence Based Decision Making***	
In the first two steps, the external environment, thus the stakeholders' interests and power and the relevant influences for A.U.Th., is linked to the university's strategists and decision makers. These steps are considered as prerequisites for the continuation of the process. The prescribed actions of the first two steps are related with the consolidation and evolution of the university's organizational model. The decision making of A.U.Th. begins with forecasting and anticipation of the future, thus the management approach shifts from reactive to proactive. By linking the external environment's influences and the organizational performance, strategic management is enhanced. Still, it is necessary to base the decision making on valid information, expressed in the designed process with an internal data-base of A.U.Th. Having strategically set the organizational goals, it is possible to decide on the ways A.U.Th. real estate portfolio may contribute to them, expressed in the university's real estate strategy.	

Step	B
Organizational Level	**Strategic**
RE Level	**Building**
Achievements: ***- Rationalization of practices*** ***- Adds to transparency*** ***- Increased Professionalization***	
For the development of the business case for the School of Journalism and Media, the organizational performance requirements are tested in the specific project. The assessment of the project's strategic aspects and the outcome of this process, resemble the first three campus management tasks, on a different scale level. For this task, increased rationality and transparency are required, similar to the Joroff's (1993) *Controller* organizational stage. It is the moment to achieve increase in the professionalization of A.U.Th.'s CREM, through an analytical approach, supported by valid real estate information. Next to the strategic information of this stage, the following step is closely related to this one; it is necessary to verify it with operational building information.	

Step	**C**
Organizational Level	**Operational**
RE Level	**Building**

Achievements:

- ***Validation of Strategic Information***
- ***Building Information Integrated in one data base -BIM***
- ***Adds to Transparency***

The assessment of the building object provides the possibility for testing the strategic information deriving from the business case. In this sense it is possible to validate the projects' strategic information and further enrich it with operational information. The registration of the building's complete information leads to the creation of a BIM model, in which both the strategic and operational building information are integrated in a coherent system, that will facilitate and support future evidence based CRE decision making, characterized of increased transparency.

In a sense, the assessment of the organization's current real estate supply has been completed in two scale levels; from this point, decision making about the transformation of current supply into selected future supply would be possible.

Step	**D**
Organizational Level	**Strategic & Operational**
RE Level	**Portfolio & Building**

Achievements:

- ***Evidence based decision making supported by BIM***
- ***Adds to Transparency***
- ***Stimulation of A.U.Th. decision making***
- ***4D BIM; Increased Forecasting Capacity by Simulation***

In this step decisions for the organization's real estate are taken. The valid building object's information is confronted with the university's strategic goals concerning its CRE portfolio. It is the moment to verify whether the university's specific real estate object contributes to the organizational requirements as intended or not. From a closed question, thus decision on information describing a set of performance criteria, to an open question; how should the desired match be achieved.

The result of the first decision will either stimulate strategic decision making or adaptations regarding the project. Either way, the BIM database provides integrated building information for transparent decision making. Next to that, here is where BIM further contributes to this process;4D BIM, allowing simulation and testing of different options in time, increases the forecasting capacity of the university. Therefore, BIM not only provides complete and coherent information but it also enhances university' potential for strategic management.

Step	E & F
Organizational Level	**Operational**
RE Level	**Building**
Achievements:	
- From Strategy to Implementation and Back	
- Evidence based decision making supported by BIM	
- Increased strategic management capacity for A.U.Th.	

In these steps the decision about the specific project is translated and ultimately materialized into the required future building, through programming, design and construction. Through this process, the information generated throughout the remaining steps of the process, gradually enriches the detail level of the BIM database, facilitating evidence based decision making of increased transparency.

Besides acquiring the required accommodation, this process also provides A.U.Th. decision makers with a complete and up-to-date database of the project. The new performance standards of the aligned building object could and should therefore be used for strategic CREM from the university.

5.2 Conclusions and Recommendations

Answering the Research question

The conclusions of the research will provide the answer to the research question, having been formulated as:

In which ways the decision making for A.U.Th. real estate can further be professionalized?
Which considerations should be taken into account in A.U.Th. RE decision making, in order to provide optimal accommodation by balancing requirements and available resources, and in which way this task should be managed?

Real Estate Decision Making

Decision making about the real estate of a university or an organization in general, is CREM. CREM aims at a match between business –as the demand side- and real estate –as the supply side. By connecting the strategic and operational level, CREM not only meets the organizational technical, functional and financial requirements but also contributes to the organization's overall performance.

Considerations

The considerations of CREM are related to the four CREM perspectives and the twelve aspects or ways in which corporate real estate contributes to the organizational performance; thus the Added Value of Real estate. Besides the twelve generic considerations deriving from the ways CRE adds value, CREM practice is an iterative process, matching demand and supply in the present as well as in the future.

Process Management

The inherent iterative nature of CREM, can be applied through a management process, in the case of the research, the DAS framework. The design of an accommodation strategy (DAS) aims at proactively managing Demand and Supply, anticipating the future and minimizing exposure to negative consequences for both the organization and accommodation. Still, the success of a CRE strategy is also dependent on its implementation. Its proper translation through Building Programming, to Design and Construction of required CRE building objects, will not only increase its success but will also provide useful feedback, as operational information.

Related Information

The iterative nature of CREM and the results of this process are related to the life-cycle of real estate, in various scales. In this sense BIM is a very useful tool for CREM as it not only provides the opportunity to integrate real estate information in a complete and coherent system but it also provides the opportunity to fully take advantage of its technological prowess, thus strategically manage real estate through simulation of different future scenarios.

Recommendations

It is therefore recommended that A.U.Th. decision making for its real estate would further be professionalized by incorporating the aforementioned conclusion, which answer the research question.
In the last part of the conclusions, the ways A.U.Th.'s CREM should be evolved in time, will be presented. The research results are combined in a conclusive recommendation for A.U.Th. , depicted and summarized in the following figure;

Past	Present	Short-Term	Mid-Term	Long-Term
CREM				
Incremental Reactive	Assessment, Consolidation, Restructuring	Act on the problem	Forecast, Strategise, Evidence based Decision making	Organization's Sustainability
CREM				
	CRE Analysis CRE Assessment Project preparation Process design	Project Realization Use & Manage Generate new performance Standards	Market Oriented Analyse & Asses new Standards Decide on CRE strategy	Network University or Virtual University
CREM				
				
Current CRE portfolio; Ambiguous Collection of Buildings	Reduce Cost Control Risks Support Activities	Reduce Footprint	Increase RE value Increase Flexibility Increase Satisfaction Increase Quality	Stimulate Innovation Stimulate Collaboration or Support Image Support Culture

CREM | Evolution

Technical Focus	*Analytical*	*Problem Solving*	*Business Planning*	*Anticipate Business Trends*
Building Engineering	Rationalization Transparency Cost Minimization	Standardization of Building Use	Match Market Options	Focus on the organization
				Business Strategist
			Entrepreneur	
		Deal-Maker		
	Controller			
Task-Manager				

BIM

-	Collect project's Strategic & Operational Information Develop CRE Supply BIM model(s) for the project	Support Decisions; Integrated Data Increased detail level of BIM model; from *Design&Construction* to *Use&Management*	Project's complete Building Information. (Repetition) Registration of CRE Supply CRE portfolio in BIM	4D BIM; Forecasting through Simulation of Scenarios

Building Programming

-	Brief Development From Strategic to Tactical information; prescribed performance requirements & constraints	(Brief Adaptations) Design Guide, by prescribed parameters and conditions to be met.	Project Evaluation; Benchmarking KPIs of Brief against KPIs from the project's BIM Evaluation results as input for CRE portfolio management	(Brief Development)

A.U.Th. has been faced with an unexpected multi-faceted crisis; still, after the initial stun of the shock, there is the need for action. Self assessment and a rational reading of the external conditions is necessary for the organization to survive in the short term and evolve in the future through a new, adapted organizational model. This model should ultimately aim at preventing the unexpected from heavily impact the organization in the long-term.

In the level of A.U.Th. real estate, due to the nature of the current problem, limited financial resources, it is necessary to react considering the relevant ways CRE adds value to the organization; by controlling risks and minimizing costs, supporting at the same time its core activities. Thus, by reducing A.U.Th.'s footprint the current problem can be tackled in the short term. The reduction could be reflected in the total square meters, resulting in reduced cost of ownership, or the carbon footprint of A.U.Th. By improving its sustainability performance, reduced operational and maintenance costs will be required in the long-run. In this sense, A.U.Th. should analyse, benchmark and assess its real estate portfolio, define and act through a project, for example the case of the School of Journalism and Media.

The project's resulting information will be integrated in the BIM database. Thus, it can therefore be used for evidence based decision making about the long-term development of A.U.Th. Having a precedent project complete, with new performance standards, it will be possible to address new real estate goals, such as ways to increase the value of its real estate, contributing to the university's profitability, or the quality of real estate, reflected in the ways real estate contributes to the university's productivity.

The elaboration on these aspects, by re-iterating the CRE management process (DAS), will ultimately generate new options for the future development of the university. In this sense, the future of the university may follow the Network or Virtual strategic model, or another strategy developed by its decision makers. At this point, A.U.Th.'s CREM should have been evolved in the fifth stage of the Joroff model, that of a Business Strategist. In the long term, A.U.Th.'s CREM should not only successfully deliver operations but should also generate strategic stimuli for the university's organizational decision making.

GENERALIZING

The research was about a specific case study, in which information from relevant theoretical fields has been applied. The end product of the research, as the outcome of a thorough analysis of a university structured by CREM theories, is a process which ultimately provides a method for solving its current problem. However, by re-observing the designed process, it can be said that it is about the complete life-cycle of real estate; from problems identified on the CRE portfolio level, during the Use Management stage, to project Initiation as a response in the building object level. Consequently this leads to the alignment of real estate Demand to desired Supply, through Briefing & Design and the Construction or Realization of the project; one cycle is closed, with a new building object and its related building information.

Therefore, this process is not only suitable for the specific organization examined in the research, but it can be applied in CREM cases in general. Being a method in which the life-cycle of real estate can be addressed in different levels, various organizations' CREM executives can use it. Even if the starting point of each user of the process differs, it is still possible to be defined while following the process' steps. That is because, instead of a linear process, it is an iterative one, therefore it is possible for its user to define itself in one of its steps, and consequently initiate his response.

In a sense, the research as well as its end product suggest a CREM approach that is about the life-cycle of real estate, in different levels. In fact, the management of consequent cycles of real estate depending on the selected time frame (from short term, 1-2 years to long-term, 10 years or more), in which input and output information should be weighted and assessed, generating strategic insights . BIM is a tool that supports this purpose, by providing the opportunity to integrate building information in one system. Furthermore, 4D BIM incorporated the time factor, thus allowing for simulation of scenarios. Finally, the potential user of the research's end product, needs to adapt the used KPIs, referring to the case of university real estate management, to his organization's performance metrics.

5.3 REFLECTIONS

The research fits in between the research subject of Educational Real Estate Strategies and Briefing and Evaluation of Buildings, thus connecting the strategic as well as operational levels of CREM. The academic fields covered in this research were:

- CREM & Campus Management
- Programming and Evaluation of Buildings
- BIM

Throughout the research, it was revealed that the success of CREM does not only depends on its strategic character but it also depends on the proper implementation. The iterative character of CREM process, matching demand and supply in the present and in the future, can also be found in different real estate scales. Top-down strategic portfolio management leads to a selected a real estate project with pre-determined requirements.

It is however equally important to examine the project's scale with the same sensitivity; translate the strategic imperatives to comprehensive building information, ensure its proper integration into the project's design which will result in acquiring what was required in the maximum possible precision. Moreover, it will be possible to generate valuable information which will provide a bottom-up feedback. Nowadays, BIM can be a useful tool for linking strategy and implementation, by integrating the real estate's life-cycle information providing the ground for evidence based strategic CREM.

With respect to Campus Management, it can be said that CREM theories apply when dealing with university's real estate. What differentiates Campus Management lies within the university's importance to the society. Increased social complexity reflected in external as well as internal stakeholders' interests that influencing the university performance.

The complexity of the university's institutional role does not allow for simplistic or all the times tangible performance evaluation. Productivity , profitability and the university's competitive advantage should contribute to a sustainable future with increased societal liability and responsibility. In this sense, university CREM or Campus management, requires increased sensitivity with respect to the organization's social surroundings, strategically supporting the goals of the organization to the delivered real estate performance, effectively and efficiently.

The research delivered an operational process, in which all the elaborated aspects were incorporated. With respect to its utilization potential, it meets the pre-defined target group. It is a process the steps of which can be followed sequentially or iteratively, by decision makers in the field of University REM specifically, but also to CRE executives in a broader scope. Even if it was designed from a specific starting point, a financial problem, it can be used for other starting points as well. CREM is a constant iterative matching process; being a process for CREM, the end product of the research incorporate this characteristic in its design.

EPILOGUE

The research was an ambitious but at the same time demanding study project. It required theoretical consistency, determination, efficient time planning and discipline. There were moments where

empirical information would not be available, though this was tackled by collection and correlation of relevant sources, which combination allowed the progress of the research.

Besides personal dedication to the purpose of the research, mentorship by A. den Heijer and A. Koutamanis, contributed to the project by proper motivation and by further widening of my academic as well as professional ends. Both mentors ensured a collaboration relationship to be remembered, thus I would like to express my deep gratitude and appreciation to them.

