Managing the University Campus

Towards a maturity model for campus management

Graduation thesis

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PREFACE

This thesis presents a research concerning the topic of managing the university campus. This thesis is developed during one academic year started on September 2014, within the master track of the department of Real Estate & Housing in the Architecture, Urbanism & Building Sciences programme at Delft University of Technology. This topic of this research arose from the gap in knowledge about how to actually measure the maturity level of campus management, especially in a different context (international). The aim is to explore the factors which influence the performance of university assets, and how to measure their maturity level of campus management by developing a maturity model. This tool will support decision making in campus management, and support institutions in creating added value with their assets.

I would like to thank my mentors Alexandra den Heijer and Yawei Chen, who supported me during my research and providing guidance during the process. They gave valuable feedback to improve the quality of my product. Furthermore I would like to thank Nico Nieboer, my external examiner, for providing valuable feedback during the presentations. I also would like to thank Theo van der Voordt, for the useful lectures about Qualitative and Quantitative research, but especially for the comments at the start of my thesis during the development of the research proposal.

Last, but not least I want to thank all my fellow students, friends & family, who supported me during the process, but also being the ones who made time to discuss the subject and giving me their opinions from a different perspective.

23rd of June 2015

MANAGEMENT SUMMARY

Problem statement

A better information system is needed in order to support decision making. Knowing the current state of the maturity of campus management will help an institution to develop itself to a higher level, in order to maximize performance. There are indeed ranking systems which measure the quality of the universities, based on certain variables such as the quality of learning and teaching, the international outlook, the research output and influence and the industry income (Times Higher Education, 2014a). However, a tool to measure the campus management does not exist yet. Knowing the current state of campus management and the performance of a university is the beginning of knowing their strengths and weaknesses, and from there, to become better.

Besides that, maturity is also difficult to measure in different contexts, such as Asia (Musa, 2012), Africa (Njungbwen & Udo, 2011) where information is difficult to find and where the term Corporate Real Estate Management is unknown. This supports the reason to develop such a tool to map down the situation in a different context.

***Problem statement**:*
No clear assessment method for measuring the level of maturity in campus management of a university, which can support their decision-making. Not only on portfolio level, but also on urban scale.

Campus management is unknown in a different context, which makes it difficult to measure the maturity level of campus management.

Research questions

The main research question is formulated based on the problem statement. The proposed research aims to answer the following question:

How can the maturity level of campus management of a university be determined in order to create added value in terms of performance [1], and support decision-making?

The sub-questions are formulated based on the questions needed to be answered to support the answer of the main question. The sub-questions related to the theoretical and empirical part are:

1) How can the maturity level of campus management of a university be determined?
   - Development of the maturity model, based on existing literature.
   - What levels in the model can be determined?
   - How can a quick scan model (for a research method with limited resources available) be developed?
   - How can a full scan model (for a research method with large amount of resources available) be developed?
   - How can the maturity model to be operationalised?
2) How does the maturity level express in the performance level (evidence) of the campus?
   - What variables affect the level of performance related to the discipline of Corporate Real Estate Management?
   - What variables affect the level of performance related to the discipline of Urban Area Development?
     - Urban factors which influences the performance of a university

3) What is the applicability of the developed model?
Testing the model: *a case in Hong Kong (The Chinese University in Hong Kong)*
a case in the Netherlands (TU Delft)

- Measuring the level of maturity and the physical outcome
- Limitations, advantages, disadvantages, differences and similarities between the quick scan and full scan model
- Which model is better applicable?

Goal:
Developing a tool to assess the maturity of campus management: This tool assesses the current level of campus management, and the actual outcome on physical level (evidence). This tool can support decision making to improve campus management.

Test the applicability of the maturity model by looking at an organization in the Netherlands, and on a case in Hong Kong.

Maturity model

In order to answer these questions literature will be used to determine how to design a maturity model. Moreover, literature will be used to determine the criteria for the maturity levels and the performance indicators. This developed maturity model will be tested on applicability and limitations. This tool will help institutions to understand their current level of campus management, and supports decision-making to reach a certain goal. Furthermore, the tool will be developed for two kind of cases:

- There will be a quick scan model for a less time consuming research method. This includes the objective analysis of documents and data provided by the university, but no field work is necessary. This model is created due to the fact the possibility exists that research resources are scarce, or limitations of the distance. Despite these problems, the goal of the quick scan model is to create a clear image about a certain case.
- The full scan model is intended for more time-consuming research methods to collect the data. This is for example in-depth interviews with people within an institution or the necessity to observe the campus. Usually this is for researchers who have more research resources available, or cases which are easy to visit.

Maturity levels

The maturity levels that can be described are divided in five levels:
1: Initial (No evidence, don't know):

- No significant evidence of strategic management on campus level
- This level supports continuous operation in the institution, without focus on future changes.
- There is also none or little focus on the attractiveness of the campus and does not act as an integrated 'campus city'.

2: Repeatable (They have plans):

- This levels indicates that there is awareness of the current state of their institution.
- They already facilitated the basic needs and have plans to improve their buildings and campuses in order to minimize costs on physical level and enhancing their competitiveness.
- This level has mostly their evidence on the management level, in which 'they have plans' but no physical evidence to prove it (yet).

3: Defined (On their way):

- The plans they had in level 2 is now implemented. This level will show more physical evidence in ensuring their institutional goals.

- This is the starting phase of the implementation of their strategic management, so there is no evidence yet if there is actual improvement of the performance in order to support their goals.
- There is physical evidence in executing the plans, which will show in a more integrated campus, with a higher focus on quality and attractiveness on the facilities/education/campus.

4: Managed (Close to good/ acceptable):

- Full implementation of the strategic plans
- Proactive in new plans to support institutional goals
- Good facilities, integration of building and campus area, a sustainable building and reduced building costs
- Evidence of new plans on how to improve this state

5: Optimizing (Fully done/ future prospect):

- The strategic plans are fully complied and tested.
- Performance is maximized in current state.
- On management level the institution has awareness for future changes and trends and anticipation for this.
- On physical level there is evidence of implementation of these plans in premature state (testing phase). Objectives to merge city development with campus development.

Operationalisation model

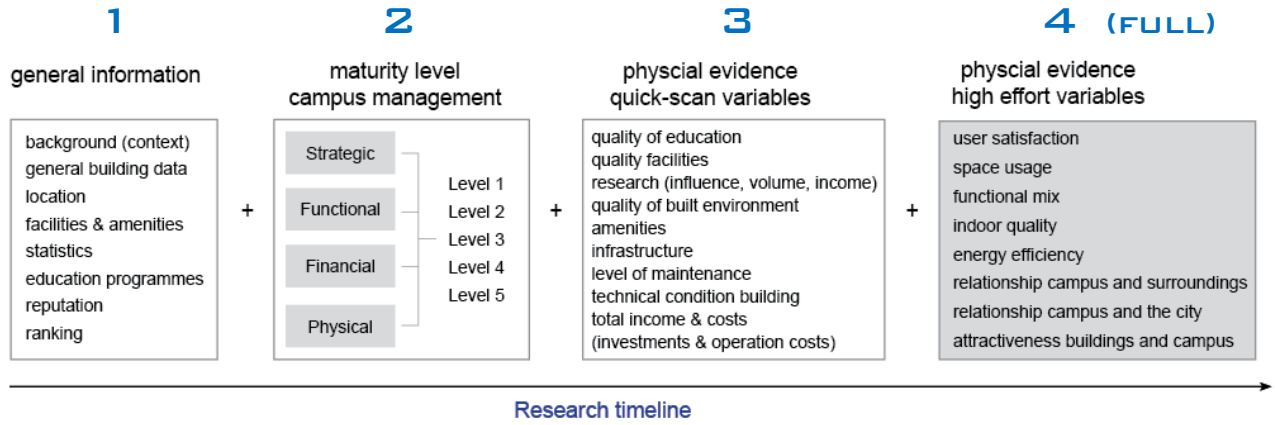
The different steps to be conducted in the application of the maturity model are:

Step 1: Collecting basic data such as background data, building information, statistics, education programmes, reputation, ranking and urban location of the selected case.

Step 2: Determining the maturity level, based on the assessment criteria awareness, goal focus, innovation level, tools & systems, skills and expertise and communication.

Step 3: Collecting the data concerning the quick scan variables. The methods that can be used are data analysis of reports, plans and visions, online-resources and drawings/maps.

Step 4: Collecting the data concerning the full scan variables. The methods that are involved in the full scan are all the methods described in step 3, complemented with fieldwork (observation and conducting interviews).



Differences

Based on the case study of TU Delft, where both of the models are being tested, some differences of the models can be described:

- Difference in assessing the maturity level. It is dependent on the character of the person who is interviewed to rate the maturity level or the performance level. If a person is honest, they will give an honest answer, if people tend to feel obligated to be positive about the situation, they will give a more positive answer. There will always be a difference on the outcome of the quick scan and full

scan model, since the opinion of experts are subjective, as well as the research who conduct the quick scan.
- When the results of the performance level are positioned next to each other, there are some differences in outcome. The ratings of the experts concerning the current physical state of the campus tends to be a half point higher on a 5-point scale than the assessment made by the myself.

Similarities
- When testing the model, the result of the quick scan and full scan were in accordance, with only a small difference concerning the maturity level of campus management.
- Other similarities were the things the expert mentioned in interviews, were also the data that could be found in the documents and reports. The most similar answers were the answers related to the plans and goals of the university, as well as the planned projects. Since the criteria is clearly defined to measure the maturity and the performance level, it is not strange that the answer from the experts and the data found in the documents are mainly the same. However, this means that one or another is expendable as source of data collection.

Preferred model

The final issue to be answered is based on the case studies, to determine which of both the models is better applicable. Based on the case studies on the TU Delft and the CUHK, to choose which model is better, is fully dependant on the chosen case. For cases in a different context, with a limitation of research resources, the quick scan is definitely better applicable. The quick scan provides a good overall view about the case. Since the data derived from the quick scan and full scan does not differ too much (conclusion of testing the model on the case of TU Delft), this method is better applicable for most cases. The quick scan is also better applicable when a multiple case study is necessary. It will save a large amount of time and effort. Based on the case study of TU Delft, in which both the quick scan and full scan is being tested, the conclusion is that the quick scan provides data that is in accordance to the full scan method. The full scan method even provides data that tend to be biased. The quick scan method is therefore for all cases, where data is easily accessible through the internet, the better tool to be used by researchers when conducting a case study.

The full scan model is better only in circumstances where the data is difficult to access through online resources. Interviewing experts from the inside will provide the answers to the questions. However, there will be a possibility of biased view in the findings. Plus more time and effort is needed when using this full scan method. The full scan method is also recommended when the case is ‘close to home’, and in a single case study analysis.

Further research

In order to enhance the framework’s validity, it should be discussed with maturity model users and developers from both industry and academia. The Delphi technique could be used, for instance, in order to provide valuable insights into whether the framework is complete and which variables and assessment criteria are generally considered mandatory or optional. The variable list should be complemented with more variables, and possibly split into different types of cases. The model that is designed is a guideline and the starting point of the further development of the model.

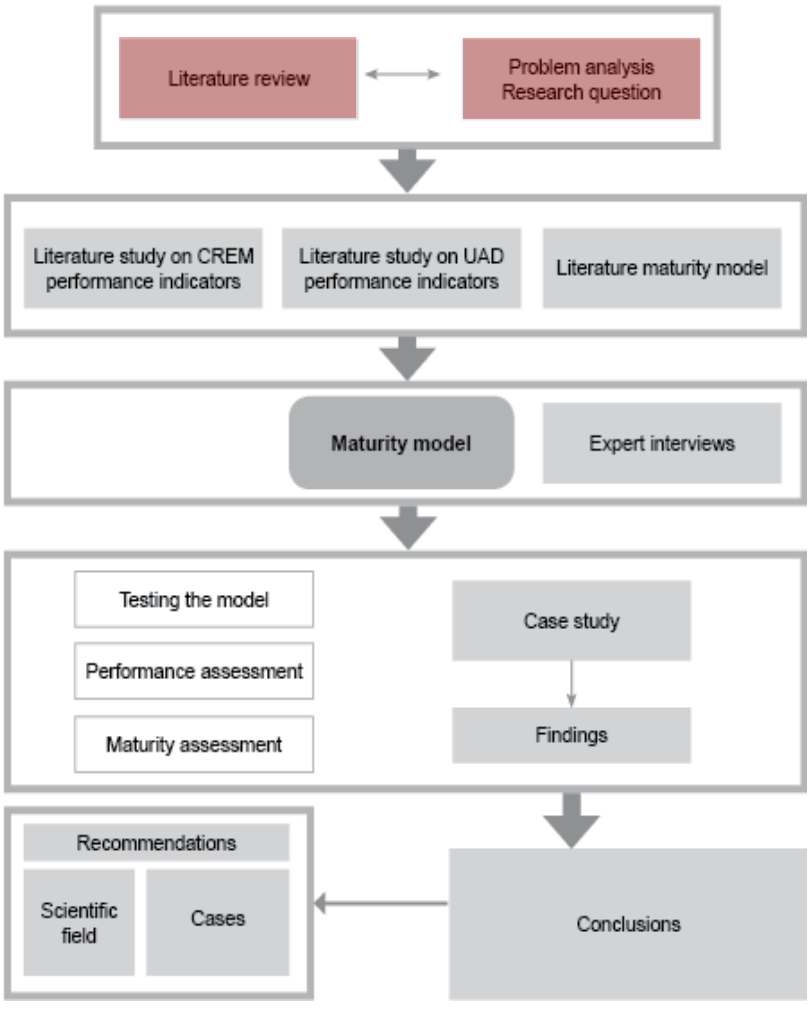
The developed model should be tested on applicability on more cases. By testing the model and taking down the findings and differences of each case, the maturity model can be revised and fine-tuned. Some other subjects can also be added to the maturity model, such as involving the last step mentioned by the literature of Pöppelbuss. The optional third step of the maturity model are the prescriptive design principles of the improvement measures for each maturity level. Complemented with this third step the maturity model would be complete.

TABLE OF THE CONTENT

Chapter 1

Research introduction

In this chapter the purpose of the topic is explained. The academic and social relevance is explained to understand the added value for the academic field. The problem of the difficulty in measuring the maturity level of campus management will be explained, and how developing such a tool would make decision making easier. Furthermore, the objectives of the research and the target group will be described.



1. RESEARCH INTRODUCTION

1.1 PROBLEM ANALYSIS

The main function of university Institutions is to produce human capital and providing students and staff with a helpful environment that will enhance their learning, and becoming more creative. It is for institutions a challenging task to match demand with their assets. Resources have to be put for the right use to update the portfolio to changing demand, now and in the future. An efficient application of these resources will prevent a drain on available funds (Musa, 2012). Managing a university campus has become a complex and challenging task for universities worldwide. It involves strategic, financial, functional and physical aspects as many stakeholders. Recent moves to diminish public involvement and funding for universities have put pressure on the internal allocation of resources and institutional leaders are having difficulty to weight investments in property and other facilities against investments in human resources at the university and faculty levels (A. Den Heijer, 2012).

In the last decades there has been a clear shift from a supply-driven approach of traditional teaching and learning to new, more customized and demand-oriented ways of teaching and learning (Simons *et al.*, 2000). Literature shows that many buildings, especially Dutch higher institutes are not sufficiently prepared for future needs and demands (De Vries *et al.*, 2008). This is due to the limitations in understanding on how to align educational buildings with changes in education and developments in learning and teaching.

The problems described by Den Heijer and De Vries (2004) are:

- The universities lack understanding in the benefits and costs of facilities in general and in real estate in particular
- Too little decision supporting information systems related to real estate decisions, both in investment and maintenance decisions
- Lack of references and figures from comparable situations (organisation, real estate stock and on project level) to assess their own situation.

As a result, there is highly need for evidence-based information to support decision making. Campus managers need better information systems and tools to support their management tasks and to inform and engage stakeholders, which are the policy makers, users, controllers, technical managers and designers.

In order to contribute to this understanding of the current condition a better information system is needed to support decision making. This is where this research is derived from, to create understanding on the current condition of campus management. Knowing the current state of campus management and the performance of a university is the beginning of knowing their strengths and weaknesses, and from there, to become better.

Knowing the current state and the (future) demand makes it possible to create a strategic plan. The process of matching the (future) demand with the (future) supply is a process which is described by de Jonge (2008). The DAS-frame (Designing an Accommodation strategy) is a tool in which is described what the steps are of strategic thinking in real estate management. Strategic thinking helps an institution to anticipate on future changes in demand, and how to match this demand with the assets. The steps in the DAS-frame are:

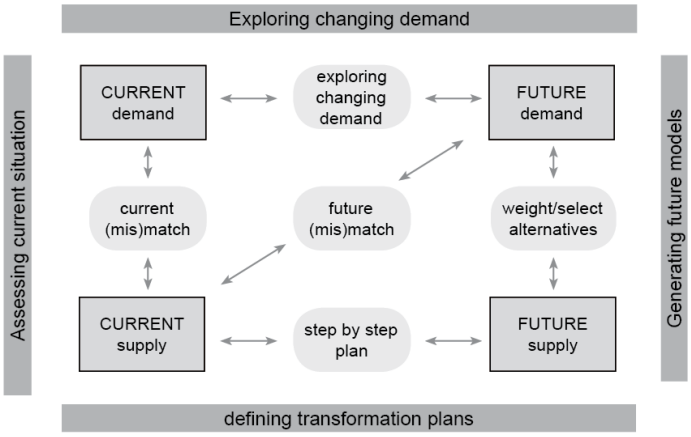


Figure 1: DAS-frame (De Jonge, 2008)

1. determining the current match: "what we need" versus "what we have"
   Assessing the current portfolio to determine the current match, from the perspectives of the stakeholders and demand derived from the current primary processes
2. "what we (might) need in the future" versus "what we have now"
   Exploring changing demand and determining the future match between current portfolio and future demand, derived from the changing primary processes- based on the changing context and the changing goals of the stakeholders
3. weigh and select alternatives for "what we should or could have"
   Generating future models designing alternatives for the portfolio of the future, based on assumptions in changing demand
4. step-by-step plan: plan of approach for the transformation of the portfolio
   How to transform current supply into the future supply

The problem that is described is related to this strategic thinking. The maturity of campus management needs to be assessed in order to know where a certain institution stands. If an institution is not aware of the current condition, it is an extremely difficult task to match the supply with the demand. Knowing the current condition is therefore essential to create added value in terms of performance. It helps to developed a strategy to anticipate on future changes and trends. To support the understanding in the current condition a supportive tool is needed for decision-making. Knowing the maturity of campus management, and the condition of the performance level of a campus is necessary for a better information system to support decision making. This is the tool to measure the maturity in campus management. This is where this research is derived from, to create understanding on the current condition of campus management.

1.2 PROBLEM STATEMENT

A better information system is needed in order to support decision making. Knowing the current state of the maturity of campus management will help an institution to develop itself to a higher level, in order to maximize performance. There are indeed ranking systems which measure the quality of the universities, based on certain variables such as the quality of learning and teaching, the international outlook, the research output and influence and the industry income (Times Higher Education, 2014a). However, a tool to measure the campus management does not exist yet. Knowing the current state of campus management and the performance of a university is the beginning of knowing their strengths and weaknesses, and from there, to become better.

Besides that, maturity is also difficult to measure in different contexts, such as Asia (Musa, 2012), Africa (Njungbwen & Udo, 2011) where information is difficult to find and where the term Corporate Real Estate Management is unknown. This supports the reason to develop such a tool to map down the situation in a different context.

***Problem statement**:*
No clear assessment method for measuring the level of maturity in campus management of a university, which can support their decision-making.

Not only on portfolio level, but also on urban scale.

Campus management is unknown in a different context, which makes it difficult to measure the maturity level of campus management.

1.3 OBJECTIVES

The academic objective of this research is focused on improving campus management. By managing existing assets and potential future assets effectively across their life cycle, added value will be created by matching the vision and mission of the institutions. Improvement of campus management will enhance competitiveness and attractiveness of the campus by matching (new)demand with (current)supply.
CREM has proven to be successful in other organization areas such as hospitality and industry, but very limited in practice and implementation in educational institutions, especially in a non-western context. By developing a tool which can be used in a different context, awareness can be created by introducing the concept of CREM, which could result in positive effects when implementing the tool and help them to support decision-making.

In order to match the supply with the demand it is necessary to know the condition of the current supply. Therefore an assessment tool is needed to assess the maturity in campus management of an institution, and how this is related to the physical outcome (performance). As a result this research will focus on developing an assessment tool which can measure the level of maturity in campus management. Such a ruler does not (yet) exist. This tool can help institutions to determine their mismatches, now and in the future, and support decision-making. This tool will be developed to measure the maturity of campus management and the performance level in terms of functional, financial, physical and strategic perspective.

Measuring the maturity level of an institution is two-fold. An institution can *claim* they have a high level of campus management, based on the assessment. But does it show as *evidence* in the outcome of their institution? This is where the tool will also test the institution on physical evidence. In order to understand the campus management it is important to know what the mission and goals are of universities. Den Heijer determined the 'key performance indicators' (2011) which affect the performance of a university. These performance indicators are from the perspective of productivity, profitability, competitive advantage and sustainable development on building level. This research wants to explore more factors which can complement the list on building level and urban level, but also in a different context. These factors are the factors which will be assessed in the maturity model.

This developed maturity model will be tested on applicability and limitations. This tool will help institutions to understand their current level of campus management, and supports decision-making to reach a certain goal. Furthermore, the tool will be developed for two kind of cases:

- There will be a quick scan model for a less time consuming research method. This includes the objective analysis of documents and data provided by the university, but no field work is necessary. This model is created due to the fact the possibility exists that research resources are scarce, or limitations of the distance. Despite these problems, the goal of the quick scan model is to create a clear image about a certain case. The quick scan model will be tested on applicability on a case on the Netherlands (
- The full scan model is intended for more time-consuming research methods to collect the data. This is for example in-depth interviews with people within an institution or the necessity to observe the campus. Usually this is for researchers who have more research resources available, or cases which are easy to visit.

The quick scan will be tested on a case of China (The Chinese University of Hong Kong) and the full scan will be tested on a case in the Netherlands (TU Delft). Using this maturity model will provide an understanding of the current situation of a university and their strengths and weaknesses. Moreover, by testing the applicability of the model, the reliability can be assessed and in furter research the maturity model can be improved. This thesis will provide the basics for the maturity model on campus management, but can be improved in the future for other institutions or a different type of real estate.

1.4 RESEARCH QUESTIONS

The main research question is formulated based on the problem statement. The proposed research aims to answer the following question:

> How can the maturity level of campus management of a university be determined in order to create added value in terms of performance [1], and support decision-making?

The sub-questions are formulated based on the questions needed to be answered to support the answer of the main question. The sub-questions related to the theoretical and empirical part are:

1) How can the maturity level of campus management of a university be determined?
   - What levels in the model can be determined?
   - How can a quick scan model (for a research method with limited resources available) be developed?
   - How can a full scan model (for a research method with large amount of resources available) be developed?
   - How can the maturity model to be operationalised?

2) How does the maturity level express in the performance level (evidence) of the campus?
   - What variables affect the level of performance related to the discipline of Corporate Real Estate Management?
   - What variables affect the level of performance related to the discipline of Urban Area Development?
     - Urban factors which influences the performance of a university

The last sub question is related to the applicability of the developed maturity model. The emphasize however is on the design of the maturity model and not on the case studies. But by conducting the steps determined in the framework of the maturity model, something can be said about the limitation, advantages, disadvantages, differences and similarities of the quick scan and full scan model.

3) What is the applicability of the developed model?
   Testing the model: *a case in Hong Kong (The Chinese University in Hong Kong)*
   a case in the Netherlands (TU Delft)
   - Measuring the level of maturity and the physical outcome
   - Limitations, advantages, disadvantages, differences and similarities between the quick scan and full scan model
   - Which model is better applicable?

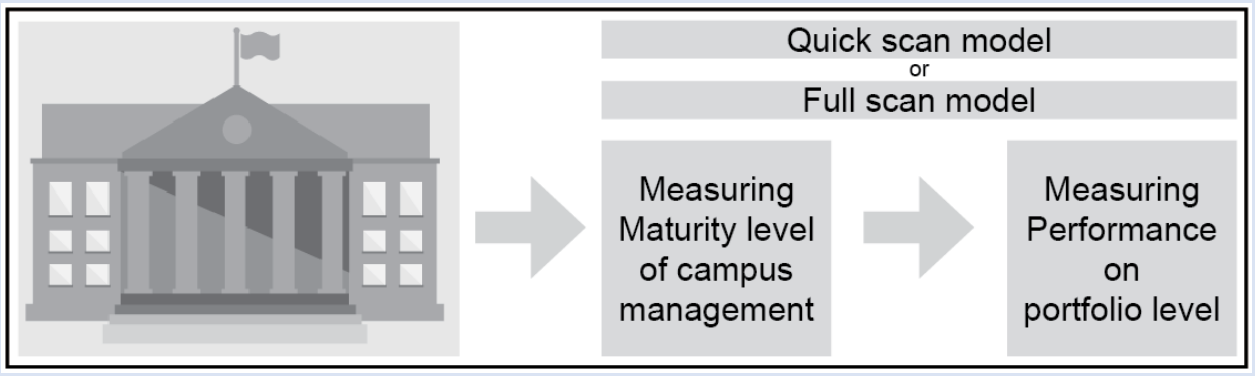
[1] Competitive advantage, productivity, profitability and sustainable development

1.5 GOAL OF THE RESEARCH

Since the launch of the first Capability Maturity Model almost twenty years ago, hundreds of maturity models have been proposed by researchers and practitioners across multiple application domains. A maturity model for campus management does not yet exist, and the goal of this thesis is to design a model that not only focus on a sequence of levels toward a predefined "end state", but on factors driving evolution and change (King & Kraemer, 1984). Maturity models are expected to disclose current and desirable maturity levels and to include respective improvement measures. The tool will help to create understanding of the situation of campus management of a certain case, but also the actual outcome on physical level.

Goal:
Developing a tool to assess the maturity of campus management: This tool assesses the current level of campus management, and the actual outcome on physical level (evidence). This tool can support decision making to improve campus management.

Test the applicability of the maturity model by looking at an organization in the Netherlands, and on a case in Hong Kong.



1.6 TARGET GROUP

CREM is a matching process between demand and supply, with activities from operational to strategic level and the overall goal to optimally attune real estate to an institution's performance (Jensen *et al.*, 2012, p. 182). In order to determine what added value real estate can create it is necessary to have insight of the interests of the involved stakeholders. These are set up in a power-interest matrix (Ambrosini *et al.*, 1998, p. 153). The stakeholders are divided in the four perspectives according to the DAS frame(Jonge, 2008, p. 19): the policy makers, controllers, technical managers and users. The stakeholders with a focus on the university are the policy makers (director, government) and the users (employees/students). The stakeholders with a focus on real estate are the controllers (asset managers) and the technical managers (facility/ maintenance manager).

	Stakeholder	Objectives	Variables	Influence on strategy
Policy makers	Board of directors	Improving quality of place Supporting image Supporting culture Stimulating innovation Stimulating collaboration Reducing costs Branding Security	Occupancy costs per office Operating costs per office Image Security level	Control over strategy, formulating goals, decisions, mission Flexibility in managing the portfolio
	Government	Rules and regulations for campus development Quality of education Improving competitiveness city	Taxes Policy Education fee	Regulation Restrictions on RE strategy
Controllers	Public controller	Maximizing efficiency Increasing real estate value Reducing costs	Cash flow	Control over cash flow
	Asset manager	Maximizing value of real estate Reducing asset costs	Occupancy costs/m2 Operating costs/m2 Energy costs/m2 Footprint/m2	Control over RE Control over amount of space Implement flexibility
Technical management	Maintenance manager	Reducing maintenance costs Improving performance building Controlling risk Reducing footprint	Performance indoor climate building Location Logistics Technical adaptability	Technical innovation (indoor climate) to improve performance
	Facility manager	Improving efficiency Workplace innovation Employee satisfaction Location, image, indoor climate, logistics, accessibility	Image Satisfaction employees Efficiency of building in terms of	Workspace innovation Study place innovation Implement flexibility

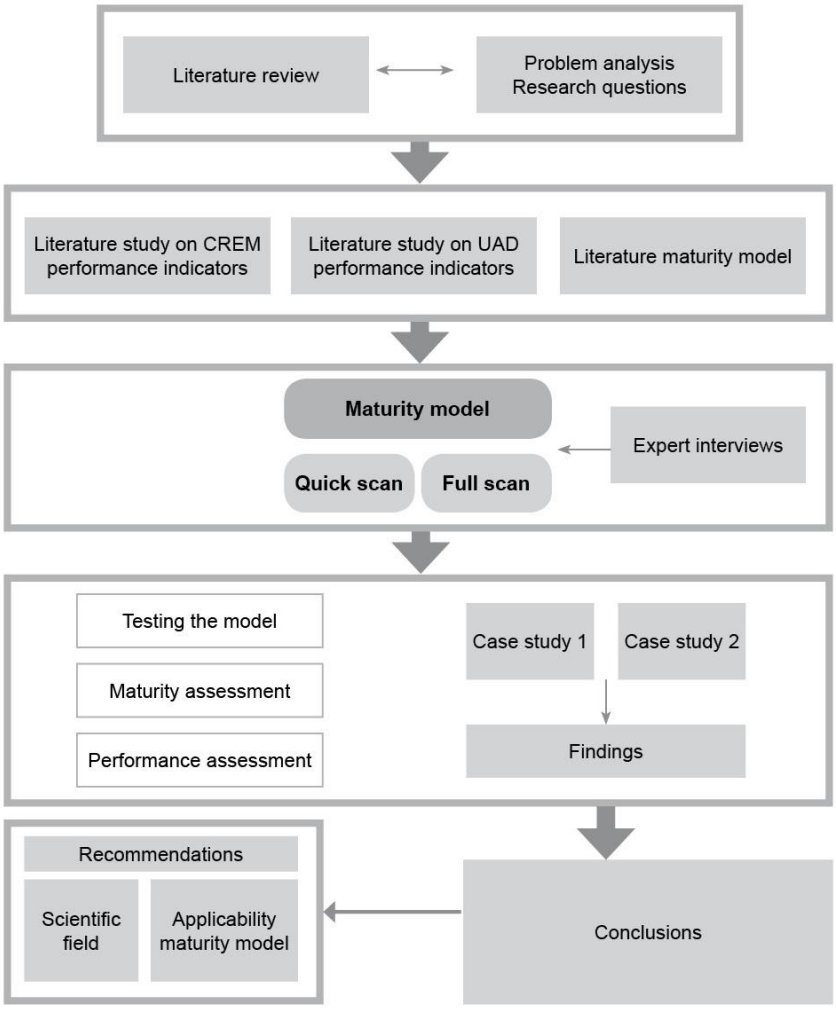
		Controlling risk Reducing footprint	logistics, accessibility	
Users	Employees	Good working environment Flexible working environment Good indoor climate Good accessibility (location, distance) Possibility to work as efficient as possible Increasing user satisfaction Supporting user activities	Performance indoor climate of building Distance to office Quality of location, facilities, environment	Workspace innovation Flexibility in working space, and way of working
	Students	Good working environment Study places Good indoor climate Good accessibility (location, distance) Facilities (housing, sport, hospitality, recreative) Increasing flexibility Increasing user satisfaction Supporting user activities	Performance indoor climate Number of facilities Accessibility	Satisfaction Workspace innovation

Table 1: Objectives involved stakeholders based on Den Heijer, 2011 and Jensen et al., 2012.

Chapter 2

Research design

In this chapter the design of the research is explained. The methodology, the type of research, the sources, the timeline and expected results will be described. As shown in the figure the research will start with an analysis of the problem and the subject. The next phase is developing a theoretical framework which supports the development of a maturity model. In the later phases the maturity model will be tested on two cases for applicability.



2. RESEARCH DESIGN

This chapter will explain about the research design and the methods which will be used in the research. First the timeline of the research will be explained and the different products which will be derived from the results of each phase. Second the research methods to answer each sub-question will be explained. This chapter focuses on the case study and the case study selection, but also the plan on how to conduct qualitative research through interviews. Third, the method of data collection will also be explained, and which resources and tools will be used to collect the information.

2.1 RESEARCH DESIGN

The graduation research is divided in different phases. In each phase there will be a different focus on gathering information relating to the case.

P1 In this phase existing literature will be consulted in order to state the problem. This is actually the research proposal including its research questions, relevance of the research, methods and research design.

P2-3 Theoretical framework: The research will start with a literature review in order to answer the sub questions relating to the theory of what components in the disciplines of REM and UAD determine the performance of an institution. Furthermore, literature concerning on how to develop a maturity model is consulted.

P3-P4 The maturity model will be developed in order to assess the level of strategic thinking and the actual implementation of strategies on building level. The components which are of influence on the performance of an institution will be tested with expert interviews, to optimize the maturity model. Furthermore, these factors will be placed into the different levels of the model.

P4-P5 In this phase the maturity model will be optimised, implementing the findings from the interviews to create a quick scan and a full scan version of the model. The *quick scan model* is intended for cases where limited research resources are available. It contains the variables which are easier to collect through data analysis of documents, report and maps of the case. This model will be tested for applicability on a case in China. Besides testing the applicability, a general view will be formed about a case from a different context. This creates understanding of their maturity level in campus management and how this shows in their performance level The result of such a quick scan is a SWOT-analysis of the case, so that the institution understands where it stands, and what strategies needs to be conducted to improve themselves.
Furthermore, in the conclusion the limitations, advantages and benefits of this quick scan model will be described.

The full scan model is intended for research methods which are more time consuming and involving field work such as observation, visits and interviews with stakeholders from the institution. This model will similarly be tested on a case for applicability. Due to a limitations of research resources, a case is chosen which is more easy to access, the TU Delft. The full scan contains conducting interviews with experts from the inside, data analysis of documents, report, monitors and maps of the university of Delft. Likewise, this scan will result in understanding the maturity level of campus management and how this shows on the performance level. Besides testing the full scan on the case of Delft, also the quick scan will be tested on Delft. The reason for this is to make this quick scan comparable with the full scan. The goal is to create a quick scan that can give a view which is quite as complete as the full scan. By testing both the models on one case, the differences and similarities can be described. This will be explained in the conclusion.

The complete scheme of the research design is shown in figure 2.

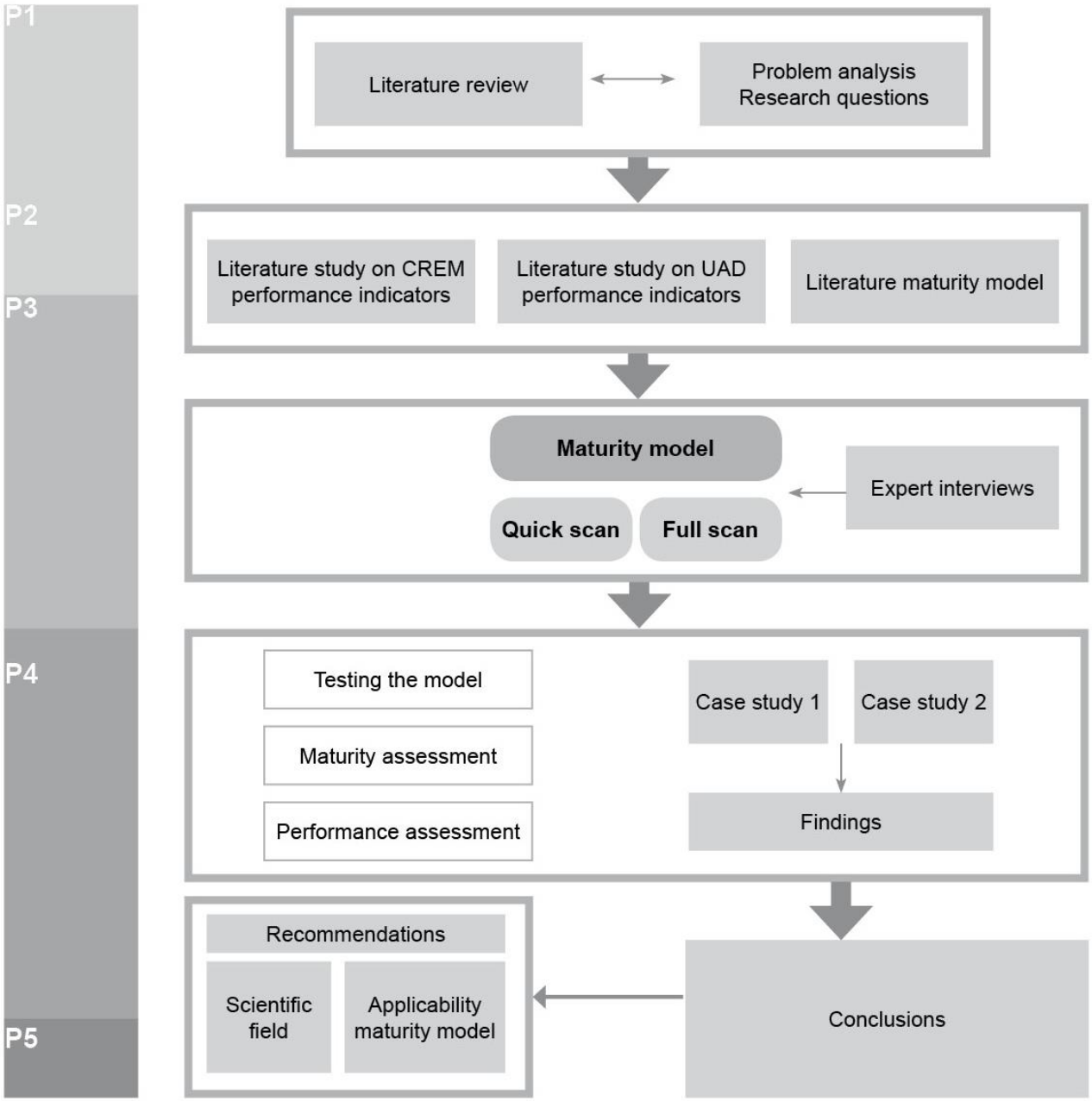


Figure 2: Research design in phases

2.2 CONCEPTUAL MODEL

The campus management has four perspectives: the management of strategic goals, the financial resources, the functional management and the physical management (campus area and the university buildings). The management factors are related to the quality assurance of the environment, but also the services of the university. It concerns the management of resources, and how this is used (financial and physcial management of the assets), but also strategically which is related to mission and goal focus. The maturity level of this management will show in the performance level of a institution, which is defined by the key performance indicators (A. C. Den Heijer, 2011). These are the variables concerning the competive advantage, the productivity, the profitability and the sustainable development.

