Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Simon Gerard Janus van Heck
Student number	
Telephone number	
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Studio	
Name / Theme	Real Estate Management
Teachers / tutors	Prof.dr.ir. A. Den Heijer, TU Delft, 1st supervisor Dr.ir. P. Koppels, TU Delft, 2nd supervisor Ir. B. Valks, TU Delft, 3rd supervisor
Argumentation of choice of the studio	The main reason for choosing this studio is based on my personal interests. First of all, in my first year of my Master program I found out that I was really interested in Real Estate Management. At the same time, I had a job as a working student at a consultancy firm. So, a few weeks later I received a new proposal from work to write a real estate strategy for a agricultural company. I really liked this experience and I was triggered to learn more about the field of real estate management. As I was reading more and more about this topic, I found out of the growing role of (big) data within the real estate industry. During the master's program, I didn't experience a lot of education about this topic. So, the thesis gives me the opportunity to understand better the concepts of smart tools, Internet of Things (IoT) and big data.

Graduation project	
Title of the graduation project	Integrating smart tools in stadiums – a research to the effects of smart tools in stadiums.
Goal	
Location:	Amsterdam (Johan Cruijff Arena) & Amstelveen (KPMG)
The posed problem,	As seen in the last years, stadiums are struggling to attract fans. Due to technology, people can easily watch sports events at home (Infosys, 2018). Another reason, as stated by KPMG (2013) is caused by the fact that in the current landscape of Europe and further afield, most

	of the stadiums were built more than 35 years ago. As a result of these outdated venues, the stadiums are unable to fulfil the expectations of today's fans (KPMG, 2013, p. 65). These trends are harming the financial viability of the key stakeholders of the stadiums and it shows that many stadiums don't realise their business case opportunities. In real estate management, the focus is in general on the match between demand and supply with can result in 'adding value' for the organization (Den Heijer, 2011). In order to keep attracting the fans to the stadium, it's important that the demand and supply are in line with each other. Current technological developments, also called smart tools, have the potential to match demand and supply more efficiently. This is caused by the fact that the implementation of smart tools in the built environment has the potential to align real estate portfolios more frequently in time and on a higher level of detail in space to the needs of their users, due to the provision of real time information. Smart tools can be defined as a service or a product to provide (real time) information to its users (Valks, Arkesteijn, Den Heijer & Vande Putte, 2018b). Other reasons for integrating smart tools in buildings is to improve the following aspects: energy and efficiency, longevity, and comfort and satisfaction (Buckman, Mayfield & Beck, 2014, p. 104). Within the context of stadiums, a lot of data can be made available due to the implementation of smart tools. As showed in different studies (D'Orazio and Guaragnella, 2014; Dong, 2015; of Panchanathan et al., 2017; O'Brolcháin, Colle & Gordijn, 2018), these smart tools can improve different touch points of stadiums, such as safety, fan experience, sustainability etc. These touch points are affecting the business case opportunity of stadiums. It can be stated that implementation of smart tools in stadiums can result to an optimization of the business case of stadiums (KPMG, 2013). However, the integration of smart tools in stadiums is a new development which is in their first infancy. Integrating smart tools in the built environment is difficult as shown in the research of Cisco (2017). The research shows that only 26% of the projects which involve smart tools are considered a success and 60% of these projects are not continued. To gain more knowledge in this field, it will help stadium stakeholders to make more informed and well-structured choices for integrating smart tools in

	stadiums successfully. This can result in a better alignment between the demands and needs of all stadium stakeholders on the short term. In addition, information required from the smart tools can be used for the long term, by using the information to develop long-term plans, real estate strategies, and for the decision-making process of stadiums (Valks et al., 2018).
research questions and	**Main research question:** How can stadium operators integrate smart tools effectively within their stadium in order to optimize their business case? **Sub questions:** Based on this division, the following sub questions will relate to the aforementioned subject division are: *Stadium operators* How is the management of a stadium organized? *Smart tools* What are smart tools? Which smart tools are available for stadiums? What are the characteristics of a smart stadium? *Stadium* How is the implementation of smart tools related to real estate management? *Business case* What is the business case of a stadium? The findings of the sub questions will be synthesized by answering the following sub questions: *Synthesis* What is the effect of smart tools on the performance of the users? Can the integration of the smart tools within stadiums be prioritized?
design assignment in which these result.	A design is not involved with this research proposal.

Process

Method description

The chosen research method is a mixed-method approach, whereby the exploratory sequential design is used. The reasons why this research method is chosen, is described in this paragraph.