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Online Databases

A.U.Th.
http://www.auth.gr

CITYLEADERS
http://www.cityleaders.info

HELLENIC MINISTRY OF EDUCATION
http://www.minedu.gov.gr

HELLENIC STATISTICAL AUTHORITY
http://www.statistics.gr

OECD
http://www.oecd.org

QS WORLD UNIVERSITY RANKINGS
http://www.topuniversities.com

TU DELFT Blackboard
https://blackboard.tudelft.nl

WORLD BANK
http://www.worldbank.org

On line sources

BING Maps
http://www.bing.com/maps

WIKIPEDIA
http://en.wikipedia.org

APPENDICES

APPENDIX 1

1.1 Greek universities' location, age and annual student enrolment from 2000 to 2011

	University Name	Founded	City	Year:	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	National and Kapodistrian University of Athens	1837	Athens		7790	7475	7125	6800	6785	6655	6390	6380	5730	5860	5825	5360
				Difference		-4,21%	-4,91%	-4,78%	-0,22%	-1,95%	-4,15%	-0,16%	-11,34%	2,22%	-0,60%	-8,68%
2	National Technical University of Athens	1843	Athens		1620	1580	1530	1475	1430	1230	1160	1160	1060	1060	1050	1050
				Difference		-2,53%	-3,27%	-3,73%	-3,15%	-16,26%	-6,03%	0,00%	-9,43%	0,00%	-0,95%	0,00%
3	Aristotle University of Thessaloniki	1925	Thessaloniki		7735	7440	7085	6750	6820	6575	6600	6550	5820	5850	5820	5610
				Difference		-3,97%	-5,01%	-4,96%	1,03%	-3,73%	0,38%	-0,76%	-12,54%	0,51%	-0,52%	-3,74%
4	Athens University of Economics and Business	1920	Athens		1570	1500	1445	1395	1405	1405	1365	1365	1280	1280	1275	1275
				Difference		-4,67%	-3,81%	-3,58%	0,71%	0,00%	-2,93%	0,00%	-6,64%	0,00%	-0,39%	0,00%
5	Agricultural University of Athens	1920	Athens		485	465	440	430	430	430	420	420	410	410	410	420
				Difference		-4,30%	-5,68%	-2,33%	0,00%	0,00%	-2,38%	0,00%	-2,44%	0,00%	0,00%	2,38%
6	Athens School of Fine Arts	1843	Athens		105	105	100	95	95	90	120	120	120	120	120	120
				Difference		0,00%	-5,00%	-5,26%	0,00%	-5,56%	25,00%	0,00%	0,00%	0,00%	0,00%	0,00%
7	Panteion University of Social and Political Sciences	1930	Athens		1850	1775	1685	1605	1650	1650	1670	1690	1430	1450	1450	1450
				Difference		-4,23%	-5,34%	-4,98%	2,73%	0,00%	1,20%	1,18%	-18,18%	1,38%	0,00%	0,00%
8	University of Piraeus	1938	Piraeus		1825	1805	1770	1705	1715	1715	1665	1655	1540	1540	1535	1530
				Difference		-1,11%	-1,98%	-3,81%	0,58%	0,00%	-3,00%	-0,60%	-7,47%	0,00%	-0,33%	-0,33%
9	University of Macedonia Social and Economic Sciences	1957	Thessaloniki		1115	1105	1055	1030	1150	1150	1160	1190	1090	1090	1095	1085
				Difference		-0,90%	-4,74%	-2,43%	10,43%	0,00%	0,86%	2,52%	-9,17%	0,00%	0,46%	-0,92%
10	University of Patras	1964	Patra		3160	3035	2955	2880	2905	2775	2810	2750	3430	3600	3590	3485
				Difference		-4,12%	-2,71%	-2,60%	0,86%	-4,68%	1,25%	-2,18%	19,83%	4,72%	-0,28%	-3,01%
11	University of Ioannina	1964	Ioannina		2720	2610	2505	2375	2475	2485	2605	2620	3340	3400	2980	2705
				Difference		-4,21%	-4,19%	-5,47%	4,04%	0,40%	4,61%	0,57%	21,56%	1,76%	-14,09%	-10,17%
12	Democretus University of Thrace	1973	Komotini, Xanthi, Alexandroupoli, Orestiada		3375	3235	3095	2955	2945	2750	2905	2925	3620	3920	3930	3545
				Difference		-4,33%	-4,52%	-4,74%	-0,34%	-7,09%	5,34%	0,68%	19,20%	7,65%	0,25%	-10,86%
13	University of Crete	1973	Irakleion, Rethymnon		2150	2100	2040	1975	2000	2015	2205	2220	2770	2850	2850	2600
				Difference		-2,38%	-2,94%	-3,29%	1,25%	0,74%	8,62%	0,68%	19,86%	2,81%	0,00%	-9,62%
14	Technical University of Crete	1984	Chania		360	375	390	370	430	375	385	400	500	520	520	515
				Difference		4,00%	3,85%	-5,41%	13,95%	-14,67%	2,60%	3,75%	20,00%	3,85%	0,00%	-0,97%
15	University of the Aegean	1984	Mytilene, Chios, Karlovasi, Rhodes, Ermoupoli, Myrina		2105	1960	1880	1790	1845	1890	2030	2145	2630	2790	2785	2340
				Difference		-7,40%	-4,26%	-5,03%	2,98%	2,38%	6,90%	5,36%	18,44%	5,73%	-0,18%	-19,02%
16	Ionian University	1984	Corfu		385	360	345	330	465	465	490	520	650	650	650	580
				Difference		-6,94%	-4,35%	-4,55%	29,03%	0,00%	5,10%	5,77%	20,00%	0,00%	0,00%	-12,07%
17	University of Thessaly	1985	Larissa, Volos, Karditsa, Trikala		1195	1130	1095	1065	1075	1080	1220	1275	1590	1590	1590	1470
				Difference		-5,75%	-3,20%	-2,82%	0,93%	0,46%	11,48%	4,31%	19,81%	0,00%	0,00%	-8,16%
18	University of Peloponesse	2002	Tripoli, Korinthos, Kalamata, Nafplio, Sparti				120	430	430	520	660	835	1040	1040	1090	960
				Difference:				72,09%	0,00%	17,31%	21,21%	20,96%	19,71%	0,00%	4,59%	-13,54%
19	University of Western Macedonia	2002	Florina, Kozani		510	465	440	420	440	525	640	675	840	840	830	700
				Difference		-9,68%	-5,68%	-4,76%	4,55%	16,19%	17,97%	5,19%	19,64%	0,00%	-1,20%	-18,57%
20	University of Central Greece	2002	Lamia, Livadeia						70	130	130	130	160	160	160	150
				Difference:						46,15%	0,00%	0,00%	18,75%	0,00%	0,00%	-6,67%
21	Harokopio University	1990	Athens		150	150	140	135	135	135	135	175	160	160	160	170
						0,00%	-7,14%	-3,70%	0,00%	0,00%	0,00%	22,86%	-9,38%	0,00%	0,00%	5,88%
2000-20011,Higher Education Enrollment in Greece				Year:	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
					40205	38670	37240	36010	36695	36045	36765	37200	39210	40180	39715	37120
				Difference		-3,97%	-3,84%	-3,42%	1,87%	-1,80%	1,96%	1,17%	5,13%	2,41%	-1,17%	-6,99%

1.2 Greek universities' revenues for 2011

2011 Greek universities revenues in min €	Payroll FTE	Payroll extra	Total Payroll	Operating Expenses	Grants	Other	Total	Difference 09-11
1 National and Kapodistrian University of Athens	117,49	0,95	118,44	48,60	0,00	2,50	169,54	-15,99%
2 National Technical University of Athens	58,60	0,26	58,86	6,15	0,00	0,00	65,01	-8,88%
3 Aristotle University of Thessaloniki	126,63	0,90	127,53	29,50	0,00	0,00	157,03	-33,77%
4 Athens University of Economics and Business	12,84	0,22	13,06	4,15	0,00	0,00	17,21	-15,94%
5 Agricultural University of Athens	15,09	0,06	15,15	3,10	0,00	0,00	18,25	-15,78%
6 Athens School of Fine Arts	3,43	0,16	3,59	2,25	0,00	0,00	5,84	-17,57%
7 Panteion University of Social and Political Sciences	17,24	0,00	17,24	3,10	0,00	0,00	20,34	-8,84%
8 University of Piraeus	11,59	0,00	11,59	4,00	0,00	0,00	15,59	-14,20%
9 University of Macedonia Social and Economic Sciences	12,57	0,86	13,43	3,90	0,00	0,00	17,33	-5,34%
10 University of Patras	46,86	2,10	48,96	11,15	0,00	0,00	60,11	-12,97%
11 University of Ioannina	33,08	0,90	33,98	8,60	0,00	0,00	42,58	-19,11%
12 Democretus University of Thrace	35,01	2,45	37,46	10,30	0,00	0,00	47,76	-14,54%
13 University of Crete	33,52	2,80	36,32	6,35	0,00	0,00	42,67	-9,78%
14 Technical University of Crete	10,67	1,40	12,07	2,65	0,00	0,00	14,72	-15,03%
15 University of the Aegean	17,80	2,80	20,60	5,80	0,00	0,00	26,40	-21,40%
16 Ionian University	5,90	0,85	6,75	2,60	0,00	0,00	9,35	-24,70%
17 University of Thessaly	26,12	2,80	28,92	6,25	0,00	0,00	35,17	-14,13%
18 University of Peloponesse	7,30	0,70	8,00	1,65	0,00	0,00	9,65	24,55%
19 University of Western Macedonia	4,50	0,64	5,14	1,60	0,00	0,00	6,74	2,27%
20 University of Central Greece	0,63	0,00	0,63	0,60	0,00	0,00	1,23	-20,11%
21 Harokopio University	3,77	0,00	3,77	1,15	0,00	0,00	4,92	-7,70%

1.3 Greek universities' Enrolment Data per Size Category | 2000-2011

X-Large Greek Universities

Year	National and Kapodistrian University of Athens	Aristotle University of Thessaloniki	Average Annual Enrolment	Growth
2000	7.790	7.735	7.763	
2001	7.475	7.440	7.458	-3,9%
2002	7.125	7.085	7.105	-4,7%
2003	6.800	6.750	6.775	-4,6%
2004	6.785	6.820	6.803	0,4%
2005	6.655	6.575	6.615	-2,8%
2006	6.390	6.600	6.495	-1,8%
2007	6.380	6.550	6.465	-0,5%
2008	5.730	5.820	5.775	-10,7%
2009	5.860	5.850	5.855	1,4%
2010	5.825	5.820	5.823	-0,6%
2011	5.360	5.610	5.485	-5,8%

Large Greek Universities

Year	Democretus University of Thrace	University of Patras	University of Ioannina	University of Crete	Average Annual Enrolment	Growth
2000	3.375	3.160	2.720	2.150	2.851	
2001	3.235	3.035	2.610	2.100	2.745	-3,7%
2002	3.095	2.955	2.505	2.040	2.649	-3,5%
2003	2.955	2.880	2.375	1.975	2.546	-3,9%
2004	2.945	2.905	2.475	2.000	2.581	1,4%
2005	2.750	2.775	2.485	2.015	2.506	-2,9%
2006	2.905	2.810	2.605	2.205	2.631	5,0%
2007	2.925	2.750	2.620	2.220	2.629	-0,1%
2008	3.620	3.430	3.340	2.770	3.290	25,2%
2009	3.920	3.600	3.400	2.850	3.443	4,6%
2010	3.930	3.590	2.980	2.850	3.338	-3,1%
2011	3.545	3.485	2.705	2.600	3.084	-7,6%

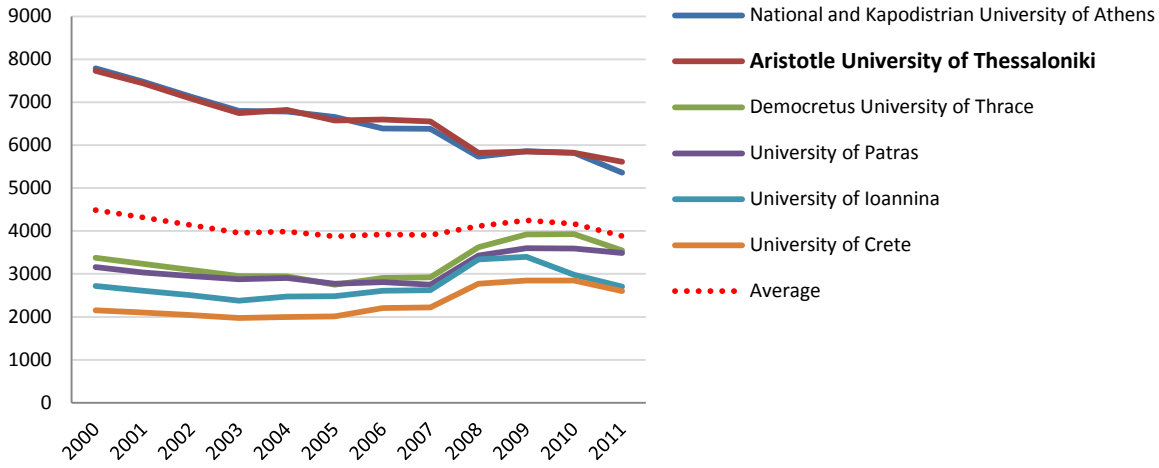
Medium Greek Universities

Year	University of the Aegean	Panteion University of Social and Political Sciences	University of Piraeus	National Technical University of Athens	Athens University of Economics and Business	University of Thessaly	University of Macedonia Social and Economic Sciences	Average Annual Enrolment	Growth
2000	2.105	1.850	1.825	1.620	1.570	1.195	1.115	1.611	
2001	1.960	1.775	1.805	1.580	1.500	1.130	1.105	1.551	-3,8%
2002	1.880	1.685	1.770	1.530	1.445	1.095	1.055	1.494	-3,6%
2003	1.790	1.605	1.705	1.475	1.395	1.065	1.030	1.438	-3,8%
2004	1.845	1.650	1.715	1.430	1.405	1.075	1.150	1.467	2,0%
2005	1.890	1.650	1.715	1.230	1.405	1.080	1.150	1.446	-1,5%
2006	2.030	1.670	1.665	1.160	1.365	1.220	1.160	1.467	1,5%
2007	2.145	1.690	1.655	1.160	1.365	1.275	1.190	1.497	2,0%
2008	2.630	1.430	1.540	1.060	1.280	1.590	1.090	1.517	1,3%
2009	2.790	1.450	1.540	1.060	1.280	1.590	1.090	1.543	1,7%
2010	2.785	1.450	1.535	1.050	1.275	1.590	1.095	1.540	-0,2%
2011	2.340	1.450	1.530	1.050	1.275	1.470	1.085	1.457	-5,4%

