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!NTERVISIE

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Internet of things

heijmans

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Wil jij zien op welke wijze Heijmans bouwt aan de ruimtelijke contouren van morgen? Ben jij nieuwsgierig naar welke spraakmakende en innovatieve concepten Heijmans ontwikkelt en realiseert? Volg ons dan op Facebook, Instagram, LinkedIn en Twitter en schrijf je op onze website in voor onze nieuwsbrief 'het Beste van Heijmans.'

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EDITORIAL

Dear readers and colleagues,

We are very pleased to present to you the 26th edition of the !ntervisiE magazine. As always this edition is packed with informative articles, addressing current topics and developments in the construction industry nowadays. In addition, the magazine contains the traditional articles related to the master's track in CME, namely testimonials from CME students and alumni. This year our colleagues will travel to the city of Taipei, Taiwan where they will have the opportunity to visit universities, as well as some local building projects executed by big construction companies.

This edition of !ntervisiE highlights the topic of 'Internet of things' which is an ongoing trend in the building industry. It's a concept that not only has the potential to impact how we live but also how we work. Simply put, this is the concept of basically connecting any device with an on and off switch to the Internet and/or to each other. This includes everything from cellphones, coffee makers, washing machines, headphones, lamps, wearable devices and almost anything else you can think of. The predictions suggest that the world will have 50 billion connected devices by 2020 and it is also expected that more than 50% of the connected devices during 2013-2020 will be added in the last 3 years of this decade. But, what exactly is the IoT, and what will be the implications of the trend on the built environment, our homes and building processes is the question we try to give the answer to in this edition.

This semester's issue contains a very interesting article from the TU/e Campus Management, explaining the renovation project of the university's main building, which has earned the title of the world's most sustainable education building in terms of design. Furthermore, the article from Enginear highlights the process of job search and application based on matching the applicants personal skills and wishes with the right companies in order to provide full career satisfaction. This, and much more is waiting for you to read in the following pages!

At last, we want to thank everyone who contributed to the creation of this edition of !ntervisiE!

Kind Regards,

The !ntervisiE Committee

Chief Editor !ntervisiE | Miryana Stancheva (left)

Editor !ntervisiE | Maria-Niki Kravari (middle)

Editor !ntervisiE | Esther Penders (right)

COLOPHON

General
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NEWS & ANNOUNCEMENTS

AUTUMN/WINTER

While being half way of the new school year, we all had to say goodbye to year 2016 and hope for an amazing 2017. During this past semester, the board of Of CoUrsE! organized a number of educational and recreational activities, always surprising pleasantly the CME community. In this edition of !ntervisiE, we give you an overview of these activities, covering the events the study association was involved in from the beginning of September 2016. If you're also curious about the upcoming activities we have planned, stay updated by subscribing to the Of Course! Facebook page. Another possibility is to come and visit us at the Of CoUrsE! corner in Vertigo, floor 2.

New Board

September 12th, 2016

One more school year began and and the inauguration of the 14th board of the CME study association Of CoUrsE! was the best way to start our new CME journey.

From left to right:

Francisco Jose Bernal Ferrer: Secretary
Elaine Kieboom: Public Relations
Guido Porteners: Treasurer
Miryana Stancheva: Commissioner Education
Mike van Vliet: Public Relations
Patricia Diaconu: Commissioner Activities
Johan Slob: Chairman

On the 12th of September, right after everyone left the exotic beaches equipped with plenty of Vitamin D and an attractive tanning, the 14th Board was officially installed with the traditional "Constitution Drinks". Several CME students made their appearance to congratulate the new board and enjoy a drink with them. Afterwards, following the custom, the old board treated the new board to dinner, where the former masters shared their experiences and tips to the newbies.

CME Committee Lunch

September 27th, 2016

Following the installation of the new board, Of CoUrsE! invited all CME students to a lunch, to introduce the formation of the new committees. The content and the responsibilities of each of the three committees (Study Trip, !ntervisiE and Activities) were described and the interested participants had the opportunity to discuss any doubts, as well as join a particular committee. Besides, the lunch offered the chance to the freshmen year CMEs to introduce themselves and meet their older fellows.

Lunch lecture AT Osborne

October 18th, 2016

AT OSBORNE

CONSULTANTS & MANAGERS

On Tuesday October 18th, Of CoUrsE! together with SERVICE organised a successful lunch lecture given by Marcel van Rosmalen, director of housing and real estate at AT Osborne. The theme of the lecture was "AT Osborne neemt je mee: de match tussen kennis en praktijk" and multiple examples of consulting, projects and management issues were considered. Following the lecture, all the participants enjoyed lunch with their fellow collegues.

CME Dutch Design Week Tour
October 27th, 2016

On October 27th, Of CoUrsE! visited one of the most important events taking place in the city of Eindhoven, the Dutch Design Week, aka DDW. A group of CME students had the chance to discover interesting exhibitions around the Strip S area, including some of the most innovative developments in the world, such as 3D printing, virtual reality and sustainability solutions. After an awesome VR ride to the future in old DAF cars, the participants enjoyed a specialty beer in a bar altogether.

Bowling Night 2016
November 3rd, 2016

The annual bowling night, which traditionally launches every new CME year was again a remarkable night, even though slightly delayed. The evening kicked off with a dinner at Vapiano, where the CME competitors filled their stomachs with carbohydrates, in order to achieve the necessary level of energy for winning the big trophy. After digestion completed, the group cycled to the bowling place in Woensel and the terrain was set. During a two hour heavy battle on four lanes and the use of multiple techniques, the CME students challenged each other for ultimate glory. Some of them thought rolling the ball backwards instead of forward was a good idea, while others tried to break the floor by achieving impressive bumps in the lane. However, most balls found their way, the points were scored and we had a champion: Congratulations Tymen!

Glow Tour 2016
November 15th, 2016

On the 15th of November, Of CoUrsE! along with a group of CME students visited the Light Festival GLOW. The whole city was flooded with light installations, sculptures, projections and performances, following the theme ‘Light in Art and Architecture’. Among the different artworks, Catharina Church made a great impression, being a tribute to Jheronimus Bosch’ hypnotic world, while the Tesla Coil which makes music was also one of the highlights of this year’s route.

Bouwkunde Bedrijvendagen Career event
November 23rd, 2016

During the Bouwkunde Bedrijvendagen Career event, Of CoUrsE! hosted several tours to the companies, which are relevant to the CME field. The participants were able to meet various companies, get to know more details about their work and orientation, as well as explore opportunities for internships and graduation projects. The BBD was a particularly useful event, since it contributed to the networking and potential collaborations between the students and the labor market, which is of course one of the main concerns of the soon-to-be graduates.

New Years Pub Crawl
January 12th, 2017

The end of the year, and therefore the beginning of the new one is always a special moment for everyone with lots of memories of the past and wishes for the future. That’s why it deserves a great celebration! Of CoUrsE! and SERVICE teamed up once again to celebrate the fresh 2017, by organising the “new year, let’s drink beer” pub crawl in the favourite location of Eindhoven youngsters, Stratumseind. On the 12th of January, the crew gathered at 22:00 to begin their pub marathon, during which several liters of beer and a few shots were consumed. After midnight, we started having our first losses, while the hardcore ones decided to stay until the closing of the bars.

CME ABROAD

HOUSNI CHAIBI

Studying in Singapore

I decided for my third semester of my master to do an exchange period in Singapore. Due to the limited places available at the university in Singapore I had to wait and hope. Ultimately, our Faculty at the TU/e (faculty of Built Environment) had two places for students to do an exchange at the National University of Singapore. Luckily, I was one of them. My choice fell on Singapore because this city has grown in the past 50 years very rapidly to a Metropolis. In addition, Singapore is centrally located in Asia and it makes it easy to travel to neighbouring countries like Malaysia, Indonesia and Thailand. Finally, and for me still the main reason, is that the National University of Singapore is very well acclaimed in the world and the number one university in Asia (QS TOPUNIVERSITIES).

After I did all the preparations, I left for Singapore on 30th of July 30 2016. Arriving in Singapore and during the taxi ride to the campus, I could notice already why this is known as a metropolis. Tall skyscrapers, well-organized infrastructure and greenery were the first three things that caught my eye.

The first days…

On the first days I was mainly trying to settle down; introducing myself to the new environment, new university, new people, new culture. There wasn't a real intro week as we are used to at TU/e, so we had to explore the university and the city by ourselves, nevertheless I enjoyed it. At my first lunch in the school canteen, I noticed that there was a good atmosphere. Many exchange students from different countries were trying to make contact with each other and everyone was looking for new friends. Fortunately, this is something I did not worry about and I moved on to some students who just had their lunch on the table and so we fell into a conversation. Soon, we had planned to visit the IKEA to arrange our rooms. With some of these students, I immediately had a good click, and we had a drink together that night. The following days I was trying to pick up my visa, student ID, select courses and complete all other requirements for the start of the semester. Several nights found us in parties, organized for exchange students, while this was also the time when I met many people. Shortly, these first days in Singapore were quite busy, although certainly a lot of fun!

Studying at the National University of Singapore (NUS)….

Singapore has three major universities with NUS being the biggest, hosting about 30,000 students. Actually, the campus provides the students with all the needed facilities to live well, eat, study and exercise. I lived in an accommodation at the campus area, where

we shared a floor with 9 people. Some of them were doing their exchange and were staying in Singapore for one semester only, while the rest were local students, who stay at this university for their entire study. This mix of locals and exchange students was really nice and helpful, because you could often turn to the locals for questions. On campus, there were buses to bring you to the different destinations of the university faculties. These buses are free for the students and almost everyone makes use of them, since the campus is very big.