For this research, a mixed-method approach is used. In a mixed method approach, both qualitative and quantitative research methods are used (Lousberg, 2018). These two methods will be combined according to an exploratory sequential design. This means that the qualitative research data collection need to precede the quantitative data collection (Bryman, 2012, p. 632). So, the quantitative part can only start when the qualitative part is finished. That's why it's named the exploratory sequential design.

The reason for using the exploratory sequential design is that in-depth knowledge acquired through the qualitative research can be used to develop a better quantitative research (Bryman, 2012, p. 632). In addition, both methods will be complementary to each other in order to understand and describe the phenomenon of the research topic better (Bryman, 2012, p. 649).

The qualitative research method in this research contains both a literature study and semi-structured interviews. The semi-structured interviews will provide the research with in-depth information and insights from practice. The main objective of the qualitative part is to understand the phenomenon of stadiums, learn theories of (smart) real estate management, and assessing the different smart tools which are available in stadiums. By combining knowledge from both theory and practice this data will be very complete.

As mentioned earlier, the quantitative research method will be based on the outcomes of the qualitative research. The qualitative part will focus on the impact of the different smart tools based on a case study. The case that will be used is the Johan Cruijff Arena in Amsterdam. Data gathered from the implemented smart tools will be analysed. The analysis will be done based on the True Value Methodology (KPMG, 2015). The reason to use a True Value Methodology is that the impact of each of the smart tools can be scored on different aspects (financial, social, economic and environmental), which results in the "true earnings". In the end, the smart tools can be easily compared with each other, based on their "true earnings". The research will be conducted at KPMG, because they are working on the Johan Cruijff Arena Project.

In the end, the results of both researches will be combined into a framework. This end-product can be used for other stadium operators in order to effectively integrate smart tools in their stadiums and will be the answer on the research question how stadium operators can integrate smart tools effectively within their stadium in order to optimize their business case. The framework will be tested by professionals from practice in order to optimize and improve the framework. In the proposed research

diagram this is showed as a feedback loop. The exact time planning of the research can be found in chapter 6.