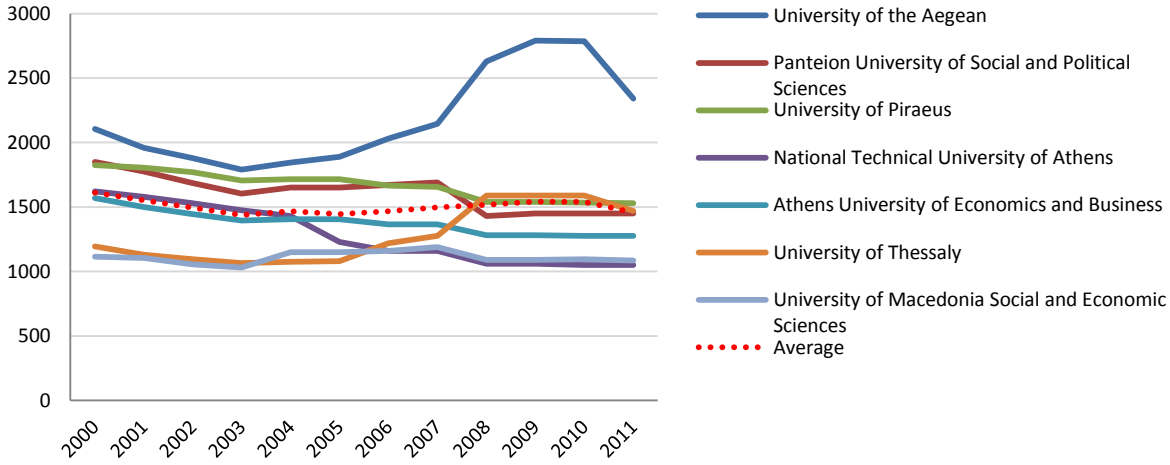
Small Greek Universities

Year	University of Western Macedonia	Agricultural University of Athens	Ionian University	Technical University of Crete	Harokopio University	Athens School of Fine Arts	University of Peloponesse	University of Central Greece	Average Annual Enrolment	Growth
2000	510	485	385	360	150	105	-	-	333	
2001	465	465	360	375	150	105	-	-	320	-3,8%
2002	440	440	345	390	140	100	120	-	282	-11,8%
2003	420	430	330	370	135	95	430	-	316	11,9%
2004	440	430	465	430	135	95	430	70	312	-1,2%
2005	525	430	465	375	135	90	520	130	334	7,0%
2006	640	420	490	385	135	120	660	130	373	11,6%
2007	675	420	520	400	175	120	835	130	409	9,9%
2008	840	410	650	500	160	120	1.040	160	485	18,5%
2009	840	410	650	520	160	120	1.040	160	488	0,5%
2010	830	410	650	520	160	120	1.090	160	493	1,0%
2011	700	420	580	515	170	120	960	150	452	-8,2%

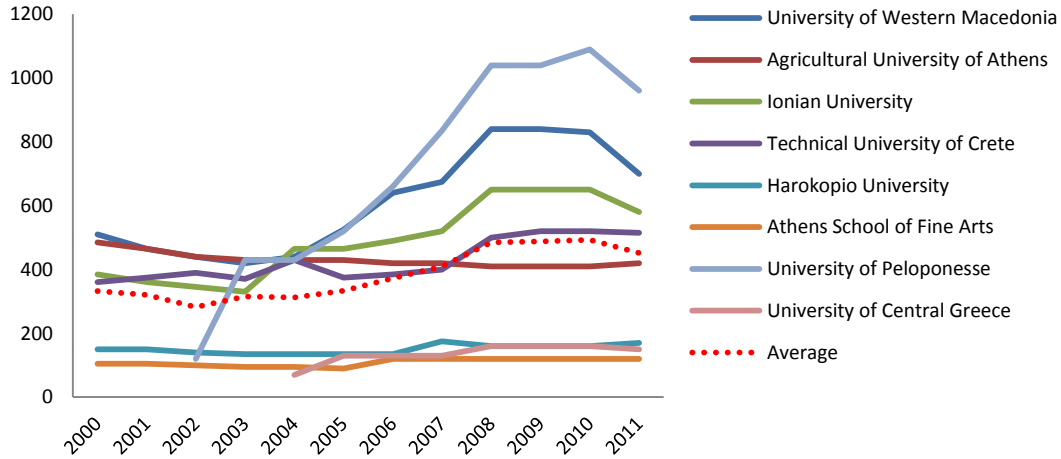
XL & **L** universities annual enrolment



M universities annual enrolment



S universities annual enrolment



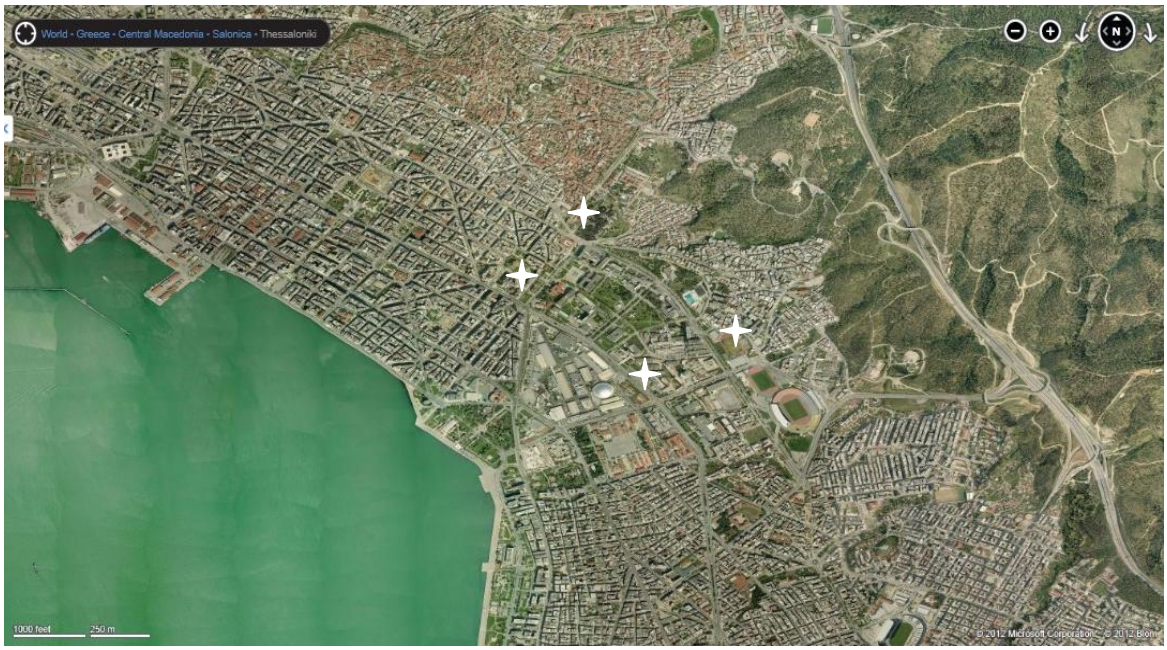
APPENDIX 2

2.1 Adding value on organizational level, connected to primary stakeholders. KPIs as management information to measure and related tools to measure (Den Heijer, 2011)

adding value by	primary stakeholder	what to measure (management information)	how to measure (tools)
(1) controlling risk	technical manager controller	• the percentage of the campus in (very) bad technical condition • the percentage of the campus that could easily be sold or disposed	• condition based monitoring • market analysis
(2) increasing real estate value	controller	• the value of the land property • the value of the campus buildings	• valuation tools
(3) reducing the footprint	technical manager	• the ecological footprint: energy use and CO2 emission • m2 per function type or user group (student, staff member)	• sustainability tools: Greencalc, DCBA method, www.duurzamecampus.nl • references on space use from databases
(4) reducing costs	controller	• costs/benefits of proposed project in comparison with alternatives • effect on other organisational costs (personnel) in comparison with alternative projects	• project database • campus database • references on investment level, maintenance costs
(5) increasing flexibility	users	• multi-functional character of space types • use by different user groups	• post-occupancy evaluations: space use
(6) increasing user satisfaction	users	• student satisfaction over the years • employee satisfaction, periodically	• post-occupancy evaluations: customer satisfaction
(7) supporting user activities	users	• occupancy and frequency rates • references on similar concepts at other universities: best practices and lessons learned elsewhere	• post-occupancy evaluations: changing demand • project database with new concepts
(8) improving quality of place	policy makers	• quality before and after • user requirements and willingness to pay for more quality • references on quality related to costs	• Maslow's pyramid with cumulative user needs, connected to investment levels • project database with references
(9) supporting image	policy makers	• image before and after • use of building as marketing tool by users • opportunity costs (related to other marketing tools)	• reputation monitor of user group (faculty or university) • project database: references on image and costs
(10) supporting culture	policy makers	• culture before and after • opportunity costs (related to other ways of supporting culture)	• post-occupancy evaluations: user satisfaction
(11) stimulating innovation	policy makers	• innovation before and after	• output assessment (before and output)
(12) stimulating collaboration	policy makers	• multidisciplinary output, before and after • effect on social encounters • effect on 'community building', sense of belonging	• output assessment (before and output) • post-occupancy evaluations: user questionnaire

APPENDIX 3

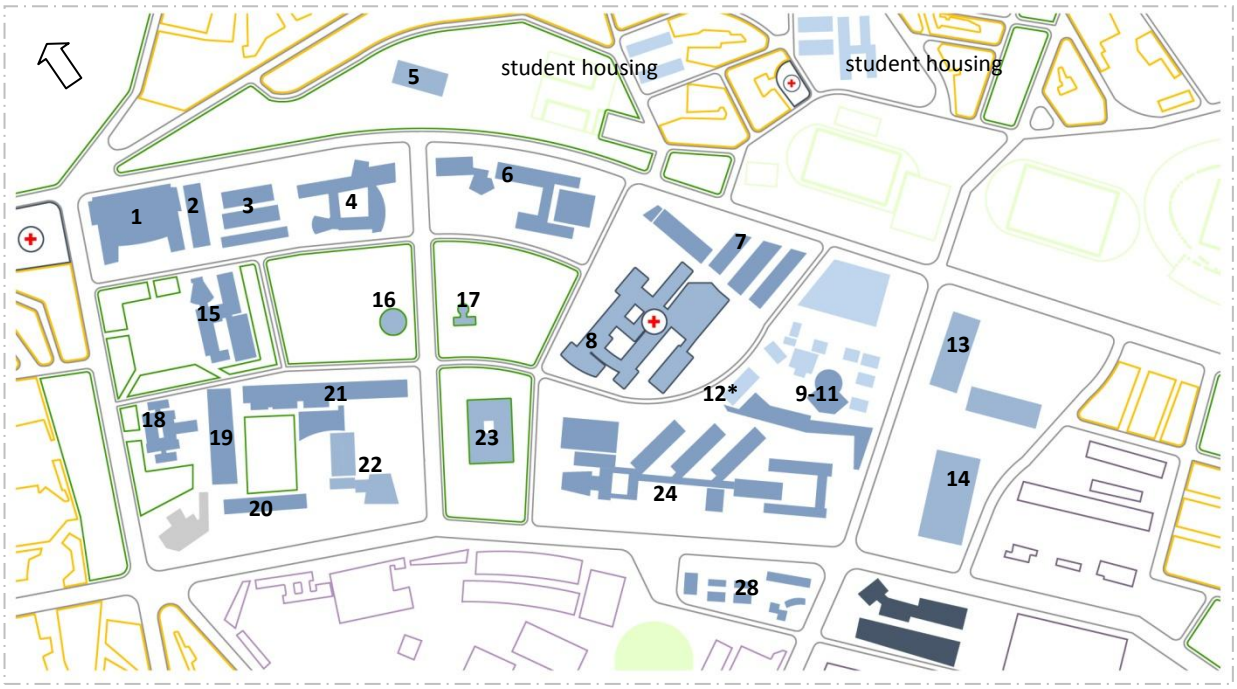
3.1 Thessaloniki Aerial Picture bird's eye view. Source: http://www.bing.com/maps/