- The competitive advantage is defined by the quality education & facilities, the user satisfaction, the ranking and reputation of the institution.
- The productivity is defined by the research output, the space usage and the functional mix.
- The profitability is defined by the costs, benefits and the real estate value.
- The sustainable development of the buildings is defined by the technical quality of the buildings and facilities, the indoor quality, the technical condition and maintenance level.
- The sustainable development of the campus area is defined in terms of accessibility, mobility, infrastructure, attractiveness and safety.

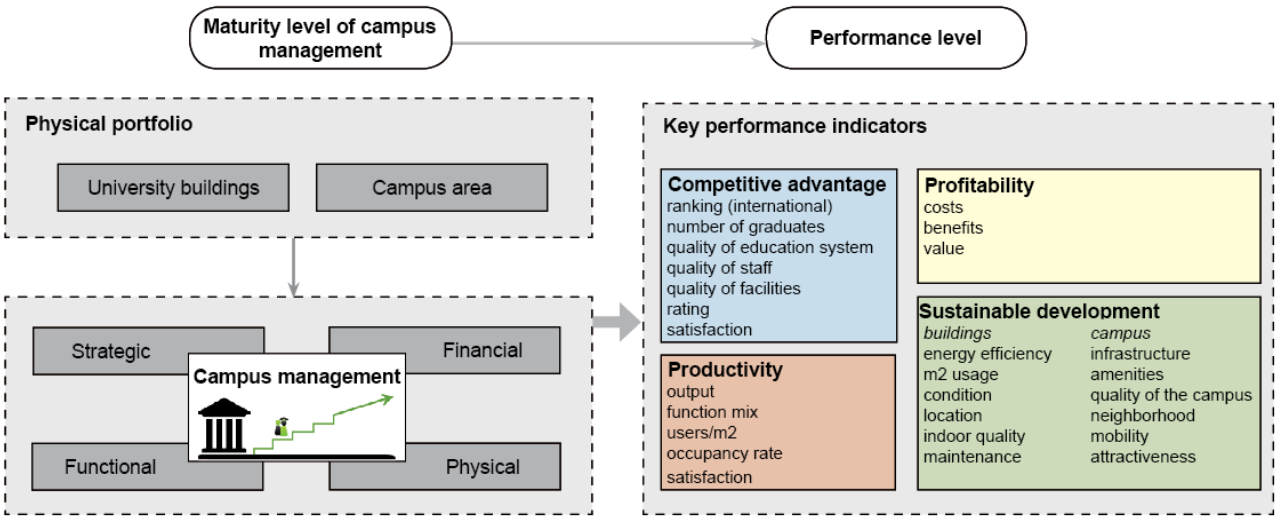


Figure 3: Conceptual model, based on Den Heijer, 2011

2.3 RESEARCH DESIGN OF THE MATURITY MODEL

The developed maturity model will consist of two parts: The part in where the maturity level of campus management can be determined, based on the *strategic thinking* of a university. This involve taking into account trends, but also being aware of their (current) state. The second part involves the actual implementation of all the strategic plans of the university, and how this shows in *evidence.* This part is to measure the actual effectiveness, which will be explained using the *performance indicators*.

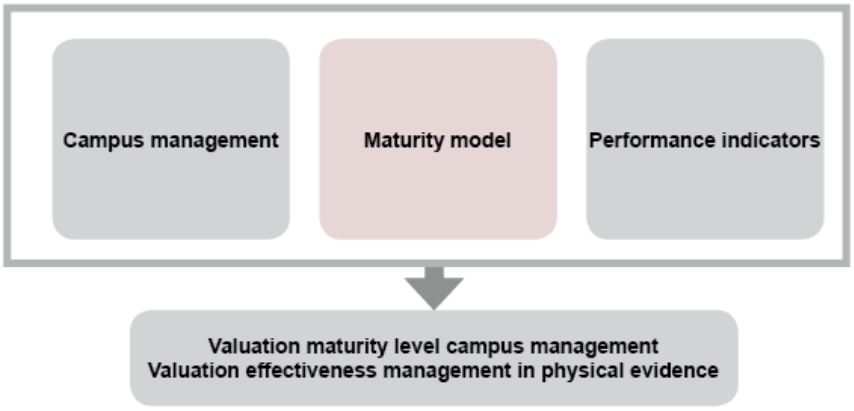


Figure 4: Research application of the maturity model (own illustration)

If we take for example the strategic component, which is determined by the level of innovation, level of goal focus and level of anticipating future trends, the model can be used to value the maturity level of campus management of a university. If the level of maturity for a certain university is high (level 4-5), this will show in physical evidence such as a high innovation level, a high goal focus coupled with clear strategies and plans. Their planning will show they take measures on anticipating the future, improving the current state of their assets to reach added value in the future. There is also a willingness of investing in for example sustainability, but also innovation.

2.4 METHODOLOGY

LITERATURE REVIEW

For the collection of literature concerning the theory different sources will be used. Sources that will be used are: books, journals, reports, online resources such as websites (googlescholar, sciencedirect, TUDelft library, scopus, springerlink).
Keywords: higher education, CRE, corporate real estate, education, globalization,

- Literature about campus management has been reviewed at the start of the research, in order to understand the basic theory of campus management. Based on this literature the problem area is being analysed.
- The theory concerning the maturity models will be critically analysed and used in order to determine what maturity models exists, and how to develop a maturity model for the use of measuring the maturity of campus management.
- Literature will be consulted to determine which factors affect the performance of a university campus. These factors will be related to the strategic, functional, financial and physical perspectives on portfolio and area level.

CASE STUDY & DATA COLLECTION

The method that will be used to test the developed maturity model is a case study approach. A case study is an intensive study of a unit for the purpose of understanding a larger class of (similar) units, wherein a unit connotes a spatially bounded phenomenon observed at a single point in time or over some delimited period of time (John Gerring, 2004). Based on these similarities a *generalization* of the findings to the whole portfolio will be possible when doing research on a selected sample of cases. The focus is on the embeddedness of the case in its context. The way of developing theories are in this research based on specific observations and thus inductive.

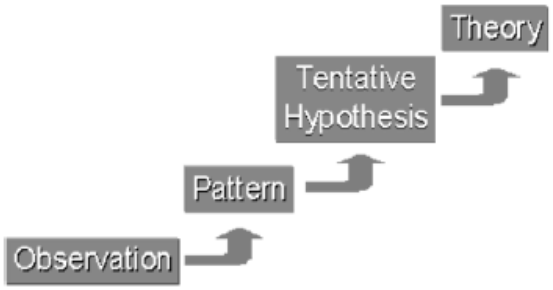


Figure 5: Inductive way of developing a theory theory (Van der Voordt, 2014, p. 20)

The two cases studies which will be conducted are used to test the applicability of the model. Using the framework of the maturity model the case will be analysed concerning the prescribed variables.

- Quick scan version: This version contains a method which is less time-consuming, and does not involve observation or interviews. In order to generate a clear image of the case based on a quick scan, the annual reports, documents, technical reports, drawings and maps will be analysed.
- Full scan version: This version contains more time consuming methods to collect the data. Interviews are part of this, including the methods described in the quick scan.

SEMI-STRUCTURED INTERVIEWS

Phase 1

During the research interviews will be conducted with experts from the field. A predefined maturity model, which is based on the literature is being presented to them. Their opinion and input is being asked to help to make the maturity model more accurate. The subjects that are being treated are:

- The important factors which determine the maturity level of campus management
- The variables that affect the level of performance of a university
- Factors that can influence the maturity level of campus management

Phase 2

Because the goal of the research is to develop a quick scan and a full scan version of the maturity model, the interviewees is being asked on how important the variables is and how much time and effort is related to collect the data. The list of variables that is presented in phase 1 and 2 are shown in the table below.

Strategic	Functional	Financial	Physical (building)	Physical (urban)
S1. Quality of education S2. Quality of facilities S3. User satisfaction S4. Attractiveness campus and facilities	Fu1. Students output Fu2. Staff output Fu3. Space usage Fu4. Functional mix	Fi1. Total income Fi2. Total costs Fi3. Real estate value Fi4. R&D education spending by government (subsidy)	Pb1. Energy efficiency building Pb2. Technical condition building Pb3. Level of maintenance	Pu1. quality of built environment Pu2. Amenities Pu3. Infrastructure Pu4. Quality of the neighbourhood Pu5. Relationship university and its surroundings Pu6. Urban diversity Pu7. Economic & social power university in urban development

Table 2: List of variables to be tested on importance and effort in retrieving the data

The results from phase 1 and 2 will be presented in a graph with two axes where all the variables are positioned based on their importance level and the effort that is needed to retrieve the data (see figure 6).

- Quick scan version: minimum variable list which contains the key variables with the least time and energy involved to collect this data.
- Full scan version: all the key variables

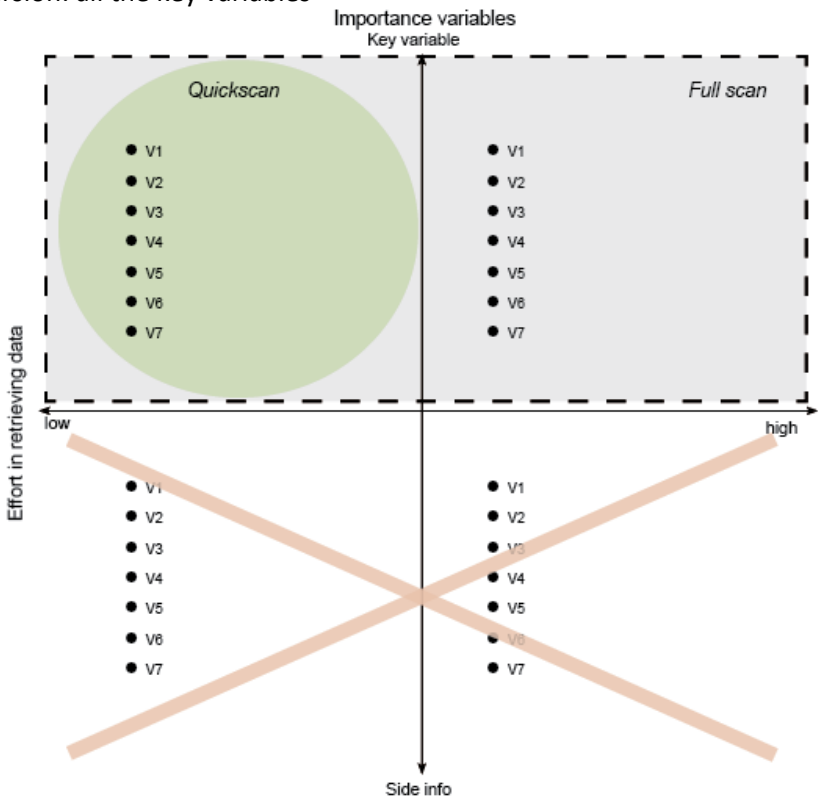


Figure 6: Variables positioned on the 'importance' and 'effort in retrieving data' axis

Phase 3

The last phase of conducting the interviews are related to level of campus management and the performance level of TU Delft. The interviewees will be asked for what they think the position is of TU Delft related to the campus management, and what the reason is for this position. Furthermore, their assessment of the performance level of the TU Delft is questioned. These are related to the four perspectives.

The complete interview framework and transcription is depicted in Appendix II.

2.5 THE CASES

CASE SELECTION

The selection of the case has been done carefully because the case should represent a larger population (J. Gerring & Seawright, 2008). The specific selection criteria:

- Universities with an international focus
- Universities with a focus on improving their competitive advantage
- Universities with a similar education system as Western countries (BSc, MCs, phD degree)
- Public universities

- Universities which appear in the world rank top 100 of Times higher Education 2014, since these rankings are based on an assessment of 5 components (Times Higher Education, 2014a): international outlook, research, industry income, the learning environment and research influence)

Dutch case
The Dutch case is selected based on expertise and time management. The facility management of TU Delft will be consulted during the development of the maturity model. The variables which are obtained from literature research will be questioned for importance and ranking the variables from 'key variable' to 'side info'. Furthermore the FMVG will be consulted in measuring the maturity of campus management of TU Delft as a case itself.

Hong Kong case
The case on which will be focused is The Chinese University of Hong Kong (CUHK). The choice on this case is based on certain factors:

- Hong Kong was governed by England. The development of universities in Hong Kong are based on Western education (influence of England). Hong Kong is part of a development state. They have a state autonomy, with a powerful state of bureaucracy, a weak and subordinated civil society, effective management of nonstate economic interests and repression, legitimacy and performance (Huff *et al.*, 2001, p. 712). They are also focused on continuous reputation building, are characterized by rapid economic growth, with a strong governance in collective providence such as infrastructure, education and housing. Because Hong Kong is an example case for Chinese universities (influence of HK) a pilot case in HK is for this reason generalizable to a bigger sample.
- Due to restrictions of data obtaining possibilities. A Hong Kong university is more accessible for foreign researchers because of the language barrier. The expectation is that they possess the knowledge of the English language more than the Chinese universities.

Case comparison
The cases are used to assess the applicability of the developed maturity model. The maturity model has a quick scan version and a full version. The notion is to use the quick scan and full scan model on the TU Delft case, and the quick scan on the case of CUHK. The aim is to determine the applicability of the quick scan model, and how it differs in findings when using the full scan model. The limitations, differences, the similarities, advantages and disadvantages of each model will be described and can be the basis for further development or research of the maturity model.

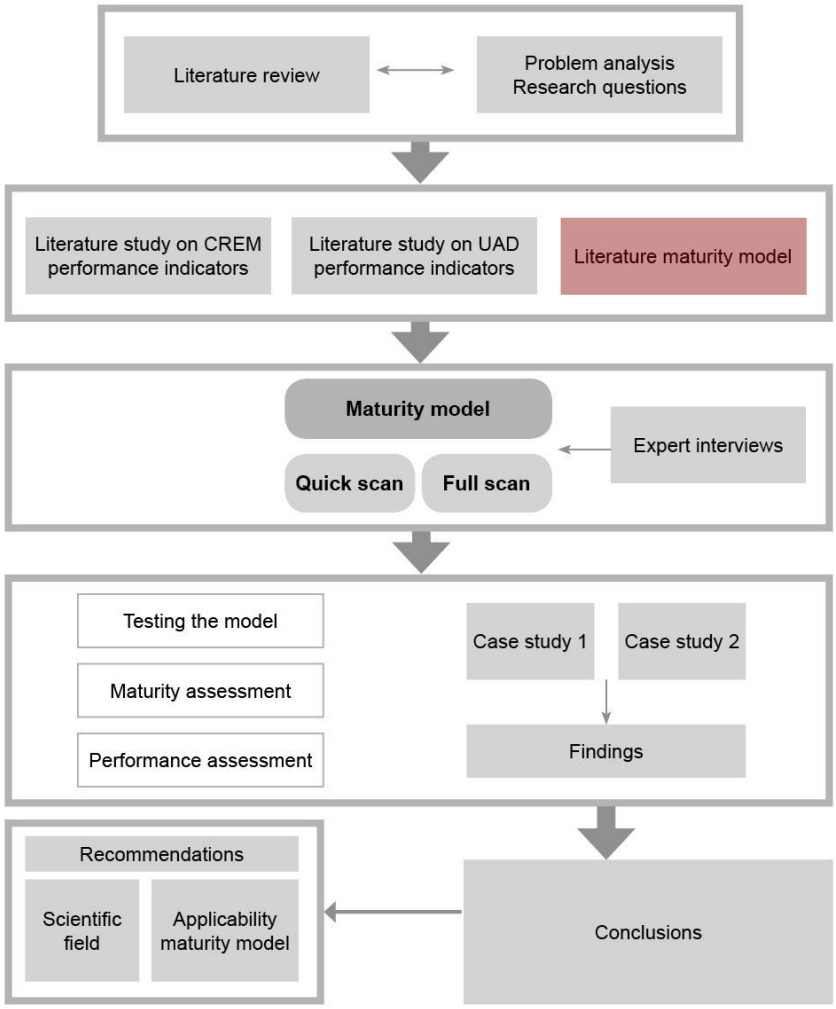
Added value of the cases
The added value of the case can be derived in several purposes:

- Research and academic value: The goals of this research is to create a maturity model to assess the maturity level of campus management. The value of this model is that it can be used in further researches concerning a different case. This will help to create understanding in a different context. The developed model should be tested on applicability, validity and reliability, and this can be done by using the developed model to conduct a quick scan on a certain case. After this phase the model can be optimized for further use in the academic world.
- Societal value: The model will to create understanding about new segments of unknown parts of the world, where CREM on university level is unknown. This thesis will first help to create understanding about the situation in China (Hong Kong) by conducting a quick scan. Based on this scan the performance level of this institution can be determined, next to their maturity level of campus management. Understanding the condition of the Chinese campus helps to support further decisions to benefit all the stakeholders. To create social value the key stakeholders are not only the users but also the city. A university can bring benefits to city level by attracting foreign students, enhancing the image of a city but also improving the competitiveness of a city.

Chapter 3

Theoretical framework: Maturity model

This chapter explains the theoretical framework concerning the design of a maturity model. Based on the variables the maturity model will be developed and explained. The maturity model will be used to test on different cases (ch. 7 & 8). The maturity model will contain two types; A quick scan and a full scan model. The quick scan model will be created intended for research methods that are less time consuming. The full scan model will contain more difficult research methods such as data collection through interviews.



3. MATURITY LEVELS

3.1 THEORY MATURITY MODELS

DESIGN FRAMEWORK OF A MATURITY MODEL

The basic purpose of a maturity model is to describe stages and maturation paths. As for application in practice, maturity models are expected to disclose current and desirable maturity levels and to include respective improvement measures. Typically, the following application-specific purposes of use are distinguished:

- Descriptive: A maturity model serves as descriptive purpose of use if it is applied for assessment where the current capabilities of the entity under investigation are assessed with respect to given criteria (Becker *et al.*, 2000). The maturity model is used as a diagnostic tool.
- Prescriptive: A maturity model serves a prescriptive purpose of use if it indicates how to identify desirable maturity levels and providing guidelines on how to improve the current condition (Maier *et al.*, 2009).
- Comparative: A maturity models serves a comparative purpose of use for internal or external benchmarking. If a sufficient large number of data is present, the maturity levels of similar business units and organizations can be compared (De Bruin *et al.*, 2005).

As proposed by Pöppelhuss and Röglinger (2011), a maturity model should possess first, the basic design principles, second, the design principles for descriptive purpose of use and third (optional), the design principles for prescriptive purpose of use. The framework intents to assist practitioners and researchers with as checklist when designing a maturity model.

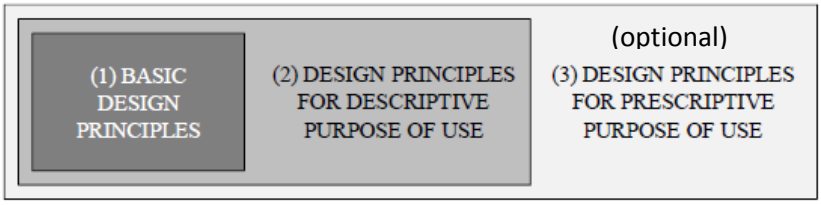


Figure 7: Organization of the maturity design framework (Pöppelbuss & Röglinger, 2011)

This graduation thesis is focused on assessing the current maturity level of campus management. The maturity model that is to be developed will be used as a diagnostic tool. Therefore the maturity model will be of descriptive type on not of prescriptive type. However, based on the descriptive maturity model, some recommendations can be given on how to improve the current state, but not comprehensively included in a prescribed maturity model.

In order to develop a descriptive maturity model some basic design principles and descriptive design principles are involved:

- Basic design principles: Maturity models have to provide a set of basic information about the application domain, the application domain, the purpose of use, the target group and the design process. The second set of the basic design principles are related to the definition of the maturity levels.
- Prescriptive design principles: Maturity models for a descriptive purpose of use must include the assessment criteria for each maturity level. These criteria must be concise and clear to distinct between levels (Maier *et al.*, 2009). Not only the criteria, but also the assessment methodology needs to be described, which is often difficult in complex application domains. An assessment methodology need to feature a procedure model that guides model users through the process containing of assessment steps, the interplay, and how to elicit criteria's values.

MASLOW PYRAMID

The variables of the maturity model are based on the framework of campus management. In order to assess the campuses some levels of needs should be determined. The pyramid of Maslow is used in order to translate these needs to real estate needs (A. C. Den Heijer, 2011, p. 93).

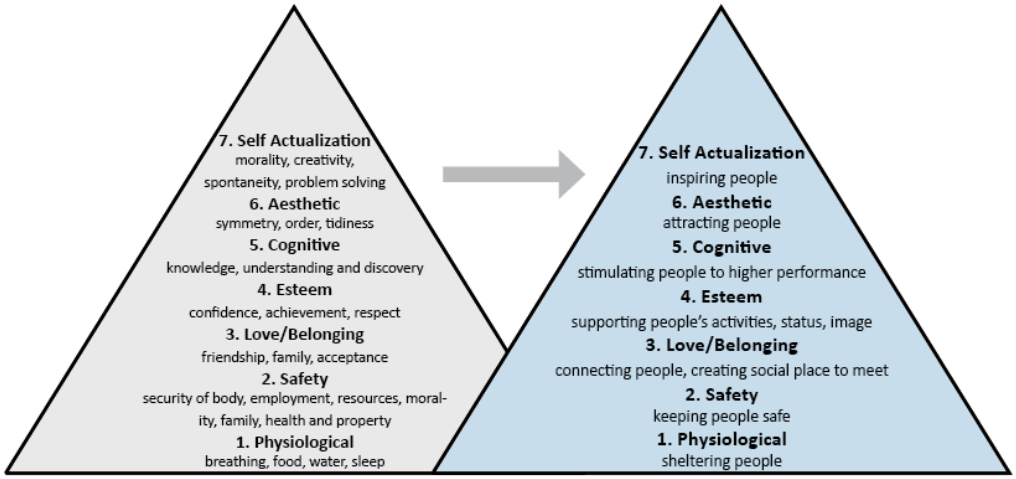


Figure 8: Maslow pyramid translated in real estate needs (A. C. Den Heijer, 2011) based on Van der Voordt

Based on this pyramid the needs for a university campus could be determined:
1. Basic needs: The need for shelter and safety. The building should provide protection against weather influences and serve the basic needs with providing facilities for food, sanitary use, climate regulation etc.
2. Esteem: all the basic needs + providing social places to meet and connect people and creating places which supports the activities of the students/employees.
3. Self-actualization & Enhancement: The working environment must facilitate opportunities for students/employees to develop their abilities as best they can. Stimulation of creativity, motivating, productivity, attracting people.

ANALYSIS OF DIFFERENT MATURITY MODELS

In order to assess the performance of the university it is important to range them in levels of maturity. First the tool to assess the performance of the universities will be developed. The key performance indicators of den Heijer will be used and placed into a categorization of five levels. This models is called the 'maturity model'. In order to determine the maturity of an institution existing literature is consulted.

CMMI & TQM

Dounos and Bohoris (2009) suggested a combined use of the total quality management (TQM) principles and the key concepts of the CMMI for process improvement in higher education institutions. The CMMI (Capability Maturity Model Integrated) was developed by both the U.S. Department of Defence and Software Engineering. The model is worldwide used in 94 different countries to elevate performance, 12 national governments invest in CMMI to support

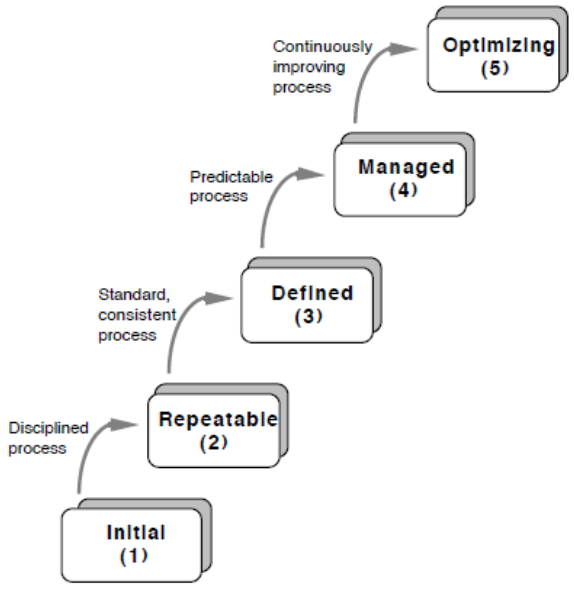


Figure 9 : The Five Levels of Process Maturity (Paulk et al., 1993, p. 8)

economic development in their countries, and the model is translated in 10 different languages (CMMI-Institute, 2014).

The five maturity levels defined by Dounos and Bohoris are (2009, p. 6):

- 1st maturity level: The university environment is chaotic, unstable and unpredictable. The quality management system which supports the specific process is non-existent or does not work properly and the success of the process depends on the heroic efforts of the academic people who intuitively or self motivating manage to monitor the quality initiatives of the other academic institutions.
- 2nd maturity level: planning and implementation of the specific process, namely of the other academic institutions' best practice review, are based on previous experience of the academic authorities and process progress is tracked. The academic organisation through the establishment and incorporation of its policy and strategy into the important aspects of this specific process develops procedures to implement the process.
- 3rd maturity level: process is controlled systematically producing not only repeatable results through the implementation of its well documentation, which reviews successfully the best practices of other academic institutions, but also the necessary mechanisms to adopt the results of these reviews configuring the academic quality goals and educational priorities ensuring continuous competitive advantage of the institution against the others.
- 4th maturity level: level of the establishment of process measurement programmes. The development of a database system is used to store all the benchmarking process evaluation results which come from the specific benchmarking process statistic measures. These measures control the benchmarking process ability to meet its design requirements and the objectives of its use.
- 5th maturity level: common causes of benchmarking process variation are understandable meaning that the process can be changed statistically achieving the established quantitative process improvement objectives, reflecting best practice and also reflecting changing academic objectives. The main reasons of non-conformances of benchmarking process towards meeting certain academic quality goals are identified, analysed and successfully confronted.

Five stages of Joroff

Another focus of CRE Development in organizations is defined by Joroff.

The primary concern of CREM is the management of a corporation's real estate portfolio by aligning the portfolio and services to the needs of the core business (processes), in order to obtain maximum added value for the businesses and to contribute to the overall performance of the corporation (Dewulf *et al.*, 2000). Within CREM, Joroff defines five stages of CRE Development (Joroff *et al.*, 1993).

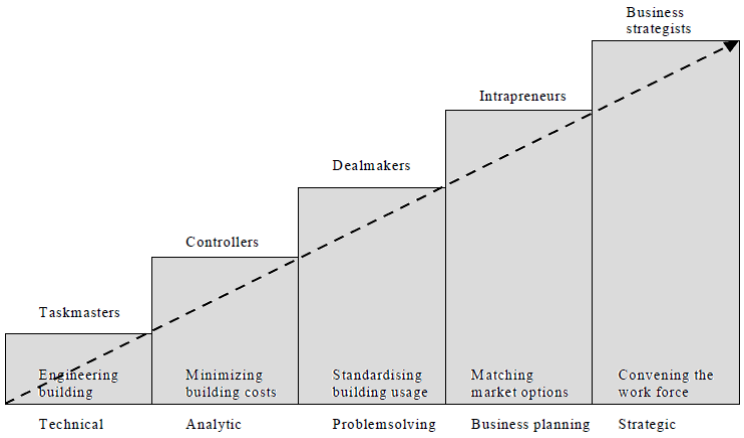


Figure 10: The Five stages of CRE Development (Joroff et al., 1993)

Joroff indicates that organizations undergo a transformation from a technical role to an added value on strategic level. This transformation can be divided in five stages of CRE competency shifts. The phase in which an organization falls, is an indicator for the added value of the business.

1. Taskmasters- Supply the corporation's physical space as required. The first phase has a technical focus, the specific task is to realise and maintain the building. The next stage can only be obtained when technical quality is satisfied.
2. Controllers- Satisfy need to better understand and minimize real estate costs. In this phase obtaining information about accommodation costs and controlling these costs stands central.
3. Dealmakers- solve real estate problems in ways that create financial value for business units. Offering optimal accommodation (organisational, financial and functionality) by connecting demand and supply. Create added value for the users of the building. The dealmaker is demand-focused, advising and proactive. Cost reduction by standardization and obtaining financial efficiency (financing and risk).
4. Intrapreneurs- operate as an internal real estate company, proposing real estate alternatives to the business units that match those of the firm's competitors. Realizing added value for the whole organization. Mostly the real estate organization has a separate division and is responsible for costs and benefits. Demand-driven, advising and proactive. Obtaining financial efficiency (financing and risk).
5. Business strategists- anticipate business trends, and monitor and measure their impacts. These units contribute to the value of the corporation as a whole by supporting the companies' core competencies with real estate strategies that optimize business results. Decision-making has a strategic nature. The strategist is demand-driven, shows leadership, is proactive and influences the business strategy extremely.

The five stage described above are cumulative rather than sequential. Each stage adds on a new role to create added value for real estate. The first three stages are more related to the internal needs of an organization and occur mainly through project-level work. In these stages, real estate decisions are based on cost-quality considerations, where corporate real estate has to be efficient (De Jonge, 2008). In the fourth stage, the intrapreneur deals with portfolio-wide needs and anticipates to trends affecting the corporate units. In the fifth stage, the business strategist takes into account more stakeholders outside of the traditional organizational boundaries in order to enhance their competitiveness (Joroff *et al.*, 1993).

Sustainability maturity model

Sustainability in corporate real estate management has been lately recognized as an integral part of almost every business. Ventovuori developed a generic sustainability maturity model for CREM based on research on 18 present sustainable CREM practices. The model demonstrates the value of implementing sustainable CREM. The sustainability stages demonstrated by Ventuvuori are (2014, p. 130):

1. Recognise & Minimum comply: The bottom line demonstrates the recognition of the added value of sustainability.
2. Plan & Initiate: Experimental phase. Environmental concerns will become more important.

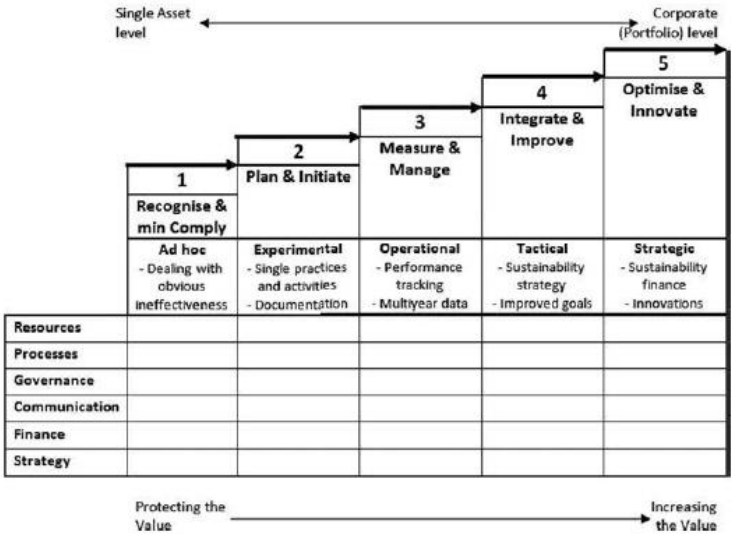


Figure 11: The Five stages of Sustainability (Ventovuori et al., 2014)

3. Measure & Manage: Operational- In the beginning, sustainability specialists are mostly motivated to implement new practices and take responsibility for that.

4. Integrate & Improve: Tactical level- Social aspects are included when a company strives for commitment and full responsibility. People will become committed to sustainability and the rest of the employees will engage as well.
5. Optimise & Innovate: At the highest level commitment refers to full awareness and responsibility of every single employee. Furthermore, innovations take place.

The findings are summarized in a matrix:

	CMMI (CMMI-Institute, 2014; Paulk *et al.*, 1993)	CMMI combined with TQM (Dounos & Bohoris, 2009)	Joroff model (Joroff *et al.*, 1993)	Sustainability model (Ventovuori *et al.*, 2014)
1	Initial: No evidence/don't know	The university environment is chaotic, unstable and unpredictable	Taskmaster: technical focus, supply of physical space.	Recognise & Minimum comply
2	Repeatable: They have plans	Based on previous experience of the academic authorities and process progress is tracked. planning and implementation of the specific process	Controller: minimize real estate costs.	Plan & Initiate
3	Defined: On their way	Process is controlled, ensuring continuous competitive advantage of the institution	Dealmaker: create financial value, offering optimal accommodation by connecting demand and supply.	Measure & Manage
4	Managed: Close to good/acceptable	Control of the process to meet requirements and the objectives	Intrapreneur: proposing real estate alternatives to the business units that match those of the firm's competitors. Demand-driven, advising and proactive. Obtaining financial efficiency.	Integrate & Improve
5	Optimizing: Fully done/ future prospect	Reflecting best practice and also reflecting changing academic objectives	Business strategist: anticipate business trends, and monitor and measure their impacts. Demand-driven, shows leadership, is proactive and influences the business strategy.	Optimise & Innovate

Table 3: Summary of findings from theory

DAS FRAME

In order to develop the campus management maturity model, the literature concerning the theory of maturity models will be combined with the four campus management components (strategic, functional, financial and physical). The key indicators for measuring the maturity of campus management are related to the strategy of designing an accommodation by de H. de Jonge (2008)(see figure). In this strategy the different steps are explained through the thinking in strategic 'steps'. The key indicators are:

- Awareness
- Developing plans/strategies
- Exploration of future changes
- Anticipation on future changes
- Implementation level of plans/strategies

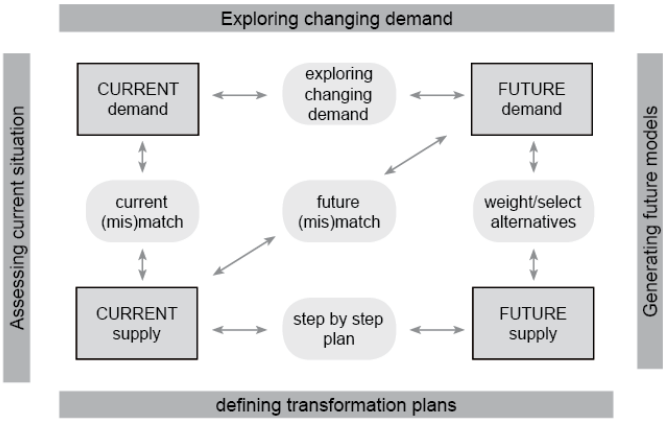


Figure 12: DAS-frame (De Jonge, 2008)

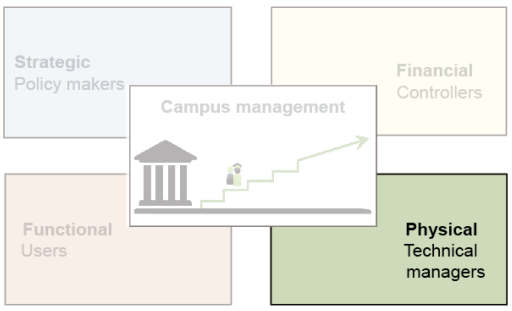
To link the different maturity levels with the DAS-frame the result will be:

Level 1	No awareness of current supply and demand
Level 2	Assessing the current situation; awareness of current supply and problems= mismatch
Level 3	Plans to improve current supply based on current demand
Level 4	Exploring changing demand; awareness of future trends and changing demand
Level 5	Defining transformation plans; step by step plan to implement, weighting and selecting of alternatives/ generation of future models

3.2 MATURITY LEVELS OF CAMPUS MANAGEMENT

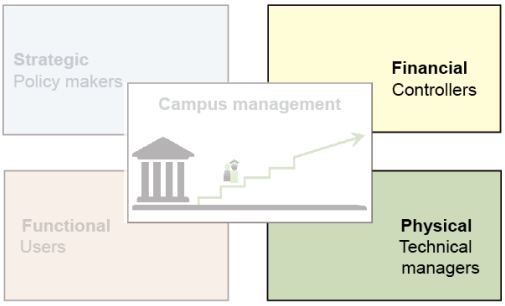
In order to connect the different theory of maturity levels with the performance levels of university campuses, it is necessary to determine the characteristics of each level and connect these with the performance indicators. Assembling of the different components into the different levels:

Maturity Level 1



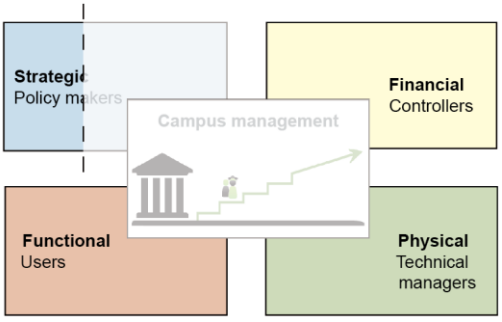
Initial (No evidence, don't know): This level shows no significant evidence of strategic management on campus level and supports mainly the *continuous operation*. This level facilitates the primary needs of a university, which is providing the necessary square meters. Furthermore there is a technical focus on providing the necessary quality of the building which supports the primary activities (education). There is no competitive focus, which makes them not aware of their competitors, but also no incentive to compete with them. There is also none or little focus on the attractiveness of the campus to attract more students or professionals. On an urban level the campus will not provide amenities to add value for the users of the buildings. Furthermore, they are not aware of the importance of the physical urban setting to add value on strategic level.