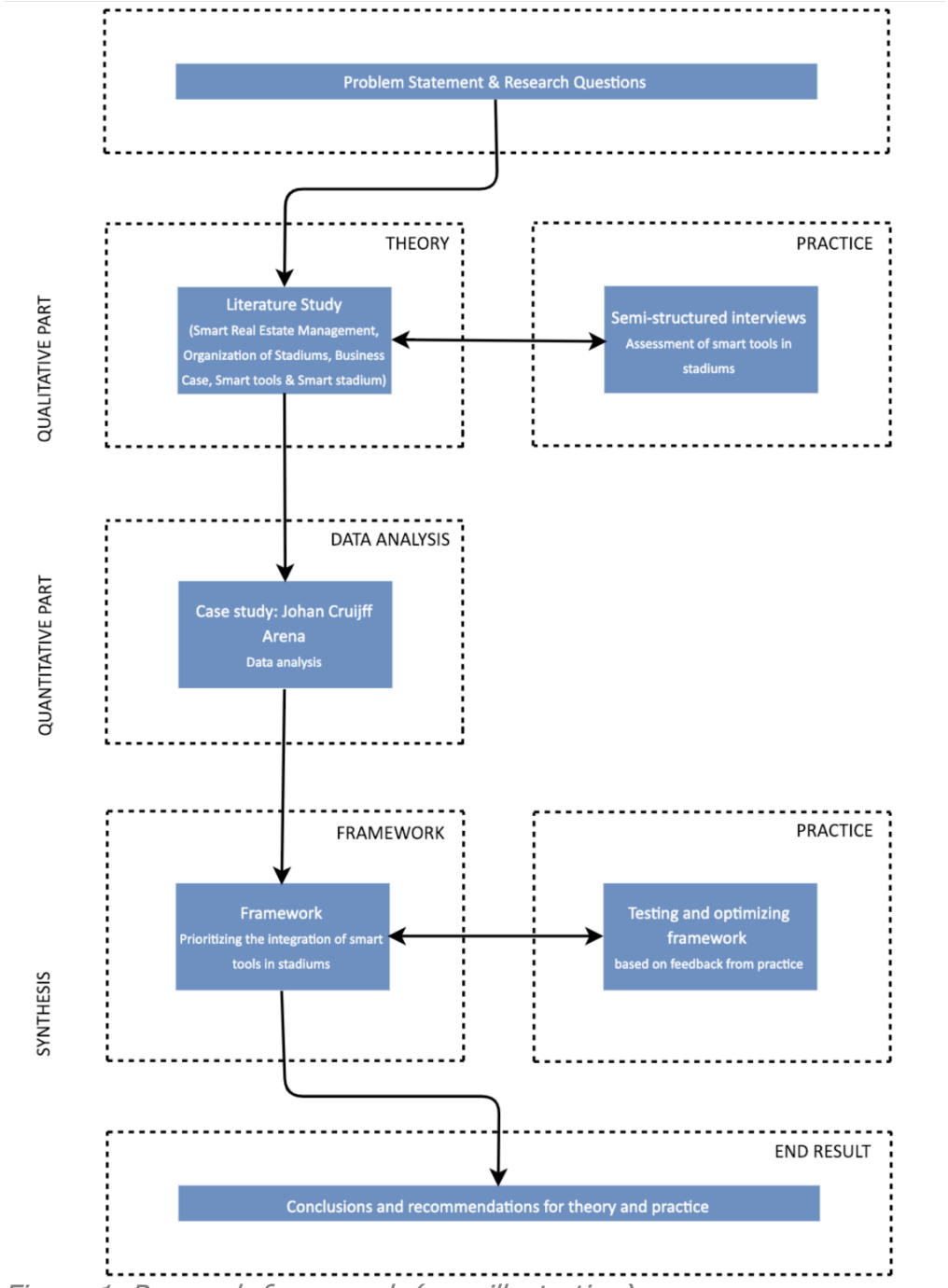

Figure 1. Research framework (own illustration)

Literature and general practical preference

Literature study

The literature study will be done in order to gain in-depth knowledge about the following four different topics: (smart) real estate management, organization of stadiums, smart tools and business case of stadiums. These topics are also linked to the sub-research questions. The sequence of the literature study with the related research questions will be:

I. Step 1: (Smart) real estate management
Sub-question: How is the implementation of smart tools related to real estate management?
II. Step 2: Organization of stadiums
Sub-question: How is the management of a stadium organized?
III. Step 3: Business case of stadiums
Sub-question: What is the business case of a stadium?
IV. Step 4: Smart tools in stadiums.
Sub-questions: What are smart tools?; Which smart tools are available for stadiums?; What are the characteristics of a smart stadium?
The literature study will be conducted by using Google Scholar, Scopus and internet sources. The selection will be based on the quality of the journal, the number of citations and the relevance of the research. For the literature, the table below shows which literature can be used. The literature contains of scientific paper or company reports.

Table 1. Determined literature from different disciplines

Subject	Search terms	Literature
(Smart) real estate management	"Real Estate Management", "Smart real estate management", "Smart buildings", "Public Real Estate Management", "Corporate Real Estate Management", "Technology in real estate" "Information Management in real estate", "Big data real estate", "Future trends real estate"	Arup (2017), Deloitte (2016), Deloitte (2018), Den Heijer (2011), De Vries et al., (2008), Lindholm & Levainen (2006), KPMG (2013), Nourse et al. (1993), University of Oxford Research (2017),
Organization of stadiums	"Stadium stakeholders", "Stadium development", "Organization stadium" "Soccer stadium"	Bale (2000), Lawrence & Crawford (2018), Walters (2011).
Business case of a stadium	"Economics of stadiums", "Business case stadiums", "Finance stadium"	Muijsson (2013)
Smart tools	"Internet of Things (IoT) real estate), "Smart tools real estate", "trends real estate", "smart technologies real estate", "Technology real estate", "smart stadium", "Sensor technology" "Ethics of technology".	Ahmadi et al. (2015), Buckman et al., (2014), Caragliu et al. (2011), Den Heijer (2011), D'Orzaio & Guaragnella (2015), Jargalsaikhan et al. (2015), Lee et al. (2013), O'Brolcháin et al. (2018), Panchanathan et al. (2017), Valks et al. (2018a), Valks et al., (2018b), Diener & Crandall (1978), Cook & Das (2007)
Research Method	"Social research method", "True value method"	Bryman (2012), Verschuren et al. (2010), KPMG (2015), Lousberg (2018)

Semi-structured Interviews

The semi-structured interview will be used to assess the different available smart tools in stadiums. The reason to conduct theses semi-structured interviews is to combine both knowledge from theory and practice, in order to come up with a complete assessment of the available smart tools for stadiums. The advantage of choosing for the semi-structured interview is that as an interviewer there is more latitude to ask further questions in response to what are seen as significant replies

(Bryman, 2012, p. 212). Also, the interviewer has a series of questions that are in in general protocol, but is able to vary the sequence of the questions.

The interviews will be held with market specialists and stadium operators. Examples of market specialists from Huawei, KPMG, stadium owner of the Johan Cruijff Arena. The interview protocol can be found in the Appendix of the P2 Report. The protocol is based on the interview protocol as used in the research of Valks et al. (2018). Only some small adaptations have been made. The interviews will be recorded and transcripted.