3.2 Thessaloniki Aerial Picture on A.U.Th. Campus. Source: http://www.bing.com/maps/

3.3 A.U.Th. Campus | Map





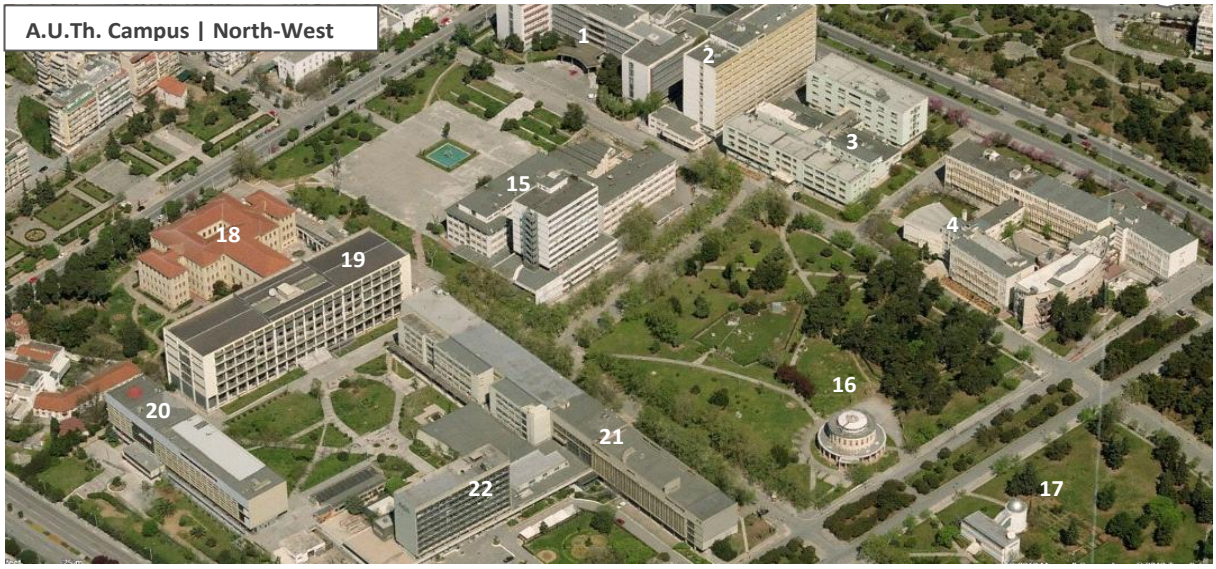
Legend

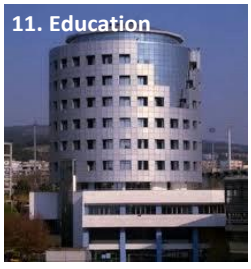
- AUTh faculties
- AUTh shared facilities
- AUTh unknown status
- residential
- public
- green
- University of Macedonia
- healthcare
- sports

A.U.Th. On-Campus Buildings			
Code-Faculty			
1	Applied Sciences	**2**	Biology
3	Agriculture & Forestry	**4**	Veterinary
5	*Telogleio* - Multi-purpose facilities	**6**	Medicine
7	Dentistry	**8**	AHEPA Hospital
9	Building complex of Education (a)	**10**	Building complex of Education (b)
11	Building complex of Education (c)	**13**	A.U.Th. Sports Centre
14	A.U.Th. Students' Club	**15**	Chemistry
16	Meteorology	**17**	*Asteroscopeio* - Observatory
18	Old School of Philosophy	**19**	(New) School of Philosophy
20	Theology	**21**	Law, Economics & Political Sciences
22	A.U.Th. Central Administration	**23**	A.U.Th. Central Library
24	Faculty of Engineering		

**The same faculty building codes are used for every part of the data analysis*
**Building 12, Hydraulics lab, belongs in the Polytechnics complex.*
**Building 28, Physical Training is considered off-campus in the A.U.Th. registered data (2005).*

3.4 A.U.Th. Campus | Views





3.5 A.U.Th. CRE portfolio by 2005 | Educational Facilities

A.U.Th. C.Real Estate Portfolio by 2005 | On-Campus

On Campus Faculties		Floor Area			Function								Users					KPIs		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	m2/Std.	m2/Stf.	Owned	Rent
Code	*Building of:*			%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
1	**Applied Sciences**	22.041	15.429	70%	36%	5.494	16%	2.424	33%	5.053	16%	2.458	7.949	697	4.121	217	49	1,6	19,0	100%	0%
2	Biology	13.897	9.728	70%	36%	3.464	16%	1.528	33%	3.186	16%	1.550	2.956	349	1.935	108	16	2,2	25,7	100%	0%
15	**Chemistry**	20.878	14.615	70%	36%	5.204	16%	2.296	33%	4.786	16%	2.328	1.746	155	1.078	104	11	6,1	41,6	100%	0%
3	Agriculture & Forestry	12.112	7.994	66%	22%	1.767	18%	1.454	34%	2.726	26%	2.046	3.731	675	2.834	171	34	0,9	13,3	100%	0%
4	Veterinary	19.540	12.896	66%	22%	2.851	18%	2.346	34%	4.398	26%	3.301	1.897	89	769	97	6	6,1	42,7	100%	0%
6	**Medicine**	22.045	16.313	74%	29%	4.677	16%	2.537	36%	5.812	20%	3.287	3.483	2.923	1.218	490	35	1,7	11,1	100%	0%
7	**Dentistry**	13.137	9.721	74%	29%	2.787	16%	1.512	36%	3.464	20%	1.959	1.212	145	1.096	97	8	3,5	33,0	100%	0%
9.11	Building Complex of Education	9.700	5.238	54%	40%	2.104	3%	182	37%	1.942	19%	1.010	2.956	143	2.388	55	14	0,9	28,1	100%	0%
18	**Old School of Philosophy**	7.385	5.243	71%	27%	1.412	23%	1.193	37%	1.917	14%	722	3.865	598	2.805	93	18	0,8	17,3	100%	0%
19	**New Philosophy**	21.097	14.979	71%	27%	4.032	23%	3.408	37%	5.476	14%	2.063	8.916	814	5.898	178	40	1,1	25,1	100%	0%
20	**Theology**	9.450	6.048	64%	24%	1.459	2%	123	40%	2.416	34%	2.050	6.227	1.269	3.515	63	15	0,3	31,0	100%	0%
21	**Law, Economics and Political Science**	22.626	15.386	68%	20%	3.145	5%	817	39%	5.931	36%	5.493	27.120	1.221	6.640	144	30	0,5	34,1	97%	3%
24	**Politechnics**	63.485	49.518	78%	28%	13.741	15%	7.576	36%	17.629	21%	10.572	10.333	986	7.997	327	59	2,4	45,7	100%	0%
																	On Average:	**2,2**	**28,3**		
	total:	**257.393**	**183.108**	**71%**	**28%**	**52.138**	**15%**	**27.395**	**35%**	**64.736**	**21%**	**38.838**	**82.391**	**10.063**	**42.294**	**2.144**	**335**	**1,5**	**26,1**	**100%**	**0%**

On Campus Administration		Floor Area			Function								Users					KPIs		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	Users	m2/U	Owned	Rent
Code	*Building of:*			%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
22	**Central Administration**	**12.044**	**8.568**	**71%**	**0%**	**0**	**0%**	**0**	**100%**	**8.568**	**0%**	**0**	**0**	**0**	**0**	**0**	**275**	**275**	**31,16**	**100%**	**0%**

On Campus Primary Process Shared Facilities		Floor Area			Function								Users					KPIs		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	Users	m2/U	Owned	Rent
Code	*Building of:*			%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
16	**Meteorology**	600	427	71%	0%	0	**100%**	**427**	0%	0	0%	0	0	697	4.121	217	0	5.035	0,1	100%	0%
17	**Asteroscopy**	708	504	71%	0%	0	**100%**	**504**	0%	0	0%	0	0	697	4.121	217	0	5.035	0,1	100%	0%
8	**AHEPA Hospital**	17.970	12.784	71%	**50%**	**6391,89**	**50%**	**6.392**	0%	0	0%	0	0	2.923	1.218	490	0	4.631	2,8	100%	0%
																	On Average:	**4.900**	**1,0**		
	total:	**19.278**	**13.714**	**71%**	**47%**	**6.392**	**53%**	**7.322**	**0%**	**0**	**0%**	**0**	**0**	**3.620**	**5.339**	**707**	**0**	**9.666**	**0,7**	**100%**	**0%**

On Campus Supportive Shared Facilities		Floor Area			Function								Users					KPIs		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	Users	m2/U	Owned	Rent
Code	*Building of:*			%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
5	**Tellogleio (multypurpose)**	5.642	4.014	71%	0%	0	0%	0	0%	0	**100%**	**4.014**	0	10.063	42.294	2.144	335	54.836	0,1	100%	0%
13	**Sports Centre**	5.565	3.959	71%	0%	0	0%	0	0%	0	**100%**	**3.959**	0	10.063	42.294	0	0	52.357	0,1	100%	0%
14	**Student Club**	10.374	7.380	71%	0%	0	0%	0	0%	0	**100%**	**7.380**	0	10.063	42.294	0	0	52.357	0,1	100%	0%
23	**Central Library**	28.920	20.574	71%	0%	0	0%	0	0%	0	**100%**	**20.574**	0	10.063	42.294	0	48	52.405	0,4	100%	0%
																	On Average:	**52.989**	**0,2**		
	total:	**50.501**	**35.926**	**71%**	**0%**	**0**	**0**	**0**	**0**	**0**	**0**	**35.926**	**0**	**10.063**	**42.294**	**2.144**	**383**	**54.884**	**0,7**	**100%**	**0%**

On Campus A.U.Th total R.E.		Floor Area			Function								Users					KPI		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	m2/Std.	m2/Stf.	Owned	Rent
				%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
13	Faculty Buildings	257.393	183.108	71%	28%	52.138	15%	27.395	35%	64.736	21%	38.838	82.391	10.063	42.294	2.144	335	**1,5**	**26,1**	100%	0%
3	Primary SF Buildings	19.278	13.714	71%	47%	6.392	53%	7.322	0%	0	0%	0	0	3.620	5.339	707	0	**0,7**		100%	0%
1	C Admin Building	12.044	8.568	71%	0%	0	0%	0	100%	8.568	0%	0	0	0	0	0	275		**31,2**	100%	0%
4	Secondary SF Buildings	50.501	35.926	71%	0%	0	0%	0	0%	0	0%	35.926	0	10.063	42.294	2.144	383	**0,7**		100%	0%
	total:	**339.216**	**241.317**	**71%**	**24%**	**58.530**	**14%**	**34.718**	**30%**	**73.304**	**31%**	**74.765**	**82.391**	**10.063**	**42.294**	**2.144**	**610**	**2,2**	**28,6**	**100%**	**0%**

A.U.Th. C.Real Estate Portfolio by 2005 | Off-Campus

Off campus Faculties / Departments		Floor Area			Function								Users					KPI		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	m2/Std.	m2/Stf.	Owned	Rent
	Building of:			%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
26	School of Education	4.836	2.611	54%	40%	1.049	3%	91	37%	968	19%	503	2.956	143	2.388	55	14	0,5	14,0	100%	0%
27	**School of Fine Arts**	20.690	13.655	66%	42%	5.726	18%	2.461	14%	1.897	26%	3.572	1.713	88	1.291	72	20	5,9	20,6	83%	17%
28	**School of Physical Training / Sports**	3.325	2.793	84%	28%	778	15%	418	49%	1.368	8%	230	3.478	139	2.129	84	7	0,5	15,0	74%	26%
29	**School of Jurnalism & Media**	1.584	1.077	68%	41%	440	3%	31	52%	565	4%	41	480	25	436	25	5	1,0	18,8	0%	100%
																	On Average:	**2,0**	**17,1**		
	total:	**30.435**	**20.137**	**66%**	**40%**	**7.992**	**15%**	**3.000**	**24%**	**4.798**	**22%**	**4.346**	**8.627**	**395**	**6.244**	**236**	**46**	**1,7**	**17,0**	**81%**	**20%**

Off campus Practice Faciliteis		Floor Area			Function								Users					KPIs		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	m2/Std.	m2/Stf.	Owned	Rent
	Building of:			%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
25	Faculty of Geotechnical Sciences	66.001	43.561	66%	22%	9.631	18%	7.924	34%	14.854	26%	11.152	5.628	764	3.603	242	40	4,0	52,7	100%	0%
30	School of Biology	1.900	1.330	70%	36%	474	16%	209	33%	436	16%	212	1.393	165	764	59	10	0,7	6,3	100%	0%
																	On Average:	**2,4**	**29,5**		
	total:	**67.901**	**44.891**	**66%**	**23%**	**10.105**	**18%**	**8.133**	**34%**	**15.290**	**25%**	**11.363**	**7.021**	**929**	**4.367**	**301**	**50**	**3,4**	**43,6**	**100%**	**0%**