Maturity Level 2



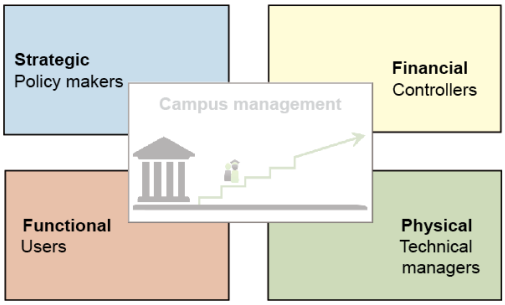
Repeatable (They have plans): This levels indicates that there is *awareness* of the current state of their institution. They already facilitated the basic needs and have plans to improve their buildings and campuses in order to minimize costs on physical level and enhancing their competitiveness. This level focuses on minimizing the operational costs, which adds the financial component to the campus management. This level has mostly their evidence on the management level, in which 'they have plans' but no physical evidence to prove it (yet).

Maturity Level 3



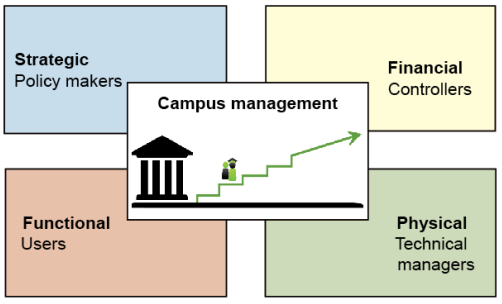
Defined (On their way): There is a presence of a management team concerning the real estate (facility management). The plans they had in level 2 is now implemented. Standardizing building usage is also a focus, which will add the functional component to the campus management. This level facilitates the technical need and the financial control to keep the university operational, but also the functional need to support the activities of the users. This level will show more physical evidence in ensuring their institutional goals. This is the starting phase of the *implementation* of their strategic management, so there is no evidence yet if there is actual improvement of the performance in order to support their goals. However, there is physical evidence in executing the plans, which will show in a higher focus on quality and attractiveness on the facilities/education/campus.

Maturity Level 4



4: Managed (Close to good/ acceptable): *Full implementation* of the strategic plans. Proactive in new plans to support institutional goals. Evidence on physical level will show in good facilities, a sustainable building and reduced building costs. On managing level there is evidence to retain this state, and even new plans on how to improve this state.

Maturity Level 5



5: Optimizing (Fully done/ future prospect): The strategic plans are fully complied and tested. Performance is maximized in current state. On management level the institution has *awareness for future* changes and trends and anticipation for this. On physical level there is evidence of implementation of these plans in premature state (testing phase).

The five levels defined in this paragraph will be further elaborated concerning the four different perspectives. The question on how to create added value, connected to the primary stakeholders and the performance indicators, will be elaborated.

3.3 ASSESSMENT CRITERIA

The assessment criteria derived from the theory in previous paragraphs can be summarized in six groups:

Criteria 1	**Awareness** clueless ↕ prepared	▪ Awareness of the current condition and (mis)match ▪ Awareness of changing demand and trends involved in the higher education sector
Criteria 2	**Goal focus** aimless ↕ high ambition	The level of goal focus expresses in the presence of plans and statements in improving a certain subject (e.g. enhancing competitiveness, reducing energy costs, increasing amount of amenities etc.) ▪ Statements ▪ Plans, strategies, visions
Criteria 3	**Innovation level** old fashioned ↕ innovational	Innovation drives up the competitive advantage, which means the level is determined by renewal of systems, tools, building materials and processes.
Criteria 4	**Tools and systems** underdeveloped ↕ advanced	▪ The presence and maturity of research tools concerning a certain subject (e.g. monitor for energy usage). ▪ Systems are related to the presence and maturity of documentation systems of information.
Criteria 5	**Skills and expertise** incompetent ↕ outstanding	The skills and expertise of the staff are an important factor which influences the maturity level of campus management. When people lack the skills to make links between disciplines, the true added value will be lost
Criteria 6	**Communication** poor ↕ excellent	▪ Information share: The presence and maturity of information sharing systems; do they have a general system for information sharing, or does every party has its own framework. ▪ The communication between stakeholders involved in the campus management. An example is that the facility management department regularly have meetings with the users of the building to determine their demand and satisfaction.

Table 4: Assessment criteria

3.4 MATURITY LEVELS OF CAMPUS MANAGEMENT PER PERSPECTIVE

The added value on campus management level is explained from the four different perspectives. The list varies from goals that focus on efficiency to goals that focus on effectiveness. Added value in campus management can be reached by connecting different stakeholder perspectives that confronts needs with costs and organisational goals with the physical consequences.

STRATEGIC PERSPECTIVE

The strategic management of a campus is determined by the level of goal focus and operational focus. The focus is directly linked to the competitive advantage of a university. The definition of competitive advantage was first described by Ansoff (1965, p. 79) as the properties of individual products/markets which will give the institution a strong competitive position. Added value can be achieved when an institution has a strong competitive position, which is linked to a high performance.

When an organization has no strategic focus at all, it typically only focuses on providing the space for the academic purpose. An institution which thinks beyond this, wants to improve their competitive advantage by achieving academic excellence, obtaining international reputation and status. This can be achieved by improving the quality of education, but also the buildings and campus. They have objectives to place themselves on the international ranking map. A better quality of the teachers and the courses provided will enhance the reputation of an institution. A high quality of facilities, buildings provided will support the activities and enhance user satisfaction. A high maturity level of strategic management is defined by high motivation, proactive and innovative vision of an institution. This also implies the use of new tools such as internationalisation, marketing and promotion for enhancing competitive advantage (Naidoo, 2010). Stimulating innovation such as sustainable concepts, introducing new ways of working on campus, making university buildings more suitable for external users, new office concepts to stimulate collaboration, to support the (changing) culture, or to improve the quality of place will bring added value on the university campus. At the same time it will enhance the efficiency by reducing costs and reducing the footprint (Jensen *et al.*, 2012, p. 189).
A specific definition of the different levels of strategic management:

Level 1	▪ No awareness of current supply and demand ▪ Not aware of their competitors, nor they have intention to compete in the battle to become the best university ▪ No research on future trends nor future changes such as student forecasts ▪ There is no strategic, nor operational improvement focus ▪ No research on innovation to add value on the buildings nor to increase competitive advantage; 'old-fashioned' ▪ 'just letting it happen' attitude ▪ Tools and systems to measure and document information are non-existing ▪ Skills and expertise of staff are incompetent ▪ Communication between stakeholders is poor ▪ Information sharing systems are non-existing or very poorly
Level 2	▪ Awareness of current supply and demand, but more importantly the mismatch ▪ Awareness of their competitors, but no focus on competing. ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Innovation is not a driver yet, continuous operation has priority ▪ Tools and systems are starting to developed; measure information to understand the current state ▪ Skills and expertise of staff are related to their field only; no analytical skills ▪ Communication between stakeholders is starting to developed to understand the basic needs of the users ▪ Information sharing is developing because communication between stakeholders are better
Level 3	▪ There is a strategic focus, which is made explicit in plans ▪ Presence of a 'campus vision' to improve current supply based on current demand to ensure competitive advantage but also innovation ▪ Tools and systems to measure the information is present (monitor for energy usage, monitor for user satisfaction) ▪ The skills and expertise of staff are competent; they have the analytical skills to make connections between different information disciplines ▪ Communication and information sharing between stakeholders is in a defined stage
Level 4	▪ Awareness of future trends and changing demand, proactive in competing with the competitors, and they have the desire to stand out ▪ Scenario planning, long term planning ▪ Full implementation of plans or already on-going execution of plans

	▪ Innovational vision for their campus strategy ▪ Attracting scientists & talents ▪ Regularly having meetings to look forward and look back on happenings
Level 5	▪ Generating future plans for continuous improvement ▪ Strong strategic focus to compete and becoming the best university; desire to stand out ▪ High ambitions ▪ High level of innovation ▪ High frequency of revising and adjusting the plans to match the changing needs ▪ Advanced tools and systems which are being regularly checked ▪ Outstanding skills and expertise of staff ▪ Iconic buildings (not always the case) ▪ Enhancing attractiveness buildings, facilities and public space ▪ Enhancing the quality of infrastructure ▪ Excellent communication and information sharing between stakeholders

Table 5: Maturity levels of the strategic component

FUNCTIONAL PERSPECTIVE

Management of the functional perspective by changing the quality and quantity of space to support the activities of users of the building aimed to enhance the productivity and output of students & staff per m². Campus decisions that aim to support primary processes more effectively, in order to improve the quality of products (publications, degrees, knowledge). Increasing the flexibility of the space will establish the possibility of multifunctional use of the space. Increasing the adaptability of the space will make space easily to transform the size or function of the space. A multifunctional use of space during the day, in which can function as different function, will enhance the productivity output/m2. It enables an institution to solve a problem in the real estate portfolio and to cope with changing demand and increase user satisfaction which will add to productivity and can also contribute to the competitive advantage of an organisation with satisfied users being (more) loyal to their employers (Jensen *et al.*, 2012, p. 193).
A high maturity in management of the functional space is linked with a flexible use of space, but also controlling the quality of space, and measuring the satisfaction level of users. The occupancy rate will be monitored, because it can affect the satisfaction level of the user or reducing the productivity.

Level 1	▪ No awareness of current state, and only focused on the required m² ▪ m² not for the right use ▪ No research on future trends nor future changes such as student forecasts ▪ No innovation in terms of space use ▪ Communication with users is poor
Level 2	▪ Awareness of current supply and problems, they want to satisfy the basic technical needs of the users ▪ Satisfy basic space needs ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Standardizing space use ▪ Facilitating the amount of students in relation to the space, but not thinking about smart space use ▪ Communication with users is starting to develop, to understand the needs
Level 3	▪ Plans to improve space usage ▪ Presence of research concerning the occupancy/ space or m² ▪ Clear view of space usage ▪ Research on innovational space use (flexible use, alternative space use)

	▪ Communication and information sharing between stakeholders is in a defined stage
Level 4	▪ They want to maximize output with and efficient use of m², they are aware of changing trends ▪ Implementation of flexible space use (multifunctional use, transformation, shared use) ▪ Student prognosis to forecast the amount of future enrolments ▪ Involve users, in order to determine their needs
Level 5	▪ They have a clear image of what their space usage/ occupancy rate is ▪ Flexible functional space use, multifunctional use of space to maximize efficiency, generating new plans to anticipate on future trends ▪ Future plans to anticipate on changing working trends, and they know how this will affect the space usage (e-learning and flexible working) ▪ Excellent communication and information sharing between stakeholders

Table 6: Maturity levels of the functional component

FINANCIAL PERSPECTIVE

Anheier (Anheier, 2005, p. 206) categorizes a university as a non-profit organization, with a mission of providing knowledge to the public. Whereby a profit-related organisation is focused on maximising profit, a university has broader goals and objectives and consequently, the planning and measurement of achievement is much more difficult. A non-profit organisation seeks to maximise utility. The core service of a university is education, which is named a preferred private good, which is mission-related but can be sold in private markets. A university can turn to the government and ask for grants for core funding, specific cost subsidies, preferential tax treatment. Next to the income of the education fee received from the services they provide, a non-profit organisation can achieve revenues through related businesses such as a bookstore or an in-house cafeteria.

The financial resources gained from the fees and related business need to be used to improve and update the current portfolio according to current and future changes in demands. An efficient application of the resources is necessary and if it not used and managed effectively the cost of these assets will be a drain on the available funds (Musa, 2012).
Key for this is to have a detailed overview of the costs of the institution and a financial planning which meets the organisations risk tolerances and available funds. The financial budget in any organisation is a key tool that assists strategic planning processes (Bhayat *et al.*, 2015). Budgeting is however complex and a challenging task which is affected by interest-conflicts.
Controlling financial risks (Jensen *et al.*, 2012, p. 187) by adjusting the size and characteristics of the real estate portfolio following changes in the organisation. This will lower the chance of production loss.
Also, by reducing the overall costs (operational, personnel, real estate) there will be a higher production. The most obvious strategy is reducing the floor area.
An institution which is acquainted with budgeting has a higher maturity level in financial management.
Budget reserved for aiming to reaching goals instead of only providing the space for the core academic use.

Level 1	▪ No awareness of current costs, and no financial plans to reduce costs, budget for required space ▪ No research on future trends nor future changes such as student forecasts ▪ Costs possibly exceeding benefits ▪ Tools and systems are underdeveloped, no clear view on what the actual income & costs are ▪ Information sharing is poor and ineffective, each party is using different framework; communication is passing along each other
Level 2	▪ Awareness of current supply and problems= mismatch, budgeting plans,

	▪ Minimizing building and operational costs ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Statements on having plans to use financial resources for creating added value for the university ▪ Tools and systems to measure the income & costs are human work, no systems yet
Level 3	▪ Plans to improve current supply based on current demand, budget for improvement of competitive advantage (marketing), improving technical condition (energy label) ▪ Presence of a clear financial cost estimation on building and operational costs ▪ Investment planning ▪ Budget control ▪ Budget reserved for creating added value for the university ▪ Tools and systems are present. ▪ Information sharing is in a defined level between the stakeholders
Level 4	▪ Awareness of future trends and changing demand, long-term financial planning (reducing footprint) ▪ Budget for new plans ▪ Presence of a financial department within the facility management department ▪ Allocating money for future plans (projects planned) ▪ Risk planning ▪ Tools and systems are advanced, and information is easy to communicate to other stakeholders
Level 5	▪ Scenario and risk planning for future projects; anticipation on the changing future ▪ Cost estimation of future plans, also from scenario's ▪ Willingness to invest a larger amount of money in projects which create added value on the long-term ▪ High frequency of revising and adjusting the plans to match the changing needs ▪ Presence of information systems in which information is easy to share between stakeholders

Table 7: Maturity levels of the financial component

PHYSICAL PERSPECTIVE BUILDING LEVEL

Physical management on building level is related to the technical aspects of a campus. Reducing the footprint is one of the goals of many universities, whereby in the future they want to own less floor area. The prospect for many universities the campus of the future is smaller than the current campus, adding to profitability goals by decreasing the costs. Reducing the footprint by reducing the CO_2-emission and 'greening' the campus adds to the sustainable goal as well. Maintaining the minimal quality level to allow user activities and by controlling technical risks that could hinder the primary activities.

The maturity in the physical management is determined by the awareness of the state, knowing the percentage of the campus which is in a (very) bad condition, can support further decisions such as improving the condition, or disposal of the asset. Creating strategies to reach these goals to add value starts with knowing the current state.

The level of maintenance is determined by the frequency and the intensity (preventive or corrective) of the action in what timeframe. These activities are cleaning, repair and replacement. Corrective maintenance is failure based, where an item is used until it faults and then be repaired. With this type the maintenance date can be deferred to a later date. Preventive (or planned) maintenance refers to cases where repairs and/or replacement take place without the occurrence of any specific fault. This type is to prevent failures (Lind & Muyingo, 2011). The frequency in which the inspections take place will also have influence on the maintenance planning and strategy that is being adopted by an institution. Also involving users of the

buildings and their feedback is also a sign of a higher maturity level. The specific maintenance with different time spans and levels of details are (Lind & Muyingo, 2011):

- One very rough 20-year plan primarily made to identify the risk of a possible peak in maintenance in the future. Knowing this in advance makes it possible to start earlier, but also investigating different maintenance strategies that may reduce costs and spread the cost over a longer period of time.
- A more detailed 3 to 5 year plan where major renovations and maintenance activities are scheduled. This plan should be updated yearly given the uncertainty.
- A detailed plan for maintenance activities for the coming year. This yearly plan has to be updated several times a year given the uncertainty.

The maturity level of the physical management of the campus is also influenced by the information systems that is being used for (automatic) monitoring. The data systems which are old-fashioned will have influence on the maturity level on assessing the current levels of the conditions of buildings which will in turn have influence on the awareness of knowing the current state.

Level 1	▪ The institution is not aware of the current technical state of the university and does not has goals for the future campus ▪ There is a presence of a technical controller, which controls the technical quality of the buildings and facilitates the demand of square meters ▪ No research on future trends nor future changes ▪ No research on innovation to add value on the buildings nor to increase competitive advantage; 'old-fashioned' ▪ Corrective maintenance with only high intensity defects ▪ Poor indoor climate ▪ Minimum comply of sustainable development
Level 2	▪ They are aware of the current technical state of the institution and the problems. They have plans to improve the technical state of the building. ▪ Awareness of what the technical buildings costs are, and try to minimize these costs by minimizing the square meters, but not so much on improving the technical state to reduce these costs. ▪ Meeting the basic needs of users (indoor climate) ▪ There is a presence of statements related to goals, but not made concrete in plans yet. ▪ Corrective maintenance ▪ Planning and initiating sustainable development
Level 3	▪ The have explicit defined goals concerning the sustainable development of the campus, reducing the footprint. There is a presence of a 'campus vision' ▪ A monitor which measures and show the energy usage, the technical condition ▪ Presence of a maintenance programme ▪ Preventive maintenance ▪ Plans for sustainable development ▪ Plans to enhance the quality of the buildings and facilities
Level 4	▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Using alternative innovative materials and products which will reduce the footprint ▪ Plans to dispose qualitative bad m2 in supply; plans for new construction ▪ Renewal building components (renovation) ▪ preventive maintenance using alternative materials and products ▪ implementation or on-going plans for enhancing the quality of buildings and facilities
Level 5	▪ They have a strategy to encounter future changes in demand, and have alternative plans to

	meet this demand. ▪ Focus on creating added value such as reducing costs over the long run. ▪ Optimising and innovating; research on alternative and new materials on the market ▪ Renewal building components ▪ Tools and methods are advanced

Table 8: Maturity levels of the physical component (building level)

PHYSICAL PERSPECTIVE URBAN LEVEL

The physical management on urban level of the campus is more difficult to control by the policy makers. More stakeholders are involved such as the municipality, the environment, the neighbourhood and the residents. However, naturally a university institution should be included in a city vision, since it enhances the competitive advantage of a city. That is why the university can present the plans to the municipality. All the area outside of the campus is the responsibility of the municipal party, and everything that is within the campus can be developed by the university themselves. This is however affected by the availability of financial resources. The maturity of campus management draws a boundary here. Everything what is within the campus can be developed, and that is all what is taken into account in this paragraph. The ambition to share development plans which enhance the added value on city level can be a sign of a high maturity level (4-5). Institutions with a low maturity level are not aware of the added value of which a location can have on the competitive advantage of a university. They only facilitate the necessary academic buildings and parking possibilities. Not thinking of adding amenities nor a public space which has a relation with its buildings will have a negative influence on the quality of the built environment and the attractiveness of the university. When a university has a high maturity level, they think about sustainable development, but also the added value of having amenities such as retail & leisure, related business and housing to attract (international) students. Creating a place to stay is one of the most important goals that is defined.

Level 1	▪ The institution is not aware of the current urban state of the university and does not has goals for the future campus. ▪ Not awareness of the added value of the location of the university ▪ Public space is not used to add value on the campus (no meeting space, or creating connections between buildings, no place to stay ▪ No amenities added to the campus; buildings are only of academic purpose ▪ Corrective maintenance on the public space occurs only with high intensity defects ▪ Minimum comply of sustainable development
Level 2	▪ They are aware of the current state of the campus and the problems. They have plans to improve the public space, infrastructure, amenities. ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Meeting the basic needs of users (parking and roads) ▪ Corrective maintenance ▪ Planning and initiating sustainable development
Level 3	▪ The have explicit defined goals concerning the sustainable development of the campus. ▪ There is a presence of a 'campus vision'. ▪ Presence of plans to improve the infrastructure (roads, parking, accessibility) ▪ Presence of a maintenance programme ▪ Preventive maintenance ▪ Plans for sustainable development ▪ Plans to enhance the quality of the public space
Level 4	▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Preventive maintenance with using alternative sustainable materials and products which

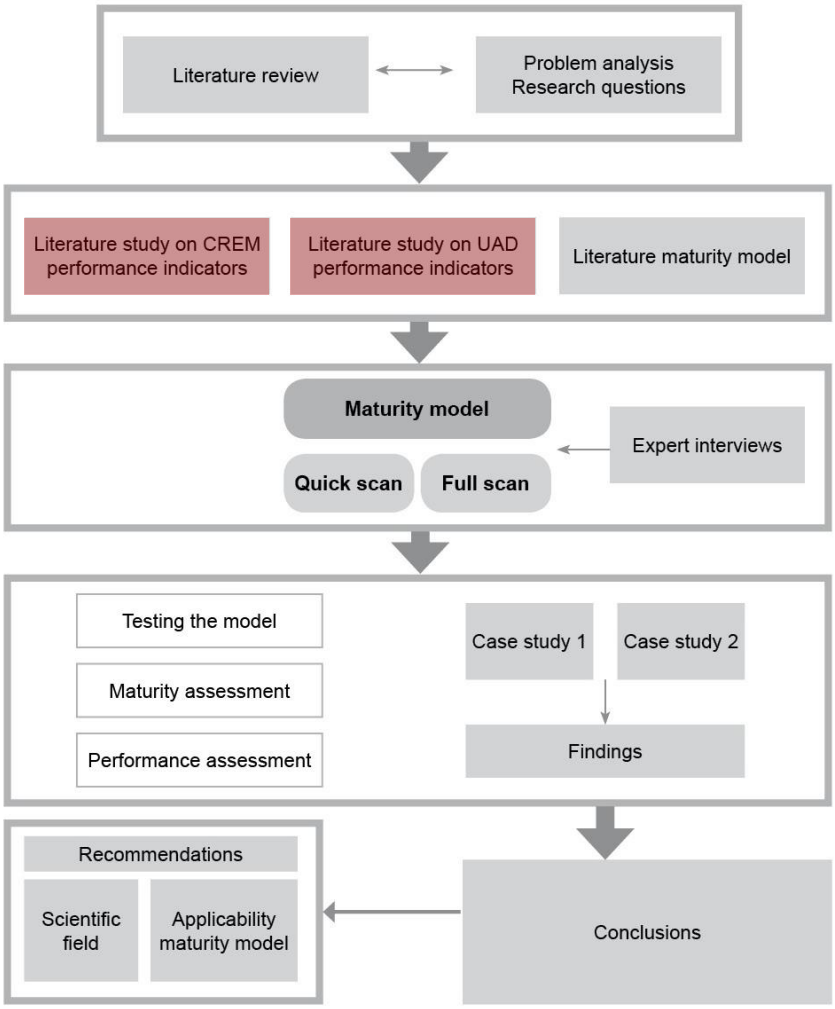
	will last longer and needs lower maintenance. ▪ Renewal/renovation public space ▪ Enhancing accessibility of the university ▪ Enhance relation buildings and public space ▪ Proactive in sharing plans with the municipal parties that create added value on urban development level ▪ Implementation or on-going plans for enhancing the quality of public space
Level 5	▪ They have a strategy to encounter future changes in demand, and have alternative plans to meet this demand. ▪ Scenario planning; e.g. an increase of people using the car will result in facilitating more cars ▪ Enhancing relation of campus with the city and the surroundings ▪ Optimising and innovating; research on alternative and new materials on the market ▪ Implementing new concepts for public space

Table 9: Maturity levels of the physical component(urban level)

Chapter 4

Performance indicators

This chapter explains the variables which determines the performance of a university divided in four different perspectives of strategic, functional, financial and physical view. Furthermore, the indicators take form in two different scale levels, which is the building level and campus area level. A theoretical approach with the complementary management forms of Real Estate Management and Urban Development Management are aimed to improve the campus management.



4. THEORETICAL FRAMEWORK: PERFORMANCE INDICATORS

This chapter summarizes the major findings obtained through an in-depth literature study on the two complementary management forms of campus and area scale levels in which the real estate objects is positioned: Corporate Real Estate Management (CREM) and Urban Development Management (UDM).
The theoretical approach with the complementary use of the instruments provided by both research field are aimed to improve the campus management. This chapter will provide the variables which affects the campus performance from the building and urban level. This list will be tested on through expert interviews to make the list more accurate.

4.1 PERFORMANCE MEASUREMENT

The organizational performance of a real estate facility is measured by the difference between input and output, which means the management of resources and supporting user activities. Performance is the measurement that considers the success of a company and its activities. It provides the basis for an organisation to assess how well it is progressing towards its predetermined objectives, to identify areas of strengths and weaknesses, and to decide on future initiatives, aiming to improving organisational performance (Amaratung & Baldry, 2002).

Figure 10 shows the performance pyramid developed by Judson (1990) and adapted by Cross & Lynch (1992). The performance pyramid establishes a clear relationship between goal setting and measurement, between business strategies and implementation. Work teams focus on quality measures, whereas leadership teams focus on process or strategy. The hierarchical structure of the organization shows the focus on the different aspects of the performance. The policy makers for example focus on creating the strategies and the campus vision of the university, whereas the facility manager is the executing force of the implementation of the plans, or the advisor of these plans.

Figure 13: Performance pyramid (Cross & Lynch, 1992)

4.2 PERFORMANCE INDICATORS ON ASSET LEVEL

QUALITY OF FACILITIES

Musa & Ahmand explain the importance of the physical assets and their facilities on the teaching and learning environment. The maintenance, and innovation of physical assets and facilities are important to ensure quality and maintaining world standards, and to attract students, staff and internationals to the institutions. Since it is so cost intensive, it is a challenging job for higher education institutions to move towards a more effective process (Musa & Ahmand, 2012). The indicators are related to the quality level of the building (layout, flexibility, ability, comfort level, safety and health), to which extend the facilities supports core activities, level of user-friendly environment, maintenance level, global acceptability of facilities, environmental/ campus quality (safe& clean, hygiene, green). The findings of their research indicated that when the quality of the facilities is low, this will have effect on their productivity or the quality outcome of their work. Furthermore, an environment that is safe, clean and gives a sense of belonging and pride is needed to become a high level maintenance culture. The indicators described will help to improve the environment towards a more effective process. Maintenance, renewal and innovation determines the quality of these assets and facilities. Quality assurance of these facilities will ensure effective realisation of goals and objectives of universities (Musa & Ahmand, 2012, p. 473).

Variable	Effect on campus performance
Attractiveness campus	The aesthetics of the campus is important for the user, and if the attractiveness of the campus is low, this can show in decline in the user satisfaction.
Quality of facilities (layout, flexibility, ability, comfort level, safety and health)	The quality level affects the user satisfaction, which in turn will affect the attractiveness of the university campus. It affects the comfort level, the productivity of the user and the degree of support in activities.
Quality of campus (safety, clean, hygiene, green)	Affects the level of user satisfaction, and the attractiveness of the campus.
Level of maintenance	Affects the quality of the facilities, buildings and campus area.
Level of renewal and innovation	Affects the quality of the facilities, buildings and campus area. Innovation can improve the support in activities and enhance the productivity of the users.

Table 10: List of variables 'quality level of facilities' and its impact of campus performance

KEY PERFORMANCE INDICATORS

The key performance indicators mentioned by Den Heijer (2011) are divided in four categories (strategic, functional, financial and physical component). The main variables which determine the performance are:

- *The functional perspective:* The key variable is number of users. For campus management on functional perspective it is important to determine the number of users per m² and the users output per m².
- *The financial perspective:* The key variable is money, measured in euro's. The financial costs are determined by the total income and costs of the institution and the real estate value.
- *The strategic perspective:* The key variable are goals. The strategic perspective influences the competitive advantage of an institution. The advantage is determined by the quality of education and teachers & courses and the user satisfaction.
- *The physical perspective:* The key variable of the physical perspective is m², floor area in gross floor area (gfa) and usable floor area (ufa). Besides the floor area, the technical condition of the building and the energy performance determines the physical perspective.

Variable	Effect on campus performance
Competitive advantage	
Ranking	The ranking system can affect the choice of the student to enrol. Ranking is measured on certain variables such as quality of education and research output. The ranking does not has direct effect on the campus performance, but it rates the performance by benchmarking with other universities.
Quality of alumni	Affects the quality of education and the user satisfaction. Losing competitive advantage.
Quality of education	Affects the user satisfaction and the overall strategic performance of a university. Less enrolments, losing competitive advantage.
User satisfaction	Important for the reputation of the university. A bad user review can result in less enrolments, losing competitive advantage.
Productivity	
Students & staff output	Citations, research contribution, research influence Affects the reputation/ranking
Space usage	Affects the productivity/m2, and thus the performance/m2
Profitability	
Total income & costs	A well-organized financial budget for the right use is more effective. Furthermore, more financial resources means more investing in goals= higher performance=better quality of the university
Real estate value	The real estate value does not have direct influence on the campus performance.
Sustainable development	
Energy efficiency	The energy efficiency affects the technical condition of the building, and thus the comfort level, health of the user. Furthermore, it affects the footprint of the building.
Technical condition	The technical condition affects the user satisfaction in terms of comfort & health. A bad technical condition will influence the energy efficiency negatively.

Table 11: List of variables 'Key performance indicators' adapted from (Den Heijer, 2011)

4.3 THE URBAN DIMENSION AND GOVERNANCE

KNOWLEDGE CITY, CAMPUS CITY

A university which is the source of producing and maintaining knowledge, skills and innovation plays a critical role in sustaining a cities' growth, and is key for the competitive advantage of a city. In order to sustain the growth and dynamism knowledge-based development is required (Chen, 2014).

The knowledge economy is defined as following by Van Winden & Van den Berg (2007, p. 527):
"*The knowledge economy is regarded as a separate section of the economy, the one in which new (technological) knowledge is generated. It comprises advanced activities in science, technology and innovation. Central actors are universities and corporate research establishments that conduct fundamental or applied research. They produce the knowledge that ultimately leads to new products, production methods and productivity growth*."
When a city has an increased knowledge-intensity, this will show in economic progress and attracting more human resources and investments, creating high-level jobs and high growth rates and innovation levels.
The performance of nations and regions in the knowledge economy is typically measured in terms of patens, R&D spending and innovations. Other factors which are mentioned are the urban amenities and quality of life which is the key determinant to attract and retain talented people. This involves the cultural activities, amenities, an attractive built environment, high quality housing, attractive parks and surroundings, and high-quality schools which are determinants for the competitive advantage of a city.
Urban diversity is also an important feature of a city's performance: diversity of inhabitants and types of economic actors facilitates the interactions that generate new ideas. This can be measured by the diversity in terms of the percentage of the population who are of foreign descent.

Quality of life determines the choice of people to study in that place, so creating a campus with a sense of place with a relation to its hosting city has a positive impact on the competitive advantage of the university. With the increased (global) mobility of students, the quality of life has an almost equal weight as academic quality and rankings, when choosing a place to study (Studyportals, 2012). When a campus is separated from the city, it requires more resources such as residential, retail & leisure and infrastructure functions. This would involve creating a new campus city. The five main components which makes a campus a 'campus city' (A. Den Heijer & Tzovlas, 2014, p. 167):

- The academic component related to the education & research facilities: classrooms, libraries, offices, meeting rooms, laboratories, lecture halls, workshops, storage space, studios, study places, academic hospital, conference facilities
- The residential component is to housing: student housing, faculty housing, hotels, short stay housing, housing support staff, alumni housing
- Related business component: accommodation for start-ups, incubators, research institutes, service providers (catering, printing, cleaning, maintenance), other (higher) educational institutions
- Retail & Leisure: coffee bars, restaurants, cafes, bookshops, supermarket, theatres, cultural facilities, sports, day-care centres, student associations
- Infrastructure: public space, parking, bicycle paths, roads, public transport facilities. The most important feature of the infrastructure is accessibility, which involves the connectivity of a knowledge city: access to (international) airports, high-speed train, public transport and highways.

Variable	Effect on campus performance
Number of patents	Related to the research output and influence. Has a positive effect on the reputation of a university.
Reputation	Reputation is an item that is built up by time. It is related to the image and popularity of a university, and thus not determinant for the real performance of the campus on the four components.
Amenities	Affects the attractiveness of a campus and its competitive advantage. Helps to enhance the quality of life.
Built environment	Affects the user satisfaction. A declining built environment is attached with a decreasing attractiveness of its campus.
Urban diversity	Diversity of inhabitants facilitates the interactions that generate new ideas. This has a positive effect on the creativity and diversity of a university. It is difficult to measure the direct influence of urban diversity on performance, which is why this is not a key variable.
Quality of housing	Has effect on the attractiveness of a campus. Especially for students who choose a campus based on the housing facilities. A good quality enhances the competitive advantage of a university.
Parks, public space	Affects the attractiveness of a campus and the user satisfaction. A bad maintained public space will represent decline.
Infrastructure *accessibility of campus* *public transport* *public space* *parking possibilities* *roads (pedestrian, bicycle)* *connectivity*	The infrastructural system is key for the accessibility and connectivity of the campus location. If the campus has good connections, there will be more enrolments from students who are living further away. It affects the competitive advantage of a university.

Table 12: List of variables 'Urban dimension' and its impact on campus performance

THE STUDENT COMMUNITY

The study of Van den Berg & Russo focuses on the student cities in European cities and the strategic planning and management of these communities. These communities including its students could be the driving force for urban development and the potential that they offer. The findings from the nine case studies can be summarised in explaining the importance of diverse, versatile student communities, the enhancement of the quality of education facilities and to build a creative, learning city which will functions as a sustainable student city. A student-friendly city should include attractiveness of its campus and facilities, which assist the students in supporting their functioning and enhance productivity, it should include housing for students, the community should empower students, increase the opportunities of contact between students and other stakeholders and enhance the embeddedness of the university as a city. The last point is to keep the students linked to the city after the completion of studies in order to keep human capital in the city and benefit from their knowledge. Education programs are generally carried out within the building level. What remains important is that the urban dimension should not be neglected. Students are the citizens and the high-skilled working class of tomorrow, and are crucial in supporting the economy of cities or neighbourhoods. The urban dimension of education programs should be attractive,

welcoming and managed locally. The exchange between cities and universities is an integral element of urban planning. Local universities and other higher education and research centres become fundamental elements of the competitiveness of cities and regions (Van den Berg *et al.*, 2003, p. 3).

The human capital formed by the high-skilled working class contributes the city's performance and quality of life. This statement is supported by Y. Jiang (Jiang & Shen, 2010) where he determines the urban competitiveness factors in Chinese cities in his research. He indicates that the human capital of education and that the quality of higher education contributes to the competitiveness of a city. His theory is based on the assumption that a higher number of colleges/ graduates and a higher number of expenditure of local government on education has impact on the competitiveness of a Chinese city economically and socially.

SURROUNDING NEIGHBORHOOD AND CITY

Along with local government, universities contribute in multiple ways to modern urban society. A university is a source of knowledge-creation, revolutions in science and technology, centre of culture, the moral forces shaping the civilized society. Universities contribute to the economic health and physical landscape of cities, serving the urban economy and built environment (Perry & Wiewel, 2005, p. 3). A good example where a university contributes to the image of a city is the city of Bilbao. The successful shift from an industrial port city to a creative city is triggered by the investment in culture by the government. Together with the Guggenheim museum and three universities, these institutions contributed to the redevelopment of Bilbao, attracting many (foreign) students and tourists (Wang *et al.*, 2014).

A university does not only affect the image of a neighbourhood, but is also a product which is affected by the relationship with the city and its surroundings. The strong belief of a 'university of the city' is seen as a community, removed from the chaos in the normal city, to produce knowledge and information. In the United States for example, they build campus environments (in cities) with an affinity with the purified, safe and calm life of suburbs (Perry & Wiewel, 2005). The state in which a university is related to a city is by all means dependent on the location of the institution (A. Den Heijer & Tzovlas, 2014). When a university is located outside the city, as described in the example, it is likely that they have a more 'calming' environment, in comparison of a university ín a city. A university which is located outside the city is more dependent on own amenities such as housing, related business, retail & leisure and infrastructure to stay connected to the city. A campus in a city includes retail & leisure, where a gated community is a campus in a city which has its own amenities. A university city is a city in where the campus buildings are spread in different buildings over the city, including their own amenities. The full list of campus types can be found in Appendix I.

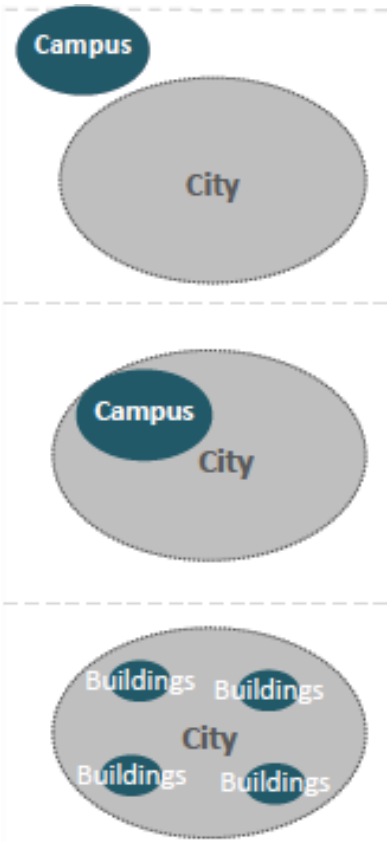


Figure 14: Location campus in relation to the city (A. Den Heijer & Tzovlas, 2014, p. 170)

The quality of the surrounding neighbourhood is also an important matter and is crucial for the attractiveness of a campus. When the surrounding neighbourhood is declining, the attractiveness of a university can be threatened. This is why a university cares for the quality of their surroundings. Safe streets, good transportation, attractive housing choices are beneficial for gaining competitive advantage of the campus location.