The assessment of stadium smart tools is based on the literature study and the interviews. To structure the assessment of the smart tools, a matrix will be made with all the smart tools whereby rows are related to the application and columns for the type of smart tool.

Quantitative Data analysis: Case Study: Johan Cruijff Arena

The case that will be used is the Johan Cruijff Arena. The goal of the stadium management is to transform and by this create the first 'smart' stadium. During this project, the focus will be on the following 6 themes: the fan experience, customer journey, safety & security, sustainability & circular economy, facility management, and digital connectivity (Amsterdam Smart City, 2018). A lot of different companies are involved in the project, including KPMG The Netherlands, where I will write my graduation thesis. Due to the fact that the stadium management has the ambition to become the first 'smart' stadium, data from the implemented smart tools and the effects are extremely interesting to research. In the end, the case study of the Johan Cruijff Arena will give insight in the implementation of the different smart tools in a stadium and the effects It has. Data before and after the implementation will be compared to each other.

The data extracted from the project are case specific and unique. However, findings can be used generic for other stadium projects. By combining the case specific variables of the Johan Cruijff Arena in combination with the effects of the implemented smart tools, a generic framework can be constructed, which could be applicable to other projects.

True Value Method

The true value method takes into account not only the financial earnings of a technology, but also the social, environmental and economic impact. So the impact of the technology will be translated into one common financial metric, which is called the "true earnings" (KPMG, 2015). These earning could also be linked with Key Performance Indicators (KPI's), which can be used to connect the smart tool with a goal.

Reflection

Relevance

Societal relevance

The integration of new technologies, such as smart tools, are an important aspect of the latest stadium developments (KPMG, 2013). To better understand the effects of the integration of smart tools can help the business case of stadiums and their

feasibility. In order to successfully implement smart tools, there is a need for a better understanding of smart tools and their effects within stadiums. Besides this, the research focusses on stadiums. However, findings from the research field of stadiums can be linked to other research fields, whereby a lot of visitors are involved.

This research can support stadium managers who participate in the decision-making processes concerning the implementation of smart tools in their stadium. By using the research, it will help the stadium operators in making choices better structured and well-informed. In the end, by making the right choices, it will result in a better alignment of the stadium with the demands, as mentioned in the first paragraph. This means that the stadiums business case potential will be optimized which increases the performance of all the organisations involved.

Lastly, the research of Panchanathan et al. (2017) proposes the use of a smart stadium as a living laboratory to more easily deploy and evaluate technologies within the smart city concept. Due to the size and heterogeneity of the stadium environment that is small enough to practically trial but large and complex enough to evaluate effectiveness and scalability (Panchanathan et al., 2017, p. 2). This can be seen as a strong justification in favour of the development of smart stadiums that can serve as a test-case for smart technologies which also can be used for entire cities. This development can also be seen in practice. In both Dublin as Amsterdam, the development of smart stadiums are used as a living laboratory for smart city concepts (Smart Dublin, 2016.; Amsterdam Innovation Arena, 2017).

Scientific relevance

Due to the fact that smart stadia are a recent development, the scientific field of smart stadia is limited. Some publications related to smart stadium can be found, however, this is very limited. Describing the phenomenon of a smart stadium will lead to enriching the current scientific body of knowledge.

In addition, the effects of the implementation of different technologies within stadiums are even less researched. Implementing technologies in stadiums are mostly based on propositions from theory. By researching the effects of smart tools in stadiums, after implementation, it can fit this scientific gap.

To conclude, due the recent development of smart stadia not a lot of research is done. This results in both societal and scientific relevance of this research proposal.

Time planning

Based on the research proposal, the following main tasks are distinguished in table 2. The meetings with the supervisors from the TU Delft are not visible yet, because they are not planned yet. For every week the to do's, special occasions and deadlines are noticed.

Table 2. Time planning research project

Week	Date	To Do	Special occasions + deadlines
3	14-01-2019	P2 report & presentation	11-01-2019: Deadline P2 report