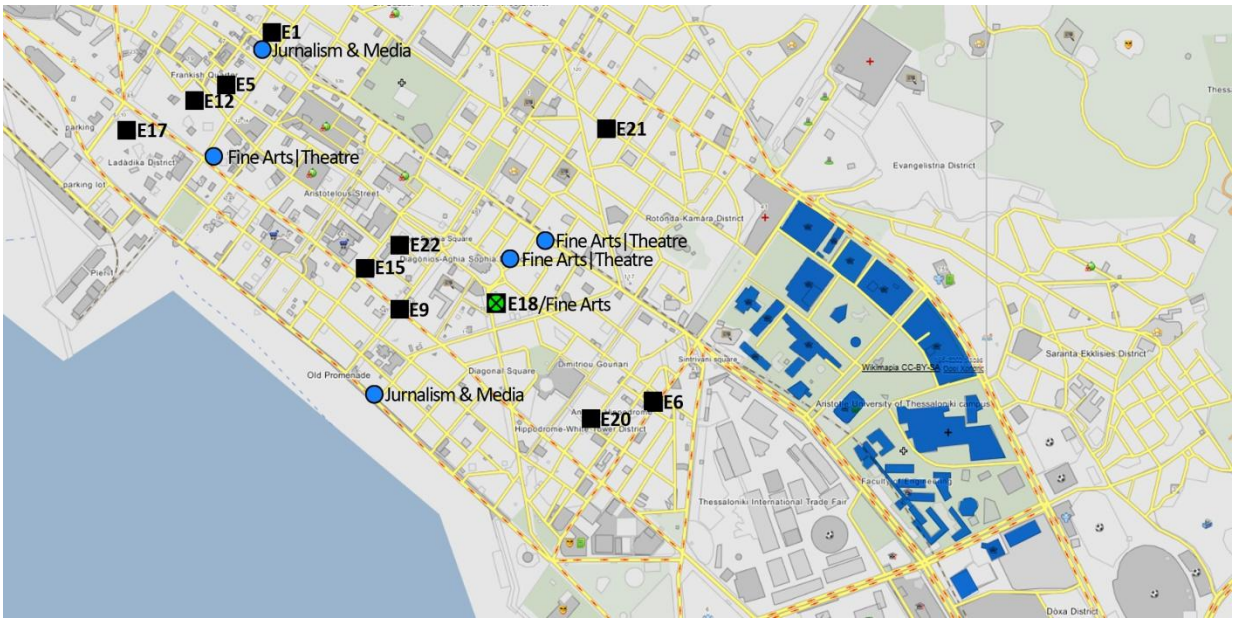
Off Campus A.U.Th total R.E.		Floor Area			Function								Users					KPIs		Ownership	
		GFA m2	UFA m2	UFA/GFA	Education		Research		Office		Other		UG Students	PG Students	Active UG	Teaching STaf	Adm. Staff	m2/Std.	m2/Stf.	Owned	Rent
				%	%	UFA	%	UFA	%	UFA	%	UFA								%	%
4	Faculty Buildings	30.435	20.137	66%	40%	7.992	15%	3.000	24%	4.798	22%	4.346	8.627	395	6.244	236	46	1,7	17,0	81%	20%
2	Buildings for Practice - Labs	67.901	44.891	66%	23%	10.105	18%	8.133	34%	15.290	25%	11.363	7.021	929	4.367	301	50	3,4	43,6	100%	0%
																	On Average:	**2,5**	**30,3**		
	total:	**98.336**	**65.028**	**66%**	**28%**	**18.097**	**17%**	**11.133**	**31%**	**20.088**	**24%**	**15.710**	**15.648**	**1.324**	**10.611**	**537**	**96**	**2,4**	**31,7**	**94%**	**6%**

3.6 A.U.Th. Investment Portfolio by 2012 | Endowments

A.U.Th.Investment Portfolio by 2012| Endowments

Code	City	Address	LFA m2	Vacancy	PGI	€/m2/year
1	Thessaloniki	Εγνατίας 43 - Συγγρού 14	1.381	22%	8.362 €	24 €
2	Thessaloniki	ΓΑΜΒΕΤΑ 4	382	20%	21.220 €	56 €
3	Thessaloniki	ΛΑΧΑΝΑ 24	310	34%	12.158 €	39 €
4	Thessaloniki	Κ. ΠΑΛΑΜΑ 6	571	60%	9.339 €	16 €
5	Thessaloniki	ΕΡΜΟΥ 5- ΚΑΠΟΔΙΣΤΡΙΟΥ 5	310	0%	4.853 €	63 €
6	Thessaloniki	ΕΘ. ΑΜΥΝΗΣ 34	421	53%	38.083 €	90 €
7	Thessaloniki	Λ.ΣΤΡΑΤΟΥ 31	153	100%	0 €	0 €
8	Thessaloniki	ΟΛΥΜ. ΔΙΑΜΑΝΤΗ 20	44	100%	0 €	0 €
9	Thessaloniki	ΑΓ. ΣΟΦΙΑΣ 4	49	100%	0 €	0 €
10	Thessaloniki	Β. ΟΛΓΑΣ 101 Α	120	0%	7.293 €	61 €
11	Thessaloniki	ΦΕΙΔΙΟΥ 8 ΠΑΝΟΡΑΜΑ	220	100%	0 €	0 €
12	Thessaloniki	ΚΑΤΟΥΝΗ 43	712	80%	2.835 €	4 €
13	Thessaloniki	Δ. ΓΟΥΖΕΛΗ 12	182	57%	3.917 €	21 €
14	Thessaloniki	ΒΕΛΙΣΑΡΙΟΥ 18	111	100%	0 €	0 €
15	Thessaloniki	Κ. ΝΤΗΛ 20	72	0%	181 €	10 €
16	Thessaloniki	Τ.ΠΑΠΑΓΕΩΡΓΙΟΥ 2	527	100%	0 €	0 €
17	Thessaloniki	ΛΥΚΟΥΡΓΟΥ 6	160	100%	0 €	0 €
18	Thessaloniki	Π. ΜΕΛΑ 40	1.169	32%	19.843 €	34 €
19	Thessaloniki	Μ. ΑΛΕΞΑΝΔΡΟΥ 29	800	0%	64.522 €	81 €
20	Thessaloniki	ΙΠΠΟΔΡΟΜΙΟΥ 3	72	0%	3.925 €	55 €
21	Thessaloniki	ΟΛΥΜΠΟΥ 119	63	0%	4.080 €	65 €
22	Thessaloniki	ΑΓ. ΘΕΟΔΩΡΑΣ 4	67	0%	13.560 €	202 €
23	Athens	ΚΕΑΣ ΚΑΙ ΝΑΞΟΥ 61	98	0%	4.260 €	44 €
24	Athens	ΜΙΧΑΛΑΚΟΠΟΥΛΟΥ 99	186	0%	3.609 €	39 €
25	Athens	ΖΑΛΛΟΓΓΟΥ 8	779	95%	2.232 €	3 €
26	Athens	ΙΦΙΚΡΑΤΟΥΣ 15	67	0%	10.049 €	151 €
27	Athens	ΑΣΩΠΙΟΥ 3	70	0%	4.656 €	66 €
28	Kavala	ΦΙΛΕΛΛΗΛΩΝ 11	336	46%	16.380 €	49 €

3.7 A.U.Th. Investment Portfolio by 2012 | Endowments in Thessaloniki CBD



3.8 Comparing two profiles of A.U.Th. | Current Supply (2005) and Current Demand (2011)

A.U.Th. profile 2005

Strategic Goals

Financial Figures

	CREM		REM
	min €		min €
Total Income	**221**		x
Total Expenditure	**214**		x
	min €	€/m2 GFA	
Values	x	x	x
Insurance Value	x	x	x
Book Value Campus	x	x	x
	min €	€/m2 GFA	*% of Expenditure*
Cost of Ownership	**12,3**	**28,11**	**5,75%**
Energy & Water	x	x	

Users and Functions

Students -AS	**56.465** (active UG and PG)		
Staff	total	Teach.	Admin.
FTE	**2.967**	**2.325**	**642**
			m2 UFA
Educational space / student			**1,36**
E & R space / student			**2,17**
Office space / FTE			**31,48**
lab space / academic staff member			**0,78**

Physical Figures

	CREM	REM
GFA m2	**437.552**	x
UFA m2	**306.345**	x
UFA/GFA	**70,01%**	x
Rented m2	**1,34%**	x
Let out m2	x	x
Land Property	x	x
% Office space	**30,49%**	
% Educational Space	**25,01%**	
% Specific Space	**29,53%**	
% Lab space	**14,97%**	

A.U.Th. profile 2011

Strategic Goals

Financial Figures

	CREM		REM
	min €		min €
Total Income	**155**	YGI	**0,25**
Total Expenditure	**155**		x
	min €	€/m2 GFA	
Values	x	x	x
Insurance Value	x	x	x
Book Value Campus	x	x	x
	min €	€/m2 GFA	*% of Expenditure*
Cost of Ownership	**8,68**	**19,84**	**5,60%**
Energy & Water	x	x	

Users and Functions

Students -AS	**55.451** (active UG and PG)		
Staff	total	Teach.	Admin.
FTE	**3.070**	**2.406**	**664**
			m2 UFA
Educational space / student			**1,38**
E & R space / student			**2,21**
Office space / FTE			**30,42**
lab space / academic staff member			**0,79**

Physical Figures

	CREM	REM
GFA m2	**437.552**	x
UFA m2	**306.345**	**9.432**
UFA/GFA	**70,01%**	x
Rented m2	**1,34%**	x
Let out m2	x	**54,87%**
Land Property	x	x
% Office space	**30,49%**	
% Educational Space	**25,01%**	
% Specific Space	**29,53%**	
% Lab space	**14,97%**	

3.9 Comparative Analysis | Benchmarking A.U.Th. against 14 Dutch Universities

Comparative Analysis: A.U.Th. and 14 Dutch Universities

Netherlands | Higher Education KPIs

University	Location	Users - Functional Perspective: Students	Education m2/Student	Staff	Office m2/staff	m2 - Physical Perspective: GFA	UFA	UFA/GFA	€ - Financial Perspective (min €): Revenues	Expenses	Balance	Expenses/ Revenues	Cost of Ownership	Energy & water	CoO/Expenses	Cost for Personell	€/m2 GFA
EUR	Rotterdam	16.680	1,4	2.330	22,5	171.000	103.000	60%	461	439	22	95%	18	2	4%	51%	105
LEI	Leiden	15.330	2,1	4.010	19,3	395.000	210.000	53%	405	416	-11	103%	44	7,4	11%	48%	111
OU	Heerlen	24.000	0	710	20	22.000	14.000	64%	62	59	3	95%	5	0,3	8%	61%	227
RU	Nijmegen	15.280	1,5	3.590	15	290.000	174.000	60%	473	466	7	99%	34	5,1	7%	57%	117
RUG	Groningen	23.480	1,8	3.870	24,2	390.000	241.000	62%	515	486	29	94%	20	9	4%	56%	51
TUD	Delft	13.680	4,1	5.330	22,6	499.000	317.000	64%	488	473	15	97%	66	9	14%	54%	132
TUE	Eindhoven	7.190	5,1	2.840	31,6	337.000	226.000	67%	265	258	7	97%	28	6,5	11%	60%	83
UM	Maastricht	11.370	2,3	3.210	15	183.000	99.000	54%	312	300	12	96%	20	2,8	7%	52%	109
UT	Twente	7.760	2,3	2.630	19,8	212.000	132.000	62%	268	251	17	94%	27	5,8	11%	62%	127
UU	Utrecht	29.300	1,9	6.320	22,1	683.000	388.000	57%	695	708	-13	102%	77	12,2	11%	47%	113
UvA	Amsterdam	23.490	1,6	4.490	23,2	406.000	252.000	62%	568	545	23	96%		8,4	0%	50%	0
UvT	Tilburg	11.200	1,4	1.680	23	121.000	72.000	60%	150	142	8	95%	12	1,7	8%	73%	99
VU	Amsterdam	18.590	1,7	3.850	19,2	320.000	173.000	54%	421	408	13	97%	28	9,2	7%	49%	88
WU	Wageningen	5.240	5	5.890	14,9	410.000	260.000	63%	224	218	6	97%	29	6	13%	60%	71
Dutch Universities		**Users - Functional Perspective**				**m2 - Physical Perspective**			**€ - Financial Perspective**								
	Average:	**15.899**	**2,3**	**3.625**	**20,9**	**317.071**	**190.071**	**60%**	**379**	**369**	**10**	**97%**	**31**	**6**	**8%**	**56%**	**102**
	Max:	29.300	5,1	6.320	31,6	683.000	388.000	67%	695	708	29	103%	77	12	14%	73%	227
	Min:	5.240	0	710	14,9	22.000	14.000	53%	62	59	-13	94%	5	0	4%	47%	51

Greece | Higher Education KPIs

University	Location	Users - Functional Perspective: Students	Education m2/Student	Staff	Office m2/staff	m2 - Physical Perspective: GFA	UFA	UFA/GFA	€ - Financial Perspective (min €): Revenues	Expenses	Balance	Expenses/ Revenues	Cost of Ownership	Energy & water	CoO/Expenses	Cost for Personell	€/m2 GFA
A.U.Th.	**Thessaloniki**																
Year: 2004		63.507	1,8	3.445	28,2	437.552	306.345	70%	221	214		97%	12		6%	54%	27
Year: 2011		62.367	1,8	3.565	27,3	437.552	306.345	70%	155	155		100%	9		6%	82%	20

3.10 Comparative Analysis | A.U.Th. CRE portfolio evaluation

A.U.Th. Faculties weighted

Type	Campus	Code	Faculty building	Functional Type: A – UFA m2 per student (Standard d m2 1,8): m2	Match	deviation	UFA m2 per FTE staff (Standard d m2 22,7): m2	Match	deviation	Functional Type: B – UFA m2 per student (Standard d m2 4,5): m2	Match	deviation	UFA m2 per FTE staff (Standard d m2 18,8): m2	Match	deviation	Financial – Ownership: Own	Rent	Market rent: Office rent level 200 €/m2 UFA	A.U.Th. Cost: Cost per m2 GFA 20 €/m2 GFA	Match
A & B	ON	1	Applied Sciences	1,6	-6%	6%	19,0	-16%	16%	1,6	-63%	63%	19,0	1%	1%	100%	0%	0	20	0%
B	ON	2	Biology							2,2	-51%	51%	25,7	37%	37%	100%	0%	0	20	0%
B	ON	15	Chemistry							6,1	35%	35%	41,6	122%	122%	100%	0%	0	20	0%
B	ON	3	Agriculture & Forestry							0,9	-80%	80%	13,3	-29%	29%	100%	0%	0	20	0%
B	ON	4	Veterinary							6,1	35%	35%	42,7	128%	128%	100%	0%	0	20	0%
A & B	ON	6	Medicine	1,7	0%	0%	11,1	-51%	51%	1,7	-61%	61%	11,1	-41%	41%	100%	0%	0	20	0%
A & B	ON	7	Dentistry	3,5	98%	98%	33,0	46%	46%	3,5	-23%	23%	33,0	76%	76%	100%	0%	0	20	0%
A	ON	9	Building Complex of Education	0,9	-48%	48%	28,1	24%	24%							100%	0%	0	20	0%
A	ON	18	Old School of Philosophy	0,8	-56%	56%	17,3	-24%	24%							100%	0%	0	20	0%
A	ON	19	New Philosophy	1,1	-37%	37%	25,1	11%	11%							100%	0%	0	20	0%
A	ON	20	Theology	0,3	-81%	81%	31,0	37%	37%							100%	0%	0	20	0%
A	ON	21	Law, Economics and Political ..	0,5	-71%	71%	34,1	50%	50%							97%	3%	5	26	28%
B	ON	24	Polytechnics							2,4	-47%	47%	45,7	144%	144%	100%	0%	0	20	0%
A	OFF	26	School of Education	0,5	-74%	74%	14,0	-38%	38%							100%	0%	0	20	0%
B	OFF	27	School of Fine Arts							5,9	32%	32%	20,6	10%	10%	83%	17%	34	54	168%
A	OFF	28	School of Physical Training / Sports	0,5	-70%	70%	15,0	-34%	34%							74%	26%	53	73	265%
A	OFF	29	School of Jurnalism & Media	1,0	-42%	42%	18,8	-17%	17%							0%	100%	200	220	1000%