POSITION OF THE UNIVERSITY IN URBAN DEVELOPMENT

University leaders are able to embed their institutional development agendas into large citywide redevelopment agendas based on the arts, entertainment, sports facilities, and tourism. University real estate development strategies that are closely linked to larger urban development agendas require leadership, planning and risk management. Public-private partnerssships with citywide range of actors including private investors, federal agencies and municipal and state governments. The university uses it economic power and social influence to acquire property for needed facilities and to negotiate favourable development contracts for the expansion and redevelopment of the campus (Perry & Wiewel, 2005, p. 289). The position of a university is very important in terms of reaching their goals and mission concerning a crime-free, vital urban development, which enhances the quality of student life, and attracts top students and teachers. Because such a power position is not always applicable for most of the universities, this variable is not the determining factor for the performance level of an institution. A power position will only enhance the possibilities in reaching goals by putting influence on urban development and getting access to funding.

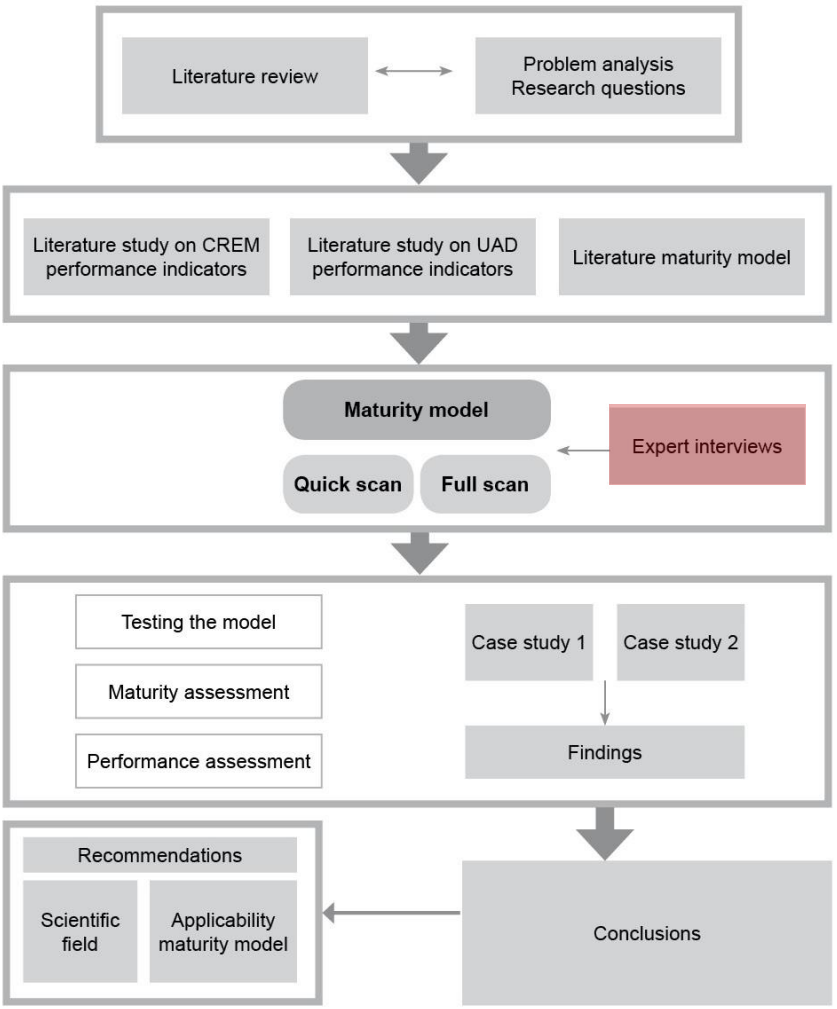
Variable	Effect on campus performance
Neighbourhood	Affects the attractiveness of the campus. A declining neighbourhood has a negative effect on the attractiveness of the university.
Location university in relation to city	The location of the university is determining the amenities it offers. It does not directly has influence on the performance of the university, but it is important to consider in what position the university is located before assessing the 'amenity-variable'.
Community	A community has positive effect on the university culture and image, but is a variable that is difficult to measure the effect on performance.
R&D and education spending	If the government spends a substantial amount on education, the university will have more resources to invest in reaching their goals, which means a higher performance.
Position of the university in urban development of a city (economic and social power)	The position can support a university in getting access to funding, and thus investing in their goals. This variable does not have direct influence on the performance.

Table 13: List of variables 'Urban dimension' and its impact on campus performance

Chapter 5

Qualitative research results & findings

This chapter explains the next step in the research following up the theoretical framework. The method chosen is to conduct several semi-structured interviews with experts from the facility department of Delft University of Technology. The choice of the interviewees are based on their expertise in the four components of the strategic, functional, financial and physical perspective. The goal is to explore what the experts find important in campus management from a different perspective.



5. RESULTS AND FINDINGS FROM QUALITATIVE RESEARCH

5.1 INTERVIEW STRUCTURE

The next step that has been taken in the research is conducting interviews with persons from the real estate development department FMVG (facility management). Their vision and view is questioned on what they think how the maturity level of campus management can be determined, but also what is important to develop the organisation to a higher level. The goal is to discover new information through in-depth interviews with experts in the field. In order to cover all the four perspectives the persons are selected based on their expertise within the organisation. Two persons who possess the knowledge about all the four components and one expert of the field of financial management and the technical perspective.

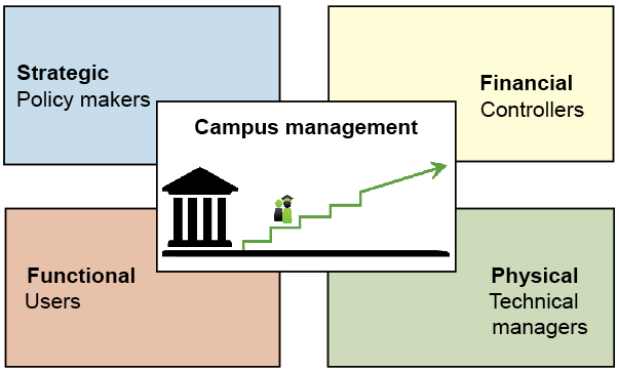


Figure 15: Four perspectives of campus management

Phase 1
During the research interviews will be conducted with experts from the field. The predefined maturity model which is explained in the previous chapter, will be presented and explained to the experts. Their opinion and input is being asked to help to make the maturity model more accurate. The subjects that are being treated are:

- The important factors which determine the maturity level of campus management
- Factors that can influence the maturity level of campus management
- The variables that affect the level of performance of a university

Phase 2
Because the goal of the research is to develop a quick scan and a full scan version of the maturity model, the interviewees is being asked on how much time and effort is related to collect the data of a certain variable. The list of variables is explained in chapter 4 of the report.

The results from phase 1 and 2 will be presented in a graph with two axes where all the variables are positioned based on their importance level and the effort that is needed to retrieve the data. Derived from these criteria of importance level and effort in retrieving the data, the quick scan and full scan model can be developed.

- Quick scan version: minimum variable list which contains the key variables with the least time and energy involved to collect this data.
- Full scan version: all the key variables, involving research methods which need more resources and time.

The complete interview framework and transcription is depicted in Appendix II. The next paragraph will explain the findings on the first phase of the interviews, next the second phase will be explained, in which the importance of the variables is being explained, including the time and effort that is needed to retrieve the data.

5.2 FINDINGS MATURITY LEVELS

FACILITY MANAGEMENT & REAL ESTATE DEVELOPMENT (FMVG TU DELFT)

The interviewees are from the facility department which have an overall view of all the four components (strategic, functional, financial and physical). They are responsible for advising the policy makers to create a campus vision and real estate strategy, but also for making these plans happening.

The facility management & real estate development department of the TU Delft is a university service, invests in quality of facilities and supporting systems for the primary processes of TU Delft. Their vision is to support education, research and valorisation through the added value of real estate and facilities. Through the efficient use of the available square meters, sustainable development and multifunctional use of space, costs will reduce in the long-run. The goals is to provide high quality places to stay and the creation of spaces that inspire and facilitate meetings, in the buildings as well as on the campus (FMVG, 2015a).
The FMVG translates the strategic goals of CvB (College van Bestuur) into a campus vision and real estate strategy. The campus vision explains the goals and how the campus should look in order to reach these goals. The CvB determines the vision for the campus for the coming 10 or 20 years, but also the focus for the coming years. The FMVG determines the process of facilitating education & research and making this possible. When there is a certain demand for space, e.g. a laboratory, FMVG will look into the supply and how to supply this laboratory. They will make an estimation about the costs, and developed a strategy on how to execute the plan. The FMVG possess all information concerning the buildings, its technical condition, the security, the energy usage, the indoor climate, the space usage. With this complete view of the campus which is documented in systems, they can provide alternative plans in how to reach a sustainable campus. They will investigate the use of alternative materials, the changing demand and trends and how to reduce the maintenance costs over time.

FINDINGS BASED ON INTERVIEWS

During the interview the developed maturity model is being presented to the experts. When is asked for factors which are important to take into account some interesting subjects came into the conversation. Factors that are mentioned as highly important and definitely are of influence on the maturity level of campus management are explained in this paragraph.

The *organisational structure* is the first subject to take into account when measuring the maturity level. The maturity of campus management is dependent on the position of the organisational structure. The policy makers have a strong strategic focus, which is shown in the campus vision and real estate strategy. However, most of the technical departments within the faculties possess a much lower level. They typically only have a technical focus (level 1), which is limited to the technical maintenance management of the building where they work.

The *level of goal focus to enhance competitiveness* drives up the maturity level of campus management. If an institution has a high focus to compete with other institutions they will have plans to make their campus more attractive.

- To make their campus more attractive they have to attract top talents, top professors and scientists and connect them to the university. By attracting (top) scientists, grants will be brought with them for their projects. Once the university has talents, scientists and good professors to offer, it will attract (international) students.
- The attractiveness of the facilities, buildings and public space is likewise an important factor for students and staff for choosing the university. First the attractiveness is related to the aesthetics of the buildings, not necessarily beautiful architecture, but a maintained look. A clean and a healthy environment in and outside of the buildings is essential for people (Berghorst, 2015). Second the

attractiveness is related to the willingness for people to go to the university. This can be influenced by the reputation, the location (accessibility, distance). Then the quality of the environment is not the determinant factor for the choice of university (Valks, 2015).

- To strengthen the position of a university, they can collaborate with other institutions. They can work together, bundle their strengths to make innovational projects happen in order to stay ahead of the competition, especially internationally.

The *management of their information systems* and the *skills of people* are an important factor which influence the maturity level of campus management. A lack of expertise, where people lack the analytical skills to make links in complex relations in a bigger picture, can cause a lot of problems on long-term planning. People are mostly good in their field, but not necessarily in understanding the bigger picture and the vision of an organization.
Information systems need to be developed, in order to make information transparent, where information is shared in a understandable way for all the people. An example is BIM (Building Information Modelling), where all the data and information between stakeholders (owners, managers, designers, engineers and contractors) in a design & build process is shared in one master model. An adjustment made by one of the parties can be seen by the other in the same model (Eastman *et al.*, 2008). By professionalising information systems adaptions can be made faster, as well as fastening the process as a whole. In institutions where information and data is produced and documented by human work, the margins in terms of reliability are fragile (Van der Kolk, 2015).

When information is transparent and easily shared between stakeholders. A *united mind* can be reached within the institution. If all the information and facts are shared, the technical managers in a faculty, who typically are limited by the building they work in, can be convinced to reach a strategic level as well. Showing them facts and information which displays that things can be different to create added value on the long-term, can help them to make the next step towards strategic thinking.

A status related factor which influences the maturity level is the *level of urgency*. A university tends to be more efficient and effective when the situation is urgent. A good example was the facilitation of the Faculty of Architecture in 2008, when a fire caused the building to be highly damaged and unusable. In a short time-span the users of the buildings needed to be facilitated in a new building. The choice came to the current old building on the Julianalaan, since new construction would take too much time and money.

The *management of financial* resources are in the end the determinant factor on what the goal focus is of a certain university. When the budget is low, it is likely that the institution wants to focus on continuous operation. The possibility then exists that they do want to innovate and become more attractive, but the financial resources are absent. For an institution with a sufficient budget, the allocation of money is important. A high maturity level expresses in allocation of budget for future projects, but especially investments which will create added value on the long-term. Furthermore, risk management is also a sign of a higher maturity level.

Lastly the *urban area* of the campus is becoming more and more important recently. Since the choice of a university not only is affected by the reputation, the quality, its facilities and its location, but also the urban structure and the relation with the city, it is highly important to mention in the maturity model. The relation of the campus with the neighbourhood affects the attractiveness of the campus. Amenities outside the campus, in the neighbourhood or the city are also a determining factor for students and staff to choose a certain university. Examples are housing, shops, restaurants, cafés, leisure that are not offered within the campus. However, this is by all means affected by the distance between the campus and the city. If the city is nearby, the city can serve the university in terms of added value. When the distance to the city is high, and the connection is bad, a campus should offer all the amenities themselves such as retail, leisure, related business and housing.

5.3 IMPORTANCE & TIME/ EFFORT OF THE VARIABLES

In the literature study a list of variables is the result. This chapter will elaborate on the key variable list divided in the four perspectives of strategic, functional, financial and physical variables. This part contains the second part of the maturity model, which is providing the evidence on physical level. This 'evidence' is determined by the variable list that affects the performance of a campus. Each variable will be explained, complemented by the methods that can be used to obtain the information needed.

The variable list is the maximum list of variables which influences the performance of a university. This paragraph will position these variables in two axes related to the effort needed to obtain such information concerning a certain variable, and the axis of the importance of a variable.

- Quick-scan: minimum variable list which contains the key variables with the least effort (time and energy) involved to collect this data.
- Extensive list: all variables excluding the least important variables

The variables used are the ones determined in paragraph 4.3. Through interviews with FMVG (depicted in Appendix II) the importance and the effort in retrieving the data will be determined. The result is showed in the figure rating from 1 to 5 in which 5 is the best in the importance axis, and the least favourable on the effort axis (see table).

Importance variables	Effort in retrieving data (energy & time)
1= very unimportant, not relevant	1= very low effort
2= unimportant	2= low effort
3= neutral	3= neutral
4= important	4= high effort
5= very important, essential	5= very high effort

Table 14: Explanation research scale 1-5

Strategic component

The strategic components are the most important variables which affects the performance. It is determined by the quality of education and facilities. The quality of these subjects determine the user satisfaction. Especially the user satisfaction is very important, because user satisfaction determines the reputation of the institution. The research output is also important, since this is the value which expresses the performance of a university. The influence of the research and valorisation is very important.

Functional component

Students & staff output not very important because it is difficult to connect this physically with a building. Space usage and functional mix are both very important. This is about what transformation can offer for the faculty. The possibility of transforming office space to education space for example means a double function of a space. This reduces the overall demand for space and reducing square meters over the long-run when all spaces are flexible in use.

Financial component

The total income & costs are an important determinant for the performance level of a university. The budget in the end determines the execution of plans, but also the possibility to make plans. Investing in the future and better materials which reduces the costs over the long-run is also affected by the availability of financial resources. Public universities are a non-profit organisation, so they do not find generating revenues (through related business for example) very important, but the costs should not exceed the benefits. When investing in a project, a university does not aim to make profit, but more about the added value that can be reached. An example would be adding amenities such as retail & leisure, creating a place to stay for students & staff, making the campus more attractive for (international) students.

Physical component (building level)
The physical variables concerning the building are very important. The energy efficiency, the condition determine the indoor quality of the buildings and thus the user satisfaction of a building. It is about the societal aspect: sustainability, health, planet, and sustainable use of available resources, but also it also affects the attractiveness of the buildings and campus.
The energy efficiency is becoming more and more important in the future. investing in sustainable materials will reduce the energy costs in the long-run, and contributing to the planet.
The technical condition shows when a building is at the end of its lifespan (technical, functional), but also the maintenance that is needed. The level of maintenance is very important. Using preventive methods by using new products can reduce the costs over the long-run, or reduce the frequency of maintenance. The maintenance for different types of space can differ. Lab spaces for example need more maintenance, because demand changes in a short period of time (project related).

Physical components (urban level)
The physical variables related to the urban level ranks most important on the importance list, next to the quality of education. The performance of these variables affect the competitive advantage of a university. Added value by a good infrastructure system, where the accessibility of the campus is very good, and well connected to the city centre or other cities are certainly attractive for students and staff. Good public transport and parking possibilities makes it more easier for the students and staff.

The amenities that the university offers are highly important. It support the campus activity to produce and share knowledge. By creating a campus to stay students, employees, companies and businesses will be stimulated to meet and share knowledge in the public space. Furthermore, adding housing, retail & leisure to campus makes it more interesting for international students.

Furthermore, the relationship of the campus with the surroundings and the city is very important. If the city is located nearby, the city can serve the university by offering the amenities the campus do not have to offer then.

The variables which are determined from the literature, but does not has direct impact on the campus *performance*, are left out in the interviews to test. The variables not enclosed, due to the fact that they are not the key variables are:

- Ranking: The ranking system can affect the choice of the student to enrol. Ranking is measured on certain variables such as quality of education and research output. The ranking does not has direct effect on the campus performance, but it rates the performance by benchmarking with other universities. Basic info of MM (step 1)
- Reputation: Reputation is an item that is built up by time. It is related to the image and popularity of a university, and thus not determinant for the real performance of the campus on the four components. Basic info of MM (step 1)
- Urban diversity: Diversity of inhabitants facilitates the interactions that generate new ideas. This has a positive effect on the creativity and diversity of a university. It is difficult to measure the direct influence of urban diversity on performance, which is why this is not a key variable.
- Community: A community has positive effect on the university culture and image, but is a variable that is difficult to measure the effect on performance.
- R&D spending by government: If the government spends a substantial amount on education, the university will have more resources to invest in reaching their goals, which means a higher performance. This variable is not relevant for determining the performance level, since the amount of what the university receives does not say much about how they spend the money. The income & costs variable will suffice for this purpose.
- Position of the university in urban development of a city (economic and social power): The position can support a university in getting access to funding, and thus investing in their goals. This variable is difficult to measure, plus it does not directly have influence on the performance level of a university. Furthermore, a high position does not necessarily mean this will show in the performance.

5.4 RESULT: POSITION VARIABLES AND THE RELEVANCE

In figure 16 & 17 is depicted how the variables are positioned on the importance- and effort- axis. Figure 16 shows that all variables are quite important, especially the quality of the education and the environment that supports the activities. Less important are the real estate value, the students & staff output because this does not directly relate to the performance of a university. As shown in the figure, all the variables that are presented to the experts, they find important. All these variables will be included in the full scan of the maturity model, except the real estate value and the users output. The selection of the variables between the quick scan and full scan model are based on the amount of the effort that is needed to retrieve the data.

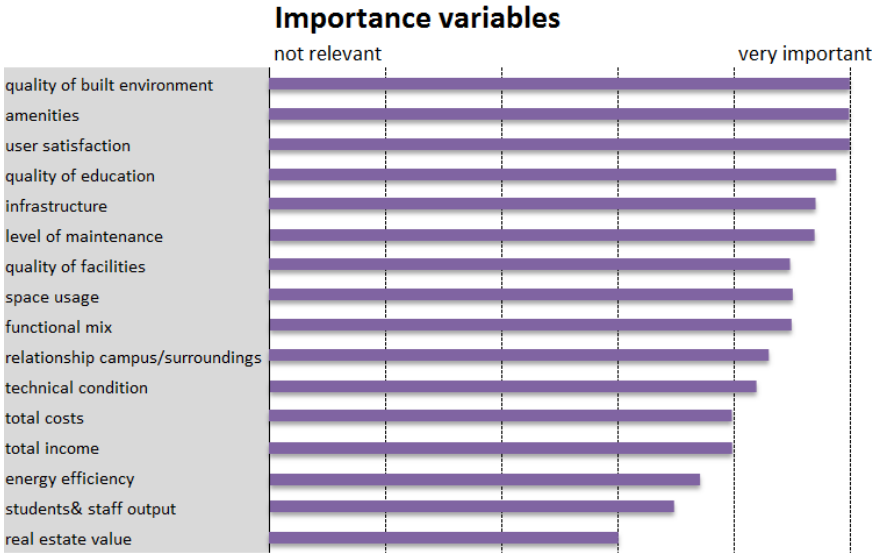


Figure 16: Variables positioned on the importance axis

Figure 17 shows the effort in retrieving the data that is related to each variable. It shows that the urban physical information is easy to find, such as the amenities and infrastructure. Harder to find are the variables which involves field research such as observation or opinions. It also depends on the maturity level of a case, whereas they already have developed monitors to measure the energy efficiency or the scores related to quality.

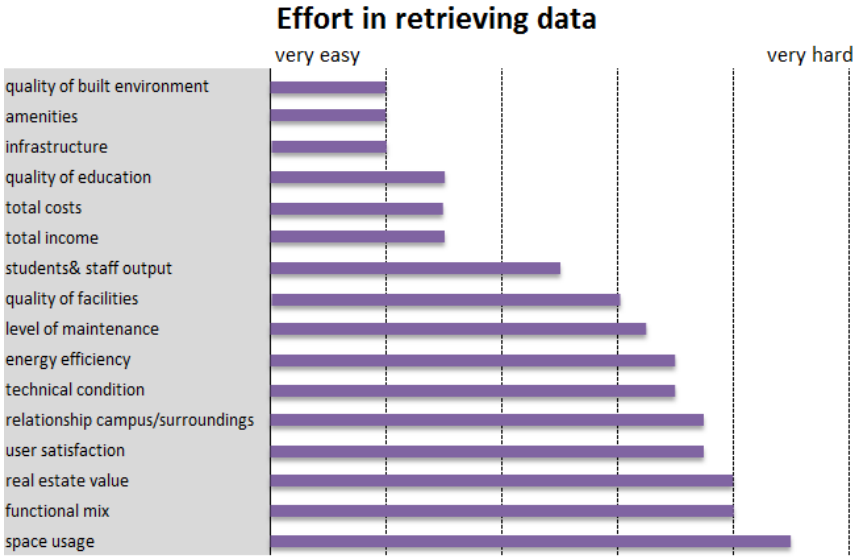


Figure 17: Variables positioned on the effort to retrieve data- axis

The next step in the research is to position the variables on both the importance and effort axis, in order to determine the key variables for the full scan, and the variables for the quick-scan. Based on the theoretical framework and the expert interviews the variables can be ranked in 'importance' and 'effort in retrieving the data' (see figure). The variables on the least important plane, below the middle will not be used in both the quick and full scan.
This figure shows that the quick-scan mainly contains the physical variables which will provide a good view of the quality of the campus on the selected case. The data needed can be retrieved through easy ways such as reading annual reports, technical reports, ranking systems, the website, analysing maps and floor plans. The quick-scan model will provide the researcher a complete view without using much resources.
The full scan contains *all* the key variables which are indispensable when providing a full view of a universities performance. This scan involves field research such as observation, contact with users of the campus and (semi-structured) interviews.

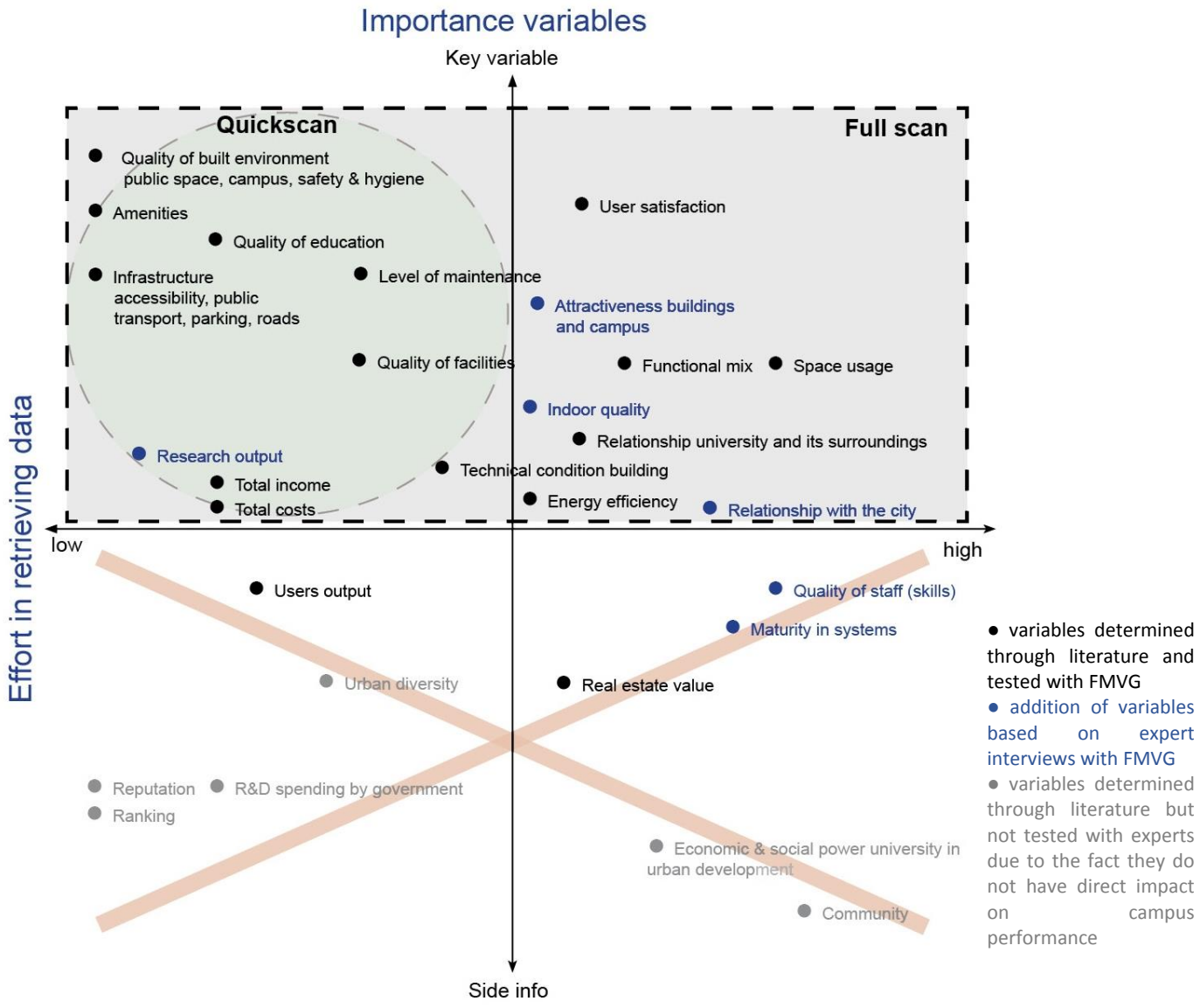


Figure 18: Variables positioned on the 'importance' and 'effort in retrieving data' axis

NEW ELEMENTS AND FINDINGS BASED ON INTERVIEW EXPERTS:

As shown in figure 18, some variables (blue in figure 18) where added by the experts. The variables which have been added to the figure by FMVG (2015b) are:

- The importance of the indoor quality: the indoor quality differs from the technical condition of the building. The indoor quality is affected by the technical condition, and affects the user satisfaction. That is the reason why this variable is indispensable (Berghorst, 2015).
- The importance of the maturity in systems they use: as explained in the maturity level of campus management, the systems and programs that are being used affects the level of information sharing between stakeholders, but also the accuracy of information that is documented and measured (Van der Kolk, 2015). It does not affect the performance level of a university directly, that is the reason why it is not included in the full scan.
- The skills of staff (excluding teachers) who work at the service departments such as finance, facility management and research are very important for the maturity level of campus management (Van der Kolk, 2015). However, it does not affect the performance directly (not determinant).
- The importance of the relation of the campus with the surroundings, but especially the city (Berghorst, 2015).
- The research volume, income and amount is also a good measurement to measure the research output performance of a university (Valks, 2015).

5.5 HOW TO MEASURE

The variables which are determined for the quick scan and full scan need to be measured. This paragraph explains each variable of the model, combined with the method to measure the regarding variable. Furthermore, the scale of values will also be explained.
Data concerning the urban factors can be done by an area analysis, which include analysing floor plans, but also conducting interviews or questionnaire with users of the campus. The data concerning the building level can be obtained through building floor plan analysis, interviews with the facility management and reading (annual) reports of the university. Data concerning the competitive advantage can be found in ranking systems mostly. The financial variables can be found in annual reports. The functional variables concerning the space usage can be collected through observation of analysing floor plans.

Strategic variables
The *quality of education* is defined by the quality of the teachers and the courses provided by the university. The quality of education affects the performance of a university with an outcome of the quality of the human capital it provides. The method of measurement can be obtained through the international ranking system, where the quality of the institutions education quality is measured. Reviews of the university and courses can also be consulted. Other methods to determine the quality of education is to conduct interviews with the students, or using questionnaires. The objects of data collection lies in the users (the students) and documents containing reviews of the quality of courses and teachers.
The *quality of facilities* is defined by the attractiveness of the provided facilities of the university. It contains the comfort level, safety and health issues on user side. This data can be collected through questionnaires or interviews asking for the opinion of the users. The physical aspect of facility quality is based on the layout, the flexibility and ability of the floor plans of the buildings. This data can be collected through floor plan analysis, drawings and building reports.
The *user satisfaction* is defined by the opinion of the users of the buildings and campus. It is influenced by the quality of the provided education, services, facilities and amenities. The relevant data can be collected through examining reviews, students and staff monitors, conducting interviews or using questionnaire to determine their satisfaction level on different aspects of the campus. The values vary from very discontent to very content.

The *research* is defined by the influence, volume and income of the research (Times Higher Education, 2014b). The ranking system of the Times Higher education give a good image this variable.
The *attractiveness of the campus and the buildings* is defined by the aesthetics of the buildings and campus, which can express in beautiful architecture. More important is the maintained look of the buildings and the campus. A clean, safe and healthy environment. The data to be collected can be subjective, where the researcher analysis the buildings and campus. Furthermore, surveys and interviews can be conducted to collect the opinion of users.

Strategic component			
Variable	**Primary stakeholder**	**What to measure (values)**	**Method**
Quality of education and research *teachers* *courses*	policy makers users	user satisfaction degree of quality	objective data review reputation monitor ranking systems
Quality of facilities *lecture rooms* *classrooms* *conference rooms* *libraries* *study places* *meeting places* *canteen/cafe* *shops*	policy makers user technical manager	user satisfaction attractiveness layout flexibility safety level comfort level health level	data analysis (report, review) building/floor plan analysis
User satisfaction	users	satisfaction level of the provided education and facilities	Student and staff monitor Questionnaires interviews
Research *influence* *volume* *income*	users	publications & diplomas number of patents research income research productivity	data analysis (annual report) ranking systems
Attractiveness buildings and campus	users	level of attractiveness of the campus based on opinions maintenance, health, hygiene, safety	Survey Interviews Monitors

Table 15: List of strategic variables

Functional variables
The *space usage* is defined by the amount of users per m² and the occupancy rate of the facilities. This data can be obtained through previous research reports concerning the space usage by the university themselves, or when this is not the case, conduct such a research yourself by observing the university. However, this method is very time and energy consuming.
The *functional mix* of the university is defined by the amount of mixed use and flexible use of floor space of facilities and the percentage it occupies in m². To collect such data floor plans have to be analysed.

Functional component			
Variable	**Primary stakeholder**	**What to measure (values)**	**Method**
Space usage *occupancy rate*	users	students/m2 employees/m2 energy costs/m2	data analysis in-field monitoring
Functional mix	users	multi-functional space use use by different user groups	maps, floor plans reports

Table 16: List of functional variables

Financial variables

The *total income* of a university are defined by the funding the university receives from the government, the tuition fees, interest and investment income, research grants, endowment income and other income.
The *total expenditure* is defined by the staff costs, interest& finance costs, operating expenses (includes energy costs), depreciation and other finance costs such as activities and education services(Higher-Eduation-Statistics-Agency, 2015). The data concerning the total income and expenditure can be found in annual reports of the universities. A positive balance between costs and benefits is also important.

Financial component			
Variable	**Primary stakeholder**	**What to measure (values)**	**Method**
Total costs *investment level* *operation*	controller	euros (€) how much spent on what how they use financial resources	annual report, database
Total income retail & leisure *fees* *research*	controller	euros (€) how much earned with what	annual report, database

Table 17: List of financial variables

Physical variables A: building level

The *energy efficiency* is defined by the energy use & CO_2-emission per user and per m², footprint and energy label. The information can be found in energy report if provided by the university.
The *technical condition* is defined by the quality, age and materials used of the building. This can be rated in a certain condition level and can be found in technical reports. The condition of the buildings are assessed through norms which are determined per country. In the Dutch case the NEN norms are used to assess the condition of the building. This is called the six-points scale, where the condition is rated from very bad to excellent. The condition assessment occur through the assessment of defects and maintenance activities (Straub, 2009). Furthermore, the condition can be assessed through defects: the importance of defects which indicates to what extent it influences the functioning of building components. The standard classifies the importance of defects into minor, serious and critical. The intensity of defects influences the condition of the building components. The intensity deals with the degradation process. The intensity stage are low, middle and high. The extent of defects is needed to assess the condition of the building. The extent classes go from 'the defect occur incidentally' to 'the defect occurs generally' (Straub, 2009).
If such technical reports are not provided when conducting a case study, an inspection on field is then necessary.

The *indoor quality* is defined by the comfort level and user satisfaction concerning the indoor environment. It is affected by the technical condition, the climate systems, the lighting and materials. The data concerning the indoor quality can be collected through the analysis of monitors, conducting interviews/surveys or visiting the location.
The level of maintenance is defined by the maintenance strategy, and how an institution maintains their buildings and facilities. The maintenance planning influences the condition of the building and the building performance. Lind & Muyingo (2011) defined the maintenance operations in a subdivision of corrective maintenance and preventive maintenance. Corrective maintenance is failure based, where an item is used until it faults and then be repaired. With this type the maintenance date can be deferred to a later date. Preventive (or planned) maintenance refers to cases where repairs and/or replacement take place without the occurrence of any specific fault. This type is to prevent failures.

Physical component A: Building level			
Variable	**Primary stakeholder**	**What to measure (values)**	**Method**
Energy efficiency	technical manager	energy use/m2 energy use/user CO2-emission/m2 CO2-emission/user footprint/m2 energy label	data analysis technical reports semi-structured interview
Technical condition	technical manager	age quality of building the percentage of the campus in (very) bad technical condition	technical reports condition based monitoring
Indoor quality	technical manager users	comfort level user satisfaction	monitoring questionnaires interviews
Level of maintenance	technical manager	corrective maintenance preventive maintenance replacement building components use of new materials	technical reports condition based monitoring

Table 18: List of physical variable on building level

Physical variables B: Urban level
The *quality of built environment* is defined by the quality of the surrounding neighbourhood, the campus, public space, housing and parking. The safety, hygiene and health influences this quality. The data can be obtained through conducting interviews or questionnaires with users of the campus (students, visitors & staff) and the inhabitants (concerning quality of the neighbourhood). Regularly, the quality of a campus can also be found on ranking systems, or reviews concerning the university. The quality of the built environment is one of the factors which determines the attractiveness of a university campus.
The *amenities* of a university campus are defined by the facilities the university provides next to the academic education & research facilities such as classrooms, libraries, offices etc. These are (student)housing, related business facilities, retail & leisure. These can be measured in values of amount, size, and percentage of the campus. To collect this data floor plans of the campus are needed to analyse.
The *infrastructure* is defined by the accessibility of the campus location. Accessibility refers to the inter and intraregional transportation networks and includes the functioning of the flow of people (Johansson, 1993).

A good infrastructural system means good accessibility of the location, which enhances growth and the competitive advantage of a university. The provisions of public transport, the roads, the public space, parking possibilities and connectivity of the campus with other cities or amenities such as an airport is also an important matter to support the competitiveness.
This data can be found through a campus area analysis by using (road) maps, campus maps and public transport maps. In this analysis it is important to emphasize the kind of public transport the location offers, the distance to these facilities, the number of public transport lines, the frequency and to what cities/amenities the location has direct connection to.
The *relationship campus with its surroundings* is defined by the connection of the campus with the surrounding neighbourhood. In an area analysis this relation can be determined. The same goes for the *relationship of the campus with the city*. Also the amenities which the campus and city shares need to be determined, the distance to the city, and the added value of the city.