I took two courses at the School of Design and Environment (SDE) and one at the faculty of Arts and Social Sciences (FAS).
Courses:
Managing Singapore's built environment (SDE)
Scope and design management (SDE)
Introduction to Psychology (FAS)

Previously, I had chosen to follow four courses, with which I would be able to convert 24 ECTS in TU/e. Ultimately, I followed three courses, as there was a clash between two of them. With these three courses I still met the minimum requirement of both the TU/e and the NUS. The choice of these courses was based on various reasons. The two SDE courses seemed to me very interesting, because I thought these courses would give me a different view in the field of management related to the built environment. I opted for introduction to psychology, because actually I always have been interested in psychology and this was a good opportunity to learn more about it. I have followed this course with great interest and learned a lot. This is also very useful for the future, considering that I learned a lot during the sessions about communication, people's reactions to situations and thinking.

During the semester and afterwards I can conclude that the NUS is a very good university, where everything is very well organized. The system is different from the TU/e. At the NUS they have, for example, a competition system in which the norm is determined on the basis of the results obtained by the students. Furthermore, there are no retakes for finals and this is also different from the TU/e. So, if you do not pass a final, then you should take the course next year again. These two major differences compared to the TU/e has resulted in motivated students who use plenty of their time and effort for their study. Sometimes 12 to 14 hours a day. I was trying to get used to it at the beginning, but throughout the semester it gave me more motivation and discipline, because I would have to measure myself with the full-time students (mostly Asians). The level of the study was very similar to that of the TU/e. I followed the courses with great interest and pleasure, and I can admit that I am ultimately happy with the choice of these subjects and the results.

Singapore and Asia....

Singapore is a cosmopolitan city in Asia that is quite westernized in my opinion. But there are several areas, where you can taste the cultures and traditions of various Asian countries. So, there is Chinatown, Little India and Arab Street. Furthermore, Singapore is well known for the good food someone can get at the food courts. In these various street food courts, people can have very tasty Asian food for relatively low prices. They can be found in different districts of Singapore, however personally, I thought the food courts of Chinatown, Little India and Lau Pa Sat were the best. Lau Pa Sat is very special, situated in the financial district of Singapore. Between 7pm and 3am, one of the roads is closed and people get to enjoy the nice satay and other tasty dishes, at the street surrounded by the skyscrapers of Singapore. Furthermore, the traffic is very well organized and there are few traffic jams. This is due to the different laws and rules established and I was very surprised to see this. Especially, since Singapore has about 6 million inhabitants in an area of approximately 750 km2.

Also, Singapore is a very clean city and you cannot even find one piece of paper on the ground. Selling chewing gum is prohibited and you get a penalty if you throw a cigarette on the ground. The people in Singapore are very friendly and it was very nice to see how good the different religions live side by side.

The nightlife of Singapore is in my opinion really nice. It starts from Wednesday till Saturday night. The biggest and most famous clubs are at the Clarke Quay district, where we spent a lot of time and I have really good moments to remember. Finally, as Singapore is centrally located in Asia, there are many cheap flights to different countries in Asia. Certainly, I did this during my stay. In the recess week I flew to the Philippines for my holiday with two study mates. Before that, I already spent two weekends in Malaysia, which is even accessible by bus. Furthermore, I traveled to different places in Indonesia and after my finals I spent two weeks in Thailand. Overall, I had an indescribable period in Singapore, where I met so many new people from all over the world. I learned a lot about different things and I saw so many beautiful places.

Actually, I can continue writing for ever, but I hope I managed to give you, through this article, an impression of my exchange period in Singapore. I strongly recommend to everyone to do an exchange period abroad. It is definitely a lifetime experience!

Housni Chaibi
MSc Student CME

GRADUATION THESIS

ESTHER PENDERS

Ownership and RE management in the Community school sector

A BBN that predicts the best ownership and real estate management model voor community schools

In the Netherlands a development from stand-alone schools towards community schools can be observed since the end of the last century. Community school initiatives are initiatives in which organizations from different sectors participate within a joint building or a network within a neighbourhood. Mostly the organizations that participate within such an initiative provide a social service or have a social goal. Organizations one can think of, next to the school, are for example libraries, childcare organizations, cultural organizations, youth care organizations etc. Influences by the depth of the collaboration between the different organizations, community schools can have different goals. In some cases this goal is only to provide a certain social service level within a neighbourhood, or save cost on building management and operations during the users phase of a joint building, in other cases the participants within the community school form a pedagogical collaboration to ensure children are treated based on the same values and vision when receiving a certain service from one of the organizations within the community school. When organizations decide to participate within a joint building it is important that agreements are made about the ownership of this building and the building management and operations (BM&O) of the building during the user phase. Choosing for a certain ownership model and arranging the BM&O is a big struggle in the community school sector, and this often leads to problems in the collaboration between the different participants in a community school. Because of this struggle sometimes the community school initiatives fail or they do not achieve the intended goals. Therefore the goal of my graduation research will be to make a model that can help in predicting the best ownership and BM&O model for community schools based on a few input variables

Selecting a topic

Just as almost all students I was struggling to find a suitable subject that was going to keep me interested during the entire duration of the graduation project. The list of possible graduation topics given in the CME graduation guide did not help me and reading articles about certain topics that I found very interesting showed me that the fields of research I was interested in were already researched thoroughly. In addition to my struggle of selecting a topic I had also set myself the goal of doing my graduation research at a company, which I also still had to find.

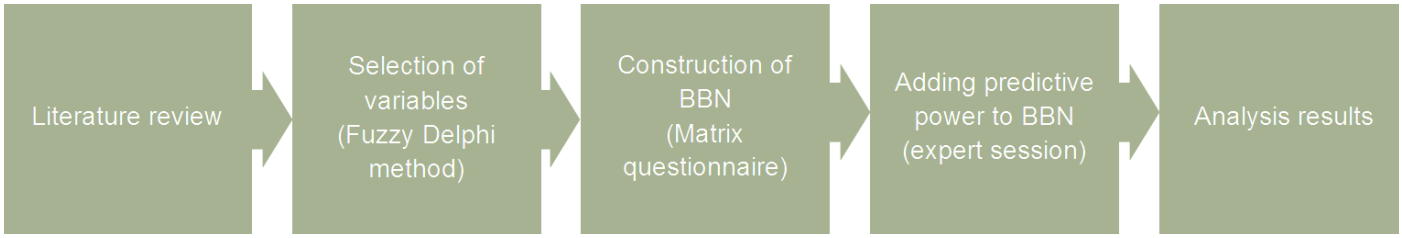
Finding a topic, and a company that was interested in this topic, was not going to be easy and I already saw myself postpone my starting date for my graduation project…. until I went to the Company Orientation Day the 26th of April 2016 organized by of CoUrsE!. Next to the interesting presentations and workshops from different companies there was also the possibility to have a speed date with certain companies. During these speed dates I asked whether the companies were looking for graduation interns and in which subjects they would be interested. Based on a brief explanation of my interests, and previous work experiences, an idea for a graduation subject emerged!: The collaboration of different participants within community schools and how to shape this collaboration. A subject I would not have thought on my own, but certainly a subject that suits my interests, strengths and weaknesses.

Because I formulated the subject together with HEVO, the speed date company, I also found a company that was interested in this topic. This ensured that all my requirements for the graduation project were met. Now I only had to convince the professors of the subject since my approach for selecting a topic was not really in line with the normal procedure for selecting a subject. Luckily I succeeded in convincing the professors and I could start writing my research proposal. I wrote my research proposal during the summer holiday in order to ensure I could start my graduation project in September 2016. During the writing of the research proposal the scope of the subject was narrowed down and in consultation with HEVO the focus of the graduation project became the ownership and building management and operation (BM&O) of community schools, because this is a real issue within the community school sector. Furthermore the focus would be on community schools in which at least one primary education school was located.

Ownership and BM&O in the community school sector

Within the community school sector there are multiple ownership and BM&O models that are being used to arrange the ownership and BM&O. An ownership model can for example be: Municipal ownership of the building, Ownership by a primary user of the building, Ownership by a third party, Ownership by a legal form or split ownership based on apartment rights (VvE). A BM&O model can for example be: BM&O arranged by a primary user, outsourced BM&O, BM&O arranged within an owners association (VvE) or BM&O arranged within a legal form. Within these BM&O models there are multiple possibilities for the transference and distribution of tasks and responsibilities that are part of the BM&O between the owner and the different users of the building. Task one can for example be outside maintenance of the building, inside maintenance of the building, facility management tasks and tasks that aim on the organisation management of the community school.

Although one can think that selecting an ownership and BM&O model is very straightforward, research shows that choosing for a certain ownership model and arranging the BM&O within the community school sector is a big struggle. These problems are for example caused by conflicting interests between the different participants (public versus private organisations), government funding mechanisms that induce a situation that is different from normal commercial multi-user buildings, political interests in the public real estate, recent changes in law and legislation concerning BM&O of (community) schools and certain articles within the WPO (Wet primair onderwijs) that make the situation more complicated. All these factors make the decision making process for an ownership model and BM&O model very complicated and cause that there is no consensus within the sector about which ownership and BM&O models are suitable in which situation. In order to change this the goal of my research will be to make a model that predicts the best



ownership and BM&O model for community schools based on a few input variables. The research question central to this research therefore is: "What is the best BM&O model and ownership model for different types of community schools?"

Research methodology

In order to answer this question the aim is to develop a Bayesian Belief Network (BBN). A BBN is a network consisting of different nodes that are connected to each other by arrows or arcs. The nodes represent certain variables and the arcs represent the cause-effect relationship between the parent node and the child node. The network can predict the probability of a certain outcome based on a certain input, and thus help in selecting ownership and BM&O models (output) for different types of community schools (input). Because a BBN gives the user of the network the ability to either calculate the value of a certain node, or give a certain set input to a node, the usability of the network in an environment with limited information (e.g. the beginning of a project) is very big. Even when only the value of one of the nodes is known, the BBN can calculate the probabilities of the other values within the occurring network. Another important reason for choosing to develop a BBN is that the methodology does not only predicts the best models, but it also ensures a lot of knowledge can be accumulated about the relationships between different variables influencing the decision towards a certain ownership and BM&O model.