	20-01-2019		18-01-2019: P2 Presentation
4	21-01-2019 27-01-2019	Implement P2 comments in theses	-
5	28-01-2019 03-02-2019	Start literature study topic (Smart) Real Estate Management	1 February 2019: Start internship KPMG, 5 days a week.
6	04-02-2019 - 10-02-2019	Literature study: (Smart) Real Estate Management Start making appointments for the interviews.	-
7	11-02-2019 - 17-02-2019	Literature study: Organization of stadiums	-
8	18-02-2019 - 24-02-2019	Literature study: Business Case of stadiums	-
9	25-02-2019 - 03-03-2019	Finish literature studies.	01-03-2019: Deadline Literature study REM, Organization & Business Case
10	04-03-2019 - 10-03-2019	Start literature study smart tools	-
11	11-03-2019 - 17-03-2019	Assessment smart tools Interviews professionals	-
12	18-03-2019 - 24-03-2019	Finish assessment of smart tools Finish literature study smart stadium	22-03-2019: Deadline phase 1, Qualitative part
13	25-03-2019 - 31-03-2019	Start data analysis from the case study of Johan Cruijff Arena.	-
14	01-04-2019 - 07-04-2019	Data analysis from the case study of Johan Cruijff Arena.	-
15	08-04-2019 - 14-04-2019	Data analysis Johan Cruijff Arena	12-04-2019: Deadline phase 2, Quantitative part
16	15-04-2019 - 21-04-2019	Start developing framework	19-04-2019 Good Friday P3 presentation
17	22-04-2019 - 28-04-2019	Implement P3 feedback in thesis Developing the framework	22-04-2019 Eastern 24-04-2019 Real Estate Career Day
18	29-04-2019 - 05-05-2019	-	28-04-2019 till 05-05-2019: in Crete
19	06-05-2019 - 12-05-2019	Finish framework Test framework by professionals Recommendations, conclusions & discussion	10-05-2019: Deadline phase 3, Synthesis.
20	13-05-2019 - 19-05-2019	Test framework & adapt Prepare P4 presentation Finalise the report	P4 Presentation
21	20-05-2019 - 26-05-2019	Implement P4 feedback in report Finalise the report	-
22	27-05-2019 - 02-06-2019	-	30-05-2019: Ascension day 26-05-2019 – 01-06-2019: in New York
23	03-06-2019 09-06-2019	Feedback in report Finish the report	-
24	10-06-2019 16-06-2019	Prepare the P5 Presentation Finish final report	10-06-2019: Whit Monday P5 Presentation
25	17-06-2019 23-06-2019	Finish final report	P5 Presentation
26	24-06-2019 01-07-2019	Final presentation for KPMG	01-07-2019: Final day internship KPMG

The different tasks & milestones are visualized in a Gantt chart, to create an idea how they are related to each other, see the figure below.

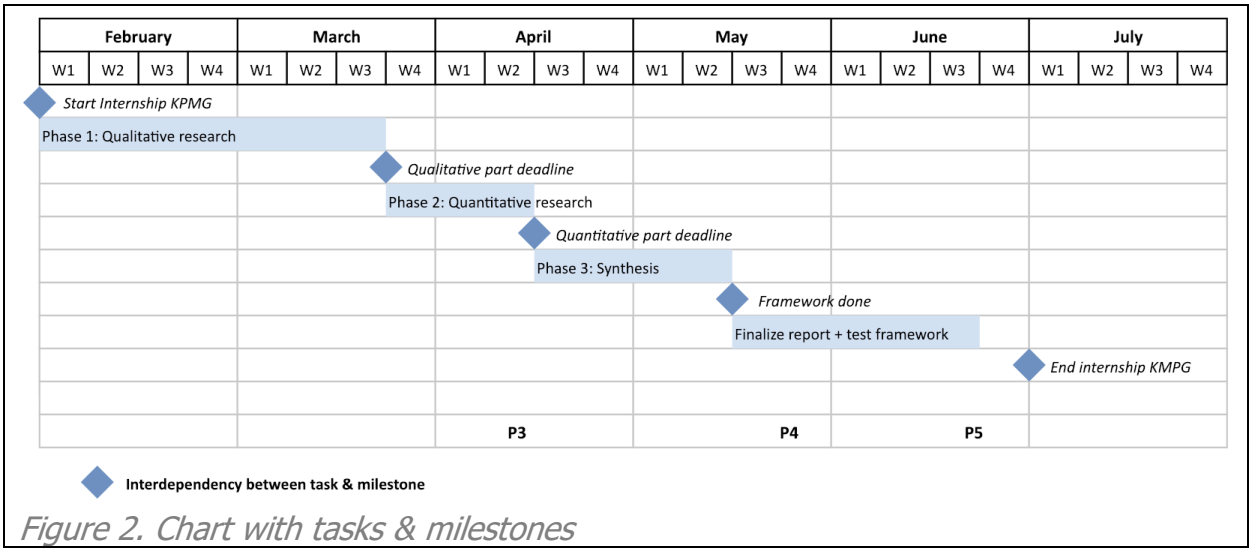

Figure 2. Chart with tasks & milestones