Physical component B: Urban level			
Variable	**Primary stakeholder**	**What to measure (values)**	**Method**
Quality of built environment *neighborhood* *campus* *public space* *housing* *parking*	users	quality level attractiveness layout public space (% of campus) safety level hygiene level	data-analysis interviews city report urban/campus area analysis
Amenities *housing* *related business* *retail & leisure*	users	amount kind size (m2) % of campus distance in m/km	data-analysis drawings interviews
Infrastructure *public transport* *public space* *parking possibilities* *roads (car, pedestrian, bicycle)*	users policy makers	accessibility of the campus provisions (distance in m/km) number of parking spots (% of total users of the campus) quality of roads public space (% of campus) connectivity to other cities/airport	urban area analysis road-, campus-, public- transport maps
Relationship campus and its surroundings	users policy makers	connection with neighborhood connection with facilities/amenities outside the campus provisions	urban area analysis road-, campus-, public- transport maps
Relationship campus and the city	users policy makers	to what extent do users of the campus use the city, and what facilities? provisions division amenities campus and city amenities which are both offered by the campus and the city distance	urban area analysis road-, campus-, public- transport maps

Table 19: List of physical variables on urban level

5.6 CONCLUSION FINDINGS

The goal of this chapter was to determine the variables and the methods for the quick scan and full scan model. The variables where selected based on the importance and effort to retrieve the data criteria. The and methods for the quick scan are:
Methods:

- Analysing reports (annual reports, technical reports, financial reports)
- Analysing plans and visions (campus vision, real estate strategy, planning)
- Online-resources (website, ranking systems, monitors, reviews)
- Area analysis (maps, drawings, floor plans, public transport maps)

The next figure shows the framework of the quick scan model:

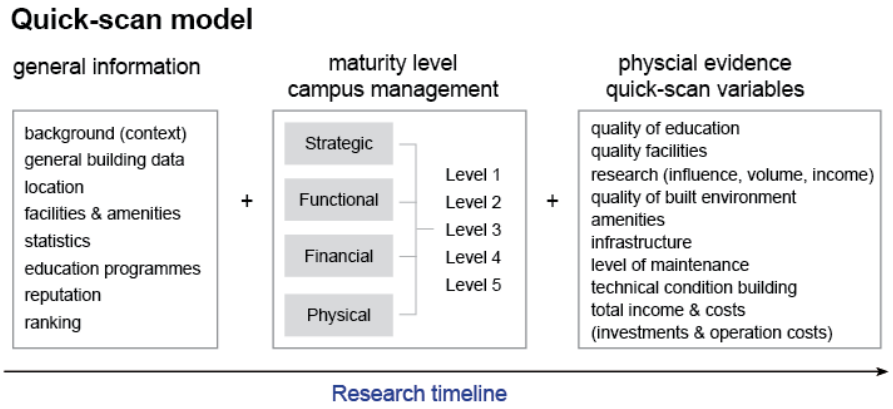


Figure 19: Quick scan model

The variables where selected based on the importance and effort to retrieve the data criteria. The methods for the full scan are:
Methods:

- All the methods described in the quick scan, complemented with:
- Visiting the location (observation, analysing buildings and campus, space usage)
- Conducting interviews (with experts, or people from the university)
- Conducting surveys

The next figure shows the framework of the full scan model:

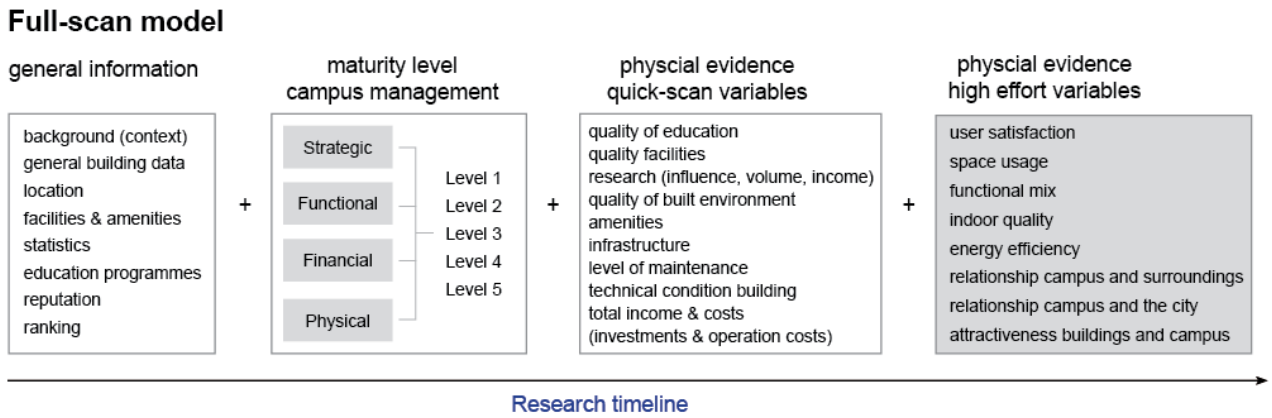
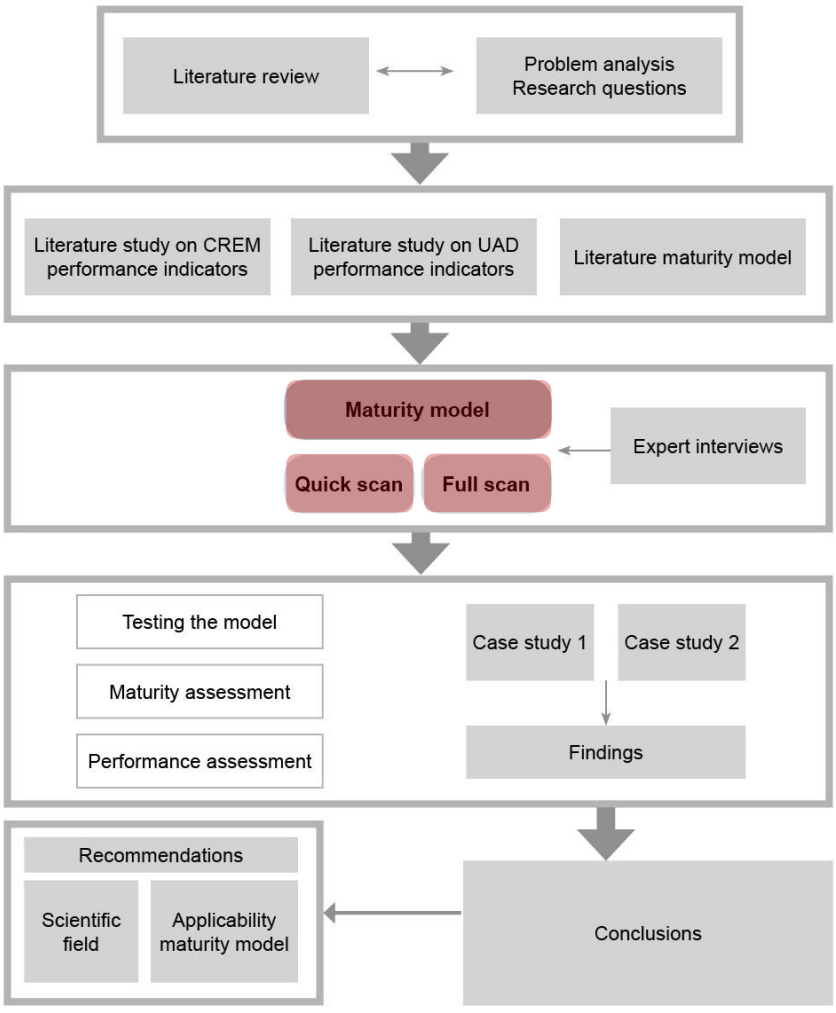


Figure 20: Full scan model

Chapter 6

Operationalisation maturity model

This chapter explains how the maturity model can be used and provides a framework on how to apply the developed model. The model is subdivided in four steps to carry out. The first step is to collect general data concerning the case. This data is necessary to understand the context in which the case is located, and to have general knowledge about the education, facilities, the statistical facts and the location of the case. The second step is to determine the maturity level of campus management. The third and the fourth step is to collect physical evidence of the actual performance of the university. The MM has two kind of applications: the quick scan model; which can be used in case of limited research resources, and the full scan model; which takes a higher amount of effort to collect the necessary data.



6. MATURITY MODEL

6.1 APPLICATION OF THE MATURITY MODEL

This chapter explains how the maturity model can be operationalized. Chapter 3 explained the management perspectives of campus management and the five levels that exist. Chapter 4 explained the performance indicators which shows on the four perspectives. The performance level act as evidence indicator for the implementation of the management. The summarized framework of the maturity model is shown in the figure below.

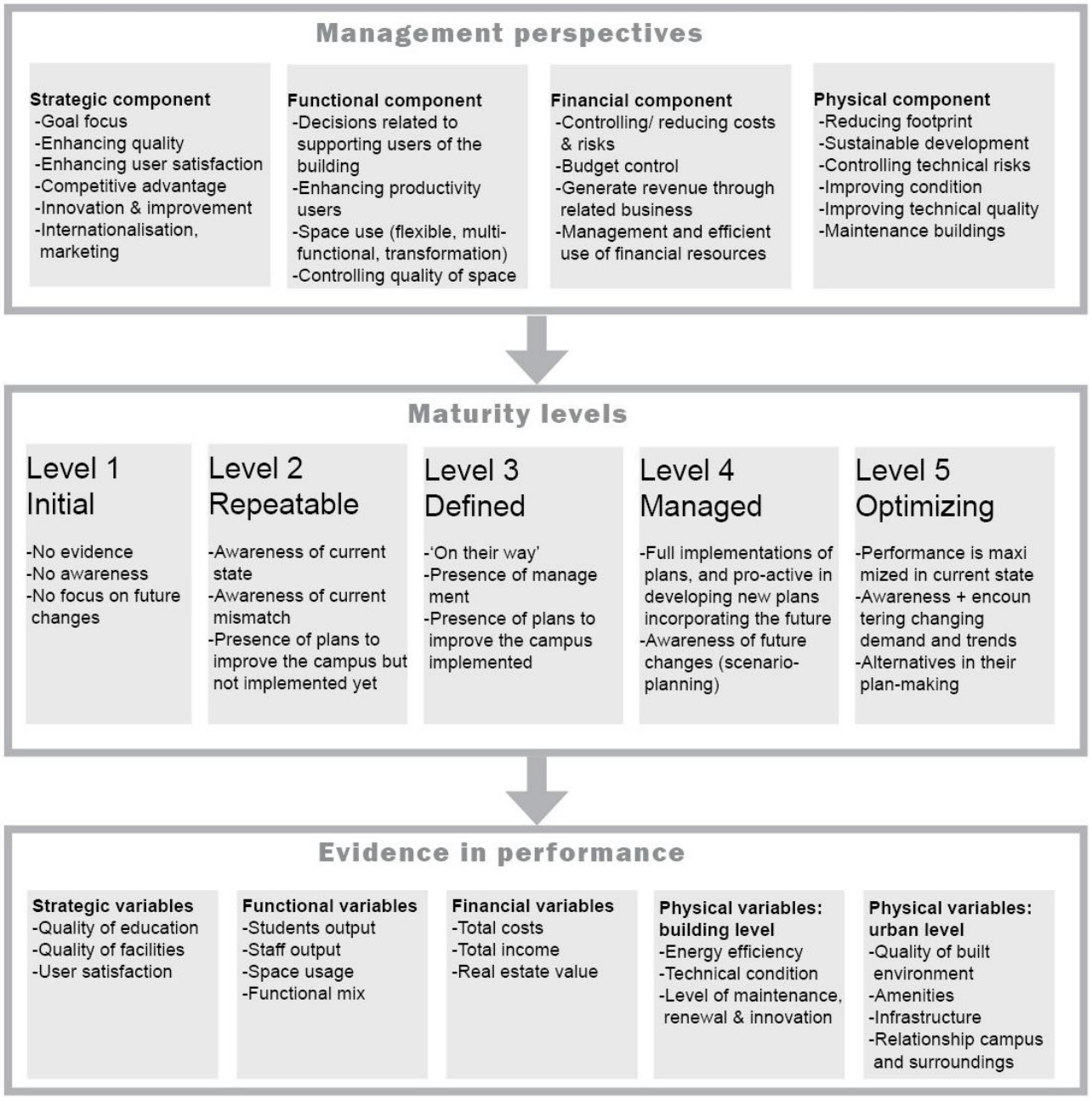


Figure 21: Framework of the maturity model

6.2 OPERATIONALIZATION MODEL

This paragraph explains how the maturity model is to be applied. The short list is to apply the developed maturity model which concerns the variables which impact the performance of an institution. If one is interested in gaining more knowledge and understanding of the case, one can also add a case study analysis concerning the governance, urban planning, education system within its context. If the study is only about providing a (quick)scan, the maturity model can be used. The components are based on a study which provides a university the indicators which maximizes their performance, but which are not necessarily focussed on a certain context.

Assessing the maturity level of campus management:

- Quick-scan: The quick-scan variation contains an objective research using documents such as annual reports, the website, ranking systems, reviews, monitors, maps and drawings, technical reports.
- Full scan contains semi structured interviews with experts. When technical reports cannot be found, a technical manager can be asked for their opinion.

Whether a quick-scan or full scan is going to be conducted, first basic information should be collected. The basic data concerning the case can be found in multiple sources such as reports and on the internet.
The specific steps that needs to be taken are:

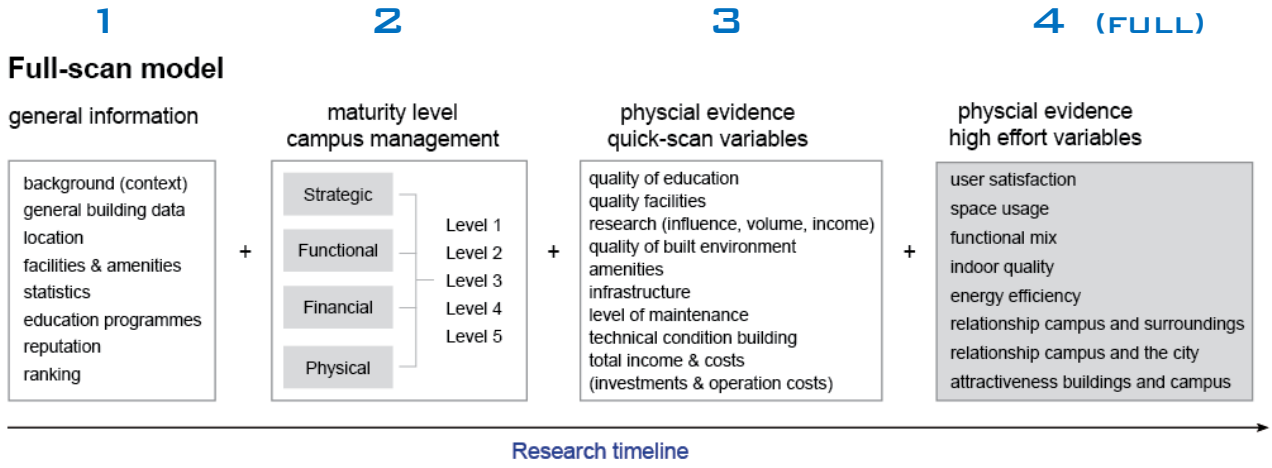


Figure 22: Different steps of the maturity assessment

The next paragraph will focus on explaining the different steps to be conducted in application of the maturity model. The full framework with detailed instructions and explanations are depicted in Appendix IV.

STEP 1 : COLLECTING BASIC DATA

You start with the collecting the background data concerning the case. This data is related to the context of the campus. Furthermore it is important to know if the campus is location in or outside the city, which type of campus it is (60's,70's/ residential/ science park/ medieval campus/gated community/ university city), public or private university. Furthermore their reputation, ranking position and influence need to be explained. Complementing that basic information about the campus such as size, and some general statistics. The specific basic information is explained in the table below.

	Instructions	Where to find
Background data (context)	Describe the location of the case Describe the country, some governance, education structure	Maps, floor plans campus
General building data	Note down the general technical building information. Size of the campus, how many faculties and size	Documents on the website
Statistics	Note down the numbers of students & teachers, enrolments, graduates/year	Annual report
Education program	Make a list of how many and what courses the institutions provides and what kind	Website Reports
Reputation, ranking, influence	Describe their research influence/patents/ their ranking/ income through research	Annual reports

Table 20: Step 1 of the MM framework

STEP 2: DETERMINING THE MATURITY LEVEL

The different maturity levels to be measured from the different components are explained in chapter 3. The application of this model is as following: First the variables of each strategic, functional, financial and physical perspective is shown. The intention is to find these variables through analysing the data. Each certain maturity level contains a different set of variables, which are characteristic for each level. However, each higher level is an summarization of the lower level, which means that the aim to find these variables should start from level one. The assessment criteria are depicted in the table.

Criteria 1	**Awareness** clueless ↕ prepared	▪ Awareness of the current condition and (mis)match ▪ Awareness of changing demand and trends involved in the higher education sector
Criteria 2	**Goal focus** aimless ↕ high ambition	The level of goal focus expresses in the presence of plans and statements in improving a certain subject (e.g. enhancing competitiveness, reducing energy costs, increasing amount of amenities etc.) ▪ Statements ▪ Plans, strategies, visions
Criteria 3	**Innovation level** old fashioned ↕ innovational	Innovation drives up the competitive advantage, which means the level is determined by renewal of systems, tools, building materials and processes.
Criteria 4	**Tools and systems** underdeveloped ↕ advanced	▪ The presence and maturity of research tools concerning a certain subject (e.g. monitor for energy usage). ▪ Systems are related to the presence and maturity of documentation systems of information.
Criteria 5	**Skills and expertise** incompetent ↕ outstanding	The skills and expertise of the staff are an important factor which influences the maturity level of campus management. When people lack the skills to make links between disciplines, the true added value will be lost
Criteria 6	**Communication** poor ↕ excellent	▪ Information share: The presence and maturity of information sharing systems; do they have a general system for information sharing, or does every party has its own framework. ▪ The communication between stakeholders involved in the campus management. An example is that the facility management department regularly have meetings with the users of the building to determine their demand and satisfaction.

Table 21: Assessment criteria maturity levels

Step 2.1: Strategic perspective

Based on the criteria the maturity levels can be determined per perspective. The detailed criteria levels per component are depicted in Appendix V. The impression of step 2.1-2.4b are shown in the figure below.

	STEP 2.1 Measuring the maturity level of the strategic component	STEP 2.2 Measuring the maturity level of the functional component	STEP 2.3 Measuring the maturity level of the financial component	STEP 2.4a Measuring the maturity level of the physical component (building)	STEP 2.4b Measuring the maturity level of the physical (urban) component
	Strategic	Functional	Financial	Physical (building)	Physical (urban)
Level 1					
Level 2					
Level 3					
Level 4					
Level 5					

Figure 23: Step 2 of the MM framework (detailed table shown in Appendix V)

STEP 3: COLLECTING THE QUICK SCAN VARIABLES

Step 3 and step 4 is about the collection of data concerning the performance level of the institution. Step 3 consists of the quick scan variables and methods. In the figure is shown which variables need to be collected to give a quick scan overview of the case. The methods that are involved in the quick scan are:

- Analysing reports (annual reports, technical reports, financial reports)
- Analysing plans and visions (campus vision, real estate strategy, planning)
- Online-resources (website, ranking systems, monitors, reviews)
- Area analysis (maps, drawings, floor plans, public transport maps)

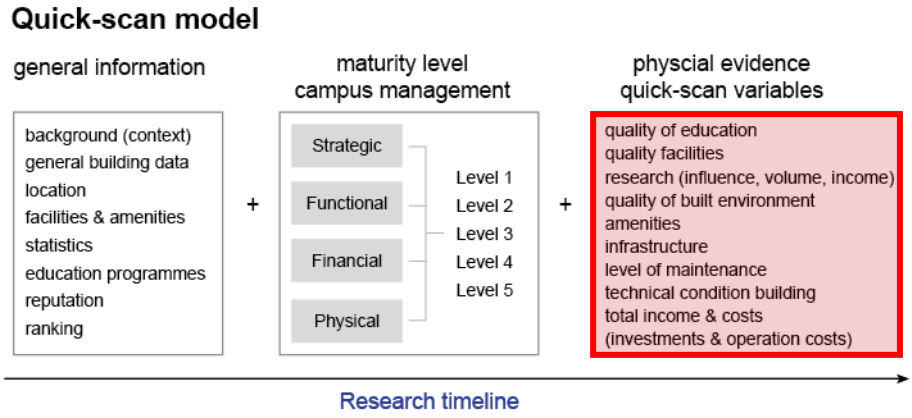


Figure 24: Quick scan model

In the previous chapter in paragraph 4.6 is in detail explained how every variables can be collected. The framework where the results can be filled in is depicted in Appendix IV.

STEP 4: FULL SCAN VARIABLES (ADDITIONAL)

The full scan model is complemented with the variables user satisfaction, space usage, functional mix, indoor quality, relationship university and its surroundings and the city, energy efficiency and aesthetics of the campus and buildings. These variables are located on the full scan model due to the fact they take a lot of time to collect the relevant data.
Step 3 and step 4 is about the collection of data concerning the performance level of the institution. Step 4 consists of the full scan variables and methods. In the figure is shown which variables need to be collected to give a full scan overview of the case. The methods that are involved in the full scan are:

- Analysing reports (annual reports, technical reports, financial reports)
- Analysing plans and visions (campus vision, real estate strategy, planning)
- Online-resources (website, ranking systems, monitors, reviews)
- Area analysis (maps, drawings, floor plans, public transport maps)
- Visiting the location (observation, analysing buildings and campus, space usage)
- Conducting interviews (with experts, or people from the university)
- Conducting surveys

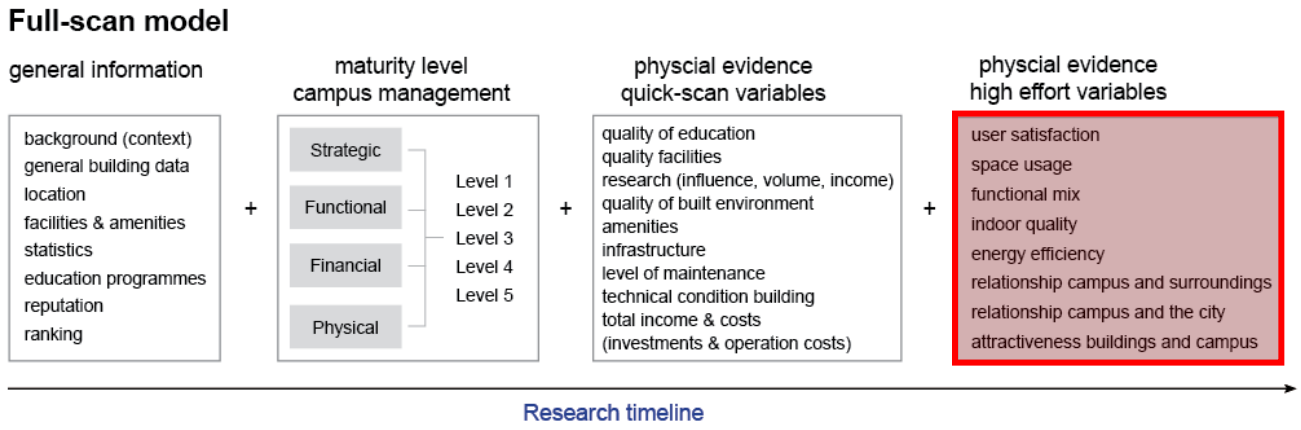


Figure 25: Full scan model

In the previous chapter in paragraph 4.6 is in detail explained how every variables can be collected. The framework where the results can be filled in is depicted in Appendix IV, including the whole framework of the four steps of the maturity model

6.3 POSSIBLE OUTPUTS MATURITY MODEL

When applying the maturity model on a certain case, the maturity levels of campus management will be based on the management level of the campus. A high maturity does not mean necessarily that the campus performance on the four indicators are high too. The different outcomes of the model is explained, and by what factors it is influenced. The possible outcomes are depicted in the figure.

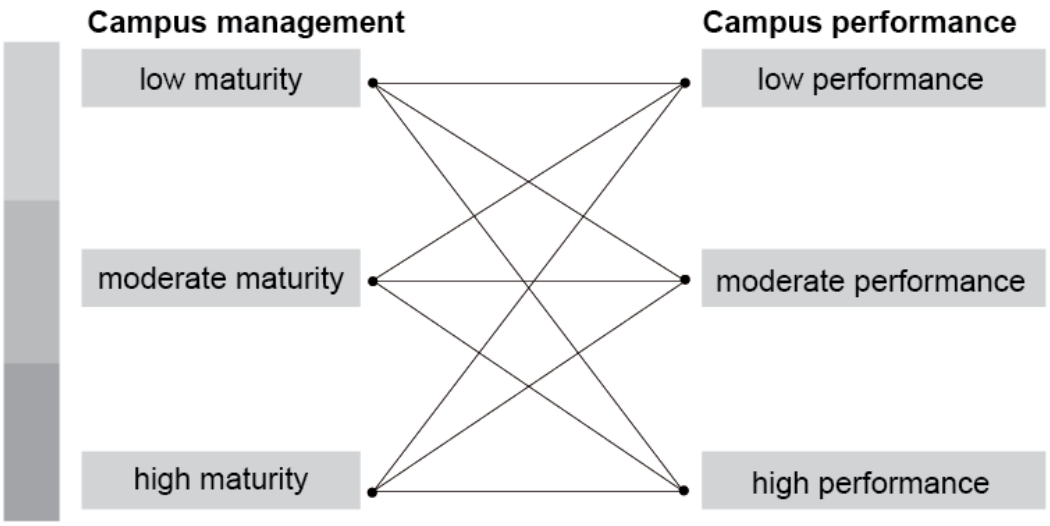


Figure 26: Possible outcomes of the maturity model

- A low maturity level of campus management shows in a lack of management of their resources, with usually a technical focus. A low maturity levels naturally expresses in a low overall performance of the university. They have no awareness of the current state, not knowing their problems nor what the demand is. This shows in poor performance on strategic, functional, financial and physical level.
- A low maturity level in combination with a high performance level is uncommon. It can be caused by a non-complex building, with little defects (new buildings). Reasons could be: the university is very small, a low occupancy rate and involvement of a little amount of stakeholders. Another reason could be is that the university is very new, and does not has a presence yet of campus management. Again, this kind of outcome is unusual, since an absence of campus management will likely result (on the longer term) in poor performance, caused by poor management of the portfolio and resources. The quality of buildings, education, environment will decline and finally result in dissatisfaction of users.
- A moderate maturity level of campus management, where the institution is aware of the mismatch and its problems and has plans to improve the current condition. When the performance is low, it is possible that they do not have the financial resources to conduct their plans to improve the current state. Usually when plans are even implemented, it needs a timeframe to show results.
- A moderate maturity level of campus management in combination with an improving or high performance is the desired outcome of an institution. They implemented their plans to improve the current state, and they actually see it happening. This outcome shows also that the institution is found in a further stage of the previous outcome, where they had just started with the implementation. This outcome indicates that they are already further in the time, where the implementations are starting to show in the performance.
- A high maturity level of campus management, where the institution has a developed organization and management of their resources. They are aware of the (changing) demand and anticipate on this by proactively doing research concerning the changing demand, and how this affects the

supply. This level shows strategies and plans on how to match this supply with this demand. If the performance level is low, it possibly indicates that the results show in a longer timeframe, and they are positioned at the starting stage. Another possibility is the lack of financial resources, which can be caused by economic problems, where the government decreases their subsidies to universities. One more reason that affects the outcome is the condition of the building stock. When the stock is very old and outdated, a high maturity of campus management is required to update the portfolio. When it is incorporated in the real estate strategy to discard bad quality square meters (which has become obsolete in time) in the future, it is likely that they will not do anything intensive anymore to update. Possibly new construction is even planned then to facilitate the new demand.

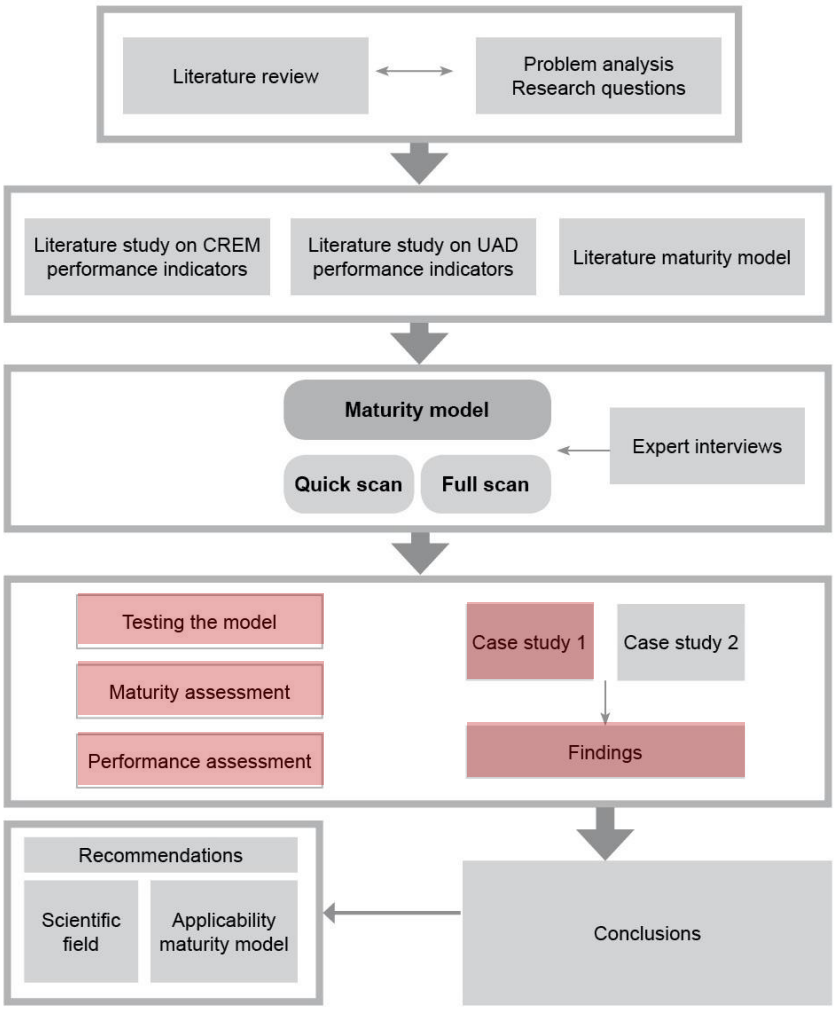
- A high maturity level in combination with a high performance is the best outcome, where performance is maximized. It indicates that the institution has adopted a high level of campus management in an early stage so now they can embrace the results.

Chapter 7

Application model: Case 1- TU Delft

This chapter tests the applicability and limitations of the developed assessment tool. The first case will be the Technological University of Delft. The assessment will be two fold; First the maturity of campus management will be determined. Second, the actual performance will be assessed to determine the effect of their campus management. This is the physical evidence of the part.

The chapter will start with a context analysis of the case, in order to understand the problems of a different context, after that the maturity model will be tested on the case.



7. CASE 1: TU DELFT

7.1 STEP 1- GENERAL INFORMATION TU DELFT

The vision of the TU Delft is to supply technological solutions that take us significantly further along the road towards sustainability and flourishing economy.
Some facts of 2013 (TU Delft, 2014b):

Education	
Bachelorprogrammes	15
Masterprogrammes	30
Student population	18781
PhD Students	2445
International students	2948
First year students	3914
Master degrees (2012)	2090
Research	
Professors (in fte)	226
Publications (scientific)	5432
Promotions	353
Valorisation	
Startups	17
Personnel	
Scientific staff (in fte)	2579
Scientific staff (in head-count)	2836
Professional services	1858
Ranking 2014-2015	71

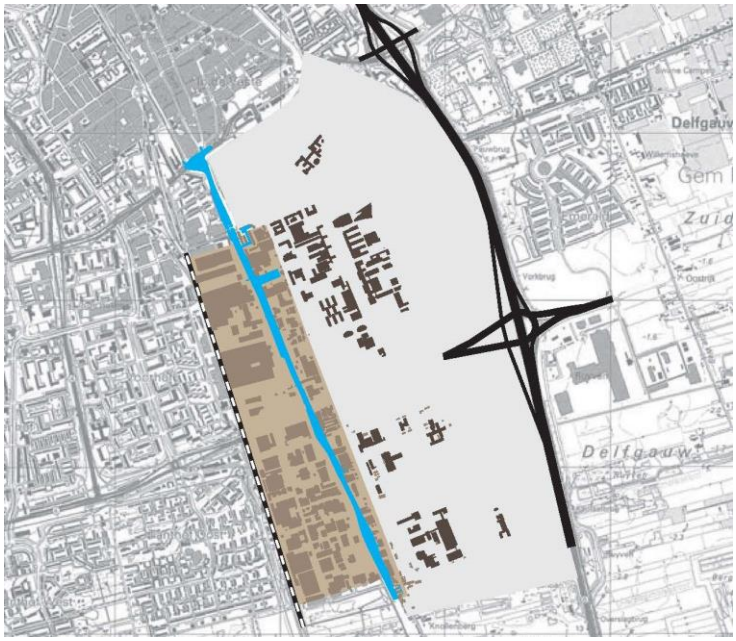


Figure 27: Location map of the campus (TU Delft, 2010)

7.2 STEP 2- DETERMINING THE MATURITY LEVEL OF CAMPUS MANAGEMENT TU DELFT

By using the framework which is developed throughout the process, the maturity of campus management in TU Delft can be determined. Starting with the quickscan method, which is only using methods like literature, the web and (annual) reports and data where personal contact, or fieldwork is not necessary.

Maturity level strategic component: 5

The goals of the campus vision that is described by the CvB are (TU Delft, 2014a):

- Provide high quality facilities for education, research and valorisation
- Attractive and living campus with spaces that stimulate meetings between users of the campus
- A pleasant working environment
- A safe and healthy learning, working and living environment
- An excellent and efficient campus
- An accessible campus
- A sustainable campus

Modern digital learning
The TU Delft offers different online courses and is connected to the online platform edX and offers different digital learning courses in the OpenCourseWare, MOOC (Massive Open Online Courses).
They are implementing blended learning (mixture of face-to-face education and online learning), they are digitilising exams (12% of its total). With these successful activities the TU Delft has made important stepts

towards more open and online education and gained a leading position within Europe (TU Delft, 2013a, p. 28).

Valorisation
Programs such as 'Entrepreneurship @ tudelft, YES!Delft (coaching, training, facilities and access to relevant networks for starting businesses), Intellectual Property (IP) policy (protection of developed technology with patent), TU Delft Holding (to make the excecution of the valorisation policy possible).

Collaborations
- Science park technopolis, location for establishing technology companies, knowledge institutes and spin-offs.
- Collaboration with companies
- Collaboration with other institutions is a strategic method to strengthen the position of the Dutch universities. A collaboration where each institution provide the knowledge from their own expert fields (technical, medical e.g.). The TU Delft is collaborating with Leiden University and Erasmus MC to develop a proton clinic. The TU Delft offers the technology (the machines & technique) and the physical environment in Delft, and Leiden and Rotterdam offers the care and the research.

Systems and tools
The TU Delft has a high maturity in documentation of information and sharing information.
- SharePoint is a system that makes it possible to share information and to work on it together.
- Back-ups of data for partner universities. The TU Delft and Leiden University agreed to back-up data in each others datacenters, in case of emergency when information can be lost.
- Flexnet makes flex working possible with own equipment
- ProMi: Professionalising Management Information to make information more transparent.

Meetings:
- Twice a year there are meetings between the CvB, the deans and the management teams of the faculties.
- Twice a year there are meetings between the CvB, the manager of the university services and the principals. These meetings are intended for looking back and to look forward. Plans and strategies will be discussed on their feasibility, ambition level, and meeting the goals of the university.

Skills of staff
Plans to improve the skills of staff
Attracting staff with outstanding skills
- Personal Development Programma TT (Tenure Track) since 2013 intended for young and talented university teachers to strengthen their career.
- PhD StartUP is a program intended for new promovendi to support them with the promotion path.
- Management Development Leadership course is intended for people who want to enhance their leadership skills

Based on the assessment of the criteria, the TU Delft has strong focus on the goals, and implementing innovational systems and programs to improve the quality of the staff, and the documentation and sharing of information and knowledge. They are aware of the changing learning trends such as e-learning, and have diverse programs that anticipate on that increasing demand. Regularly they have meetings to discuss the plans or looking back on things, but also for future planning. The strategic campus management is marked with the highest level of 5.

Maturity level functional component: 4

The campus vision involves the development of the working environment of the staff. They are aiming for a working environment that support the working processes of the scientist as well as the supporting staff. The demand for type of spaces and office facilities depends per employee and the activities they need to conduct. For this there are different office concepts and workspace concepts available (such as Social Innovation or Smart@Work) which take into account with these differences in demand. During the development and implementation of these concepts within the TU, the focus is not on reducing space use, but the enhancement of productivitity and job satisfaction (TU Delft, 2014a, p. 22). Furtermore they want to enhance the quality of the existing office space and upgrade it to the current office demands. Currently a surplus of office space is experienced, the TU Delft has to goal to use this space for other purposes.

In addition to the plans to develop office space, there is a presence of student prognosis which means they anticipate on changing amounts of students. Forecasting the amount of students gives the institution the opportunity to develop plans to facililitate this amount.

	2013	2014	2015	2016
Studenten aantallen	18.781	19.200	19.500	19.800

Figure 28: Student prognosis 2013-2016 (TU Delft, 2013a)

The rating of the maturity level is a 4. The reason for this is because the buildings in the TU Delft campus are quite flexible. The buildings on the middle of the campus are flexible, and BK the most flexible. Furtermore, based on knowing they have the plans to implement new ways of working and enhancing the quality, puts then on this maturity level.

Maturity level financial component: 4

The criteria for investments of TU Delft are (TU Delft, 2014a, p. 32):

- The total of projects needs to be financially feasible, not only within the budget of the coming years, but also on the solvency and liquidity. The projects needs to be divided evenly.
- The execution of the projects needs to be feasible. Too many projects at once can cause problems for the availability of facilities, space, accessibility of the buildings and the nuisance of project management. A good overall planning is important.
- The building portfolio needs to be qualitative and quantitative tuned to the demands of TU Delft. Too many space leads to extra and unnessasary exploitation costs. Less (and better) real estate is the goal which means bad quality of square meters should be disposed.
- The TU Delft has on-going sustainability projects. This means space needs to be given for sustainable energy generation and limitation of energy use.