A BBN can be made, based on (historic) data or based on experts' opinions. For this subject a network that is based on experts opinions is considered to be better. A network that is based on data needs a great amount of, at the moment unavailable, data in order to make a good prediction. Furthermore in a network that is based on data about a decision making process in the past, wrong decision influence the predictions in such a way that it is even possible that the network keeps predicting wrong decisions. Therefore a network that has been constructed based on experts opinions is more suitable in this case.

To develop the BBN, first of all, the different variables influencing the decision towards a certain ownership model and BM&O model had to be selected. In order to select these variables a literature study has been carried out. Because literature gave no complete overview of the variables influencing the decision, an additional brainstorm session with experts has been held to make a complete list of variables. Next, people within the community school sector (schools, municipalities, childcare organisations and other participants) have been asked to rate the importance of the different variables influencing the decision towards a certain ownership and BM&O model. The most important variables will be selected and included in the BBN. Selecting the most important variables has been done by using the Fuzzy Delphi Method (FDM).

After the selection of variables is complete, people within the field will be asked to fill in a cause effect matrix in order to determine the relations between the different variables. Based on the variables and the cause-effect matrix the BBN could be constructed. In order to give the model predictive power experts will be asked to judge the probability value for the different variables within the network based on the state of another variable.

Research Results

At the moment I am still conducting my graduation research and therefore I am not yet able to publish a great amount of findings. At the moment I am working on determining the relationships between the different variables in order to construct the BBN, and thus I have already selected the variables influencing the decision towards a certain ownership and BM&O model. During the selection of variables, using the Fuzzy Dephi Method, one important finding was that the decision towards an ownership model and a BM&O model was mainly influenced by organisational and psychological factors, which are both "softer" variables, and the decisions were less influenced by financial factors and legal factors, which are "harder" factors. These "softer" variables can be influenced more easily in comparison to the "harder" variables and thus this conclusion shows that it is possible to steer a community school initiative in a certain direction by changing organisational or psychological aspects within the initiative.

Graduation Process

Since I am still graduating at the moment it is not possible to evaluate the entire process of my graduation project. What I however have experienced during the first three months of my graduation project is that it can be hard to keep in mind the goals of your research project. Having multiple supervisors, with different objectives and different opinions, influences me every time when I have a meeting. Sometimes this makes it hard to keep track of your own goals and work methods, but it also lets you think beyond your set idea of the subject. This can be very helpful, but occasionally it caused that I wandered off and started searching for another methodology, redefined my scope etc. This costs a lot of time and often it has brought me back to where I started. Therefore, for my own research project, at a certain moment in time, I tried to stop questioning myself and wandering off. You have to make a decision about a methodology, scope of your research and the way of questioning during a survey etc. and stick with it. Of course the decision has to be well thought out and you have to feel confident about the decision you make, but by keeping wandering off you will only find an infinite amount of roads that lead to Rome, and all roads can be the right one which makes the decision even harder!

While writing this article I am just over half my graduation time and I am working very hard to finish everything before my intended graduation date. Although sometimes there are some struggles, I am confident that I can call myself a MSc graduate at the end of March 2017!

Esther Penders
MSc student CME

GRADUATION THESIS

ESPER ASHKAR

A BIM integrated approach to quality management

Enabling information and knowledge management during the execution phase of a project lifecycle

The construction phase of a project is the manifestation of an engineering design that fulfills the requirements of the owner or namely, the ultimate user of the facility. Unfortunately, construction firms are rarely able to deliver projects that are 100% to the satisfaction of the owner. The gap between the requirements of the owners and the abilities of the construction firms leads to the occurrence of quality defects. Surprisingly, construction quality management practices have not been effective in eliminating the occurrence of quality defects on projects. Furthermore, there has been little progress and innovation in this field of study over the years. The research topic explores the possibilities of integrating new trends, such as BIM concepts, to enhance quality management practices.

Choice of thesis subject

Just like every CME student planning to begin his/her graduation project, the question of choosing a graduation topic was a frightening endeavor. Since I have taken an elective course in BIM, which in the recent years has been gaining interest in the industry, and since I had a general interest in the subject, I decided to pick a topic in this field of study. I also wanted my topic to be as practical as possible, which would increase my chances of finding a company that would be interested in supporting me by offering me an internship.

Conducting a research on the issues the construction industry faces revealed that quality defects are still considered a major issue, which is the main reason for wasted resources, schedule delays and cost overruns in the industry. In fact, it is estimated that defects constitute between 4-5 % of construction projects contract value. The research also revealed that quality management practices have not significantly changed over time and have not been effective in reducing the occurrence of quality defects. Factors contributing to the occurrence of defects were mostly related to information gaps and knowledge mismanagement (loss of valuable "lessons learned" experience, leading to repeated mistakes in the future).

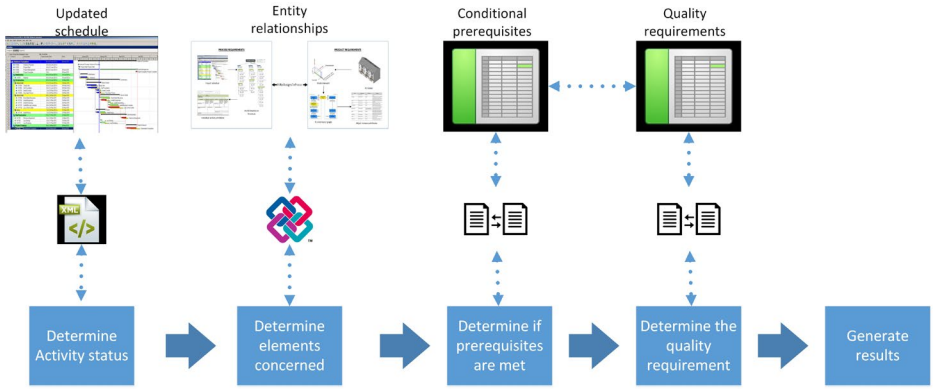
Because I believed that these factors could be controlled with the use of BIM, or BIM concepts, I decided to focus my thesis on the topic and directly had a conversation with Dr. Jakob Beetz about my idea. He was interested in the concept I presented to him and suggested as an initial step to firstly formulate my thesis proposal into a one page summary. In this manner we eliminated any misunderstandings before proceeding with the final detailed proposal. Dr. Beetz reviewed my idea presented in writing and connected me with other supervisors who could contribute to my research.

Process experience

Since it explained the idea in a concise way, the initial one page summary was very helpful when contacting companies which might be interested in my topic. One disadvantage to mention, was that I planned my thesis during the end of the second semester, which coincided with the summer holidays when companies are not enthusiastic about hiring interns. I sent my summary to several companies before my full-length proposal was complete.

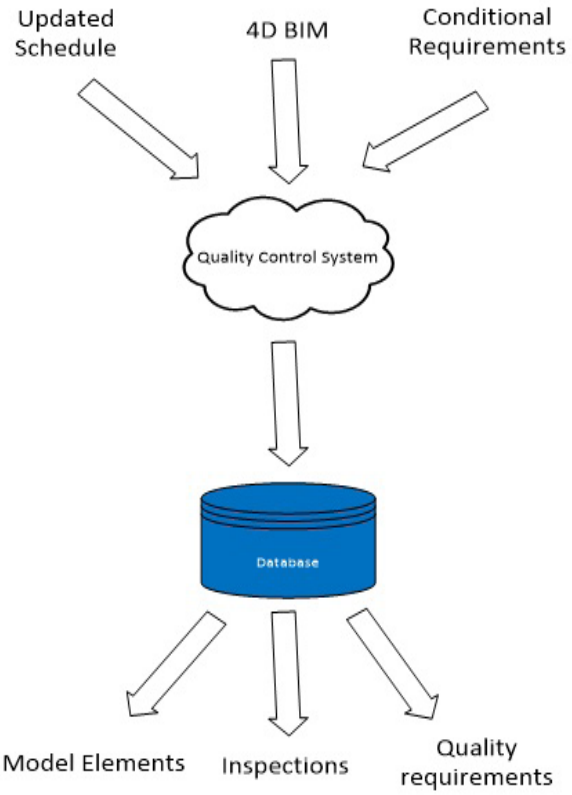
Eventually, the practical aspect of the research grabbed the attention of Joost Van De Koppel, a BIM manager at "Hendriks Bouw en Ontwikkeling", a project development and construction firm located in Oss. He was very interested in the topic for two main reasons, the first of which was the frustration in the company regarding the unnecessary costs related to quality defects. The second reason was that in the coming years the Dutch law is expected to change based on a proposal by the government (Wetvoorstel kwaliteitsborging voor het bouwen), adding further pressure on contractors. Joost also became an external supervisor in my graduation committee and saw the importance of this topic.

Thanks to Joost's support, the company was very opened in providing me with the necessary field data to validate my integrated quality management system. Statistics from the company's maintenance department were used to validate the main hypothesis of my research, interviews and meetings with site personnel were conducted to gather additional information and furthermore, suggestions for the developed schemas and requirements, a vital part in the integrated system, were also provided by Hendriks Bouw en Ontwikkeling. In addition to that, I gained access to one of the company's construction sites in order to test the system on a pilot project, which allowed me to bring tangible results to the table and helped me with the defense of my thesis.



Research summary

Based on the literature review, I proceeded to determine the weaknesses and shortcomings of previous research attempts in integrating BIM into quality management practices, focusing on the authors' reflections and thoughts in the discussions. A theoretical framework for a BIM-integrated quality management system was developed so that it ensures that most factors contributing to quality defects are addressed by the means of proper data management in all divisions and namely, Quality Assurance (QA), Quality Control (QC) and communication protocols. The framework determined the required input and the resulting output for each division, as well as the information exchange requirements between the two divisions. The Quality control system takes several input parameters and based on the actual project progress generates a list of the necessary quality inspection requirements that need to be fulfilled on-site. In order to generate these results, the QC system requires the means to determine the relationship between a 3D model element, a construction activity supplied by 4D BIM (BIM with schedule integration), the actual project progress, determined by the updated project schedule, and the circumstances that trigger inspections, determined by the conditional requirements.