A.U.Th. Faculties sorted

Type	Campus	code	Faculty building	Weights & Scores: 30% Education	30% Office	40% Cost
A	OFF	29	School of Jurnalism & Media	42%	17%	1000%
A	OFF	28	School of Physical Training / Sports	70%	34%	265%
B	OFF	27	School of Fine Arts	32%	10%	168%
B	ON	24	Polytechnics	47%	144%	0%
B	ON	4	Veterinary	35%	128%	0%
A	ON	21	Law, Economics and Political ..	71%	50%	28%
B	ON	15	Chemistry	35%	122%	0%
A & B	ON	7	Dentistry	60%	61%	0%
A	ON	20	Theology	81%	37%	0%
A	OFF	26	School of Education	74%	38%	0%
B	ON	3	Agriculture & Forestry	80%	29%	0%
B	ON	2	Biology	51%	37%	0%
A	ON	18	Old School of Philosophy	56%	24%	0%
A & B	ON	6	Medicine	31%	46%	0%
A	ON	9	Building Complex of Education	48%	24%	0%
A	ON	19	New Philosophy	37%	11%	0%
A & B	ON	1	Applied Sciences	35%	9%	0%

Faculty score per aspect

UFA m2/student: code	Education	UFA m2/FTE staff: code	Office	Cost: €/m2: code	Cost
20	81%	24	144%	29	1000%
3	80%	4	128%	28	265%
26	74%	15	122%	27	168%
21	71%	7	61%	21	28%
28	70%	21	50%	24	0%
7	60%	6	46%	4	0%
18	56%	26	38%	15	0%
2	51%	2	37%	7	0%
9	48%	20	37%	6	0%
24	47%	28	34%	26	0%
29	42%	3	29%	2	0%
19	37%	9	24%	20	0%
15	35%	18	24%	3	0%
1	35%	29	17%	9	0%
4	35%	19	11%	18	0%
27	32%	27	10%	19	0%
6	31%	1	9%	1	0%

3.11 Universities' historic Development and their Location in the City Landscape

UNIVERSITIES' TYPOLOGIES

There is a strong connection between a university and the city in which it is located, with Both sides being engaged in an interactive relationship. In this part of the research it is necessary to identify the ways a university can be located in a city and examine potential functional models, and how these two aspects can be combined. It is also interesting to examine the historic development of universities and their physical settings in order to understand what shaped their current form and what may influence it in the future.

In the dissertation of van der Zanden (2009) universities are categorized according to their purpose and organizational structure in three generations (Figure 74). The physical development of universities follows this timeline and provides various models that responded to the demands each period posed to them. Considering the three generations of universities a brief overview of their physical development will follow.

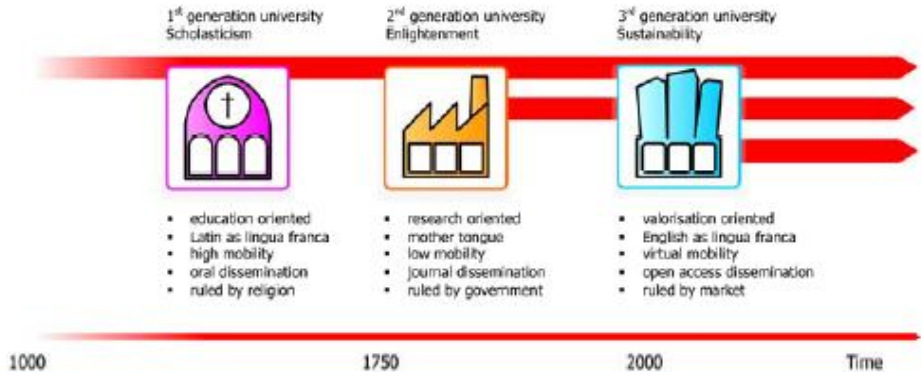


Image 74. University generations with basic characteristics. Van der Zander, (2009)

First Generation Universities

Universities initially emerged in Paris and Bologna at the end of the 11th century, evolving from the cathedral schools. As the number of students increased and more fields of study were added, it became necessary to build buildings to accommodate university activities in one location. The creation of permanent structures marked the establishment of the university as an independent institution (Cobban 1992). The first important prototype for university design was the single college edifice, which later became the most common type of university building in England. The first college of this type was probably Merton College at Oxford, founded in 1264 (figure 75). Its distinct architectural structure—a square unit surrounding an internal court—reflected its social and educational character. This closed configuration reflects the severe character, the strict discipline, and the rigid daily routine of the college. Over time, as the number of students increased, additional colleges were founded, thus forming clusters (figure 76) (Hashimshony and Haina, 2006).

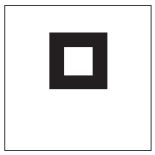


Image 75. Single building, Oxford(1264). Hashimshony and Haina (2006).

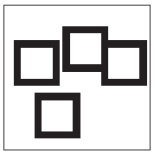


Image 76. Oxford Colleges Cluster Hashimshony and Haina (2006).

Second Generation Universities

During the middle ages and until the late 18th and early 19th century universities remained unchanged. Universities became institutions of modern learning and research when religion gradually lost its dominant position in Europe. In Europe the typical example of this new type of university was the (1809), as a complex of graduate schools performing research and experimentation. however, this new role of the university did not offer a new physical type, a new design (Hashimshony and Haina, 2006). On the other hand, on the other side of the Atlantic the first American institutions of higher education were founded- Harvard University (1636), College of William and Mary(1693), Yale University(1701) (Hashimshony and Haina, 2006).

The modern American university, arguably the most influential academic model today, derives from three basic ideas: the English collegiate model, the German research university of the 19th century, and the American concept of service to society (Altbach 1998 in Hashimshony and Haina, 2006). The American universities represent the concept of an "academical village"—a term coined by Thomas Jefferson, the designer of the University of Virginia in Charlottesville in 1817 (figure 78), to describe universities as communities in themselves, where shared learning infused daily life, similar to the English colleges (Turner, 1990 in Hashimshony and Haina, 2006). But unlike the cloistered character of the European colleges, a more open and dispersed spatial model evolved in America (Hashimshony and Haina, 2006).

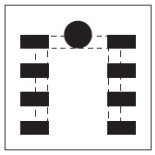


Image 78. Campus, University of Virginia (1817) by T.Jefferson Hashimshony and Haina (2006).

In this sense, the Latin word Campus was first used to describe the distinctive physical character of the American universities. The romantic idea of isolation from the city and civilization came to its pure expression in the American college, located in nature and "removed from the corrupting forces of the city" (Turner 1990 in Hashimshony and Haina, 2006). In addition to the learning facilities, the American campus contains many other functions for students' comfort, including residence halls and sports facilities. This typology was later adopted by many designers for campuses throughout the world.

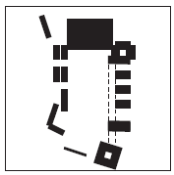


Image 77. The Hebrew University (1954) by Kaufmann, Klarwein and Rau Hashimshony and Haina (2006).

Twentieth Century Universities

At the beginning of the 20th century, universities blossomed throughout the world. Their organizational structures changed as additional fields of knowledge gave rise to the division of universities into different faculties and departments. However, in contrast to earlier periods when higher education remained largely a private enterprise in most countries, universities no longer conducted research for their own sake, but tried to develop applied research for the benefit of society, strengthening the ties between the university and the state. The result was stronger collaboration with external factors, such as industries, and greater openness to the outside world(Hashimshony and Haina, 2006).

The term "multiversity," first used by Kerr (1995) (Hashimshony and Haina, 2006), expresses the fact that university activities became increasingly complex from both the organizational and the spatial point of view. The physical dimensions of the campus became so large that the distances prohibited good communication among its different parts. The approach of duplicating architectural spaces no longer worked. The university required new and radically different designs to support the increasing complexity of its organization. These new universities were designed as a single large concentrated building, called a "megastructure."

The term “megastructure” usually means a vast structure, containing some of a city’s functions, including dwellings, leisure, and commerce(Hashimshony and Haina, 2006). “A large frame in which all the functions of a city or part of a city are housed. It has been made possible by present day technology” (Hashimshony and Haina, 2006). However, the concept of the megastructure never fulfilled the designers’ expectations in terms of scale compared with the existing urban setting and in terms of functional flexibility ,since it did not allow easy expansion or interchange of activities within the structure. This model was abandoned in the late 1960s.

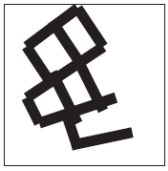


Image 80. Megastructure, University of Essex (1963) by K. Capon
Hashimshony and Haina (2006).

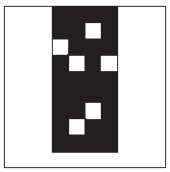


Image 79. Megastructure, the Free University of Berlin (1964) by Candilis, Josic, Woods, and Schiedhelm
Hashimshony and Haina (2006).

Third Generation Universities

The third generation university refers to the contemporary and future universities. It is increasingly valorisation oriented, focusing on knowledge transfer, exploring alternative funding options, stimulating international exchange and student mobility using English as lingua franca. moreover, ICT developments influencing universities introducing the notions of virtual as well as network, as future challenges. Following the historical development of universities, it becomes clear that a current campus -as the university property- can reflect the history of each university.

The current university real estate portfolios comprised of buildings that reflect the university's development through time, being for example single historical buildings or university campuses. Dependent on each university's establishment date and related with the aforementioned timeline three basic types of universities and their positioning in a city, can be identified;

1. Following the first generation of universities, it is possible to have buildings in and around the city centre. The buildings housing the university would be expected to be of historical value, if they used to accommodate it since that period. The first type will refer to a university integrated in the city, as "Univer-city" (den Heijer, 2011).

2. With respect to the second generation universities, and the modern American paradigm, universities can be located in a campus. Initially university campuses were intentionally developed outside cities as already mentioned, however urban growth sometimes exceeded the initial urban boundaries. Still, the second type will be describing a campus outside of the city, as a "Village" (den Heijer, 2011).

3. Finally, a university campus can be found concentrated within the city, being a 'gated' campus, or a "Park" (den Heijer, 2011).

APPENDIX 4

4.1 The process from Brief to Construction and the Implementation of BIM

EXPRESSING THE FUTURE DEMAND: BRIEF

In order to proceed with the requirements statement, the information of the first table concerning Function need to be filled in.

Function	Needs
People Activities Relationships	Area Requirements -By organization -By space type -By time Parking Requirements Outdoor space requirements

Users

People refer to users. The users number can be defined by population's trend analyses related with the current number of users.

Functions

By organization

Activities refer to the accommodated Functions. User groups predispose the functions of the building. It becomes clear that it is first necessary to define the functions that will be accommodated so that thereafter area requirements can be defined.

Based on the goals of the A.U.Th. CREM, deriving from one of the three strategies for universities as elaborated on chapter 3.3, it is possible to define what kind of concepts will apply in the building brief. In this way spatial requirements per each function can be more accurately prescribed.
The strategic choices that will define the spatial concepts are related with the questions:

1. What will be shared with other parties and what will be exclusively used by the university?
2. What part of the floor area could or would be possible to be replaced with virtual workspace?

The first question directs the brief development in issues regarding the intensification of space usage and it is related with the frequency and occupancy rated per function. Therefore by analysing these two variables by comparing the current supply and the required future supply of each activity's space, it will be possible to define the residual space. The residual space can further on be assessed for its future suitability; what kind of function can be supported by this space and how this space can optimally add value to the university. Therefore a demand driven approach by the side of the university is required in order to explore and assess the potential future functional mix and the related costs and benefits, that should match the university's goal of cost-efficiency.

The second question is related with the organization's decision regarding the exchange of physical space with virtual. It is related with the implementation of new ICT developments which will negatively affect the demand for physical space. Again, the result of relevant concepts like the New Ways of Working in the case of office space or more virtual teaching and learning concepts result in a residual space for the university. The required space, affected by the implementation of the new concepts should be of increased quality compared to the current space. The residual space can again be assessed for its future suitability, like in the previous case. Being related more with the strategy of a Virtual university, focusing on the quality of space (as a

meeting place), it would be possible for the university to follow a supply driven approach for the residual space. In this way, it would be easier for the university to control the future functional mix according to its organizational goals.

After these considerations it will be possible to state the required functions that will be accommodated in the building and their related functional requirements. The spatial requirements per function can be determined by relevant space norms or by benchmarking similar developments as already elaborated in the comparative analysis of chapter 3.2. Moreover, it is also necessary to calculate the effects of concepts that would further impact on the spatial requirements of each function.

By space type
In the case of A.U.Th. the current functional supply concerns only academic related space types. It is therefore necessary for the decision makers to decide on the future functional mix.

By time
Conducting room audits is an integral part of measuring Space Utilisation Rates. Room auditing involves counting the number of students using the various teaching facilities within a university: this is generally undertaken over all the operating hours for the campus for one week each semester (AAPPA, 2002).