The financial component is more difficult to determine without based on only financial reports in where the institutions justifies the expenditures and costs. It is more difficult to find something about how they manage their financial resources, what the criteria are, and what the focus is when spending money. However, the TU Delft has a clear view of what their costs and income are, but also know how to reduce costs by reducing the energy usage and disposal of bad square meters. This means they know to what purpose they need to spend the money in order to created added value over the long-term. The final rating for the maturity level of the financial component is a 4.

Maturity level physical component: 4

The plans related to the physical component is extensive. The projects that are described by TU Delft involve:

- new construction for TNW, reason for this is because the old building of TNW has become obsolete
- renovation CiTg
- renewal plans for BK and EWI

Furthermore, they have the plans related to the sustainability and energy:

- Reducing energy costs
- Reducing CO2 emissions
- Reducing waste and use of water
- BREEAM certification when building
- Using sustainable products
- Prospect of reducing energy usage by 30% in 2020 starting 2005 (2% a year)
- Prospect of becoming energy-neutral in 2050 with reducing the CO2 emission, reducing energy usage, sustainable production of energy and intelligent energy systems

Planning ahead (will be adapted frequently: once a year)

- Short-term (2013-2016)
- Long-term (until 2022)

The TU Delft is investing in large maintenance activities in order to enhance the technical condition to a minimum level of 'good'. The total amount of investment is €75 million (TU Delft, 2013b).

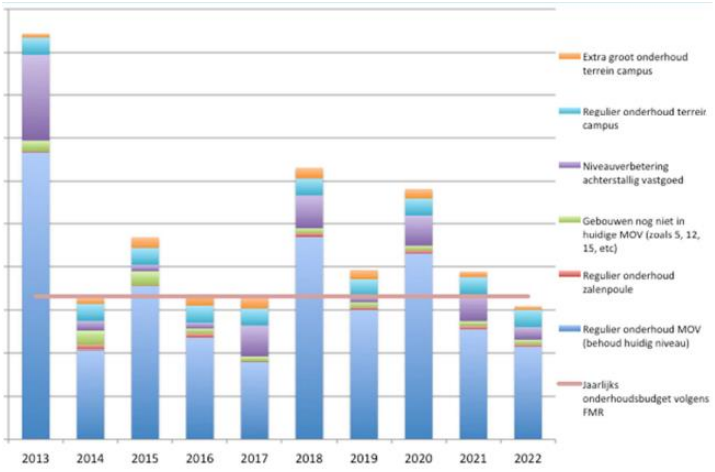


Figure 29: Investment in maintenance in coming years (TU Delft, 2013b, p. 22)

A large amount of projects are planning concerning the enhancement of the portfolio. Furthermore, the existing stock will be less energy comsuming. The sign that they have the plans, but not seen in the actual physical assets puts them on a level 4 of physical management.

Maturity level physical component (urban level): 3.5

The TU Delft has stated in their campus vision they want to develop the campus on urban level. Some ambitions and plans they have:

- The TU Delft has projects planned such as the public transport tram line 19. The tramline connects The Hague with Delft and goes through the TU Delft campus, connecting North and South. Due to circumstances the projects has been delayed, or else it would have already been there. However, the delay made it possible to open the discussion of extending the line to Rotterdam Airport.
- Enhance the relationship between buildings and the public space
- Student housing planned on the Balthasar van der Polweg. The TU Delft collaborates with DUWO and the municipality of Delft to renew and improve the surrounding neighborhood of the campus.
- Plans to develop a junior school, with an international oriented focus on the campus. Together with the daycare that is already on the campus this can grow to an international center for childs in the age from 0-12.
- Plans to add more retail and leisure in order to attract more (international) students

The mark for the maturity level of the urban physical management is a 3.5. The reason for this is due to the fact they have the plans to improve the accessibility and adding amenities, but it is not implemented yet. However, the Mekelpark definitely has brough added value in terms of enhancing the relationship between the public space and its buildings.

MATURITY LEVEL BASED ON INTERVIEWS

The current maturity level based on interviews with people from FMVG (Berghorst, 2015; Valks, 2015; Van der Kolk, 2015):, the resulting table is shown:

Strategic component maturity level: 4.8

CvB is on the strategic level
FMVG is on level 4, because they are more the executing power

Differences in organisation
The policy makers (CvB) have a strong strategic focus, which is shown in the campus vision and real estate strategy. However, most of the technical departments within the faculties possess a much lower level. They typically only have a technical focus (level 1), which is related to the technical maintenance management of the building where they work.
The CvB possesses the money, so in the end they make the decisions.

Attracting talents
Attracting/ connecting top scientists to the university. This will in turn attract students. The TU Delft has a budget for the strategy to attract these people. they provide the first money flow to provide the space and equipment for the scientist, the salary. By attracting top scientists, who brings grants with them for projects.

Looking forward
They do have meetings twice a year where they reflect on the things they have done and achieved in the previous year, and to look forward of what is going to happen, or what should happen. The FMVG will look into the demand and the possibilities in how to reach that goal. They provide the plans, the alternatives but also the financial budget of what it is going to cost.

Systems
Busy with Professionalising information (ProMi-project), making information
more transparent. Nowadays the information is determined in different systems by different perspectives. They plan to make it more general.

Collaboration with other institutions
Collaboration with other institutions is a strategic method to strengthen the position of the Dutch universities. A collaboration where each institution provide the knowledge from their own expert fields (technical, medical e.g.). The TU Delft is collaborating with Leiden University and Erasmus MC to develop a protonclinic. The TU Delft offers the technology (the machines & technique) and the physical environment in Delft, and Leiden and Rotterdam offers the care and the research.

Functional component maturity level: 4

Responsibiliy of faculties & services
FMVG talks frequently with the users to determine the demand.

New type of spaces
The TU Delft is currently developing new learning methods such as e learning. Together with O&S the FMVG determines what kind of facilities are necessary for that. This resulted in a new type of spaces, such as a learning centre, but also space where they can record lectures.

New ways of working
Flexworking, new workplace concepts, FMVG does look at what the consequences are for the existing m2's.
Student prognosis
The O&S is responsible for the student forecasts, the FMVG will place that next to the existing stock, and find ways in how to match this new demand.
They also anticipated on the changing distribution of national and international students. The amount of international students are increasing, and their demand differs from the national students. This means other facilities and amenities are needed.

Financial component maturity level: 3.7

System & skills
Based on the opinion of interviewee of the finance department, the maturity level of the financial component is less as mature as the other components. A few years ago there was a lack of expertise within the finance department, where people lack the analytical skills to make links in complex relations. In recent years there has been a development, where the systems are being developed, especially to make all the costs for the projects, the maintenance costs, costs to reach the campus vision, to make them presentable. Making all this information transparent is a way to develop the maturity of the management of financial resources, where costs and advise can be presented to policy makers so they can make decisions based on that. But there is development. The recent years they are able to show more graphs, and in the near history it was only numbers

Controllers
The financial controllers control the budget, the FMVG gives advice on financial feasibility of the plans of the CvB. They anticipate on future incomes and expenditures, but also what impact a certain plan has. The plans should fall within the budget. They have a system for risk management.

Finance from municipality
350 million a year finance from the municipality of The Hague. It is affected by the budget of the municipality however. Then the TU Delft will split this amount up over the different faculties with the BTS-system, where the money will be divided based on the amount of education & research. FMVG received approximately an amount of 90 million on yearly base.

Physical (building level) component maturity level: 3.5

Long-term thinking in using materials
(H)They also think forward when it comes to using materials. They are aware when they don't invest in sustainable materials, the maintenance costs will only increase in the coming years. They are also willing to make a big investments, where the maintenance costs will reduce in time, instead of only doing corrective maintenance- says something about the maturity of the management of the financial resources.

Disposal of m2
They have the plans to dispose bad m2. There are new buildings planned to facilitate TNW, which is has become obsolete.

Sustainability
Development of a sustainable campus, and how to reach such a goal. Connecting research on sustainability with the real estate strategy.

Monitor
They have an energy monitor, which measures the energy consumption of each building
They include users to think about the condition of the buildings and the indoor quality. It is important for them that the facilities looks maintained, clean and new.
By monitoring the technical condition, they know when the building is at the end of its lifespan, as well as what kind of maintenance is needed for the coming period. The maintenance is reactive for all normal spaces, but for the lab spaces they think ahead more proactively because the demand changes every time for these spaces.

Physical (urban) component maturity level: 4

Plans
Planning for enhancing the accessibility. Tram 19, improving the connection between The Hague, and possible extending the line to Rotterdam Airport. Furthermore they have plans to add housing, and retail and leisure to the campus to attract (international) students. Furthermore, they want to enhance the relation with the South-wing of Delft (The Hague, Rotterdam.

7.3 STEP 3- PERFORMANCE LEVEL QUICK SCAN

Quality of education 3.5

Based on the Times Higher Education ranking system the teaching quality is 55.5 in a maximum scale of 100. Based on the NSE 2013 (National Students Questionnaire) (NSE, 2013):

	Scale 1-5
Teachers	3,60
Study support	3,45
Quality of support by tutors	3,48
Quality of support by teachers	3,63
Quality of feedback by teachers	3,37
Quality of the study materials	3,70

Quality of facilities 3.7

Based on the NSE 2013 the score of the

	Scale 1-5
study facilities	3,61
The study environment	3,76
Suitability of education spaces	3,78
Information facilities	3,32
Suitability of working spaces (computers, study spaces with sufficient quality)	3,63

Availability of work spaces	3,72
Library	3,76

Research **3.6**

Research (Reputation survey 18%, research income 6%, research productivity 6%): final grade 71,4 on a scale to 100 (Times Higher Education, 2014b).

Total income & costs **4**

A university's ability to help industry with innovations, inventions and consultancy has become a core mission of the contemporary global academy. This category seeks to capture such knowledge transfer activity by looking at how much research income an institution earns from industry, scaled against the number of academic staff it employs. The industry income based the Times HE ranking is a maximum score of 100. The reason for this is because the TU Delft is a innovational research institute, which excellent scientists. They bring with them high grants and subsidies for projects.

Finances	
Equity	345,8 mln
First income stream	415,3 mln
Second income stream	42,0 mln
Third income stream	101,2 mln

Figure 30: Finances of TU Delft (TU Delft, 2014b)

In 2013 the TU Delft made a profit of €31,2 million. The benefits will be used for the finance of renewal of education and research and investments for the real estate strategy.

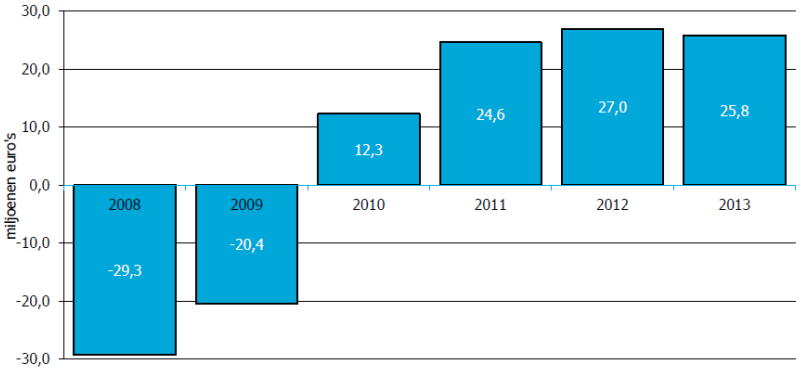


Figure 31: Profits time period of 2008-2013 (TU Delft, 2013a, p. 86)

In the coming years the TU Delft can spend 650 million of new construction projects (new construction TNW, renovation TN, renovation CiTg, but also in the coming years EWI renovation).

Technical condition **2.5**

40-50% of the portfolio is in bad condition, which should be renewed or replaced.
They have plans to dispose the square meters that are in bad condition. New construction is also planned.
Furtermore, there are plans to reduce the energy costs and usage of the existing building stock.
Renovations of CiTg and TN are also planned.

Level of maintenance **3.5**

The TU Delft have a maintenance planning for each faculty. Moreover, they check the condition (once a year) of the buildings frequently so they can determine the necessary maintenance activities in the coming years. The institutions also thinks forward when it comes to using materials. They are aware when they do not invest in sustainable materials, the maintenance costs will only increase in the coming years. Doing research on new products on the market is also included in the maintenance strategy.

The level of maintenance is very important, especially in lab spaces. The demand changes in a short period of time, that is related to the span of each project. For the lab spaces the TU Delft has a preventive maintenance strategy. For the rest of the buildings the maintenance is currently only reactive.

Quality of built environment **4**

The quality of the public space (Mekelpark) is very good. It facilitates meetings between all kinds of users of the buildings. The park was a big improvement, connecting buildings with the public space. It contributes to the vision of a 'Living campus'

Amenities **3**

The amenities on the campus can be better. Retail such as places to eat and drink are under-represented. Furthermore, the availability of housing in and in the nearby surroundings is low. The shortage of amenities and student housing makes it less attractive for international students and students who live far. A plus is the opening of a daycare on the TU Delft campus in 2014.

Infrastructure **3**

The travel through public transport is moderate. The train station is 15 minutes walking away. Most students take the bus from the station to the campus. During non-peak hours this bus only has an frequency of two per hour. The accessibility for students living in Delft, with a bike is excellent.
They have plans to improve the accessibility with tram 19. This tram connect The Hague with Delft, and the buildings within the campus from North<->South. There is a possibility of extending this line to Rotterdam Airport.
Parking on the TU Delft is difficult. The number of cars are exceeding the parking spaces in peak-hours.

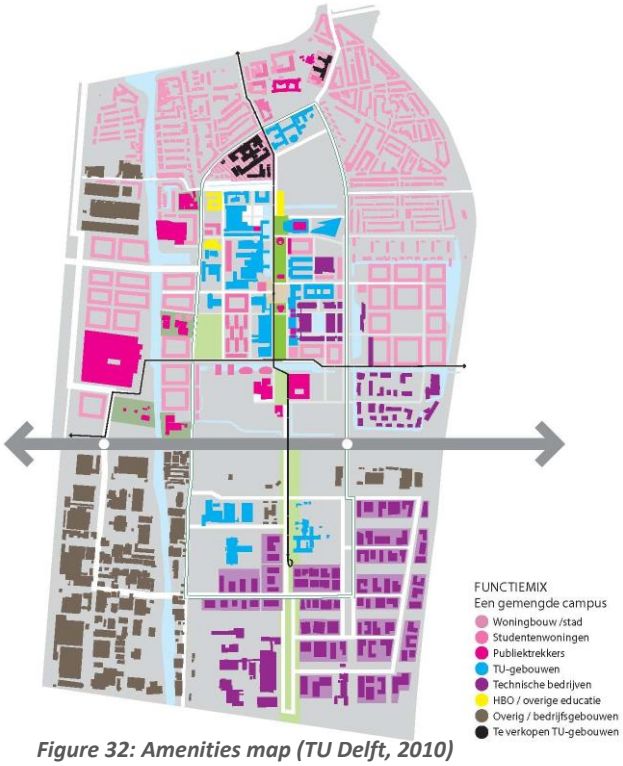


Figure 32: Amenities map (TU Delft, 2010)

7.4 STEP 4- PERFORMANCE LEVEL FULL SCAN

Step 4 is concerning the data collection of the full scan variables, which needs additional research methods such as interviews and observation. The scores are based on the opinions of the experts that are interviewed.

User satisfaction **3.2**

NSE 2013 scores:

	Scale 1-5
Assessment and review	3,58
Study schedule	3,10
Study load	3,79
Group size	3,71
Housing	3,03
Accessibility of the institution	3,84
Availability of student housing in the city	3,05
The restaurants/canteen in the own faculty	3,2
Ambiance/ atmosphere	4,11
Hospitality in the city	3,20
Cultural amenities	4,26

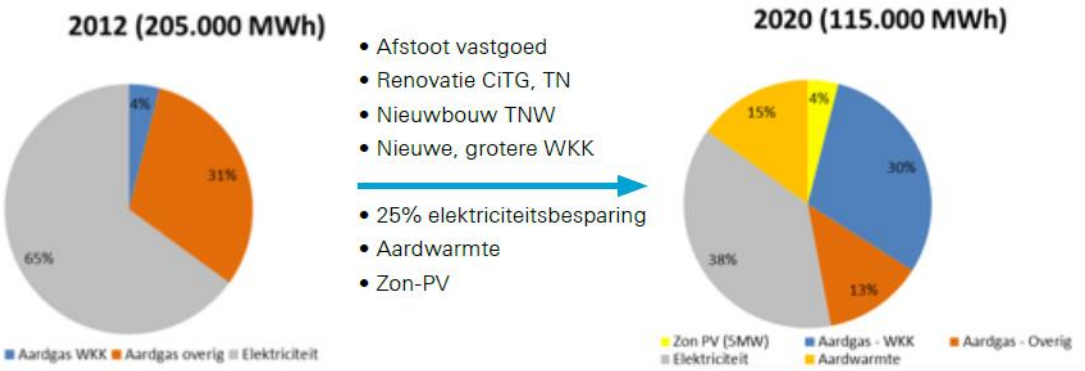
Space use & functional mix **3.5 and 2**

The space use and functional mix differs per faculty. The BK faculty for example is the most flexible. Spaces are transformable and can be used for more functions. The TU Delft also want to facilitate the new ways of learning into the existing supply, by adding a new type of space intended for online learning. If that is not possible, an addition of square meters will be the case.

The TU Delft also thinks about flexible use in laboratory spaces , because a research usually takes about 3-4 years and then the set up should be possible to change for a new project.
The other faculties are less flexible and thus the overall ranking will be lowered.

Energy efficiency **3.5**

Moderate to good, the TU Delft has quite an old portfolio with old buildings. They have become obsolete, which means they have a maintenance strategy that only has corrective maintenance for the old buildings. There is a need to improve the façade and the installations. There is new construction planned, so in the future the old and bad square meters of the buildings can be disposed. Furthermore, the maintenance strategy for the buildings in which the quality is still good, they have preventive maintenance. The FMVG conducts research on what new products are available and can be used in order to improve the durability of building components.
There are some on-going projects to make the buildings more sustainable. Furthermore, the coming year the TU Delft has plans to reduce the energy usage. The forecast of reducing the energy usage is shown in the figure below.



Primary energy usage TU Delft 2012-> 2020 (TU Delft, 2013a, p. 61)

Indoor quality **3**

In old buildings the indoor quality is poor. The campus vision does include a large maintenance investment project to enhance the existing building stock to a minimum level of good, which means the current technical condition of the building stock is not acceptable.

Relationship campus and surroundings **3.5**

The TU Delft wants to strengthen the relationship of the campus with the South-wing (Rotterdam, Delft, The Hague and Leiden), but also the city center. This relation is very important since the university itself does not offer all the amenities which is needed on the campus. Currently, a large amount of students take their leisure to the city center.

Relationship campus and city **3.5**

The relationship with the city is good for students who live in Delft. These students visit the city centre often for the retail and leisure that is offered. However, the city centre is not well connected without a bike. The walking distance is 10 minutes to the city centre, and 15 minutes to the station. Moreover, students who do not live in Delft does not necessarily have the willingness to visit the city centre. They would only travel to Delft for the education.

Aesthetics/ attractiveness buildings and campus **4**

The external aesthetics of the buildings are good. The building architecture are attractive and impressive. The buildings and public space look well maintained, clean and is safe.

Figure 33: Impression TU Delft campus

The summary of the rating of the maturity levels and the performance levels of TU Delft are depicted in Appendix V.

7.5 CONCLUSION

The goal of conducting the case study is to test the applicability of the model. The differences in the result are shown in the figures. Figure 34 shows the maturity level based on the quick scan assessment without using the expert view (blue line), and the extensive method (red line) where experts from the field are asked for their opinion to rate the maturity level of campus management divided in the four components. The figure shows that the results are rather the same.

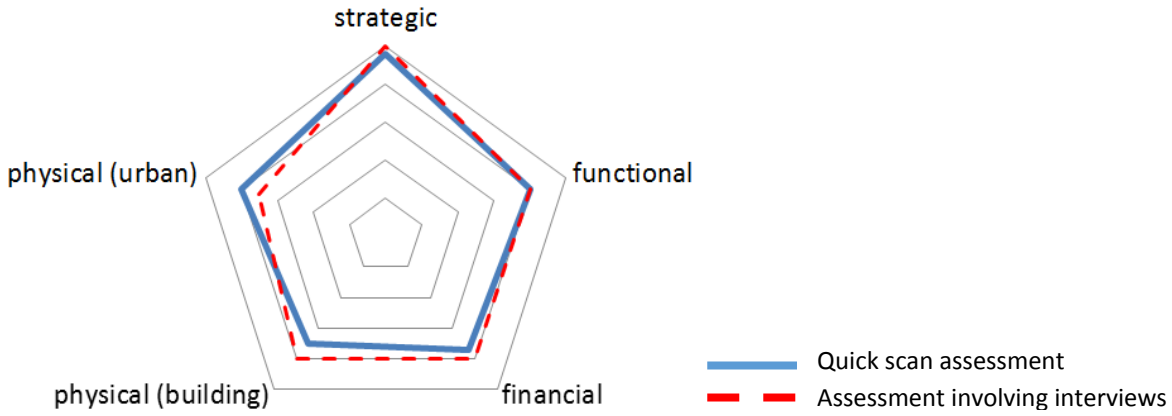


Figure 34: Maturity level TU Delft campus based on interviews with FMVG (Berghorst, 2015; Valks, 2015; Van der Kolk, 2015)

Figure 35 shows the differences quality of the current condition of the campus, based on the quick scan assessment (blue) and the full scan assessment (red) including interviews. As shown in the figure, the opinions based on the opinions of the experts are higher rated than the ratings made by the quick scan. Mostly the facility department are more positive. The reasons for this can be affected by different factors:

- Subjective view of the researcher in analysing the data using the quick scan
- Positive view of the experts because they are biased, when rating their own campus where they work

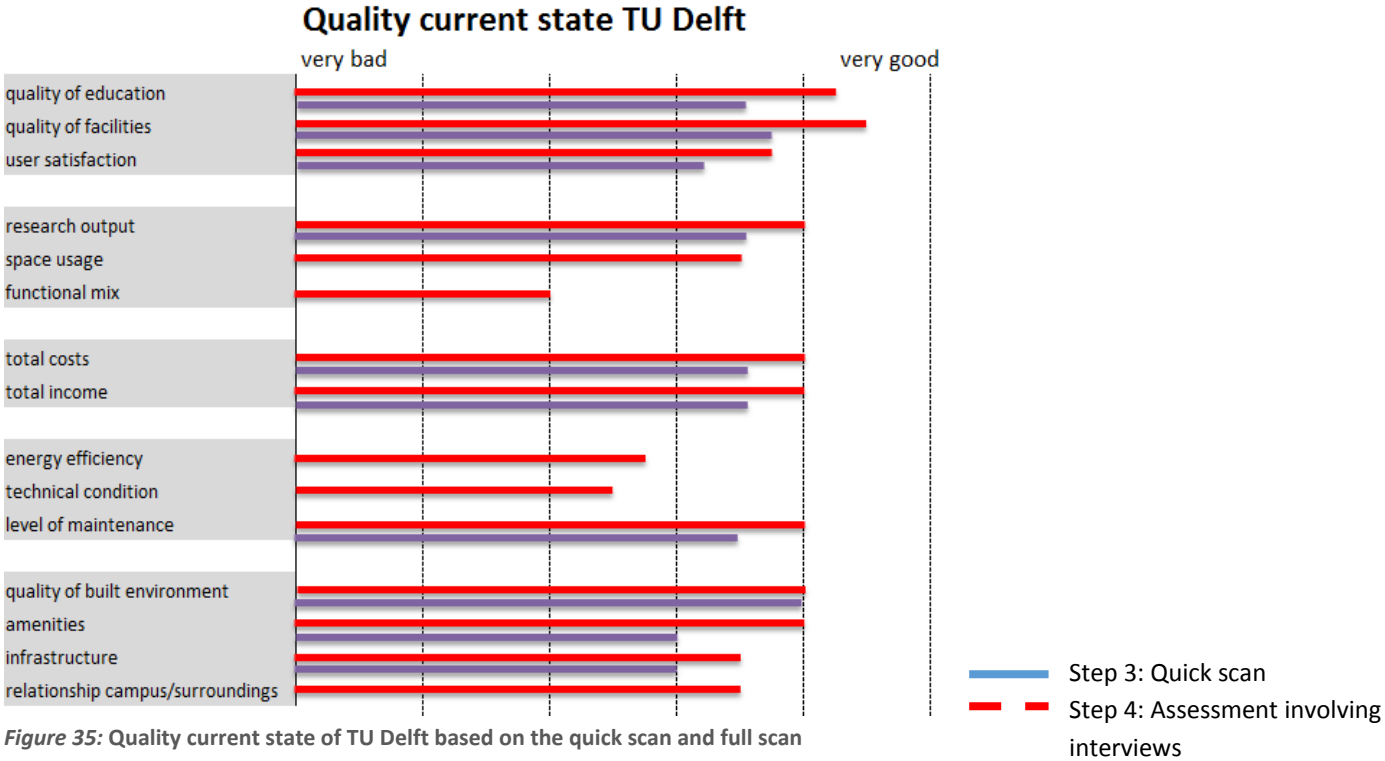
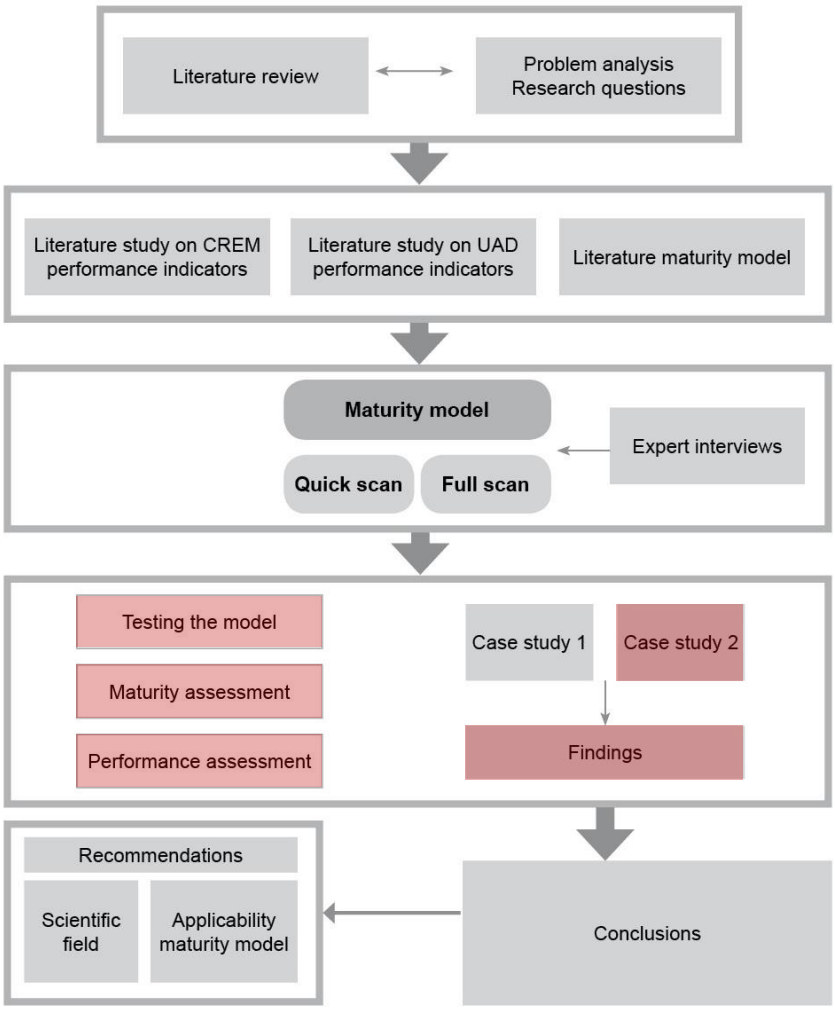


Figure 35: **Quality current state of TU Delft based on the quick scan and full scan**

Chapter 8

Applicability of the model: Case 2- CUHK

This chapter tests the applicability and limitations of the developed assessment tool. The used case will be The Chinese University of Hong Kong. The assessment will be two fold; First the maturity of campus management will be determined. Second, the actual performance will be assessed to determine the effect of their campus management. This is the physical evidence of the part. The chapter will start with a context analysis of the case, in order to understand the problems of a different context, after that the maturity model will be tested on the case.



8. CASE 2: THE CHINESE UNIVERSITY OF HONG KONG

8.1 STEP 1- GENERAL INFORMATION

In order to understand more about the situation in Hong Kong, the context of East-Asia is explained in this paragraph. In the figure is depicted what the dimensions are of higher education in the East-Asian countries. Some facts of these countries are stated below:

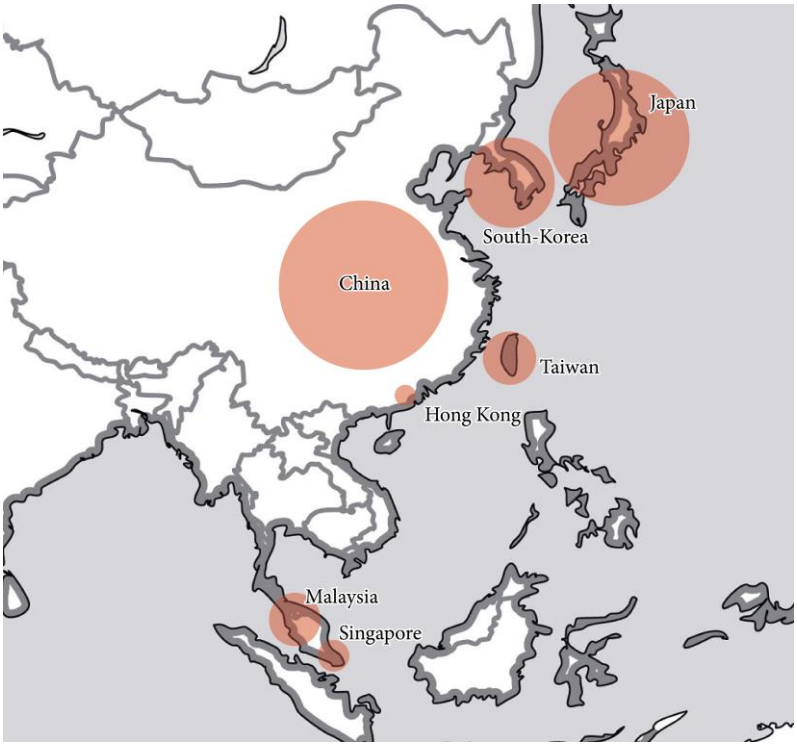


Figure 36: Dimension of amount of universities in East-Asia, based on the total number of universities (own illustration; based on statistics of (Ranking-Web-of-Universities, 2014)

China: There are over 2000 universities and colleges, with more than six million enrolments in total. China has set up a degree system with Bachelors, Masters and Doctoral degrees which makes the institutions also open for international students. China is the most popular country in Asia for international students, ranking third among countries that host the most international students ((US News) Sheehy, 2013).

Japan: In 2010 more than 2,8 million students were enrolled in 778 universities in Japan. There are 86 national universities, 95 local public universities (founded by prefectures and municipalities) and 597 private colleges (Wikipedia, 2014). The quality of universities and higher education is internally recognized.

South-Korea: In Korea are 376 official higher education institutions with 3,7 million students enrolled and 60.000+ academic staff. This includes 179 private universities, 43 national universities and 149 colleges (The Observatory, 2014).

Hong Kong: In 2013/2014, 88600 students have enrolled in the universities. There are 18 higher education institutions in Hong Kong with local degree-awarding power. Eight institutions funded by the public through the University Grants Committee and ten self-financed (Education Bureau HongKong, 2014a). Hong Kong has many world-class institutions, and also host the best executive business management programmes. They offer a wide array of joint programmes in collaboration with prestigious universities around the world.

Taiwan: In 2012, there are 163 universities and colleges in Taiwan. The number of university and college students count around 1.35 million. Currently more than 80% of the full-time professors at universities hold doctoral degrees, which makes the quality of Taiwanese universities higher than China and Hong Kong (Department-of-Higher-Education, 2012, p. 13).

Malaysia: Malaysia has 37 private universities, 20 colleges and 418 private colleges. Malaysia currently hosts more than 93.000 international students from more than 100 countries (Tawau, 2013). Based on the ranking of Ranking Web, none are in top 500.

Singapore: Singapore has 7 public universities, with 2 in the top 200. These universities are funded by the government and open to both Singaporean and foreign students.

RANKING OF UNIVERSITIES

Ranking development and competition

The development of Hong Kong and its competing countries are explained (Times Higher Education, 2014a, p. 11):

Japan: Japan is on top of the Asian nation for higher education and research. But their top position is in danger, because it seems like they don't have commitment of staying in that position. Competing countries such as China will soon surpass Japan if they continue this way.

China: China has a lot of institutions climbing the rankings, and soon will surpass Japan.

South-Korea: South-Korea is climbing the ranking ladder very fast. They spend a high amount on education and research

Taiwan: Taiwan spends a lot on its leading universities ($3.3 billion over 10 years starting 2006). But with the high competition, some of the top universities are pushed off the top. In 2013 Taiwan had 17 universities in the top 100, which is now 13.

Hong Kong: All six of the institutions are above the top 50. Also, the three highest ranked universities remained stable with the high competition development.

Singapore: Singapore only has 2 universities in the top 100, but both are top ranked, with even the highest rank of number 2 on the Asian market.

THE CHINESE UNIVERSITY OF HONG KONG

zThe Chinese University of Hong Kong (CUHK) is a public research university, formally established in 1963. It has eight academic faculties. The CUHK consists of 9 faculties and a graduation school. The university offers a wide scala of studies in different directions ranging from arts, business, education, engineering, law, medicine, science and social science. English is the main language of instruction in most classes, with Cantonese and Mandarin Chinese being retained only by a minority of colleges and academic departments.

Figure 37: Campus located on the mountain range

The campus has a total number of 166 buildings with a total Gross Floor Area of 708.164 m² (CUHK, 2014b, p. 3). The main campus is located on the mountain range with views over the Tolo Harbour (see figure 19) . The buildings have a mixture of Chinese and Western architecture and formulated a sustainable campus. The CUHK also owns the Prince of Wales Hospital located at Shatin and teaching centres located at Admiralty(Bank of America). In Shenzen, the CUHK owns a research institute since 2011.

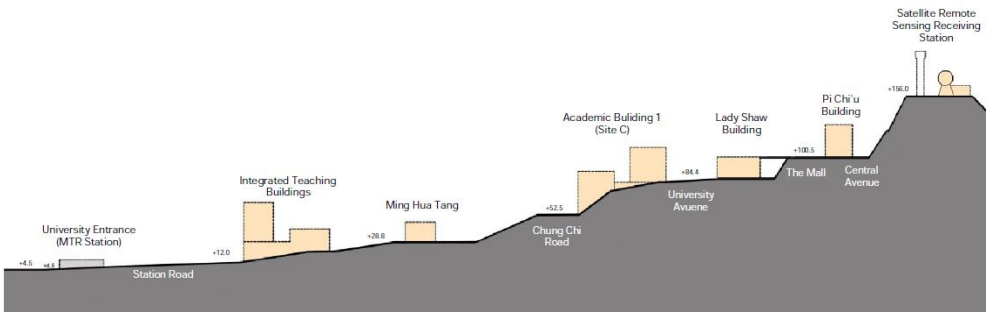


Figure 38: Section of the campus located on the mountain

Urban structure

The campus is formed as an island, a 'city within a city'. This supports the urban planning structure of Hong Kong, due to the shortage of land and high density. The campus is connected with the existing infrastructure and is easily accessible by car and public transport. The campus buildings are connected with a shuttle bus, and easily accessed by car, bike or a walk. In the table shown the fact sheet of the CUHK is shown (CUHK, 2014b).

Education	
Bachelorprogrammes	58
Masterprogrammes	36
Student population	18781
PhD Students	1768
International students	3419
Student enrollment	19.263
Student admission	5236
Master degrees (2013)	5782
Research	
Research output (publications, papers, books, patents, others)	7778 items
Personnel	
Teaching staff	1647
Research staff	1339
Professional services	4410
Ranking (2014-2015)	109

Figure 39: Map of the campus (GoogleMaps, 2015)

8.2 STEP 2- DETERMINING THE MATURITY LEVEL OF CAMPUS MANAGEMENT OF CUHK

By using the framework which is developed throughout the process, the maturity of campus management in the CUHK can be determined. In this case only the quick scan model will be used, using data sources such as literature, the web and (annual) reports. The quick scan is developed for cases in which there are limitations of research resources, such as limitations in funding and the distance. The quick scan makes it possible to nevertheless create a complete view about a certain case without using fieldwork or personal contact.

Maturity level strategic component: 4

Mission & vision

To assist in the preservation, creation, application and dissemination of knowledge by teaching, research and public service in a comprehensive range of disciplines, thereby serving the needs and enhancing the well-being of the citizens of Hong Kong, China as a whole, and the wider world community. To be acknowledged locally, nationally and internationally as a first-class comprehensive research university whose bilingual and multicultural dimensions of student education, scholarly output and contribution to the community consistently meet standards of excellence.