The conditional requirements are divided into two categories: process and product requirements, both of which are present in the 4D BIM model. The results of the QC system are provided as input to the QA system, where an user interface displays the inspections for the reviewer to processes. The results of the inspections, along with the reviewer's comments, are registered and recorded together with the QC system's initial results. The QA system also processes the results and provides direct feedback to the QC in the form of a color coded model (red for rejected and green for approved inspections), as well as more detailed information in the form of BIM Collaborative Format (BCF) files regarding rejected inspections. The color coded model is intended for use by the construction supervisors, who only require a visual representation of on-site work status. The BCF reports are intended for engineers and managers who are not involved on a daily basis in the construction activities, so that quality issues are discussed and resolved. Data records of project performance allow analysis to be performed in order to continuously improve ineffective engineering.

In order to validate that such an approach would improve the efficiency of current construction quality management practices, a functioning prototype needed to be developed based on the proposed theoretical framework concepts. Since it provides flexibility for interaction with various other software formats (XML, IFC, SQL and XLS), Python was used as the basic programming language. The developed tool was tested on a pilot project for a duration of two weeks. The pilot project highlighted the practical application of the proposed methodology, as well as showcased the ease of collecting actual data from construction projects for process improvements.

Further insights into the topic

The research provides a useful insight into the possibility of BIM implementation in construction quality management, however there are several topics that require further research and development. From the theoretical aspect, more complex scheduling scenarios, where all possible activity relations are explored, is needed. This ensures that the developed framework can function properly in all project scenarios (e.g. in fast track projects). Due to the current BIM models' level of modeling detail (LOD), only several quality checks are relevant to model object properties or lack of model detailing. Therefore, an approach to overcome these shortcomings would be useful for the BIM community.

There are several interesting research topics for the practical aspects as well. During the pilot project testing, the number of inspections that were generated were far greater than what was actually inspected. An interesting research would be to determine a statistical approach for the number of inspections necessary to be conducted on-site in order to ensure an "acceptable" level of quality. The data was also displayed in no particular order, creating a lot of inefficiency when the reviewer was inspecting on-site. A possible solution for this issue is to use GPS to determine an optimal path for the reviewer along the construction site in order to be able to cover all necessary inspections.

Final presentation and graduating from university

Every person feels differently before the final presentation, but for me the green light meeting was much more stressful. This is because I still had doubts whether the thesis was developed to an acceptable level for a graduate student. Luckily, I was wrong and the supervisors were really happy with the initial presentation. I was very proud when presenting my final work on Dec. 8, 2016 in front of my supervisors, classmates, family and friends. The presentation itself was challenging to conduct since it was difficult to include just in 30 minutes and to a detailed level all the topics and processes that I have done! I remember that at times I had to speak at a faster pace than I had planned, but all in all, the presentation went exactly as expected.

I feel a great sense of pride having graduated from the Construction Management & Engineering Master's program at TU/e and I am confident that the broad areas of study offered in this program have provided me with the required skills for a successful career. In the future, I hope to be involved in a field that applies BIM practices in the construction industry.

Esper Ashkar
Graduate MSc CME

MILTIADIS GKATZIOS

A pleasant surprise

From Greece to Eindhoven

Being a foreigner in the Netherlands, while following the CME Master's in TU/e. Too many things can be mentioned, with no clue about where to start from. For the last 4 months, every single day here, in Eindhoven, is unique and unfortunately a single page cannot totally express all this experience. To begin with, my name is Miltos and I come from Greece. I remember my parents asking me the reason behind my choice for the specific master and every time, even until now, I keep telling them that there are three particular reasons, which made me take such decision: the Netherlands, the university and the scope of the program. Fortunately, all these reasons have been proved correct until now.

To make everything clear, the Netherlands first of all constitutes one of the wealthier European countries that is located in the center of Europe. It is actually an international and multicultural environment, where almost everyone speaks English, making you feel that you belong to a universal European unity. Furthermore, the ranking and reputation of TU/e played an important role in my choice, since it is one of the highest ranked engineering universities worldwide with high professional perspectives. However, what I was not aware of was the university's environment, which actually turned to be beyond my expectations. A totally friendly university that makes you feel welcome no matter where you come from or what your background is. Finally, having studied architecture engineering and realizing the need for management and cooperation of the various engineering fields, I found the CME program really interesting. The fact that the level and the contents of this program are assessed by representatives of the profession, as well as that it belonged to the 3TU (now 4TU) federation, were additional reasons to entice me selecting the specific master program. Nowadays, my little experience to particular subjects, such as Legal and Governance and Systems Engineering provided me with basic knowledge which I am going to need both during my studies and in my work afterwards.

But to be honest, almost all this information and experience was sort of expected, -Google is your best friend!-. However, during the first weeks in Eindhoven, I understood that I knew nothing. And surprisingly, I will not mention the weather, because I had already been told that it would be totally different from what we are used to in Greece. Nevertheless, it was really interesting the fact that during the summer, I actually experienced the four seasons of the year during just one day!

When I talk about things you cannot validate by searching on the Internet, the first that comes to my mind is the introduction week, which still remains one of the most memorable moments of my life. I still remember -Monday morning 15th of August- listening to the university music and voices from almost 1km away, without understanding what was happening (it was still 08:00am), until I entered the campus. And only a few hours after, a fire truck made us wet during an amazing game. My intro parents (younger than me!) showed us the city in a way I couldn't imagine. And of course there were crazy nights and days partying along the city, in "Skybars" or other bars. Overall, one week was more than enough to make me say: "Yes I want to be here, I actually belong here".

Also, the country's geography and infrastructure provide cheap and excellent opportunities for travel. Its location is actually a gateway to several European cities with easy and fast accessibility through public transport. I also realized that travelling for about a maximum of 3 hours, you can reach whatever place you want in the Netherlands and explore the Dutch culture. Having been for just 4 months in Eindhoven, I have already travelled to Brussels, Bruges, Tilburg, Amsterdam, Breda and Rotterdam. And the list has many more cities yet to be explored. Finally, as far as the transportation is concerned, bicycles are everywhere. That was a shock to me, if someone takes into account that in Greece bikers have to ride and survive in big streets in competitive races with cars and buses. Actually, I used to and I still do cycle, feeling every time that sense of freedom to move around the city.

So, without any doubt, I feel that Eindhoven and TU/e are my new city and home respectively, something that I am grateful for. And this is just the beginning.

Miltiadis Gkatzios
MSc Student CME

HOW ARE YOU DOING ?

ARTHUR VAN KEMPEN

CME-ers: Restless, Curious, Mischievous, Spirited and Dissident Libertines (Losbollen!)

Arthur van Kempen is one of the first graduates from the CME master program. Arthur started the CME study in 2001 and graduated in 2003. Within the !IntervisiE commission we felt that asking someone that is already working in the construction sector for more than 10 years after completing the CME master was a real chance to showcase what current CME graduated and students can achieve within a few years' time! Arthur is currently working as senior project manager at HEVO, a project management and consultancy firm that is mainly active in the public real estate sector.

Wow! When I was asked, as one of the first graduates of the magnificent Construction Management & Engineering study, to write an article for this magazine everything from my college days resurfaced. After a particularly exiting (rowing) student life, and a less "challenging" study industrial engineering and building management at Avans Hogeschool in Tilburg I just had to do something with the scientific side of real estate. The choice for Eindhoven and a study Real Estate management seemed to be the right one, but after the first lectures about dull real estate maintenance models, and the accompanying feeling I was only collecting more knowledge about theories, I've got an uneasy feeling. I became so uneasy with my choice that within five days I switch from a masters in Real Estate management to the, for me at the beginning of the week completely unknown, CME masters! After following a CME guest lecture I understood that the CME master track was a pilot study aimed on connecting the scientific and practical side of Real Estate and Construction management and I knew immediately this was the right study for me. It suited me as a person: slightly impulsive, restless, making decision based on feelings and then go for it one hundred percent! Ever since I was young I cannot really place myself within one label, and I do not really tend towards one specific job or specialization. I want to know a bit of everything. The turmoil and curiosity for something completely knew, yes that suited me! So I ended up as a CME student. I have not regretted my decision one day, and an exiting extension of my student days followed. Together with a bunch of slightly crazy, determined and curious troublemakers we started the CME studies under the inspiring leadership of people like Professor Schaeffer and Bert van Eekelen. During the years we even developed certain components of the program further together with Professors. A large optional part of the study contributed to the ability to combine your own interest in a scientific manner.

Towards the end of my studies I had, together with fellow student Daan, one last wish: To study abroad! The study was, and is, very internationally oriented and with the cooperation of the university we got the opportunity to do a wonderful graduation project at Strathclyde University in Glasgow. Our graduation e project focused on the Public Private Partnership (PPP) project 'The Glasgow Harbour regeneration Compared to PPP IJburg Amsterdam', one of the first PPP area development projects in the Netherlands. A beautiful project, but frankly the memories of the views we encountered during our Highlands & Lowlands tours on the weekends and the pubs stayed with me the most! My CME time and the feeling of freedom, entrepreneurship and variety I was able to continue at HEVO in 's-Hertogenbosch. HEVO is a company in which we develop mostly social real estate, but also other types of real estate, from start to end. From building such as large water board office and town halls to my currently favourite projects, being a father of two small kids, primary education buildings; I've got to build them all in my role of all-round consultant, construction manager or whatever other function name you want to give me! One day I am sitting at a table with school administrators and I am working at connecting modern day educational visions to the modernization of the real estate portfolio of educational foundations, and in the same week I am at the construction site as supervisor for the construction of a new school building. My favourite role is being the delegated contracting authority, this is a unique way of construction management within the Netherlands with which HEVO has become widely known. The organizational structure accompanying this concept causes that HEVO takes extensive risks in terms of budget, planning and quality that clients simply can't or won't bear (clients for which teaching is the daily practice and building a new school is something they might do once in a lifetime). This concept is particularly suitable for clients that want influence and maximum involvement in the process but won't or can't bear the risk. For example not HEVO selects an Architect of contractor, but the client does this. HEVO does however offer professional guidance when these kinds of choices have to be made. In short, it is a way of working together with the client with which we distinguish ourselves from the average developer or contractor that often brings in "own" people into the process. This is also what makes these kinds of projects beautiful because in every project you are working with different process partners. This makes my job exiting, instructive but especially nice because I love to work with a wide variety of people!