The data collected via room auditing is collated as Room Frequency and Room Occupancy. Room Audit data gives an indication of the actual use of an institution's facilities, and should be used in conjunction with room booking and class enrolment data. This data is useful when attempting to grasp the use of facilities within an institution(AAPPA, 2002).
Accurate information about the rooms within an institution is an integral part of successful room auditing. Information regarding room use, room types, room ownership, and room capacities is required to enable thorough examination of audit data(AAPPA, 2002).Typically, audit data is analysed using the following performance indicators:

- **Room Frequency (RF)** as the number of hours the room is in use, during the audit period, divided by the number of hours that the room is available for use, during the audited period.

  RF = Hours Used / Hours Available

- **Room Occupancy (Occ)** which represents the average number of students in the room, when the room is in use, compared to the total room capacity. Room Occupancy is independent of Room Frequency.

  Occ = Total Students / (Room capacity X Hours Used)

- **Utilisation (U%)** combines Room Occupancy and Room Frequency data to give an indication of how the room is being used. Utilisation, as an abstract measure, is only useful as an indicator of rooms requiring further investigation of usage patterns, and comparative assessments.

  U% = RF X Occ

As Room Occupancy is dependent on the accuracy of Capacity, and Capacity is generally an approximate measure (particularly in spaces other than classrooms and lecture theatres), Room Occupancy data can be misleading. Room Occupancy levels above 100% can occur (AAPPA, 2002).

A Room Occupancy level in excess of 100% may be due to either overcrowding or reflect how the facility is being used, e.g. a laboratory space may be used as a convenient seminar space between laboratory classes. The number of students may exceed the room's listed capacity as a laboratory (AAPPA, 2002).

Another concern with Room Occupancy data is the difference between students enrolled in a course, and the number of students attending the classes. Rooms must be booked to allow for every enrolled student to attend the class, even if this rarely occurs. In these cases low occupancy may not be an issue with the facilities provided (AAPPA, 2002).

Concluding it should be mentioned that a room may be poorly utilised due to its physical attributes: its condition, an oversupply of similar facilities, insufficient capacity, too much capacity, wrong location, changing teaching methods causing obsolescence. Aside from the physical nature of the space, other reasons for poor utilisation include:

***Flexibility*:** Students are being offered a wider range of options within courses, and across disciplines. As students enrol in a greater number of subject combinations the difficulty of timetabling increases, and may lead to decreased utilisation.

***Part-Time/Sessional Staff*:** Part-Time and Sessional Staff are not available to deliver programs at all times across the institution's operating hours. This reduces timetabling freedom and may lead to lower utilisation rates for teaching spaces.

***Room Ownership*:** Granting control of rooms to groups within an institution reduces the accessibility of other groups to those rooms, and thus reduces the flexibility of timetabling.

***Timetabling*:** Unavailability of a particular resource, such as specialised teaching staff or the student group themselves, may make optimal use of a physical facility impossible.

***Teaching patterns*:** Particular teaching patterns that vary by institution may have an impact on overall utilisation. For example, practical placements in programs such as teaching and nursing may result in periods of low utilisation.

***Departmental vs. Institutional Cost*:** If salary costs are paid from departmental funds, the department may timetable in order to minimise these costs. This may involve hiring part-time or seasonal teaching staff. A timetable minimising cost to the department may not be the most cost effective timetable for the institution, as the cost of operating and maintaining the teaching facilities are often not included when determining a timetable.

***Specialist Space*:** Some highly specialised facilities may not achieve high utilisation rates, but may be required in the successful delivery of an academic program. In these instances utilisation should be looked at in reference to the service provided by the space. This is particularly pertinent for spaces that may be in use when the room itself is vacant (e.g. an unattended research project)

Area requirements

UFA

By knowing the users of the building and the spatial requirements for each function, it is possible to determine the total required UFA of the building.

Building Efficiency

The building efficiency is expressed by the UFA/GFA ratio. Differences in predominating room sizes, occupancy levels, circulation requirements, and special mechanical requirements lead to different overall building efficiency factors for various building types. For example, the predominance of small rooms requiring higher percentages in circulation and partitions.

Overall Building Efficiency: The ratio of the net assignable areas to the building gross area expressed as a percentage of the gross area. In the programming phase, this factor is used to calculate the total building gross area requirements using the net area requirements as a base. To do this, divide the sum of the net assignable areas by the appropriate overall efficiency. This factor is commonly used for public and educational building design applications therefore it is also possible to consult relevant examples of similar buildings and define a required overall building efficiency factor beforehand, that the design should meet.

Unassigned Areas

The unassigned areas of a building are:

Circulation Areas: These include interior corridors, exterior covered walks (half of full area), and phantom corridors, which are undefined circulation paths through assigned areas, such as a pathway through a programmed lobby space.

Primary Circulation: Lobbies, corridors, and vertical circulation between elevators public toilets, building entrances and exits required to satisfy the building code.

Secondary Circulation: Corridors providing access from net assignable areas to the primary circulation.

Mechanical Areas: Areas for the building heating, ventilation, air conditioning, electrical, plumbing, and communications distribution. These areas vary considerably based on the building type.

Walls, Partitions, Structure: Building area for structure walls, columns, and dividing partitions. Generally, this amounts to 7 percent to 9 percent of the gross building area.

Public Toilets: Public restrooms required by the building code range from 1.5 percent to 2 percent of the gross building area.

Janitor Closets: Space for general cleaning supplies, normally requires less than 0.5 percent.

Building Storage: General building storage, normally requires less than 0.5 percent.

By applying national or international norms about building regulations (for example safety, and fire) concerning the unassigned areas requirements per user, it is possible to determine the required type of unassigned areas.

GFA

Knowing the required UFA and the building efficiency ratio, it is possible to define the total GFA. Moreover, GFA can also be defined by the sum of the required space for the unassigned areas.

Building Efficiency = UFA/GFA

GFA = UFA + Unassigned Areas

Parking Requirements and Outdoor Space Requirements

With the case focusing on locations already developed in the city of Thessaloniki, parking and outdoor space requirements will be considered as amenities provided by the municipality, therefore not influenced by the university. Still an assessment of the supplied parking space and outdoor space quality should be made, in order to facilitate an evidence based assessment of the future options.

Cost Estimate Analysis

The cost estimate analysis for a new building must be as comprehensive and realistic as possible, with no doubt as to what constitutes the total budget required. Once the total net assignable area of a project is determined, it is an easy task to arrive at a reasonable efficiency factor and then calculate the total gross building area (Peña and Parshall, 2001). This area, multiplied by a realistic unit cost, will produce the estimated building cost (Line A), upon which depend estimates of many cost items.

Having developed a general idea of the spatial requirements for the building, it is possible to proceed with a cost estimate analysis, where the initial budget of the project can be determined. The budget can be broken down in the following components:

Cost Estimate Analysis Example		
A. Building Costs	200,000 GSF @ $90.00/GSF	$18,000,0
B. Fixed Equipment	(8% of A)	1,440,0
C. Site Development	(15% of A)	2,700,0
D. Total Construction	(A + B + C)	$22,140,0
E. Site Acquisition/Demolition		500,0
F. Moveable Equipment	(8% of A)	1,440,0
G. Professional Fees	(6% of D)	1,328,4
H. Contingencies	(10% of D)	2,214,0
J. Administrative Costs	(1% of D)	442,8
K. Total Budget Required	(D + E through J)	$28,065,2

In this example (Peña and Parshall, 2001) the GFA (GSF) is known, 200.000 square feet and the construction cost assumed is 90,00 $ per square feet. The construction cost per square meter can be obtained by benchmarking similar projects and calculating the local market ratios. Doing so it is possible to have a gross estimation of the total cost of the project and test this cost with the available financial resources of the organization.

In the case of A.U.Th. the resulting budget estimate can serve as a point of reference with a pre-determined budget, imposed by its available resources. In this case the total size of the project has to be adjusted according to the budgets' comparison outcome and the expected quality should be the same as the current quality.

On the other hand, the estimated budget can be set as an acceptable budget and assess the resulting LCC of the project with the current accommodation's LCC afterwards. In this case the LCC of the two options will be assessed in terms of financial performance of the applied design concepts, aiming at different quality levels.

Components of the Building Cost

Being possible to have a first estimation about the budget of the project, the components of the building cost should be analyzed in order to define the building's performance requirements. When the Uniform Classification is used (Peña and Parshall, 2001), the components of building cost (Line A) include: foundations, sub- and superstructure, exterior enclosure, roofing, interior construction, mechanical systems, electrical systems, conveying systems, and general conditions.

A 1. Foundations: Wall and column foundations and pile caps, plus special conditions.

A 2. Substructure: Slab on grade, basement excavation, structure walls.

A 3. Superstructure: Floor, roof, stair construction.

A 4. Exterior enclosure: Exterior walls, louvers, screens, balcony walls, handrails, soffits, doors, windows.

A 5. Roofing: roof coverings, traffic toppings, paving membrane, roof insulation and fill, flashing, roof openings.

A 6. Core Finish, Interior Fit-Up: Partitions, interior finishes and specialties, such as lockers, toilet accessories, counters, kitchen cabinets, closets.

A 7. Mechanical: Plumbing, HVAC, fire protection, special systems.

A 8. Electrical: Service distribution, lighting and power, special electrical systems.

A 9. Conveying systems: Elevators, moving stairs and walks, dumbwaiters, general construction items.

By breaking down the building cost components it is possible to prescribe the relevant performance requirements, that will meet the organizational goals, in this case increased cost efficiency.

Building Systems Performance Criteria: The performance criteria used for the evaluation and selection of building systems. They define the functionality sought from building systems to meet quality level expectations (Peña and Parshall, 2001).

*Building Systems***:** Components of a building organized by a specific discipline, such as architectural, structural, mechanical, electrical, and plumbing (Peña and Parshall, 2001).

For the purpose of the brief, building systems performances criteria for the whole building or for each space type have to be defined. The unit cost allocated should achieve the building system performance criteria(Peña and Parshall, 2001). For example, comfort control increases with smaller Heating Ventilating Air Conditioning (HVAC) zone areas. As a result, more mechanical equipment may be necessary to achieve this performance and the unit cost is greater(Peña and Parshall, 2001).

Quality

Having set the building systems performance requirements, the quality of the project can be estimated. The building cost (Line A of the Cost Estimate Analysis) depends on (1) the total net area (the sum of all space needs),(2) a reasonable efficiency ratio of net to gross area, and (3) the cost per square meter escalated to mid-construction (Peña and Parshall, 2001).. Of these, it is the cost per square foot, the unit cost, that usually expresses the quality of the building.

The cost per square meter represents the quality of materials, systems, and construction— the quality of the architectural fabric. In addition, both the total net area and the building efficiency also represent aspects of quality— functional and spatial qualities, respectively(Peña and Parshall, 2001).The construction quality level is represented by a unit cost figure, such as cost per gross square meter. The unit costs typically include architectural, structural, electrical, plumbing, and mechanical work, but do not include site development and fixed equipment.

The average unit costs are typically identified with different types of construction or building types related to building code fire ratings, but these average unit costs represent only the average quality level of construction in each type. The average quality represents good standard construction with adequate mechanical and electrical services and an average level of finishes(Peña and Parshall, 2001). These average unit costs can be used to advantage; however, in the briefing process, there is a great need to know a wider range of unit costs than those representing national averages. The level of quality depends on the level of construction, mechanical and electrical services, and interior and exterior finishes.

Dealing with existing buildings

In the case of the School of Journalism & Media the project concerns only existing buildings, the one where the department is currently accommodated and two potential locations which are owned by the university. The project can be characterized as building renovation, as it does not involve the construction of a new building.

Renovation projects have become rather popular with many organizations that face changing missions, in the case of A.U.Th. imposed by the reduced State funding and yet often have existing buildings that have become obsolete or do not fit up to date functional requirements.

In such a case, building premises are many times vacant, like in the case of the two endowments. The vacancy rate of E1 is 20% and the vacancy rate of E 12 is 80%.

Based on the building's vacancy, it can be natural to assume that these buildings can be renovated more easily and cheaply that providing a new construction. But renovation work can be very complex and expensive. It can range from a simple open plan office renovation with minimal impact, to hard construction and utilities, to the renovation of an old building for new occupancy that fails to comply with a variety of codes, and may have hazardous materials to abate(Peña and Parshall, 2001).

The age of a building is directly proportional to the cost of renovation. Issues that make an old building

expensive are prior occupancy; floor -to-floor height; mechanical, electrical, and plumbing systems; energy efficiency; structural capacities; seismic codes; and life safety and disabilities access guidelines.

This can be a problem for A.U.Th. as the building stock in the CBD of Thessaloniki is old, with a small part of it built in the early 20th century and the majority built between the 1950's and 1970's. Next to that, these buildings were designed to accommodate residential or office functions, so there might be a mismatch with the abovementioned issues related with prior occupancy, comparing them with the specific requirements for academic functions. If the previous use cannot easily adapted to the new occupancy, a lower layout efficiency should be expected. The result of a lower efficiency will contribute to a higher project cost.

Major renovations almost always require compliance with all current codes. If the floor -to-floor height is less than desirable, the mechanical, electrical, and plumbing design will incur cost penalties (Peña and Parshall, 2001).Often, the original structural drawings are unavailable, forcing one to do expensive tests to determine structural conformance to new codes. In this case, the next phase of the project, design, will tackle this issue, towards the development of BIM building models. Moreover, exterior wall glazing may fail to comply to energy codes. In some cases, the only systems that can be salvaged are structure and solid exterior walls. A renovation of this nature will rival new construction in cost.