Specific points in their vision are the enhancement of College Life:

- form a neighbourhood setting for the new and existing colleges
- enhance linkage within and among colleges, particularly to enhance linkage to the Central Campus
- maintain and enhance the identity of each college
- provide more spaces for both resident and non-resident students for interaction and meetings

The Venues for Academic & Recreational Activities:

- maintain the Central Campus as the major teaching and administration centre, but avoiding overcrowding
- locate research facilities relatively further away from the Central Campus
- forming communities of academic disciplines to achieve physical proximity and obtain the benefits of interdisciplinary collaboration
- provide more indoor or semi-open venues for learning and sharing of knowledge

Maturity level functional component: 3

The functional component is the management of the quality and quantity of space to support the activities of users of the building in order to aim to enhance the productivity and output of the users. Campus decisions that aim to support the primary processes more effectively that have been found are related to the class schedule improvements made by the CUHK. They have plans to assign rooms based on primary zones and on the best-fit between class and room size. This facilitates a more effective use of space. In order to reduce the inconveniences the classes are mainly scheduled at the central campus or at the Chung Chi college (CUHK, 2014a). Furthermore, there are no statements found on how to improve space usage or the implementation of flexible space use. They also do not mention the current use of space, nor is the space are flexible or not. The assumption is that they have awareness of the space needs and have plans to improve the space usage. The mark that is given for this component is a level of 3.

Maturity level financial component: 3

The maturity level of the financial component is related to the way of using the financial resources to improve and update the current portfolio to meet (changing) current and future demands. Since 70% of the budget is available for research and instructions in the CUHK, it tends to be that the university gives scientists and teachers much freedom and support in their researches and lectures. All colleges offer various programs and courses in order to attract different students from different regions and backgrounds. This explains the high amount of different scholarships available at each college. The United College offers 57 different scholarships and financial aids (CUHK, 2015b). Information concerning the financial planning, the budgeting and how they control the financial risks could not be found. However, the data in how they spend their financial resources are clearly stated (see figure 40). For this component is was difficult to determine a maturity level, since the information is not complete.

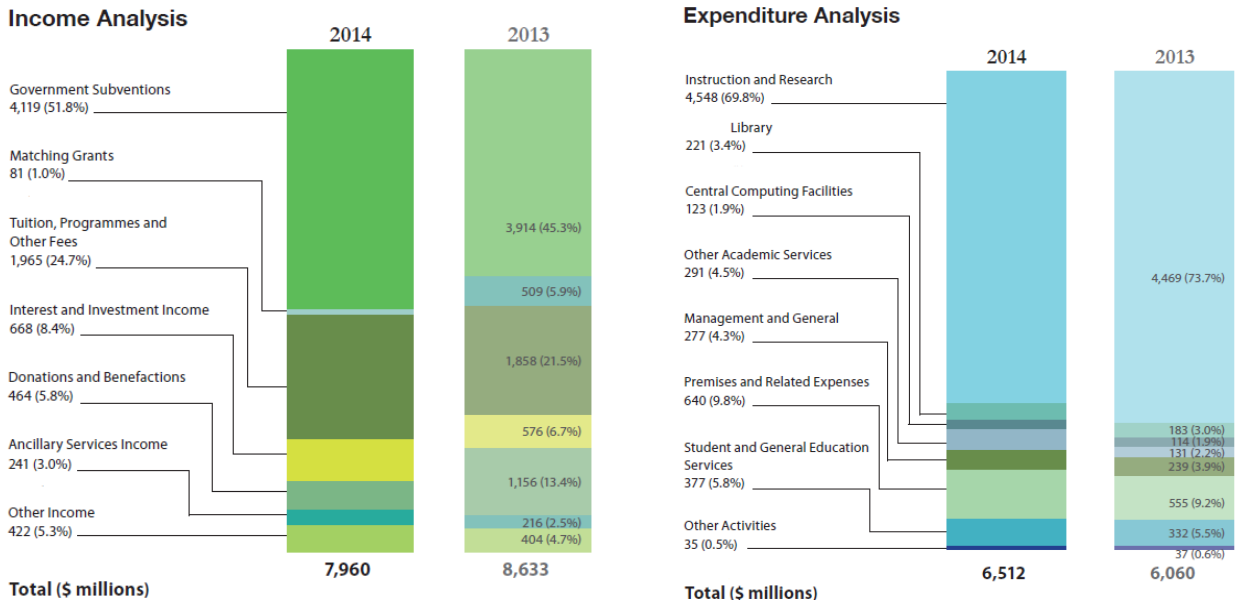


Figure 40: Income & expenditures in HK dollars 2013 and 2014 (CUHK, 2014a)

Maturity level physical component (building level): 4

The physical management on building level is related to the technical aspects of the buildings on the campus. It is determined by the maintenance level, the quality of the square meters and decisions to improve the condition in combination with a sustainable development. The CUHK recognizes climate change as one of the most pressing issues facing society today, and accepts this challenge. Highlights of the University's targets and commitments include (CUHK, 2015a):

- Cutting per capita campus energy use and greenhouse gas (GHG) emissions by 25% and 20% respectively by 2025, from base figures of 2005 (Campus Master Plan, 2010)
- Achieving a further per capita reductions in energy consumption (8%) and GHG emissions (10%) from 2012 to 2017 (5-year Sustainability Targets, 2012)
- Requiring every office to appoint an Energy Warden and supporting offices in conducting self-evaluation of carbon emissions (5-year Sustainability Targets, 2012)
- Adoption of an Energy Policy in 2003 and revised Energy Policy and Energy Conservation Guidelines in 2013
- Adoption of a Sustainability Policy (which stipulates the Campus Master Plan's energy and carbon emission reduction goals)
- With a growing campus population and new facilities, demand for electricity will continue to increase in the coming years. CUHK will continue pursuing energy efficiency and try to reduce energy usage.

Based on the information found the CUHK has a long-term strategy to improve the quality of the buildings as well as a focus on sustainable development. They anticipate on climate changes, and have plans in how to meet these challenges.

Maturity level physical component (urban level): 5

The physical management on urban level of the campus is related to the campus development and the added value on the competitive advantage of an institution. The expectation for CUHK is an addition of 3000 undergraduate students in the coming years. To accommodate this flow, plans are being made and works being carried out to improve the transportation infrastructure as well as to implement the recommendations of the Campus Master Plan for building a sustainable campus in the years ahead.

CUHK occupies a land area of 137.3 hectares. Constrained by a hilly topography with altitude varying from 5m to 140m, commuting up and down the terrain becomes the daily routine of most staff and students. Most stakeholders are having concerns about whether the existing transport system can accommodate the flow of students. The objectives in the Campus Master Plan (Aedas, 2010) is to promote a pedestrian friendly campus, with four specific objectives related to the transportation:

- Improve connectivity
- Optimize transport facilities (pedestrian linkage, road system, shuttle bus services)
- Park-n-ride
- Cycling (minimize reliance on vehicular transport)

Objectives related to road improvement:

- They have plans to widen walkways for pedestrians
- converting driveways into wider single lanes with bays provided
- complaints from users have been taken in treatment where drives complain on poor organisation of some intersection roads. A plan is proposed to improve the safety and reduce confusion for drivers from different directions

According to the data found the maturity level of CUHK is very high, since they have a Campus Master Plan since 2010. The implementation of these plans are showing in the campus area of the CUHK in which the relation of the campus and the buildings have been improved, as well as the quality of the campus (roads, connectivity and transport facilities).

8.3 STEP 3- QUICKSCAN VARIABLES

Quality of education 2.8

The CUHK has a rating of 45,5 with teaching on the Times HE ranking (Times Higher Education, 2014a, p. 11). The maximum is a score of 100, which means the score is below standard.

Quality of facilities -

The data concerning the quality of the facilities have not been found. Assumptions can be made based on the quality of the buildings, which is quite new in comparison with older universities such as TU Delft. The existence of a similar monitor like the NSE is absent in Hong Kong, which makes it more difficult to find the data that is needed. That is the reason to not rate this variable with a grade.

Research output 3

Research (Reputation survey 18%, research income 6%, research productivity 6%): final grade: 54.7 (Times Higher Education, 2014b). The maximum score is 100, which means the score is lower than fellow institutions. The figure depicts the number of research output/ publications of the university (figure 41).

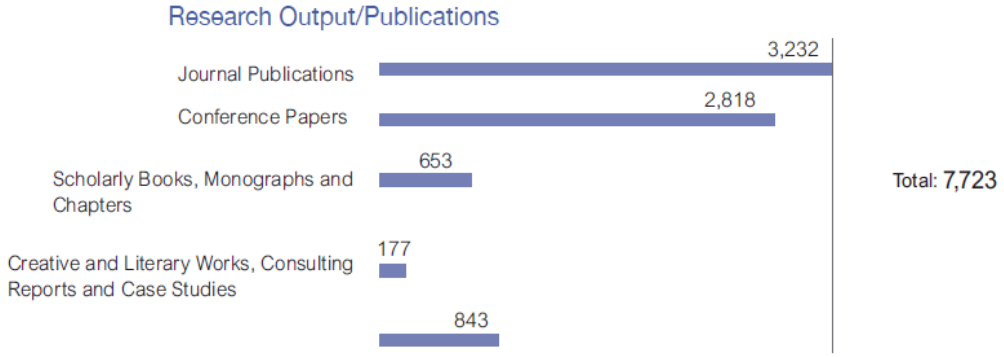


Figure 41: Research output/publications in number of items (CUHK, 2014a)

Total income & costs 3

The university receives a large amount government subventions (52.8%). They spend their financial resources on investing on enhancing the quality of the campus, but also the quality of the buildings. The CUHK has positive balance between the costs and benefits. They have a high income stream through government subventions, but a low income stream from the grants and subsidies for projects.

Income

	2013–14*		2012–13**	
	HK$ million	(%)	HK$ million	(%)
Government Subventions	4,200	52.8%	4,423	51.2%
Tuition, Programmes and Other Fees	1,965	24.7%	1,858	21.5%
Interest and Investment Income	668	8.4%	576	6.7%
Donations and Benefactions	464	5.8%	1,156	13.4%
Ancillary Services Income	241	3.0%	216	2.5%
Other Income	422	5.3%	404	4.7%
Total	**7,960**	**100%**	**8,633**	**100%**

Expenditure

	2013–14*		2012–13**	
	HK$ million	(%)	HK$ million	(%)
Instruction and Research	4,548	69.8%	4,469	73.7%
Library	221	3.4%	183	3.0%
Central Computing Facilities	123	1.9%	114	1.9%
Other Academic Services	291	4.5%	131	2.2%
Management and General	277	4.3%	239	3.9%
Premises and Related Expenses	640	9.8%	555	9.2%
Student and General Education Services	377	5.8%	332	5.5%
Other Activities	35	0.5%	37	0.6%
Total	**6,512**	**100%**	**6,060**	**100%**

Figure 42: Income and costs (CUHK, 2014b, p. 38)

Technical condition 4

In 2014, four CUHK building projects were honoured by the 'Green Building Award 2014', which was co-organized by The Hong Kong Green Building Council (HKGBC) and the Professional Green Building Council (PGBC) to promote sustainability in building projects. The building projects of CUHK won 2 merit awards (out of a total of 5 awarded for the category) and 2 Finalist awards.

Striving to be one of the greenest colleges in Hong Kong, Lee Woo Sing College has incorporated numerous pioneering green building features in their new student hostels. All 300 rooms of the hostel dormitory have sub-meters installed to record the electricity consumption of each room.

The concrete walls and roofs of the buildings absorb and re-radiate a large amount of heat, increasing the amount of air-conditioning that they need and also contributing to the "urban heat island effect" outside.
CUHK recognizes the importance of third-party verification, and has subscribed to various Government recognition schemes including the *Carbon Audit*, *Indoor Air Quality Certification* and *Quality Water Recognition Scheme*.

Maintenance 3

The University is mindful of the ongoing needs to renovate and upgrade existing buildings, and to stabilize slopes through regular maintenance; special funds have been secured to meet these needs without drawing on normal operating budgets. Several major projects have significantly improved the overall environment for staff and students: The University will continue to sustain the programme of renovations and improvements for the entire campus, and through advanced planning to minimize the inconvenience caused during the renovation process.

Quality of built environment 5

While there will inevitably be pressures due to increased density (as with Hong Kong as a whole), a long-term view needs to be taken to preserve and indeed enhance the quality of the campus environment. In particular, more attention is needed to enhance greenery through the preservation and planting of trees and the conscious protection of grass and lawns. The campus should also become more pedestrian-friendly. The campus vision points are:

Creating a Pedestrian-Friendly Campus

- provide additional vertical links with proper integration with the buildings
- provide new exit at northern edge of University Station, with appropriate entrance design to enhance the University's identity
- provide a designated and safe cycling track and parking spaces at low-level area
- provide centralised car park on the border of the campus, but with sufficient support of a comprehensive pedestrian network and improved shutter bus service
- improve shuttle bus service including adapting the bus route

Campus Landscape

- explore thematic planting, yet maintaining the existing bio-diversity of birds and plants
- preserve the existing natural environment

A Sustainable Campus

- establish guidelines for new structures/ buildings
- promote greening and environmentally friendly building design
- establish additional policies on the reduction of greenhouse gas emissions and energy consumption

Amenities 5

The campus offers a wide range of amenities on the campus. The proximity is all within the range of the campus borders, and accessible through bike, car, walk and the shuttle busses.

Sport Facilities	
Swimming Pool (50 m)	1
Sport Fields (with running tracks and soccer pitch)	2
Tennis Courts	12
Squash Courts	6
Indoor Gymnasiums	5
Games Rooms	8
Water Sports Centre	1
Fitness Rooms	10
Outdoor Playgrounds	6
Archery Practice Range	1
Climbing Walls	2
Other facilities	
Libraries	8
Museum and galleries	12
Bookstore	1
Cultural facilities	5
Canteen	11
Banks	2
Medical services	3
Supermarket	1
Souvenir counter	1
Hair salon	1
Student Hostels	8,856 (beds)

Table 22: Amenities of CUHK

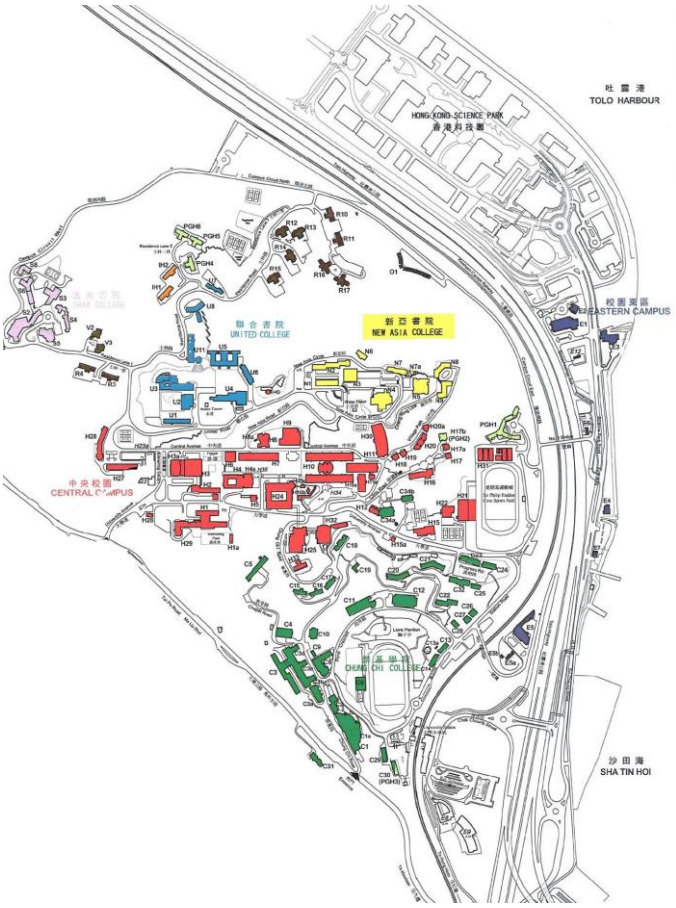


Figure 43: Campus map (CUHK, 2015)

Infrastructure 4

Public transport

The campus is located outside the city centre of Hong Kong. The travel time with the subway is approximately 30 min from Kowloon (city centre) to the CUHK, using the MTR East Rail Line. On the campus there are 11 lines of shuttle busses which a frequency varying from 2-6 times an hour from Monday to Saturday (Travel China Guide, 2015). Sunday has a adapted schedule with fewer lines and frequencies.

Furthermore, the campus master plan explains some improvements like optimising transport facilities, parking, improving the roads for both cars and pedestrians.

The details of the rating of the maturity levels and the performance levels of CUHK are depicted in Appendix VI.

8.4 CONCLUSION

The goal of conducting the case study of CUHK is to test the applicability of the quick scan model in a different context, where the collection of data is dependent on using online-resources, reports and drawings/maps. The applicability will be compared to the full scan model. The difficulties but also the advantages will be explained in this paragraph.

Maturity level CUHK

The result of the maturity levels is depicted in figure 44. The rating of the maturity levels is based on the subjective analysis of the documents, without using qualitative research methods such as conducting interviews with people from the university. As shown in the figure, the maturity level on the physical urban level is very high, following with the strategic and physical building components. These ratings are based on the information that is provided by the university website and reports. In their documents a strong vision concerning the campus development can be found, but also the strong mission of enhancing the competitive advantage of the university. The aesthetics of the buildings and campus is a high priority in retaining the status of a university in Asia. The data concerning the financial component was difficult to find, due to the fact that China is reserved in sharing private information. The data concerning the functional component tend to be harder to find, due to the fact the focus does not lie on this topic. The CUHK focuses on developing the campus master planning, and does not so much have statements made about the functional component. The only statement they made is about a more efficient use of space by assigning the right amount of students per class to the right size of class rooms.

However, that the data concerning the functional and financial component was not found, or hard to find, does not mean it does not exist. But using the quick scan assessment an assumption is made concerning the maturity level.

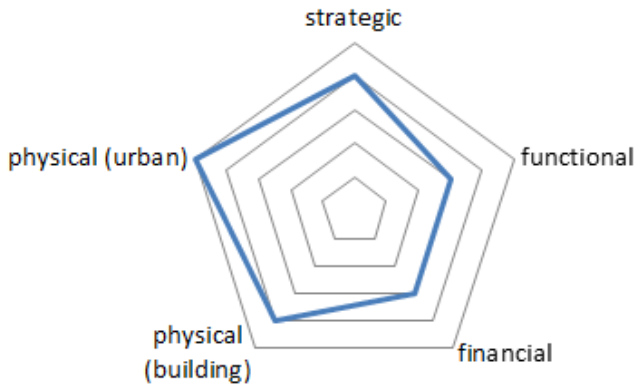


Figure 44: Maturity levels of the CUHK

Performance level CUHK

The performance level of the CUHK is depicted in figure 45. This figure shows the performance level of the quick scan variables. As shown the quality of the built environment (the campus) is very good. The campus is located on the mountain range, which is why the university has a high priority of using the natural environment as an added value for the quality of the campus. They also have taken the geological environment into account from the beginning in developing the campus and its buildings. Therefore the quality of the built environment is highly developed.

The variables which score lower are the quality of the education, the research output and income & costs. These data is derived from the ratings made by the ranking systems, in which the universities are being compared. Some variables where difficult to collect, which can be caused by the reserved thoughts of sharing information concerning the financial information or information that is negative.

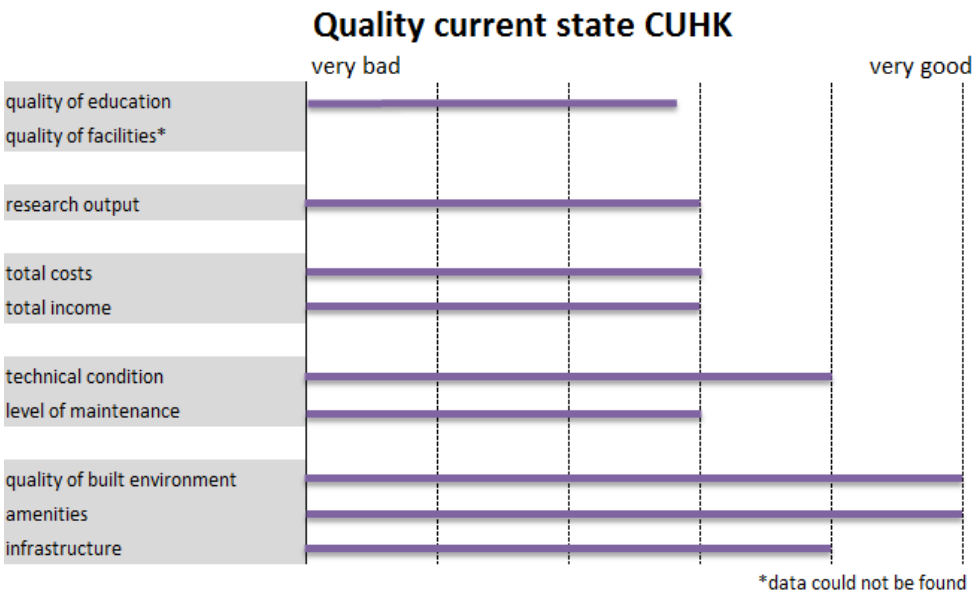


Figure 45: Performance level (quick scan variables) of CUHK

Applicability of the quick scan model

The quick scan model measuring the maturity levels of the CUHK gives a good overall view. Using the quick scan based on online-resources and documents is a reliable method in determining the maturity level. The researcher searches for signs, plans and statements concerning the strategic/functional/financial and physical management of the campus. The researcher can use an objective view to analyse the data, and give a maturity level based on the information found. To determine the performance level of the CUHK is somewhat more difficult, since the information that have been found through online-resources or reports may not be reliable when information tend to be made more positive. However, conducting interviews with people from the university who have a biased view can also influence the reliability of the data. When people are asked to rank a certain variable, they tend to be more positive as well. A solution would be to visit the site and the buildings to assess the performance yourself. However, this a highly time-consuming and difficult method, since all sort of documents exists that can answer a lot of the questions related to performance levels.

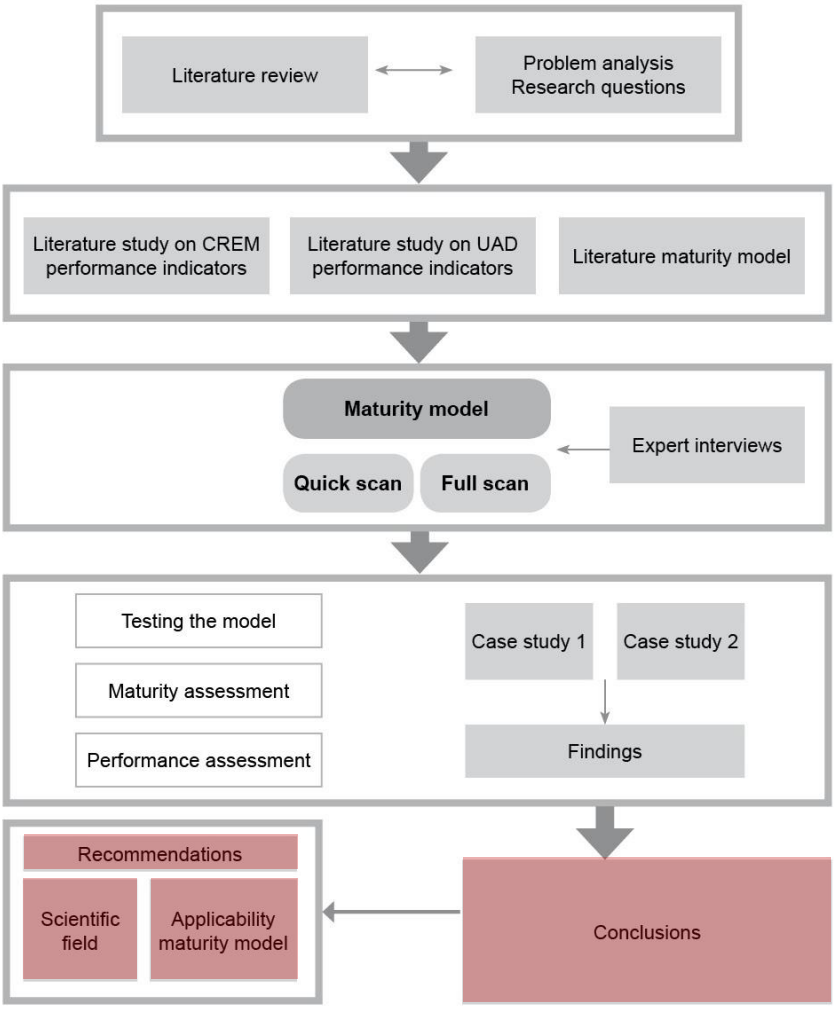
The final remarks concerning the quick scan:

- The quick scan method is a method which uses limited amount of research resources (time and money) to conduct a case study which provides a good overall view about a case.
- The collected data can be analysed in an objective way, in which the researcher can provide the final assessment of the maturity level and the performance level
- No risk of wasting time and money when data collected are not reliable (biased data)
- Possibility of missing some key issues which will create a view that is not complete, however the most important variables are included in the quick scan.

Chapter 9

Conclusions, Recommendations & Reflection

This chapter is the final chapter of the report. It will provide the answers to the raised research questions. The applicability of the maturity model will be explained, that resulted from testing the model in the case studies. Furthermore this chapter will explain the limitations, advantages and disadvantages of the models, but also the similarities and the differences between the quick scan and full scan model. Next some recommendations for further research will be given. Lastly the report will provide a reflection on the research process.



9. CONCLUSION & RECOMMENDATIONS

This is the final chapter of this report. The following section will concisely outline the most important findings of the previous chapters. Hereby connecting the different research methods used in this research: literature review, expert interviews, and two case studies. First the four sub research questions will be discussed. These sub research questions together answer of the main research question. This chapter will end with some indications for further research and a brief reflection on the master thesis.

9.1 CONCLUSION

Q1) How can the level of maturity of a university be determined (strategic thinking)?

- How can the maturity model be developd?
- What levels in the model can be determined?
- How can a quick scan model (for a research method with limited resources available) be developed?
- How can a full scan model (for a research method with large amount of resources available) be developed?
- How can the maturity model be operationalised?

This question is answered in chapter 3 and 5. The maturity model is divided in five levels, which is derived from various literature. The levels rank from 1 to 5 where 1 is the lowest maturity level and 5 is the highest. The criteria in which the maturity level is being measured is related to the level of awareness of an institution, the level of goal focus, the innovation level, the tools and system that support data documentation and sharing, the skills and expertise of staff and the communication between stakeholders.

The quick scan model is intended for a research method with limited resources available. With the use of online resources, reports, maps and drawings a general view can be created. The quick scan model is developed based on putting the variables on a 'effort in retrieving' data axis, in which the variables that are more intensive, are left out in the model.

The full scan model contains all the key variables which are indispensable when generating a view of a certain case. This model is intended for research methods which involve the availability of more research resources. Methods like conducting interviews, site visits and observation are included in this model.

The operationalisation of the model is explained in chapter 6 and is divided in four steps:
Step 1 contains the collection of background information about the case, step 2 the assessment of the maturity level, step 3 the collection of the quick scan variables and step 4 the collection of the full scan variables.

Q2) How does the maturity level express in the performance level (evidence) of the campus?

- What variables affect the level of performance related to the discipline of Corporate Real Estate Management?
- What variables affect the level of performance related to the discipline of Urban Area Development?
  - Urban factors which influence the performance of a university

The variables that affect the performance level are explained in chapter 4. The factors that affect the performance level are related to the user satisfaction, the attractiveness of facilities/buildings/campus, the quality of education and facilities, the technical state and quality of the buildings and built environment, the research output, the income & costs and the urban structure such as the infrastructure, amenities and the relations with the neighborhood and the city.

Q3) What is the applicability of the developed model?

Testing the model: a case in Hong Kong (The Chinese University in Hong Kong)
a case in the Netherlands (TU Delft)

- Measuring the level of maturity and the physical outcome
- Limitations, advantages, disadvantages, differences and similarities between the quick scan and full scan model
- Which model is better applicable?

Quick scan

Advantages quick scan

The advantage of the quick scan are the limited need of research resources (time and money) to conduct the research. The research can be conducted through home in a way of speaking. No visits or field work is included, nor speaking to people from the inside of the institution. Because these research methods are not necessary, the risk of wasting time and money for the research is also lower, when the collected data through interviews or fieldwork is not reliable (biased data).

Disadvantages quick scan

The disadvantage is the quick scan is that some of the key variables are left out in the research. There is the possibility that a key issue is missed by the researcher due to this reason. The may affect the result of the findings.

Limitations quick scan

The possibility exists that the quick scan variables, which are only a part of the full variables, will create a view which is not complete. However, the quick scan variables are derived from expert interviews, in which the experts are asked to rank the importance of the variables. The quick scan model contains the most important variables which creates a good general view about a certain case.

Final remark: Using the quick scan based on online-resources and documents is a reliable method in determining the maturity level. The researcher searches for signs, plans and statements concerning the strategic/functional/financial and physical management of the campus. The researcher can use an objective view to analyse the data, and give a maturity level and performance level based on the information found.

Full scan

Advantages full scan

The full scan gives a broader view but also a complete view of the campus management and performance of the university. Furthermore, all key variables are included in the research. Talking to people can also makes it a lot easier to collect the relevant data. When an expert gives the answer right away, including a good argumentation, that can save time analysing all the documents and reports to find the information. Furthermore, conducting interviews can bring a richness of data that is interesting. The experts can also give advice on where to find certain data, and possibly providing documents that can help with the research, that otherwise were not available through online resources. Triangulation is then possible when using the data derived from interviews, which makes findings more reliable.

Disadvantages full scan

There is a possibility of a biased view of employees who work for the universities. They tend to glorify the condition of the portfolio and the maturity level of management because they do not want to talk bad about the university. By speaking with people the findings can be influenced. Especially when they are from different (management) perspectives. This means that the full scan can provide information that is biased.
Furthermore, there is a risk of spending a lot of (financial) resources such as travelling costs to conduct interviews with people from the inside, and they do not actually want to share too much information. If the result of such interviews are not relevant for the research, a lot of time and effort will be wasted.

Limitations full scan

When selecting experts to interview from a certain perspective the possibility exists of a biased view. Employees in the university tend to glorify the condition of the portfolio and the maturity level of the management, especially on their own expertise field. In countries where the country is more closed, there is a risk where they tend not to share information. Based on the case study of CUHK it can be concluded that the detailed information concerning the financial component was difficult to find. The assumptions is that the institutions is reserved in sharing private information.

Differences

Based on the case study of TU Delft, where both of the models are being tested, some differences of the models can be described:

- Difference in assessing the maturity level. It is dependent on the character of the person who is interviewed to rate the maturity level or the performance level. If a person is honest, they will give an honest answer, if people tend to feel obligated to be positive about the situation, they will give a more positive answer. There will always be a difference on the outcome of the quick scan and full scan model, since the opinion of experts are subjective, as well as the researcher who conducts the quick scan.
- When the results of the performance level are positioned next to each other, there are some differences in outcome. The ratings of the experts concerning the current physical state of the campus tends to be a half point higher on a 5-point scale than the assessment made by myself in the quick scan.

Similarities

- When testing the model, the result of the quick scan and full scan were in accordance, with only a small difference concerning the maturity level of campus management.
- Other similarities were the things the expert mentioned in interviews, were also the data that could be found in the documents and reports. The most similar answers were the answers related to the plans and goals of the university, as well as the planned projects. Since the criteria is clearly defined to measure the maturity and the performance level, it is not strange that the answer from the experts and the data found in the documents are mainly the same. However, this means that one or another is expendable as a source of data collection.

Which model is better?

The final issue to be answered is based on the case studies, to determine which of both the models is better applicable. Based on the case studies on the TU Delft and the CUHK, to choose which model is better, is fully dependant on the chosen case. For cases in a different context, with a limitation of research resources, the quick scan is definitely better applicable. The quick scan provides a good overall view about the case. Since the data derived from the quick scan and full scan does not differ too much (conclusion of testing the model on the case of TU Delft), this method is better applicable for most cases. The quick scan is also better applicable when a multiple case study is necessary. It will save a large amount of time and effort. Based on the case study of TU Delft, in which both the quick scan and full scan is being tested, the conclusion is that the quick scan provides data that is in accordance to the full scan method. The full scan method even provides data that tend to be biased. The quick scan method is therefore for all cases, where data is easily accessible through the internet, the better tool to be used by researchers when conducting a case study.

The full scan model is better only in circumstances where the data is difficult to access through online resources. Interviewing experts from the inside will provide the answers to the questions. However, there will be a possibility of biased view in the findings. Plus more time and effort is needed when using this full scan method. The full scan method is also recommended when the case is ‘close to home’, and in a single case study analysis.

Main question: How can the maturity level of campus management of a university be determined in order to create added value in terms of performance, and support decision-making?

The maturity model that is developed during the research can measure the maturity of campus management on the four perspectives (strategic, functional, financial and physical). The level to be determined is a level from 1 between 5. After knowing the maturity level of the institution the next step is to determine how the campus management shows in physical evidence. Knowing the current condition of the maturity level gives the opportunity to develop the management, support decision making and become better. Starting from knowing the condition, following in an action-plan, the implementation, and seeing the results will add value in terms of performance on building and portfolio level. The maturity model is actually a strength and weakness analysis. The levels that are depicted in the maturity model are of descriptive purpose. It includes the assessment criteria for each maturity level, but also the assessment methodology. The maturity model features a procedure that guides model users through the process containing the assessment steps, the interplay, and how to elicit criteria's values.
The descriptive purpose of the model contains also an action-plan, or activities that are needed enhance the maturity level. When a certain maturity level is determined, the activities stated in the next level are the actions that need to be taken to reach this next level.

An example:
If the physical component on building level is graded a 3, and the institutions has the goal to enhance their maturity level, they can look at the points stated in level 4. They provide a guideline for the actions that need to be taken in order to reach this higher level.

Level 3	▪ The have explicit defined goals concerning the sustainable development of the campus, reducing the footprint. There is a presence of a 'campus vision' ▪ A monitor which measures and show the energy usage, the technical condition ▪ Presence of a maintenance programme ▪ Preventive maintenance ▪ Plans for sustainable development ▪ Plans to enhance the quality of the buildings and facilities
Level 4	▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Using alternative innovative materials and products which will reduce the footprint ▪ Plans to dispose qualitative bad m2 in supply; plans for new construction ▪ Renewal building components (renovation) ▪ preventive maintenance using alternative materials and products ▪ implementation or on-going plans for enhancing the quality of buildings and facilities

Figure 46: An example of a prescription of the guideline of actions to evolve from maturity level 3 to level 4

9.2 DISCUSSION

Reliability: The results of the research are repeatable, if the variables and context is kept the same. Then the research findings are consistent. It is possible that in different occasions the result will be different, for example by choosing another university outside the case selection criteria or a case that is exceptional.
The variables which are disposed based on the importance-axis can be questioned. The ranking of the variables are based on opinions of experts from different departments. Also the variables are first determined by the literature as important. However, the variables that are left out in the quick scan and full scan model can be different when the research is conducted in a different time with different experts.
When different model users use the model, the data collection is the same. However, the conclusions drawn from the findings can involve the subjective view of the researcher when grading the maturity level or performance level of an institution. Researchers who are from similar backgrounds or expert levels will have finding that are more related than researchers who are from a totally different perspective such as the user level.

Validity: The conclusions generated through the use of the maturity model may be difficult to generalize, since there are a lot more factors than mentioned in the selection criteria, which will have influence on the results. The findings from one university cannot all be generalized to a larger population, but it is possible to give some statements. In terms of validity of the tool, the tool can be used for other cases as well.
The validity of the theory obtained has taken place through triangulation, which means that information is validated by two or more sources (by literature and expert interviews).

Credibility: The case studies are conducted objectively, but the data collected will be used grade the level of maturity and level of performance, which will be done with a subjective view of the researcher. To tackle this problem, triangulation of data is a solution. Moreover, the data collected from employees of a certain case may be not credible, when they tend to overpraise their university. To encounter these issues, a solution would be to be selective in choosing the interview cases. Choosing persons which are more objective are better cases than for example technical facility managers.

Missing data
Data not found does not necessarily mean that data does not exist. An example is for the CUHK, where the data of the financial component concerning their financial strategy, their budgeting and their financial planning could not be found. Some information is classified, and not to be found on public documents. This does not mean that they do not have a financial strategy, planning nor budgeting plan. When data is missing, the grading of a maturity or performance level can be influenced. The researcher should then always mention such an issue in the findings, and the influence on the reliability of the assigned level.

Limitations of the model
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). Furthermore, the model is influenced by a large amount of factors, such as the type of organisation of the case, the country and governance.

Despite these limitations, I believe that the framework that is provided in this thesis constitutes guideline and a valuable starting point for future research in advancing the model.

9.3 RECOMMENDATIONS

Stakeholders

The developed maturity model can be used by the *policy makers* to understand their current condition of the campus management as well as the performance level. Their objectives are to improve the competitive advantage of the institution by enhancing the quality and attractiveness of the learning and working environment. Using the maturity model will support decision making in knowing what the next step should be. The highest level can be reached through the development of information systems, and anticipating on changing demand. Upgrading systems, tools and the skills of people puts the institution on a higher level, the same goes for the overall quality of the institution.

The *technical managers* can use the model to support their decision making. Typically technical managers focus on the level of their own building. By showing facts and the result of the maturity assessment they will start realising that development is necessary. If they continue to think only the technical level, they will obstruct the process in reaching the vision and goals of policy makers. This is not beneficial for them as well. Using the maturity model the technical managers can understand what steps needs to be taken in order to become better and reach that next level of maturity.