The entrepreneurship, freedom and variety in my everyday job ensure that I have not been bored for one day since I am working at HEVO. Overall, a CME-er completely in his element! I could also conclude this in the first Alumni CME day at Rijkswaterstaat, with not only a good turnout and a nice reunion with my classmates, but most of all a room full off, the for me so recognizable, restless, curious, mischievous, spirited and dissident libertines (Losbollen!)…. In short: CME-ers!

HEVO

Arthur van Kempen
Graduate MSc CME
Project manager HEVO

HOW ARE YOU DOING ?

JEROEN VERBERNE

A consultant in the real estate and housing industry

At the time I write this article, I am an employee at Alba Concepts for eight months. Alba Concepts is a consultancy firm in the real estate and housing industry. It all started during my pre-university secondary education, which I finished in 2009. There my interest for architecture, structure and economics was developed. Therefore, I decided to enroll in the Bachelor in Building Engineering at the university of applied science. I have been fortunate that during the four year Bachelor's program, the opportunity to go abroad and join an international company came along. Together with BAM International I worked as an engineering coordinator at a construction site. Due to that particular experience, in 2013 I decided to enroll in the pre-master's program in Construction Management and Engineering (CME) at TU/e and subsequently, I was also accepted in the CME Master's track.

During the (pre-)master's program, I spent most of my time either attending classes or working on assignments together with my fellow colleagues. The curriculum of CME was more extensive than I initially expected; Project and Process Management, Entrepreneurial Economics, Fundamentals of Building Information Modelling (BIM), Legal and Governance and Business Plan Development, were some of the subjects which to a greater or lesser extent I apply at my current job. Due to the assignments and trips around the world, I decided to write my graduation thesis with a focus on the circular economy. The circular economy is, compared to the traditional take-make-waste economy, restorative and regenerative by design. It aims to keep products, components and materials at their highest utility and value at all times. It also aims to minimize waste and maximize the reusability of materials and products.

My contribution to the topic was primarily the development of a measuring method, since there was none existing at that moment. Immediately after my graduation, I went, as I say to myself, on a well-deserved holiday. Together with a fellow student and my backpack, we travelled through Thailand, Malaysia and Singapore. After that trip, I became even more convinced that working in the domain of sustainability is a necessary endeavor.

At my current job I am implementing the theory into practice. Alba Concepts is a company, which focuses on two activities within the real estate and housing industry and namely, consulting and process management. In both activities we get involved in the early planning stage at the point, where real estate, sustainability, strategy and finance meet with the intent of contributing to the sustainability of the existing environment. Therewith, we help the clients to create sustainable strategies, set financial business cases and we also unburden the participating parties by setting up the process to arrive at the desired results.

In order to give you an insight to my work activities, below you will find three projects to which I have contributed:

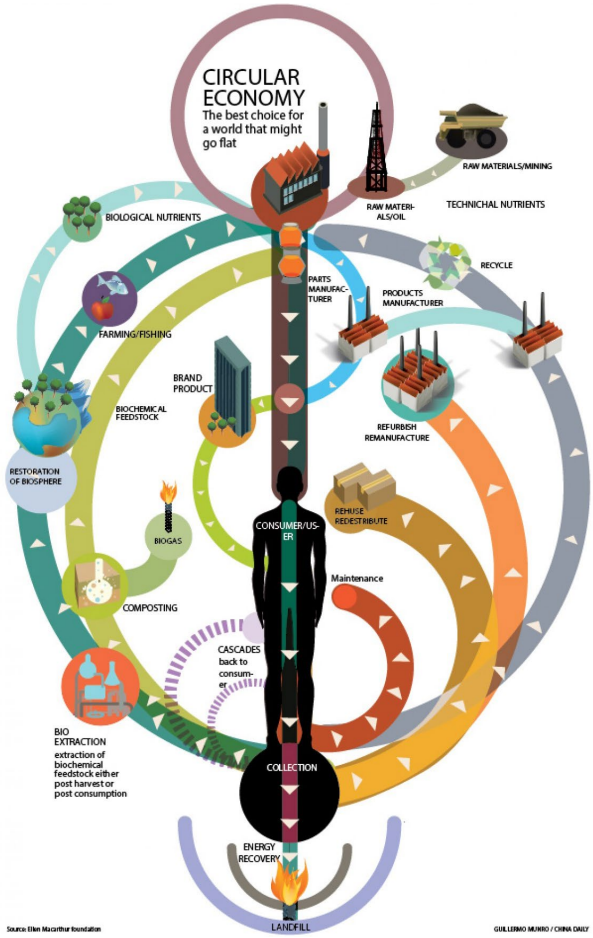
Zero energy renovation of the FUMO headquarters - zero energy, comfortable and durable offices

The mission is to stimulate the market for zero energy renovations of office buildings and ensure that supply meets demand. A zero energy building produces enough renewable energy to meet its own annual energy consumption requirement (building & users consumption). The result is excluding the use of non-renewable energy in the building sector.

The FUMO is a regional implementation service (NL: regionale uitvoeringsdienst) and works on behalf of its members: the Municipalities of Friesland, the province of Friesland and Wetterskip Friesland. The city of Leeuwarden has the ambition to make its municipal property stock more and more sustainable in the next years. The FUMO headquarters herein is the first project where the zero energy ambition will be realized. In addition to this ambition, both parties strive for a healthier indoor environment, and also for improving the image and the circular use of materials and products.

The business case: circular realization of new homes for the Municipality of Amsterdam

The case represents a research into the impact of circular realization of new homes on the land allocation rates and ground rent of housing. This is a key question demanded by many communities,



in which the Municipality of Amsterdam wants to have a leading position. Alba Concepts executes, in cooperation with Copper8 and the Municipality of Amsterdam, a research into the financial impact of circular realization. Therefore, a calculation method that allows stakeholders to start working with circular targets in the upcoming land allocation is going to be developed. From measuring the level of circularity of a building, towards estimating the financial costs and benefits, this case would be a beautiful study which challenges us to accelerate the transition from linear to circular!

The Municipality of Amsterdam wants to catch up in the field of sustainability. In order to do so, they created their own sustainability agenda, setting targets regarding the following pillars: Sustainable Energy, Clean & Healthy Air, Circular Economy and Climate-proof city. The municipality wishes to achieve a circular economy with new forms of production, distribution and consumption by promoting innovation, research and circular activities. They recognize that government and industry must work together to seize the opportunities that arise and to accelerate the transition towards a circular economy.

Circular procurement for the Regional Water Authority Zuiderzeeland (WAZ)

In addition to the current renovation and preservation of the WAZ office, WAZ has the ambition to procure the installation package according to the principles of circular economy. One of the pillars of sustainability taken into account by WAZ is the consideration of raw materials. Besides the focus on the raw material cycles, WAZ would further like to organize the innovative financial cycle. The challenge is to try to find an optimum between the two cycles. Alba Concepts guides WAZ with the definition of circularity and the process of procurement.

The intention of WAZ is to enter into a stable relationship with a market participant, who designs the installation package, as well as realizes its delivery, management, maintenance and receipt. (Construction) materials arising from the demolition and/or the existing installation package should maximally be reused or recycled. Market participants are challenged to provide maximum performance with a pre-announced budget. At present, the stated ambitions are translated into Key Performance Indicators (KPIs), with a starting point being the contracted performance. In addition, the first inventory is carried out on the basis of availability of materials and conditions of the current built-in package. This inventory is documented and incorporated into the market research.

My role as a consultant in the real estate and housing domain

As a consultant at Alba Concepts, I'm involved in a variety of activities. Depending on the type of project, my role is related to specific requirements. Often, it starts with analyzing the benefits of pursuing different perspectives in relation to real estate decisions. Therefore, alignment of efforts with the clients' corporate goals, as well as supporting the options that optimize marketability, are very important factors for success. This can be done on both the building level, as well as the portfolio level and can contain baseline assessments, operations and maintenance, energy management, certifications, product and service procurement. In that case, communication with clients and contractors is essential.

After defining the goals and strategies from a clients' perspective, procurement or tender phases have to be arranged. At that time, it is important that experienced tender teams are allocated to both public and private partners. This is essential for improving the collaboration between the different stakeholders in a project, for maximizing process efficiency, for making smarter decisions and for asking the right questions or giving the right answers.

Since all the aforementioned activities require communication with the different stakeholders, I am attending numerous meetings with both clients, suppliers, contractors and other consultancy firms. At the moment, my work mainly focuses on the initiation phase of the building process. Therefore, I need to have knowledge about contracts (E&C, D&B, DBFMO, etc.), procurement methods (request for proposal, open tendering, restricted tendering), good technical background and also process experience.

After eight months of work experience, I can state that the CME Master's program contains a solid basis on which students can rely when entering the employment's market. Due to the wide range of courses, points of recognition often pop up. Being a CME Alumnus entails great advantages resulting from the variety of knowledge gained. I still keep in touch with my fellow colleagues from the university and I follow them on LinkedIn. I believe that with the changing market nowadays, broad knowledge is requested and thus, it is important for students to continue to expand their knowledge also in practice.

I would like to use this opportunity to thank all people from the CME Master's track who taught and supported me, provided opportunities, as well as a great part of their time for my development and career. I would also like to thank of CoUrsE! for all the great experiences and leisure activities they organized.