It becomes clear that after the development of the brief it is necessary to inspect and register the existing buildings in order to assess their condition and consequently estimate the required renovation actions and related costs. Moreover, it is beneficial to benchmark and compare major renovation to new construction, even if it is desirable to salvage the building for historical purposes. The programmer should base a reliable renovation cost estimate on a building condition assessment that defines the degree of improvement required (Peña and Parshall, 2001).

Employing BIM

Consulting RIBA Plan of Work (RIBA, 2012) it is observed that BIM can also be employed in the preparation stages, Appraisal and Design Brief. It becomes clear that at this stage it is also necessary for the organization to decide on the implementation of BIM, by analysing and understanding the improvements this action can bring to its current processes. Looking at the preparation stages the following table briefly presents the key task of each stage and the core BIM Activities.

Preparation		
RIBA work Stage	**Key tasks**	**Core BIM activities**
A. Appraisal	Identification of client's needs and objectives, business case, sustainability, life cycle and Facilities Management aspirations and possible constraints on development. Preparation of feasibility studies and assessment of options to enable the client to decide whether to proceed.	• Advise client on purpose of BIM including benefits and implications. • Agree level and extent of BIM including 4D (time),5D (cost) and 6D (FM) following software assessment. • Advise client on Integrated Team scope of service in totality and for each designer including requirements for specialists and appointment of a BIM Model Manager. • Define long-term responsibilities, including ownership of model. • Define BIM Inputs and Outputs and scope of post-occupancy evaluation. • Identify scope of and commission BIM surveys and investigation reports.
B. Design Brief	Development of initial statement of requirements into the Design Brief by or on behalf of the client, confirming key requirement sand constraints. Identification of procurement method, project sustainability and BIM procedures, building design lifetime and project organizational structure and range of consultants and others to be engaged for the project, including definition of responsibilities.	

Within the preparation phase, it is important for the organization to know about their operational needs. In the case of refurbishment, a starting point would be the modelling of the existing building to explore the performance of the services that are affected by the design of the facility (Codinhoto et. al, 2012). This is

related to the case of School of Journalism & Media where in fact, the existing buildings should be registered in BIM building models.

In relation to refurbishment projects Point Cloud tools connect laser scans directly into the BIM model. In this respect, an existing building can be tri-dimensionally scanned and the point cloud generated exported to the modelling tool (Codinhoto et. al, 2012).

Simulations like, staff walking time throughout the facility, distances walked from where the service started to where it ended, flow of people inside the facility are examples of analysis that could support better design.

The design brief can be assisted by the use of automated schedule of accommodation sheets that are linked to the model and vice-versa. Within this phase, changes are likely to happen frequently and problems to keep all data sheets up to date may occur in large projects (Codinhoto et. al, 2012).

In this respect, parametric design (also known as parametric associativity; relational modelling, variational design and constraint based design) signifies that the artefact geometry is associated to parameters that generate/constrain its form (Monedero, 2011 in Codinhoto et. al, 2012).

When components of a building are designed parametrically, they are assigned parameters which have limits or boundaries. When these boundaries change (elements within a repeated component in the model, for example), the parameters assigned to adjacent elements allows them to be automatically adjusted and changed. For example, if a classroom design incorporates the furniture layout and the classroom size changes, the parametric design would automatically adjust the seating layout based on the parameters assigned to the seats(RIBA, 2012). In this respect, building regulations can be used as parameters that constrain design facilitating the approval process.

PLANNING THE FUTURE SUPPLY: DESIGN

Based on RIBA Plan of Work (RIBA, 2012), the design of the project is broken down in three work stages; concept design, design development and technical design.

The Concept sub-stage (Stage C) refers to the implementation of Design Brief and preparation of additional data. In addition, it includes the preparation of Concept Design including outline proposals for structural and building services systems, outline specifications and preliminary cost plan. A review of the procurement route is also conducted at this stage (Codinhoto et. al, 2012).

The Design Development (Stage D) refers to the development of concept design to include structural and building services systems, updated outline specifications and cost plan, the completion of Project Brief and finally Application for detailed planning permission (Codinhoto et. al, 2012).

The Technical Design (Stage E) refers to the preparation of technical design(s) and specifications, sufficient to co-ordinate components and elements of the project and information for statutory standards and construction safety (Codinhoto et. al, 2012).

Therefore the building information of each stage should be sought and developed into a BIM model that will be gradually enriched with that information, thus increase its detail level, as the stages progress.

Looking at the design stages the following table briefly presents the key task of each stage and the core BIM Activities.

Design		
RIBA work Stage	**Key tasks**	**Core BIM activities**
C. Concept Design	Implementation of Design Brief and preparation of additional data. Agreement of Project Quality	• BIM pre-start meeting. • Initial model sharing with Design Team for strategic analysis and

	Plan including BIM and Change Control protocols. Preparation of Concept Design including outline proposals for structural and environmental strategies and services systems, site landscape and ecology, outline specifications, preliminary cost and energy plans. Review of procurement route.	options appraisal. • BIM data used for environmental performance and area analysis. • Identify key model elements (e.g. prefabricated component) and create concept level parametric objects for all major elements. • Enable design team access to BIM data. • Agree extent of performance specified work.
D. Design Development	Development of concept design using project BIM data to include structural and environmental strategies and services systems, site landscape and ecology, updated outline specifications and cost and energy plans. Completion of Project Brief. Application for detailed planning permission.	• Data sharing and integration for design co-ordination and detailed analysis including data links between models. • Integration/development of generic/bespoke design components. • BIM data used for environmental performance and area analysis. • Data sharing for design co-ordination, technical analysis and addition of specification data. • Export data for Planning Application. • 4D and/or 5D assessment.
E. Technical Design	Preparation of technical design(s) and specifications, sufficient to co-ordinate components and elements of the project, BIM data and information for statutory standards, sustainability assessment and construction safety.	

Within this phase many BIM deliverables can be used. The used of 3D, 4D and 5D Visualisation is an example of that. One fundamental benefit of BIM relates to its capacity to create visualisations, even photorealistic images, at very early stages of the project. Traditional 2D drawings are highly abstract representations of buildings and spaces. The abstractions are difficult to understand for non-professionals and may lead to misinterpretations and errors in decision-making and construction. Visualisations are easy to understand and reduce misinterpretations and errors. Other deliverables within this phase are described in the following.

Design Compatibility / Interference Check / Clash detection

Since all the components of a building are designed tri-dimensionally, it is possible to identify to components that are occupying the same place on space when the different models are brought together for example, the architectural model, M&E models, structural models (Codinhoto et. al, 2012).

Many BIM software packages are compatible with clash detection software. This software can be utilised to discuss clashes that exist in the building, particularly between structure and engineering elements. Such software should be used as part of a QA (Quality Assured) process in relation to co-ordination and not only as part of the design process per se (RIBA, 2012).

Quantity take-off / Estimating

For each tri-dimensional component that is created a data-base containing the physical characteristics of the component and its performance is created simultaneously. That enables faster and more accurate quantity take-off materials at different stages of design (Codinhoto et. al, 2012).

Information stored in one place

In BIM tools, each building component is stored as on object in the model, and all drawings are generated from the model. This means that after changes documents are automatically updated as opposed to having to update the changes in all plans, sections and elevations in 2D traditional approach. The same applies to quantitative tables and schedules (Codinhoto et. al, 2012).

Scheduling / Programming

For each tri-dimensional component that is created a data-base containing the predicted day of its assembly on site, the lead time for delivery, the supplier is created simultaneously allowing for, for instance, the creation of a assembly simulation and an early warning system. That means that a more accurate programme can be elaborated (Codinhoto et. al, 2012).

Energy Analysis:

The energy analysis feature allows for simulating energy consumption at short, medium and long term. Life cycle energy analysis is key in supporting design decisions at early stages. The different types of analysis that can be carried out include (Codinhoto et. al, 2012).:

- Calculation of the total energy use and carbon emissions of the building model
- Calculation of the thermal performance, for example the heating and cooling loads for the building models including the effects of scenario occupancy, internal gains, infiltration, and equipment.
- Calculation of water usage estimate inside and outside the building model.
- Visualisation of incident solar radiation on windows and surfaces.
- Calculation of day-light factors and luminance levels.
- Visualisation of shadows and reflections.
- Natural ventilation potential estimate and calculation of the mechanical cooling required to cool the building naturally;
- Noise levels estimation: levels of noise can be calculated inside the building;
- Wind analysis: the incidence of wind in external walls used to design better cladding and finishing systems.
- LEED / BREEAM or other Sustainability analysis.
- Storm water analysis
- Shadow analysis.

From Design to Pre-Construction

It is important that after completion of the design stages, there would be information in a sufficient detail level to enable performance specified work to commence and enable a tender or tenders to be obtained. Pre-Construction can be broken down in three work stages; production Information, tender documentation and tender action.

Production Information (Stage F) has 2 parts. “F1” refers to the preparation of production information in sufficient detail to enable a tender or tenders to be obtained and the application for statutory approvals. “F2” refers to the preparation of further information for construction required under the building contract (Codinhoto et. al, 2012).

Tender Documentation (Stage G) refers to preparation and/or collation of tender documentation in sufficient detail to enable a tender or tenders to be obtained for the project (Codinhoto et. al, 2012).

Tender Action (Stage H) refers to the identification and evaluation of potential contractors and/or specialists for the project. Additionally, it considers obtaining and appraising tenders; submission of recommendations to the client (Codinhoto et. al, 2012).

Looking at the pre-construction stages the following table briefly presents the key task of each stage and the core BIM Activities.

Pre-Construction		
RIBA work Stage	**Key tasks**	**Core BIM activities**
F. Production Information	F1 .Preparation of production information	• Export data for Building Control Analysis.

	Development of BIM data in sufficient detail to conclude co-ordination of design team inputs, to enable performance specified work to commence and enable a tender or tenders to be obtained. Application for statutory approvals. F2 . Development of BIM data to integrate performance specified design work into model. Review of BIM information provided bycontractors and specialists, including	• Data sharing for conclusion of design co-ordination and detailed analysis with subcontractors. • Detailed modelling, integration and analysis. • Create production level parametric objects for all major elements. • Embed specification to model. • Final review and sign off of model. • • Enable access to BIM model to contractor(s). • Integration of subcontractor performance specified work model information into BIM model data. • Review construction sequencing (4D) with contractor.
G. Tender Documentation	Preparation and/or collation of tender documentation in sufficient detail to enable a tender or tenders to be obtained for the project.	
H. Tender Action	Identification and evaluation of potential contractors and/or specialists for the project. Obtaining and appraising tenders; submission of recommendations to the client.	

PROVIDING THE FUTURE SUPPLY: CONSTRUCTION

After the client's decision on the tender and the contractors' selection the next stage is the construction, or the renovation of a selected building. Based on the contract form, the responsibility gradually changes shift, from the owner-A.U.Th. to the contractor's. Still it is necessary to review this stage, in order to identify how BIM can add value to the construction stage, and the way building information stream continues. Based on RIBA Plan of Work (RIBA, 2012), the construction of the project is broken down in two work stages; mobilization and construction to practical completion

Mobilisation (Stage J) is related to letting the building contract, appointing the contractor; to issuing information to the contractor and arranging site hand over to the contractor (Codinhoto et. al, 2012).

Construction to Practical Completion (Stage K) relates to the administration of the building contract to Practical Completion, to the provision to the contractor of further Information as and when reasonably required and to the review of information provided by contractors and specialists (Codinhoto et. al, 2012).

Looking at the construction stages the following table briefly presents the key task of each stage and the core BIM Activities.

Construction		
RIBA work Stage	**Key tasks**	**Core BIM activities**
J. Mobilization	Letting the building contract, appointing the contractor. Issuing of information to the contractor already solved with BIM. Arranging site handover to the contractor.	• Agree timing and scope of 'Soft Landings'. • Co-ordinate and release of 'End of Construction' BIM record model data. • Use of 4D/5D BIM data for contract administration purposes.
K. Construction to Practical Completion	Administration of the building contract to Practical Completion. Provision to the contractor of further Information as and when reasonably required, already solved with BIM. Clarification and resolution of design queries as they arise. Review of information provided by contractors and specialists already solved with BIM.	

	Assist with preparation for commissioning, training, handover, future monitoring and maintenance.	

For this phase, many deliverables related to BIM implementation can be achieved according to different types of projects. In this stage BIM can be employed for:

- Assessment of constructability / build-ability.
- Demolitions activities.
- Site planning, layout and logistics.
- Construction system design.
- Steel off-site fabrication.
- Timber off-site fabrication.
- Glass off-site fabrication.

Finally after the construction, it is interesting to look for the future usability of the developed BIM building model. How this information can be used in the use and management phase of the project's life-cycle. In a way, the information of this stage would ultimately be the answers that should be generalized again to portfolio level, and provide input for evidence based decision making.

USE AND MANAGEMENT

Based on RIBA Plan of Work (RIBA, 2012), the phase of the project can also be broken down in two stages; post practical completion and model maintenance and development. Post Practical Completion (Stage L) has two parts. "L1" refers to the administration of the building contract after Practical Completion and making final inspections; "L2" relates to assisting building user during initial occupation period. finally Model Maintenance and Development (Stage M) refers to the review of project performance in use (Codinhoto et. al, 2012). Looking at the pre-construction stages the following table briefly presents the key task of each stage and the core BIM Activities.

Use and Management		
RIBA work Stage	**Key tasks**	**Core BIM activities**
L. Post Practical Completion	L1 Administration of the building contract after Practical Completion and making final inspections. L2 Assisting building user during initial occupation period.	• FM BIM model data issued as asset changes are made. • Study of parametric object information contained within BIM model data.
M. Model Maintenance & Development	Review of project performance in use and comparison with BIM data. Analysis of BIM data for use on future projects, following feedback and research.	

APPENDIX 5: END PRODUCT