Further research

In order to enhance the framework's validity, it should be discussed with maturity model users and developers from both industry and academia. The Delphi technique could be used, for instance, in order to provide valuable insights into whether the framework is complete and which variables and assessment criteria are generally considered mandatory or optional. The variable list should be complemented with more variables, and possibly split into different types of cases. The model that is designed is a guideline and the starting point of the further development of the model.

The developed model should be tested on applicability on more cases. By testing the model and taking down the findings and differences of each case, the maturity model can be revised and fine-tuned. Some other subjects can also be added to the maturity model, such as involving the last step mentioned by the literature of Pöppelbuss. The optional third step of the maturity model are the prescriptive design principles of the improvement measures for each maturity level. Complemented with this third step the maturity model would be complete.

9.4 REFLECTION

Reflection on the subject

The aim for this research was to develop a maturity model which was for academic relevance. The problem continues of increasing complexity of managing the campus, since the number of stakeholders involved are increased. To support the decision-making related to campus management, a tool needed to be developed to assess the current state of art. By knowing the current condition of the maturity level the institution can make the mismatch in demand and supply. After that they can think about the changing future demand, and generate plans in how to match the current supply with the future demand. This way of thinking is actually the maturity in strategic thinking of an institution.

The developed maturity model is a way to show people where they are positioned, but also making them aware of this state. Consequently, by knowing the position people tend to have more willingness to develop and become better. The results of this research contributes to the subject of supporting decision making in campus management. Campus management is part of the subject of Real Estate Management, but nowadays more and more related to Urban Development as well.

Reflection on the process/ personal reflection

Starting from the P1 my ambition was high. The subject was derived from an interest in the context of China and its campus management. The aim during this phase was conducted a case study for a university in a Chinese context. But during the research, I realized that the limitations of research resources forced me to change my subject. If I would have continued the focus on China, interviews and visits were necessary. Due to the limitations of time and resources there was no possibility to consider this option. During the P2 I made a switch on changing the focus of my subject.

Because I experienced the problem myself, I wanted to develop a case study tool, which assesses the maturity level of campus management and the performance level, but also a version in which a limited amount of research resources are available. I believed that a case study can be done without visiting the campus, nor speaking to people from the inside. And that was how the focus was changed from conducting a case study of China, to developing a maturity model.

Continuing from the change of focus I actually was glad that the focus was changed. Developing a maturity model has a higher academic value than the first idea.

During the development of the maturity model a large amount of literature have been reviewed, in order to map down the existing models, but more importantly, in how to develop one. After analysing the theory of the maturity model a rough version was made, divided in the five levels that most maturity models have. The second part was to determine the variables which affected the performance level of a university. Again a large amount of literature have been reviewed in order to note down the relevant variables. Once the variables have been determined the maturity model started to become more complete. During the fine-tuning of the maturity model, different steps and actions have been taken. The model have been revised every time new input is found from literature, mentor meetings and interviews. This iterative process made the maturity model more accurate after each feedback loop. The final model is presented in Appendix IV.

Lessons learned

The lessons learned during the process in the last year are extensive. The lessons learned are:

- The findings from the interviews tend to be biased. When planning the interviews in the case studies, such a problem was not yet taken into account. In the future, I will be more selective in choosing the persons.
- Conducting case studies in a different context, in the case of CUHK, the government policies and habits of the countries tend to influence the data that has been found. Some information was not found due to the fact China is reserved in sharing private information. Moreover, Chinese institutions tend to glorify the status of their institutions and leaving out negative information.
- Using qualitative research methods involving interviews are very time-consuming. The data that has been derived from the interviews are similar to the objective analysis of documents and reports of the case.
- When conducting the expert interviews in ranking the predetermined variables, the richness of data is lost due to the fact a prescribed list of variables is presented to the experts. If the interviews were conducted in an earlier phase, the variables could be derived from the expert interviews instead of literature sources. However, during the interview the experts were asked if they have additional variables to add which they found indispensable.

LIST OF ABBREVIATIONS

BIM	Building Information Modelling
BK	Faculteit Bouwkunde (Faculty of Architecture and the Built Environment)
BTS-system	Budget Toewijzingssysteem (Budget Allocation System)
CiTg	Faculteit Civiele Techniek & Geowetenschappen (Faculty of Civil Engineering and Geosciences)
CMMI	Capability Maturity Model Integration
CMP	Campus Master Plan
CREM	Corporate real estate management
CUHK	The Chinese university of Hong Kong
CvB	College van Bestuur (Executive Board)
DAS	Designing an Accommodation Strategy
EWI	Faculteit Elektrotechniek, Wiskunde en Informatica (Faculty of Electrical Engineering, Mathematics and Computer Science)
F&D	Faculteit & Diensten (Faculty & Services)
Fi_x	variables of the financial component
FMVG	Facility Management & Real Estate
Fu_x	variables of the functional component
HE	Higher education
MM	Maturity model
NSE	Nationale Studenten Enquête (National Student Survey)
Pb_x	variables of the physical component on building level
ProMi	Professionalisering Management Informatie (Proffesionalizing Management Information)
Pu_x	variables of the physical component on urban level
REM	Real estate management
UAD	Urban area development
S_x	variables of the strategic component
SWOT	strengths, weaknesses, opportunities and threats
TBM	Faculteit Techniek, Bestuur en Management (Faculty of Technology, Policy and Management)
TQM	Total Quality Management
TN	Faculteit Technische Natuurkunde (Faculty of Applied Physics)
TNW	Facultiet Technische Natuurwetenschappen (Faculty of Applied Sciences)

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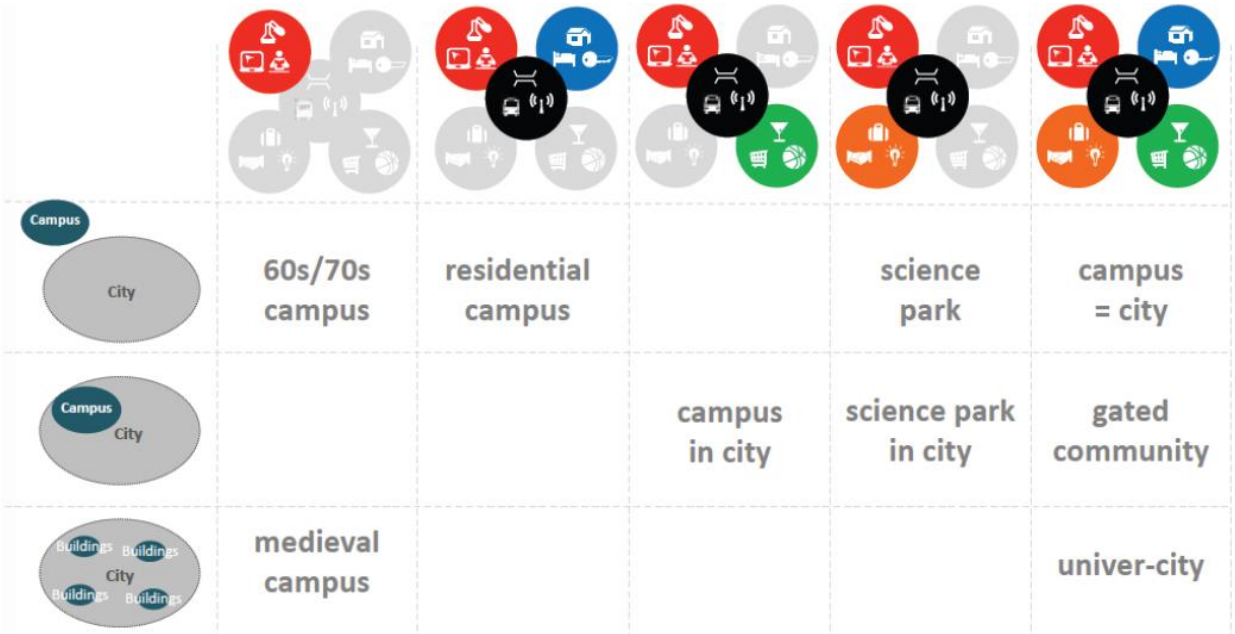
APPENDIX I

Different types of university cities depending on the location of a university in relation to the city and its amenities (A. Den Heijer & Tzovlas, 2014)



- **ACADEMIC**
  classrooms, libraries, offices, meeting rooms, laboratories, lecture halls, workshops, storage space, studios, study places, academic hospital, conference facilities, ...
- **RESIDENTIAL**
  student housing, faculty housing, hotels, short stay housing, housing support staff, alumni housing, ...
- **RELATED BUSINESS**
  accommodation for start-ups, incubators, research institutes, service providers (catering, printing, cleaning, maintenance), other (higher) educational institutions, etc.
- **RETAIL & LEISURE**
  coffee bars, restaurants, cafes, bookshops, supermarket, theatres, cultural facilities, sports, day-care centres, student associations, ...
- **INFRASTRUCTURE**
  public space, parking, bicycle paths, roads, public transport facilities, ...

APPENDIX II

INTERVIEW FRAMEWORK

1. Maturity model

Het doel van deze scriptie is het ontwikkelen van een meetlat dat de volwassenheid van campus management kan meten. Het te ontwikkelen is tweeledig: eerst zal er een 'maturity model' worden ontwikkeld waarbij de volwassenheid van campus management gemeten kan worden. Deze is verdeeld in 5 niveau's:

1. Initial: Geen bewustzijn van de huidige staat en geen neiging tot verbetering van het campusvastgoed, verder hebben zij geen toekomstfocus. Doel: alleen de nodige m^2 aanbieden voor het ondersteunen van de werkzaamheden.
2. Repeatable: De universiteit is zich bewust van hun zwakheden en heeft plannen om dit te verbeteren, maar in een vroegtijdig stadium.
3. Defined: Er is een aanwezigheid van een bepaalde management afdeling dat zich bezighoudt met de verbetering van het vastgoed. De universiteit hanteert een bepaalde strategie om hun zwakheden tegemoet te komen.
4. Managed: De universiteit is zich bewust van de huidige situatie maar ook zeker van de toekomst en anticipeert hier ook proactief op door op langere termijn te plannen.
5. Optimizing: Hoogste niveau, waar een universiteit prestaties maximaliseert. Goede lange termijn planning, meerdere alternatieven in plannen, zwakheden elimineren.

Het doel van het interview is om te bepalen of er op deze niveau's nog iets aan te vullen is. Aan de hand van inzichten van experts kan er informatie en suggesties toegevoegd worden aan het model.
Vervolgens is het doel om het model te kunnen gebruiken om de volwassenheid in campus management te bepalen van een bepaalde case, maar ook in een andere context, waar Real Estate Management minder bekend is. Het meten van de volwassenheid is tweeledig. Een universiteit kan claimen dat het een hoog niveau bezit in campus management, maar het bewijs ervoor zal zich ook moeten uiten in de fysieke omgeving en gebouwen. Hierbij is het van belang om te weten wat nou belangrijke variabelen zijn die de 'performance' van een universiteit bepalen. Dit is het tweede deel van het onderzoek.

2. Bepalen van de variabelen die de performance van een universiteit beïnvloeden.

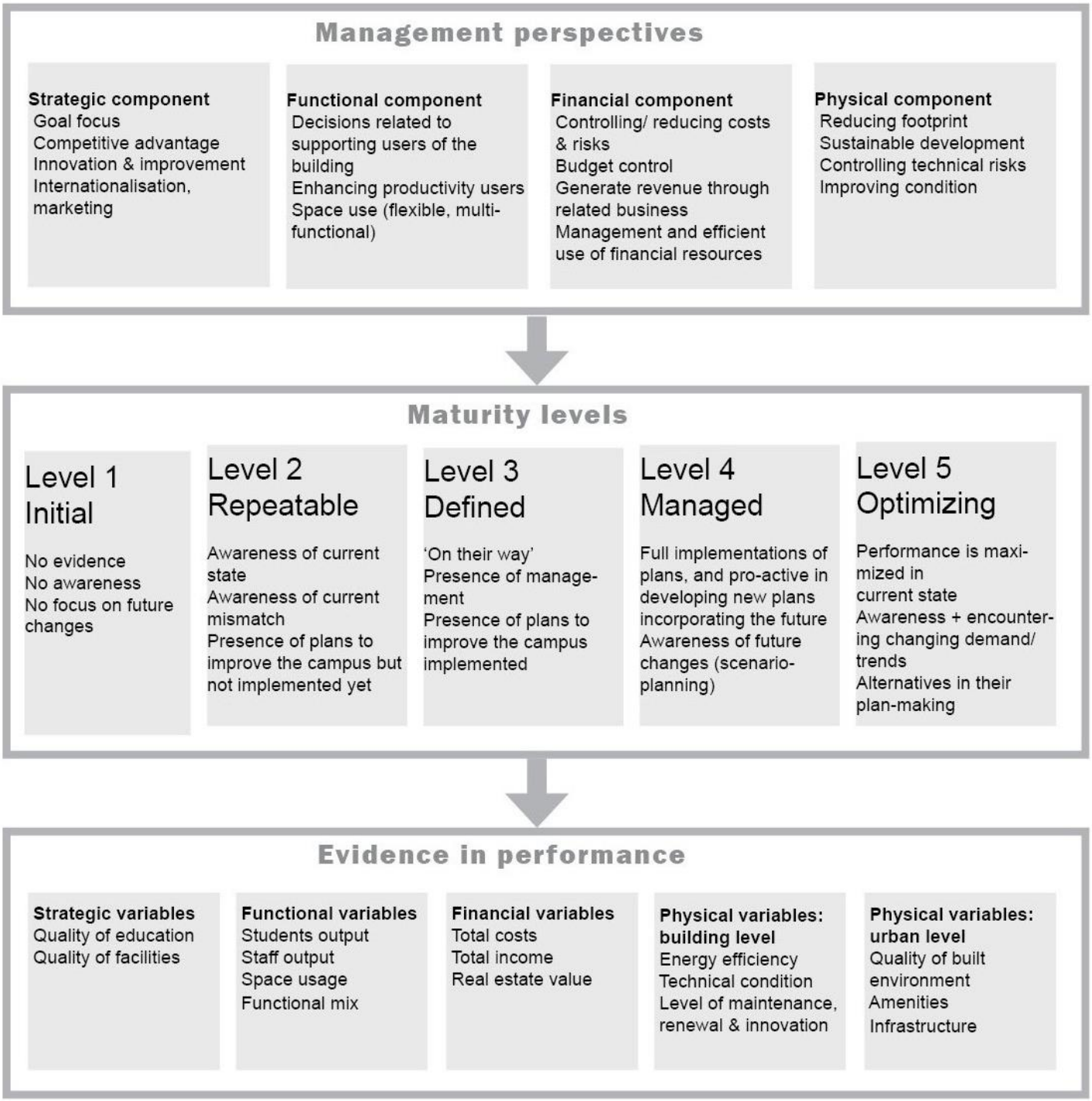
- strategic performance - functional performance - financial performance - physical performance

Naast het bepalen van belangrijke variabelen is het van belang om te weten hoeveel tijd en moeite erin zit voor het verzamelen van de data van het desbetreffende variabele. Dit is omdat het doel van de scriptie is om een meetinstrument te ontwikkelen dat ook gebruikt kan worden in een ander context, waar informatie soms gelimiteerd kan zijn. Dit is het quick-scan model.

3. Bepalen van de huidige staat van campus management in TU Delft, en of dit ook zichtbaar is in de fysieke uitkomst.

Aan de hand van het ontwikkelde model zal ook de huidige volwassenheid in campus management van TU Delft getoetst worden. Dit zal geschieden in enkele vragen aan de geïnterviewde.
Verder zal er ook een beoordeling van de fysieke staat van het vastgoed gevraagd worden aan de geïnterviewde.

Dit schema laat de opzet van de maturity model zien:



APPENDIX III

Adding value on organizational level, connected to primary stakeholders, KPI's as management information to measure and related tools to measure (A. C. 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 IV: FINAL MATURITY MODEL (DETAILLED)

Step 1 Basic information

	Instructions	Where to find
Background data (context)	Describe the location of the case Describe the country, some governance, education structure	Maps, floor plans campus
General building data	Note down the general technical building information. Size of the campus, how many faculties and size	Documents on the website
Statistics	Note down the numbers of students & teachers, enrolments, graduates/year	Annual report
Education program	Make a list of how many and what courses the institutions provides and what kind	Website Reports
Reputation, ranking, influence	Describe their research influence/patents/ their ranking/ income through research	Annual reports

Step 2 Assessment criteria

Criteria 1	**Awareness** clueless ↕ prepared	▪ Awareness of the current condition and (mis)match ▪ Awareness of changing demand and trends involved in the higher education sector
Criteria 2	**Goal focus** aimless ↕ high ambition	The level of goal focus expresses in the presence of plans and statements in improving a certain subject (e.g. enhancing competitiveness, reducing energy costs, increasing amount of amenities etc.) ▪ Statements ▪ Plans, strategies, visions
Criteria 3	**Innovation level** old fashioned ↕ innovational	Innovation drives up the competitive advantage, which means the level is determined by renewal of systems, tools, building materials and processes.
Criteria 4	**Tools and systems** underdeveloped ↕ advanced	▪ The presence and maturity of research tools concerning a certain subject (e.g. monitor for energy usage). ▪ Systems are related to the presence and maturity of documentation systems of information.
Criteria 5	**Skills and expertise** incompetent ↕ outstanding	The skills and expertise of the staff are an important factor which influences the maturity level of campus management. When people lack the skills to make links between disciplines, the true added value will be lost
Criteria 6	**Communication** poor ↕ excellent	▪ Information share: The presence and maturity of information sharing systems; do they have a general system for information sharing, or does every party has its own framework. ▪ The communication between stakeholders involved in the campus management. An example is that the facility management department regularly have meetings with the users of the building to determine their demand and satisfaction.

Step 2.1 Maturity levels strategic component

Level 1	▪ No awareness of current supply and demand ▪ Not aware of their competitors, nor they have intention to compete in the battle to become the best university ▪ No research on future trends nor future changes such as student forecasts ▪ There is no strategic, nor operational improvement focus ▪ No research on innovation to add value on the buildings nor to increase competitive advantage; 'old-fashioned' ▪ 'just letting it happen' attitude ▪ Tools and systems to measure and document information are non-existing ▪ Skills and expertise of staff are incompetent ▪ Communication between stakeholders is poor ▪ Information sharing systems are non-existing or very poorly
Level 2	▪ Awareness of current supply and demand, but more importantly the mismatch ▪ Awareness of their competitors, but no focus on competing. ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Innovation is not a driver yet, continuous operation has priority ▪ Tools and systems are starting to developed; measure information to understand the current state ▪ Skills and expertise of staff are related to their field only; no analytical skills ▪ Communication between stakeholders is starting to developed to understand the basic needs of the users ▪ Information sharing is developing because communication between stakeholders are better
Level 3	▪ There is a strategic focus, which is made explicit in plans ▪ Presence of a 'campus vision' to improve current supply based on current demand to ensure competitive advantage but also innovation ▪ Tools and systems to measure the information is present (monitor for energy usage, monitor for user satisfaction) ▪ The skills and expertise of staff are competent; they have the analytical skills to make connections between different information disciplines ▪ Communication and information sharing between stakeholders is in a defined stage
Level 4	▪ Awareness of future trends and changing demand, proactive in competing with the competitors, and they have the desire to stand out ▪ Scenario planning, long term planning ▪ Full implementation of plans or already on-going execution of plans ▪ Innovational vision for their campus strategy ▪ Attracting scientists & talents ▪ Regularly having meetings to look forward and look back on happenings
Level 5	▪ Generating future plans for continuous improvement ▪ Strong strategic focus to compete and becoming the best university; desire to stand out ▪ High ambitions ▪ High level of innovation ▪ High frequency of revising and adjusting the plans to match the changing needs ▪ Advanced tools and systems which are being regularly checked ▪ Outstanding skills and expertise of staff ▪ Iconic buildings (not always the case) ▪ Enhancing attractiveness buildings, facilities and public space ▪ Enhancing the quality of infrastructure ▪ Excellent communication and information sharing between stakeholders

Step 2.2 Maturity levels functional component

Level 1	▪ No awareness of current state, and only focused on the required m² ▪ m² not for the right use ▪ No research on future trends nor future changes such as student forecasts ▪ No innovation in terms of space use ▪ Communication with users is poor
Level 2	▪ Awareness of current supply and problems, they want to satisfy the basic technical needs of the users ▪ Satisfy basic space needs ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Standardizing space use ▪ Facilitating the amount of students in relation to the space, but not thinking about smart space use ▪ Communication with users is starting to develop, to understand the needs
Level 3	▪ Plans to improve space usage ▪ Presence of research concerning the occupancy/ space or m² ▪ Clear view of space usage ▪ Research on innovational space use (flexible use, alternative space use) ▪ Communication and information sharing between stakeholders is in a defined stage
Level 4	▪ They want to maximize output with and efficient use of m², they are aware of changing trends ▪ Implementation of flexible space use (multifunctional use, transformation, shared use) ▪ Student prognosis to forecast the amount of future enrolments ▪ Involve users, in order to determine their needs
Level 5	▪ They have a clear image of what their space usage/ occupancy rate is ▪ Flexible functional space use, multifunctional use of space to maximize efficiency, generating new plans to anticipate on future trends ▪ Future plans to anticipate on changing working trends, and they know how this will affect the space usage (e-learning and flexible working) ▪ Excellent communication and information sharing between stakeholders

Step 2.3 Maturity levels financial component

Level 1	▪ No awareness of current costs, and no financial plans to reduce costs, budget for required space ▪ No research on future trends nor future changes such as student forecasts ▪ Costs possibly exceeding benefits ▪ Tools and systems are underdeveloped, no clear view on what the actual income & costs are ▪ Information sharing is poor and ineffective, each party is using different framework; communication is passing along each other
Level 2	▪ Awareness of current supply and problems= mismatch, budgeting plans, ▪ Minimizing building and operational costs ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Statements on having plans to use financial resources for creating added value for the university ▪ Tools and systems to measure the income & costs are human work, no systems yet
Level 3	▪ Plans to improve current supply based on current demand, budget for improvement of competitive advantage (marketing), improving technical condition (energy label) ▪ Presence of a clear financial cost estimation on building and operational costs ▪ Investment planning ▪ Budget control ▪ Budget reserved for creating added value for the university ▪ Tools and systems are present. ▪ Information sharing is in a defined level between the stakeholders
Level 4	▪ Awareness of future trends and changing demand, long-term financial planning (reducing footprint) ▪ Budget for new plans ▪ Presence of a financial department within the facility management department ▪ Allocating money for future plans (projects planned) ▪ Risk planning ▪ Tools and systems are advanced, and information is easy to communicate to other stakeholders
Level 5	▪ Scenario and risk planning for future projects; anticipation on the changing future ▪ Cost estimation of future plans, also from scenario's ▪ Willingness to invest a larger amount of money in projects which create added value on the long-term ▪ High frequency of revising and adjusting the plans to match the changing needs ▪ Presence of information systems in which information is easy to share between stakeholders

Step 2.4a Maturity levels physical component (building level)

Level 1	▪ The institution is not aware of the current technical state of the university and does not has goals for the future campus ▪ There is a presence of a technical controller, which controls the technical quality of the buildings and facilitates the demand of square meters ▪ No research on future trends nor future changes ▪ No research on innovation to add value on the buildings nor to increase competitive advantage; 'old-fashioned' ▪ corrective maintenance with only high intensity defects ▪ poor indoor climate ▪ minimum comply of sustainable development
Level 2	▪ They are aware of the current technical state of the institution and the problems. They have plans to improve the technical state of the building. ▪ Awareness of what the technical buildings costs are, and try to minimize these costs by minimizing the square meters, but not so much on improving the technical state to reduce these costs. ▪ Meeting the basic needs of users (indoor climate) ▪ There is a presence of statements related to goals, but not made concrete in plans yet. ▪ Corrective maintenance ▪ Planning and initiating sustainable development
Level 3	▪ The have explicit defined goals concerning the sustainable development of the campus, reducing the footprint. There is a presence of a 'campus vision' ▪ A monitor which measures and show the energy usage, the technical condition ▪ Presence of a maintenance programme ▪ Preventive maintenance ▪ Plans for sustainable development ▪ Plans to enhance the quality of the buildings and facilities
Level 4	▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Using alternative innovative materials and products which will reduce the footprint ▪ Plans to dispose qualitative bad m2 in supply; plans for new construction ▪ Renewal building components (renovation) ▪ preventive maintenance using alternative materials and products ▪ implementation or on-going plans for enhancing the quality of buildings and facilities
Level 5	▪ They have a strategy to encounter future changes in demand, and have alternative plans to meet this demand. ▪ Focus on creating added value such as reducing costs over the long run. ▪ Optimising and innovating; research on alternative and new materials on the market ▪ renewal building components ▪ tools and methods are advanced

Step 2.4b Maturity levels physical component (urban level)

Level 1	▪ The institution is not aware of the current urban state of the university and does not has goals for the future campus. ▪ Not awareness of the added value of the location of the university ▪ Public space is not used to add value on the campus (no meeting space, or creating connections between buildings, no place to stay ▪ No amenities added to the campus; buildings are only of academic purpose ▪ Corrective maintenance on the public space occurs only with high intensity defects ▪ Minimum comply of sustainable development
Level 2	▪ They are aware of the current state of the campus and the problems. They have plans to improve the public space, infrastructure, amenities. ▪ There is a presence of statements related to goals, but not made concrete in plans yet ▪ Meeting the basic needs of users (parking and roads) ▪ Corrective maintenance ▪ Planning and initiating sustainable development
Level 3	▪ The have explicit defined goals concerning the sustainable development of the campus. ▪ There is a presence of a 'campus vision'. ▪ Presence of plans to improve the infrastructure (roads, parking, accessibility) ▪ Presence of a maintenance programme ▪ Preventive maintenance

	▪ Plans for sustainable development ▪ Plans to enhance the quality of the public space
Level 4	▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Preventive maintenance with using alternative sustainable materials and products which will last longer and needs lower maintenance. ▪ Renewal/renovation public space ▪ Enhancing accessibility of the university ▪ Enhance relation buildings and public space ▪ Proactive in sharing plans with the municipal parties that create added value on urban development level ▪ Implementation or on-going plans for enhancing the quality of public space
Level 5	▪ They have a strategy to encounter future changes in demand, and have alternative plans to meet this demand. ▪ Scenario planning; e.g. an increase of people using the car will result in facilitating more cars ▪ Enhancing relation of campus with the city and the surroundings ▪ Optimising and innovating; research on alternative and new materials on the market ▪ Implementing new concepts for public space

Step 3

Level of campus management on physical level as evidence:
Quick-scan model:

Variable	What to measure (values)	Method
Quality of education and research *teachers* *courses*	user satisfaction degree of quality	objective data review reputation monitor ranking systems
Quality of facilities *lecture rooms* *classrooms* *conference rooms* *libraries* *study places* *meeting places* *canteen/cafe* *shops*	user satisfaction attractiveness layout flexibility safety level comfort level health level	data analysis (report, review) building/floor plan analysis
Research *influence* *volume* *income*	publications & diplomas number of patents research income research productivity	data analysis (annual report) ranking systems
Total costs *investment level* *operation*	euros (€) how much spent on what how they use financial resources	annual report, database
Total income retail & leisure *fees* *research*	euros (€) how much earned with what	annual report, database
Technical condition	age quality of building the percentage of the campus in (very) bad technical condition	technical reports condition based monitoring
Level of maintenance	corrective maintenance preventive maintenance replacement building components use of new materials	technical reports condition based monitoring

Quality of built environment *neighborhood* *campus* *public space* *housing* *parking*	quality level attractiveness layout public space (% of campus) safety level hygiene level	data-analysis interviews city report urban/campus area analysis
Amenities *housing* *related business* *retail & leisure*	amount kind size (m2) % of campus distance in m/km	data-analysis drawings interviews
Infrastructure *public transport* *public space* *parking possibilities* *roads (car, pedestrian, bicycle)*	accessibility of the campus provisions (distance in m/km) number of parking spots (% of total users of the campus) quality of roads public space (% of campus) connectivity to other cities/airport	urban area analysis road-, campus-, public- transport maps

Output:

Variables	Very bad (1)	Bad (2)	Neutral (3)	Good (4)	Very good (5)
Quality of education					
Quality of facilities					
Research output					
Total income					
Total costs					
Technical condition					
Level of maintenance, renewal, innovation					
Quality of built environment					
Amenities					
Infrastructure					

Step 4 (optional)

Level of campus management on physical level as evidence:
Full-scan model:

Variable	What to measure (values)	Method
User satisfaction	satisfaction level of the provided education and facilities	Student and staff monitor Questionnaires interviews
Attractiveness buildings and campus	Level of attractiveness of the campus to enroll, based on opinions	Survey Interviews Monitors
Space usage *occupancy rate*	students/m2 employees/m2 energy costs/m2	data analysis in-field monitoring
Functional mix	multi-functional space use use by different user groups	maps, floor plans reports
Energy efficiency	energy use/m2 energy use/user CO2-emission/m2 CO2-emission/user footprint/m2 energy label	data analysis technical reports semi-structured interview
Indoor quality	comfort level user satisfaction	monitoring questionnaires interviews
Relationship campus and its surroundings	connection with neighborhood connection with facilities/amenities outside the campus provisions	urban area analysis road-, campus-, public- transport maps
Relationship campus and the city	To what extent do users of the campus use the city, and what facilities? provisions division amenities campus and city amenities which are both offered by the campus and the city	urban area analysis road-, campus-, public- transport maps

Output :

Variables	Very bad (1)	Bad (2)	Neutral (3)	Good (4)	Very good (5)
User satisfaction					
Attractiveness buildings and campus					
Space usage					
Functional mix					
Energy efficiency					
Indoor quality					
Relationship campus and surroundings					
Relationship campus and the city					

Legend

- Strategic variable
- Functional variable
- Financial variable
- Physical variable

APPENDIX V: RESULT CASE STUDY 1 TU DELFT

Maturity level TU Delft

Component	Maturity level	Reason
Strategic	5	▪ Generating future plans for continuous improvement ▪ Strong strategic focus to compete and becoming the best university; desire to stand out ▪ High ambitions ▪ High level of innovation ▪ High frequency of revising and adjusting the plans to match the changing needs ▪ Advanced tools and systems which are being regularly checked ▪ Outstanding skills and expertise of staff ▪ Iconic buildings ▪ Enhancing attractiveness buildings, facilities and public space ▪ Enhancing the quality of infrastructure ▪ Excellent communication and information sharing between stakeholders
Functional	4	▪ They want to maximize output with and efficient use of m², they are aware of changing trends ▪ Implementation of flexible space use (multifunctional use, transformation, shared use) ▪ Student prognosis to forecast the amount of future enrolments ▪ Involve users, in order to determine their needs
Financial	4	▪ Awareness of future trends and changing demand, long-term financial planning (reducing footprint) ▪ Budget for new plans ▪ Presence of a financial department within the facility management department ▪ Allocating money for future plans (projects planned) ▪ Risk planning ▪ Tools and systems are advanced, and information is easy to communicate to other stakeholders
Physical (building level)	4	▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Using alternative innovative materials and products which will reduce the footprint ▪ Plans to dispose qualitative bad m2 in supply; plans for new construction ▪ Renewal building components (renovation) ▪ Preventive maintenance using alternative materials and products ▪ Implementation or on-going plans for enhancing the quality of buildings and facilities
Physical (urban level)	3.5	▪ The have explicit defined goals concerning the sustainable development of the campus. ▪ There is a presence of a 'campus vision'. ▪ Presence of plans to improve the infrastructure (roads, parking, accessibility) ▪ Presence of a maintenance programme ▪ Plans for sustainable development ▪ Plans to enhance the quality of the public space ▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Preventive maintenance with using alternative sustainable materials and products which will last longer and needs lower maintenance. ▪ Renewal/renovation public space ▪ Enhancing accessibility of the university ▪ Enhance relation buildings and public space

		▪ Proactive in sharing plans with the municipal parties that create added value on urban development level ▪ Implementation or on-going plans for enhancing the quality of public space

Performance level step 3

Variable	**Performance (level 1-5)**	**Reason**
Quality of education	3.5	Derived from the NSE, based on the opinion of students
Quality of facilities	3.7	Derived from the NSE, based on the opinion of students
Research	3.6	Based on the rating by Times Higher Education
Total income & costs	4	The TU Delft has a high industry income. The scientists bring in high grants and subsidies for projects. Furthermore, the profit the institutions makes will be spent on renewal of education and research and investments for the real estate strategy.
Technical condition	2.5	The current rating is based on the bad condition of the 40-50% of the real estate portfolio. New construction is also planned, but is not taken into account in this rating. The assumption is this rate will only improve in the near future.
Level of maintenance	3.5	The TU Delft has a maintenance strategy and planning for each faculty. The buildings are monitored on energy usage and efficiency. Yearly check will take place to determine the maintenance needed. However, the maintenance strategy concerning the laboratory spaces can be improved.
Quality of built environment	4	The Mekelpark of the TU Delft has a real added value on enhancing the contact between users of the campus.
Amenities	3	Retail and hospitality are under-represented on the campus. However, the university does have a vision on improving the number and type of amenities on the campus.
Infrastructure	3	The provision of public transport is moderate. The nearest station is 2 km away. There are busses from the station to the campus, approximately two per hour. The accessibility with the car and bike is excellent. However, parking is difficult during the morning hours.

Performance level step 4

Variable	**Performance (level 1-5)**	**Reason**
User satisfaction	3.2	Derived from the NSE, based on the opinion of students
Space usage	3.5	The space usage differs per faculty. The BK faculty has a more efficient use of space. The other faculties have less flexible square meters, and a less efficient use of space.
Functional mix	2	Differs per faculty. The BK faculty is most flexible and transformable. The other faculties are less flexible and thus the overall ranking will be lowered.
Energy efficiency	3.5	The TU Delft has an old real estate portfolio, with a bad quality of square meters. Costly maintenance is needed for these buildings. However, there is new construction planned in the

		future, which will replace the disposed bad square meters.
Indoor quality	3	The indoor quality of the old buildings is poor. The university does has a goal to make a large maintenance investment to enhance the existing building stock to a minimum level of 'good'.
Relationship campus and surroundings	3.5	The university has plans to strengthen the relationship of the campus with the South-wing (Rotterdam, Delft, The Hague and Leiden), but also the city center.
Relationship campus and city	3.5	The relationship of the campus with the city is good. The students visit the city center often for the retail and leisure that is offered. However, the walking distance is approximately 10 minutes, which can reduce the willingness to visit the center without a bike.
Aesthetics/attractiveness buildings and campus	4	The external aesthetics of the buildings are good. The building architecture are attractive and impressive. The buildings and public space look well maintained, clean and is safe.

APPENDIX VI: RESULT CASE STUDY 2 CUHK

Maturity level CUHK

Component	Maturity level	Reason
Strategic	4	▪ Awareness of future trends and changing demand, proactive in competing with the competitors, and they have the desire to stand out ▪ Scenario planning, long term planning ▪ Full implementation of plans or already on-going execution of plans ▪ Innovational vision for their campus strategy ▪ Attracting scientists & talents ▪ Regularly having meetings to look forward and look back on happenings
Functional	3	▪ Plans to improve space usage ▪ Presence of research concerning the occupancy/ space or m² ▪ Assigning class rooms based on class size, facilitating a more effective use of space
Financial	3	▪ Plans to improve current supply based on current demand, budget for improvement of competitive advantage ▪ Plans to improve the technical condition ▪ Presence of a clear financial cost estimation on building and operational costs
Physical (building level)	4	▪ They have a future prospect of developing the campus of the future, and are aware of this changing demand. ▪ Focus on sustainable development ▪ Using alternative innovative materials and products which will reduce the footprint ▪ Plans to dispose qualitative bad m2 in supply; plans for new construction ▪ Renewal building components (renovation) ▪ preventive maintenance using alternative materials and products ▪ implementation or on-going plans for enhancing the quality of buildings and facilities
Physical (urban level)	5	▪ They have a strategy to encounter future changes in demand, and have alternative plans to meet this demand. ▪ Scenario planning; e.g. an increase of people using the car will result in facilitating more cars ▪ Enhancing relation of campus with the city and the surroundings ▪ Optimising and innovating; research on alternative and new materials on the market ▪ Implementing new concepts for public space

Performance level quick scan

Variable	Performance (level 1-5)	Reason
Quality of education	2.8	The CUHK has a rating of 45,5 with teaching on the Times HE ranking (Times Higher Education, 2014a, p. 11). The maximum is a score of 100, which means the score is below standard.
Quality of facilities	-	Data could not be found.
Research	3	The CUHK has a rating of 54.7 on the Time HE ranking (Reputation survey 18%, research income 6%, research productivity 6%). The maximum score is 100, which means the score is average.
Total income & costs	3	The university receives a large amount government subventions (52.8%). They spent their financial resources on investing on enhancing the quality of the campus, but also the quality of the buildings. They have lower income stream generated through grants and subsidies for projects.
Technical	4	The building stock of the CUHK is quite new. Moreover, some buildings

condition		have been awarded with the 'Green Building Award 2014'.
Level of maintenance	3	The university is mindful of the ongoing needs to renovate and upgrade existing buildings. There is regular maintenance on the slopes of the campus, which is located on a mountain range. However, there is no significant evidence found about a maintenance strategy nor the frequency of the maintenance measures.
Quality of built environment	5	The CUHK has a long-term plan to improve the quality of the campus. They want to create a pedestrian-friendly campus, with a sustainable development and landscape.
Amenities	5	The campus offers a wide range of amenities. Sports facilities, retail & leisure, stores, supermarkets, student hostels and even a hair salon.
Infrastructure	4	The campus is well connected to the city center with the subway, with a travel time of approximately 30 minutes. Furthermore, the university offers shuttle busses within the campus.