For more information about the projects of our company and the company itself, please visit our website www.albaconcepts.nl or take a look at our company page on LinkedIn *Alba Concepts*.

alba Creative Concepts.

Jeroen Verberne
Graduate MSc CME

CORENET CHALLENGE

ELAINE KIEBOOM

CoreNet Global Academic Challenge in Philadelphia, USA

After following the elective course 'Corporate real estate strategy' at the TU/e our Proffesor dr.ir. H.A.J.A. Appel-Meulenbroek drew our attention to the so-called 'CoreNet Global Academic Challenge' the focal point of which was closely related to the knowledge we have gained from the course. Together with four other fellow colleagues of mine - Arlette Vrusch, Sharon Vosters, Elise Wijnker and Lana Trepels, we decided to form a team and take part in the contest, which involved the creation of a feasible solution to a given case study.

CoreNet Global is a non-profit organization representing almost 10.000 executives in 50 countries with strategic responsibility for the real estate assets of large corporations. The organization's mission is to upgrade the practice of corporate real estate management through professional development opportunities, publications, research, conferences, designations and networking in 47 local chapters globally.

The CoreNet Global Academic Challenge resembled the case study from the Corporate real estate strategy course, in which students would act as a consulting firm that advises a fictive company on a strategy for a corporate real estate portfolio. Within the CoreNet Global Academic Challenge our team was going to be given the task of developing an enterprise solution relevant to a company's business sector. The requirements for the solution included the following points:

- It maximizes the productive and creative ability of its human capital;
- It increases the success rate for hiring top talent;
- It reduces employee turnover;
- It earns the company's "employer of choice" status.

In order to participate in the competition, our TU/e team had to answer some questions in connection to the background of the team and its members, the motives for participating, the strategy for approaching the challenge, the unique characteristics of the team, etc. Weeks after submitting our application form, we were told the great news that we were selected as one of the 4 finalists! We were invited for the final round of the 2nd CoreNet Global Academic Challenge, sponsored by Cushman & Wakefield live in Philadelphia, USA. We had to compete against the teams of three different universities and namely, the Indian Institute of Technology (Bombay), the University of Houston and the University of Illinois. The winning team could win $5.000 and an additional $5.000 for the academic institution that it represents.

Round 2 of CoreNet Challenge in Philadelphia, USA

On Saturday, the 15th of October, we left for Philadelphia, and of course, all of us were extremely excited about the upcoming days! When we arrived at the airport, we were picked up by representatives of the event and then taken to our hotel in the city centre. This first day we took our time to prepare ourselves for the challenge and discuss our tactics.

On the next day, the official opening of the CoreNet Global Academic Challenge took place, during which the instructions for the second round of the challenge were presented to us. We were welcomed by the leader of the event, Dean Jorden (Vice President of University & External Relations at CoreNet Global), the five

judges from the panel, our team mentors and also experts from the various sectors that the challenge was targeting. The leader of CoreNet Global welcomed us all and introduced us to the persons that we were going to be involved with. Afterwards, the experts from all four sectors namely, high-tech, insurance, finance and manufacturing, gave us an insight into the problems in their sector. After the talks the teams were allowed to pick an envelope the contents of which determined the sector and the assignment. Our team got sector 'insurance'.

It was suggested in the assignment that the insurance company, is amongst the top five largest writers of US commercial property casualty insurances and furthermore, one of the largest writers of personal insurances through independent agents. Besides its headquarters, the company maintains 18 regional operation centres throughout the United States and 160 claim offices. The company also owns field offices in every US state and in addition to that, its business operations expand to countries such as the United Kingdom, Ireland, Singapore, China, Canada, and Brazil. Competition to attract the best talent was fierce and the company wanted to create an atmosphere that created opportunities for people to express their inherent capacity for creativity and innovation in meaningful ways. The Board of Directors believed it was the time to

develop an employee experience that was consistent with their values as a company. Our challenge was to deliver a workplace experience strategy that was a reflection of the ideals of the Board.

When our assignment was announced, we got time to talk to the CEO of this insurance company in order to find out what was really important, so we asked questions and made some suggestions. After the introduction, we got a workplace between all the stands of the participating companies, where we had a moment to discuss the assignment. Right after this, the event evolved into a social gathering with drinks during which there was time for networking with the experts from all of the companies. When the socializing was at its end, the event was officially opened.
Later that evening in the hotel, we discussed the assignment in detail and made a plan and strategy for the next day. We had already prepared a questionnaire before arriving to Philadelphia, so we had to only reorganize and upgrade it. During that evening we also invited several experts for an interview the next day.

On Monday we woke up early in the morning and started the day with the questionnaires. We wanted to have at least 100 questionnaire entries because then that meant that the information we have received was objective and also from a great value for our research. The questionnaire contained general questions such as: why do you want to work at a certain company, the reasons to stay or leave a company, the image of the employer, most important aspects to be a productive employee, best tools for companies to bring out the creative ability of their employees, etc. We tried to put a lot of effort in the interviews so that they were more in depth and also directly related to the insurance companies. As a result, in the afternoon we had gathered enough information to come up with some solutions. All the data from the questionnaires was processed in SPSS and the good news was that we had received more than 140 replies to our questionnaire. Therefore, another important step was yet to be started and namely, processing all the gathered information. We decided to go back to the hotel where we could focus better on our own, rather than stay at our workplace at the congress, where the situation was too busy.

Back in the hotel, we discussed our results and made a strategic plan because the following morning at 10 o'clock we had to hand in our presentation and abstract. Therefore, that evening we worked really hard to make everything ready. We worked until 1+30 at night but we decided to go to bed because we were not really productive anymore.

At 07.00 the next morning our team came back together to finish the presentation and the abstract. Just a few minutes before 10.00 we were ready with everything and handed in our solution. Arlette and myself were the ones chosen to present and in order to prepare, we were given time until 12.30 that day. The time was, of course, really short and this made the preparation a really stressful period in which we needed to manage everything at once. Needless to say, at the end the presentation went very well. Our supervisor, Mrs. Appel-Meulenbroek confirmed that we did a great job compared to the other teams. After the presentation we got a lot of compliments from the companies present during the presentations.

The winners were going to be announced during a recognition dinner that same evening. So after our presentation we finally had some time to rest and get some sleep. The recognition dinner was organized with a lot of attention and everything was beautifully decorated with candles, lights, glitter and music. During the event, there were several awards presented but our turn was right after the dessert. All teams had to come to the stage, where the winner was announced. The winning team was the team from the University of Illinois. Their idea was also good, but for us it was a bit disappointing. We had worked so hard and we were so proud of the results that we had presented. Unfortunately, it was just not enough to win this time.

Regardless of the final result, participating in this event was also a great opportunity for all of us. We met many experts from real estate companies all over the world; we talked to interesting people and heard about their opinions. In addition to that, we also learned about new technologies and new concepts for the future. So, in the end, it was such a great experience for us! Of course, here we would really like to thank our TU/e supervisor Mrs. Appel-Meulenbroek for all the effort and guidance!

Elaine Kieboom
MSc Student CME

THE ATLAS BUILDING

THIJS MEULEN & ESTHER PENDERS

The most sustainable education building in the world!

Within the !intervisiE magazine commission we often tend to look to business and their innovative project, ideas and working methods, but closer to the CME home, the TU/e campus, is the place "Where innovation starts" as the TU/e slogan tells us. The renovation project of het Hoofdgebouw, or as the building will be called after the renovation, the Atlas building, connects completely to this slogan as within the process innovative and emerging technologies are used and the building will be used as a living lab. At the moment the building design is the most sustainable design for educational building in the World. The expected BREEAM outstanding score is 93,86% and the project is nominated for the international BREAAM award in the category education and health care! To get a sneak peek in what the building will look like after the renovation, which technologies will be used and how the BREEAM score of 93,86% will be reached the TU/e Real estate management was asked provide a little bit of insight to the project.

Real estate management is the department within the university that is responsible for the real estate development, the park management and the 75-hectare area of the TU/e science park. Real estate management carries out the project and building management of all buildings and installations on the campus. In recent years the real estate management department has carried out a lot of interesting project such as the development of the FLUX building, MetaForum, the renovation of Ceres and the Groene loper project. As icing on the cake currently one of the most iconic buildings on the campus, Het Hoofdgebouw, is being renovated.

The TU/e campus has to become 50% energy neutral in 2030 because of more restrictive law and legislation for office buildings. Furthermore the TU/E wants to increase its the status as a sustainable university. Therefore when the old Hoofgebouw was up for renovation the campus management and university board aimed on a sustainable renovation of the old building. When determining the targets and aims for the renovation project they however never expected that the building would become the most sustainable education building in the world! The renovations of the building started in November 2016 and it is expected the renovation will be finished in 2018. The building will then accommodate roughly 4.000 students and 1.100 TU/e employees. Within the building the ID and IE&IS faculties will be located and different facilities such as lecture halls, flexible study areas, laboratories, office spaces, conference facilities, a restaurant and an exhibition center will be present.

In order to become the most sustainable education building in the world emerging technologies, such as an automatic façade that ensures natural ventilation and adjustable LED lighting, and proven technologies, such a PV panels and thermal storage installation, will be incorporated in the building. In addition to the use of technologies a lot of the old materials within the building will be re-use, such as the steel in the floors and façade and the concrete skeleton of the building.

The automatic façade that will be installed on the west and east façade of the renovated Atlas building will be a curtain wall in which sunlight-reflective triple glazing will be used and combined indoor blinds for heat and glare control. Because of the combination of tripple glazing and these blinds the façade matches the thermic values of an isolated cavity wall. The different glass panels within the façade open automatically in order to ventilate the building in a natural manner, but they can also be operated manually. The façade will be a SMART façade and uses numerous sensors that de-

What does a 93,86% BREEAM Score Tell us?

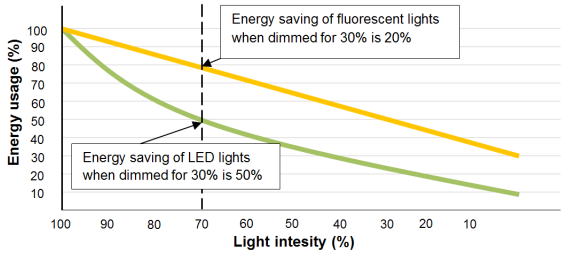
In order to reach a 93,86% BREEAM score a total of 93,86% of the points that are available in the different BREEAM assessment categories have to be earned. The outstanding label is handed out when more than 85% of the points have been achieved. Buildings that have a BREEAM outstanding score are considered to be innovative and use innovative and emerging sustainable technologies.

In the Netherlands there are a total of 32 buildings with a BREEAM outstanding score. 2 out of this 32 buildings are educational buildings, the renovated Atlas building with a 93,86% BREEAM score, and the Energy Academy of the university of Groningen (89,62%).

Although a BREEAM outstanding score is handed out after the construction or renovation is complete, after two years the buildings will be assessed again to see whether the expected performances of the buildings are made true.

termine which windows have to be opened or closed in order to ventilate the building. The different window panels within the facade, which will be 2.60 meters high, and do not open at an angle but will slide open entirely! When the windows are for example automatically opened in the morning it is expected that it will look like the entire façade consisting of massive glass pannels will come forward! To ensure the building can be ventilated in case of extreme weather conditions also mechanical ventilation installations are placed within the building.

The adjustable LED lighting will also be a SMART component within the building. The LED's used in the building will be daylight-controlled and make use of occupancy detection. Furthermore the LED lamp on floor 4 to 11 can be operated by smartphone. When you install an app on your phone, your phone will automatically make connection with the lamp above your workstation through your phones camera and a flashing LED indicator. When your phone has made connection you can adjust the amount of light above your workstation. Within the Atlas building a lot of daylight can enter the building, therefore the default light intensity for the LED lights will be lowered to 100 lux. When someone enters the room the light intensity will automatically be increased to 300 Lux but people can change this by using their smartphone. In the Netherlands the default light intensity in offices is 500 Lux, however based on a satisfaction survey conducted in the Amsterdam Deloitte office "The Edge", in which also a light intensity of 300 lux is used, the settings for the Atlas building will initially be set to 300 lux. Such a measure can save a lot of energy since in case of dimmed LED light a lot more of energy is saved than when normal fluorescent lamps are dimmed (see figure 2). Giving people control over the light intensity and decreasing the light intensity when rooms are not used will therefore also have a positive effect on the energy usage of the renovated Atlas building.



Although these emerging technologies have a major impact on the energy usage and CO2 emission of the building the use of existing technologies already present on the TU/e campus contribute significantly to the decrease of energy usage and CO2 emission. Since 2002 the biggest thermal storage installation of the Benelux is present on campus. The Atlas building will also be connected to this installation. In the summer this installation will cool the building by using cool groundwater, and in the winter the installation will ensure the building gets heated by using the heat that is stored during warmer periods.

In order to obtain a BREEAM score 93,86% more is needed than using technology. Other factors that have to be kept in mind are the health and wellbeing of the buil-

BREEAM at a glance

BREEAM is founded in 1990 and was the world's first sustainability assessment method for buildings. Within Europe it is the most used assessment tool to determine the sustainability level of a buildings and has a market share of 80%. BREEAM is the world's leading sustainability assessment method for master planning projects, infrastructure and buildings. The BREEAM assessment evaluates the procurement, design, construction and operation of a development against targets that are based on performance benchmarks. The BREEAM assessment therefore does not only look at energy savings but assess a building within different categories. This makes the assessment tool an integral sustainability assessment.

The different categories BREEAM uses to measure the sustainable value of a building are: Energy, Health and Wellbeing, Innovation, Land use and Ecology, Material, Management, Pollution, Transport, Waste and Water. Within every category points can be earned. Based on the number of points earned in each category a weighed percentage score will be calculated that represents a certain sustainability category. In order to achieve an outstanding BREEAM score a total of 85% of the points that are available must be earned. The lowest BREEAM category is Pass, followed by Good, Very Good, Excellent and outstanding.

Over the years a total of 2.258.782 buildings world-wide have been registered for a BREEAM assessment and a total of 555.441 BREEAM certificates have been handed out. The sustainability assessment tool is used in 78 countries worldwide. Within the Netherlands the BREEAM assessment is used since 2009. Since then a total of 735 BREEAM certificates have been handed out.

The added value of a BREEAM Assessment

In order to obtain a BREEAM certificate certain costs have to be made. Next to the cost for the actual certification of the building often BREEAM Experts are being consulted and/or extra sustainability measures are included in the building design in order to obtain a higher BREEAM score. Although some might think these extra costs do not weigh up to the added value of the BREEAM Assessment the assessment is already carried out for numerous of projects worldwide.

The added value of a BREEAM Assessment is mainly that you can express independently that the project is sustainable. In case of developments in the private market this often influences the height of rent or is a unique selling point for a new building. For public parties the certification of a building can influence their image as a front runner on sustainability. Furthermore if public parties show that sustainability is important this can influence private parties to pick up on it too.

By obtaining a BREEAM certificate also certain financial benefits can be created. In the Netherlands for example you can obtain certain investment benefits based on the MIA/Vamil regulation. Furthermore by keeping in mind the different categories on which a BREEAM score is based during the design process often the operational cost of the building during the user phase can be minimized. Research of the World Green Building Council shows that extra investments in sustainability are often earned back by a reduction of energy cost, water conservation and maintenance during the user phase of the building.

ding users and of the environment. In order to make the building comfortable for its users one of the design principles was that the building needed to be a place where people felt physically and psychologically well. The starting point for the building (re)design were therefore the users of the building. To keep in mind the impact of the renovation project on the environment also an ecological assessment has been carried out. Based on this assessment initiatives have been taken such as the placement of bee hotels and nesting boxes for bats, swifts and house sparrows are included in the project. By doing this the project also takes in consideration its direct impact on the environment.

When constructing a new, or renovating an old building it is important to keep in mind the lifetime of a building. In order to ensure that the building design will be suitable for the lifetime of the building the design of the Atlas building is very flexible. The building will consist of multifunctional rooms and a flexible interior design. Within the building a fixed spine has been designed in which all support functions are being placed. The other areas of the building can be partitioned as required within the building, which ensures flexibility for the future. Almost every floor within the building will have the same floorplan and the installations acoustics and fire prevention and protection procedures are matched to this floorplan.

For CME students or alumni it is always interesting to know how the process itself is made more environmental friendly. Since this is also one of the grading criteria for the BREEAM assessment the TU/e campus management has also focused on this question. One of the components that had a great effect on the sustainability of the building process was the choice for renovation instead of constructing a new building. Because of this choice the impact of the construction process on the environment can be minimized. Less new materials have to be used and also the impact of the energy use and water usage during the building process is less in case of renovation. The decision to renovate the building rather than demolish it and built a new building was, next to the fact that it is more sustainable, also heavily influenced by the historic value of the building. The Hoofdgebouw is one of three historic high-rise buildings on campus. When a decision had to be made about renovating versus demolishing the building, it was very clear that the iconic building was part of the TU/e appearance and had to be retained. In order to ensure that the contruction process is carried out as sustainable as possible also a commisioning manager is involved during the renovation of the building. and the first few months of the user phase. The commisioning manager keeps an eye on wether the construction process is carried out as agreed upon regarding sustainability measures (types of materials, installations etc.), and whether the installations installed in the building are being used as it was intended during the design process.

Also during the design process certain action have been taken to ensure a sustainable design was put together. The design for the Atlas building has been created within an integral design process. One of the partners involved in this design process, next to the Team v Architectuur, Van Rossum Raadgevende Ingenieurs, Peutz and Valstar Simonis, was a BREEAM expert. A BREEAM Expert is certified by BREEAM-NL and has a consulting role about sustainability within the process. By involving a BREEAM Expert the sustainability objective is being kept in mind during the entire process. After the completion of the renovation of the building the aim is to use the building as a living lab. The living lab concept is already used within the campus area. Examples of TU/e living labs are the light systems and designs used during GLOW and the street lights on the campus that are connect to Wi-Fi. Also within the Atlas building the living lab experiments will mainly focus on light. The abovementioned LED smart lights are already part of the living lab experiment and aim on studying whether using these types of lights will have an effect on people getting winter blues or winter depression!

Because of the effort of the TU/e campus management and the other partners within the integral design team the sustainability goals set in the beginning of the project have been far exceeded. After renovation the Atlas building will not use any direct fossil fuels anymore. Atlas will already be the fifth building on campus that is not connected to the gas network anymore! Furthermore, the energy usage of the building, in comparison to the situation before the renovation was carried out, will decrease with 66%, and the CO2 emission of the building will decrease with 80%. It is very impressive that such a reduction will be achieved despite the fact that the number of building users will double after the renovation! By completing the renovation of the former Hoofdgebouw the TU/e can once again show its innovative nature and the importance of sustainability!

If you are interested to get another sneak peek of what the Atlas building will look like after the renovation is finished, than take a look at the tue website! On the tue website more information about the project, vlogs and even a VR movie can be found!

ing. Thijs Meulen
RE management TU/e

Esther Penders
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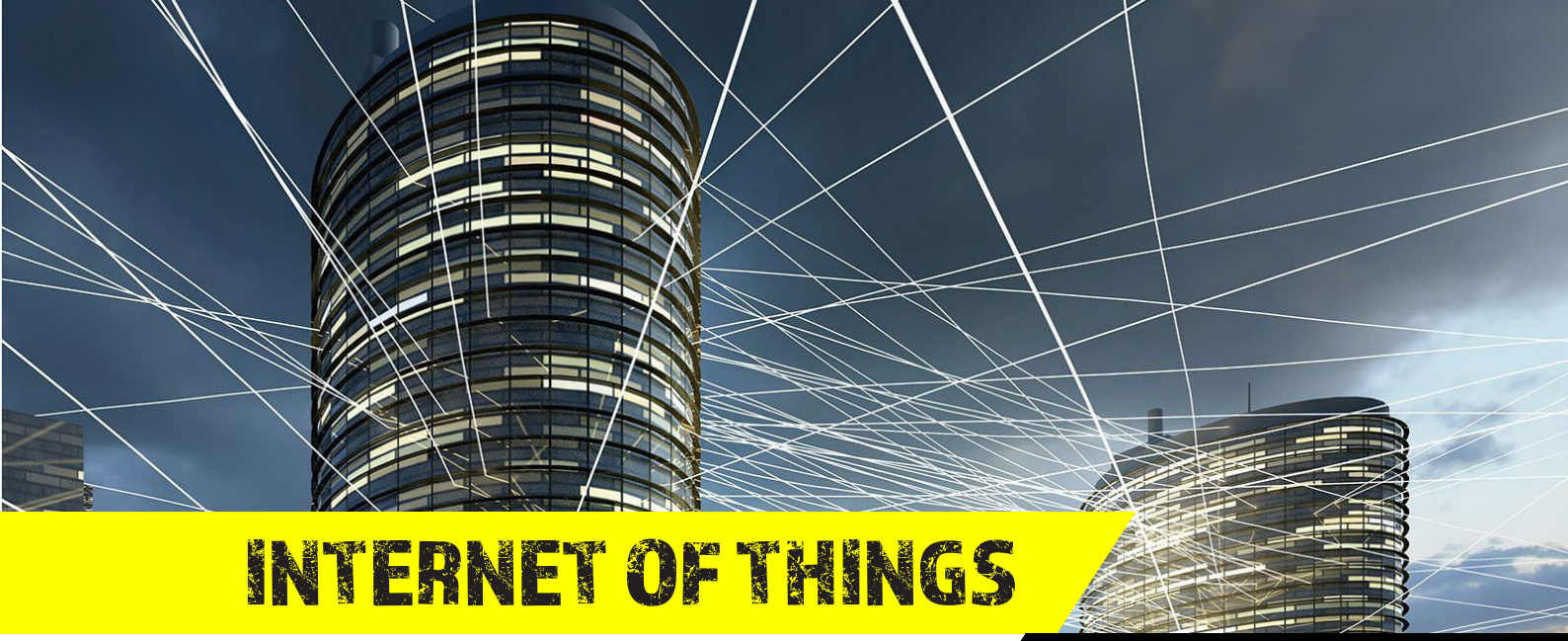


INTERNET OF THINGS

ESTHER PENDERS

When you are following the trend "The internet of things:" (IoT), a prediction you have probably heard is that the world will have 50 billion connected devices by 2020(CCS, 2013). This prediction was made by Cisco in 2013 and is already considered to be conservative. Whether the prediction is accurate or not, there is no escaping from the fact that the IoT is a trend that can change the way we live within our homes and cities and the way the construction industry will arrange the building processes. But, what exactly is the IoT, and what will be the implications of the trend on the built environment, our homes and building processes?

What is IoT?

When looking to the basics the IoT is the concept of connecting any device with an on and off switch to the Internet or to each other. Devices one can think of are cell phones, washing machines, lamps, wearables, but also components of machines such as a jet engine of an airplane. By connecting "smart" devices to the internet a larger web of devices, that are also connected to the rest of the network devices, is created. Since the different devices are interconnected through the web, the devices now have access to much more data and potential than they did on their own.

The Internet of Things (IoT) is emerging as the third wave in the development of the Internet. The 1990s' Internet wave connected 1 billion users while the 2000s' mobile wave connected another 2 billion (Goldman Sachs, 2014). The IoT has the potential to connect 25 times as many (50 billion) "things" to the Internet by 2020. Breakthroughs in the cost of sensors, processing power and bandwidth to connect devices are enabling ubiquitous connections (Goldman Sachs, 2014). IoT allows us to gather great amounts of data that can help improving product design, process design, customer engagement, executive decision making, after sale services and Marketing strategies (IDC Research, 2016).

Although you might think "Why would I want to connect everything to the internet?" this trend creates opportunities and can make life easier. In this article we will discuss the impact of the IoT on the CME working field.

IoT in the urban environment

Adopting ICT solution in the urban environment enables the development of so-called Smart Cities. This objective can be pursued by the creation of an urban IoT. The creation of an urban IoT, and the accompanying creation of big data, can benefit the management, design and optimization of traditional public services such as transport, parking, lighting and the surveillance and maintenance of public areas (Zanelaa et al, 2014). According to Zanelaa et al. there are different domains within the built environment on which it is expected that IoT will have a great impact:

I. Waste management
Waste management is a big issue in modern day society. Using more ICT in this domain could result in economic and ecological advantages. An example can be an intelligent waste container that can detect the level of load and allow for an optimization of the collectors trucks route.

II. Pollution monitoring
Bad air quality and noise pollution is a growing problem in cities. An Urban IoT can provide means to monitor this pollution in cities. By placing air and noise sensors, and making the data from these sensors available to people, it is possible to let people find the most "healthy path" within the city. Furthermore the data can be used to study pollution patterns to identify the main problem sources. Sound sensors can also be used to detect certain sounds that indicate danger, such as noise of glass, crashes or brawls, and thereby improve security.

III. Traffic Congestion
Although camera-based traffic monitoring systems are already broadly available and used in many cities, a better traffic monitoring could be realised by using data from car sensors and GPS signals from modern vehicles. Together with air and sound sensors a better overview of traffic within the cities can be created. This information can be of great importance to authorities to create discipline within traffic situations and improve city designs. For the public this information can be used for better route scheduling.

IV. Smart Parking
Within parking garaged Smart Parking systems can already be found, but a city wide smart parking system does not yet exist. A Smart parking service could be based on road sensors and intelligent displays that directs motorists along the best path for parking in the city. People could benefit from this because they can park faster, but also the environment benefits because faster parking means less pollution and less traffic congestion. Furthermore it is possible to create an electronic verification system for parking permits or slots reserved for residents or disabled people.

Don't Flush Me!

DontFlushMe is an IoT citizen initiative started by Here Percifield, a graduate student at Parsons University (New York). Don't Flush Me aims on solving one of New York's biggest water issues. Every time there is heavy rain in the city, raw sewage is pumped into the harbor at a rate of 27 billion gallons each year.

DontFlushMe is Percifield's attempt to deal with combined sewage overflows (sewages that drain both waste water and rainwater), or CSOs, through a low-cost solution that engages locals. By installing an Arduino processor, placing sensors in New York's combined sewers and developing an App he has found a way of letting the sewage talk back to the people of New York. When the water levels are high people get text messages telling them whether they can flush the toilet or whether this causes a combined sewage overflow!

V. Smart Lighting
In order to save energy smart lighting is an important feature. Possibilities are to connect the lamps to the urban IoT and optimize the intensity of street lamps according to the time of the day, the weather condition or the presence of people. By connecting the lamps to the IoT it is also possible to develop a fault detection system that can be used for maintenance purposes.

VI. Energy Consumption
Because of the numerous amounts of sensors within a city it becomes possible to develop an energy monitoring system for the entire city based on the sensor infrastructure within the city. By doing this authorities and citizens can get a clear view of the amount of energy required by different services, identify possible main energy consumption sources and optimize these sources. Other IoT energy related solution included the development of a smart grid.

In general the aim of the urban IoT structures is to optimize people's behaviour in cities and make cities more efficient. Although in China some smart city IoT projects take massive forms, the reality is that currently most urban IoT projects are pretty small scale. Sometimes these initiatives are taken by governments and sometimes citizens take matters into their own hands by developing apps, DIY sensors, etc. As Dan Hill, chief executive of research firm Fabrica, said: "It is going to be smart citizens that make cities smart!" Although governments have great impact on the creation of an urban IoT, also citizens initiatives can change the way we live in the city (see Box Don't Flush me!).

IoT on a building level

Not only in large scale urban areas IoT can optimize the way we live and design our environment, but also in offices, and our own homes IoT can improve our quality of life. IoT on the building level is often divided into four categories (IBM, n.d.):

I. Home automation and convenience
Devices within this category aimed at simplifying life and are currently often aimed on elderly or disabled people. Examples of home automation technologies are application that allow for easy control of appliances through smartphone applications. A buzz word within home automation is the smart kitchen. These concepts aim on changing the way we order, store, cook and consume food. Systems that are already existing are trashcans that monitor which items you are throwing away in order to make a list of items you need to restock in the pantry and smart forks that tell you when to eat slower.

II. Energy and cost management
In general appliances and services within this category aim at gathering data about energy usage and cost, and decreasing both. Within this category appliances such as smart thermostat NEST or apps for home solar energy management are already available. Other examples include systems that monitor and optimize the energy consumption and the climate of the environment in a building by using different types of sensors and systems that control lights, temperature, and humidity.

III. Health and wellness
Within this category most of the appliances are not directly implemented into the home but they occur in the form of wearables such as activity trackers. Although currently the health and wellness IoT market mainly focus on wearables or M2M connections (Machine 2 Machine) the aim is that in the future IoT can also be implemented in homes in order to remotely monitor patience health and capture a patient's health data from a variety of sensors. Other options include the development of wearable systems that constantly monitor medical conditions such as diabetes and can take action in case the glucose levels are not within the healthy boundaries.

IV. Safety and security
There are already a lot of IoT devices within this category. For example alert systems that send real time camera footage to your phone in case certain sensors are set of, smart locks (see box Open Sesame), water leak detection systems, smart gas and carbon monoxide monitors or glass break detectors. In the future it might be possible that safety and security IoT systems can even use voice or facial recognition to tell which family members are already at home.

Although more and more home IoT devices are being developed a complete smart home is something that is still something from the future. It is however important to make new buildings IoT ready, install a basic ICT platform and keep in mind the possible placements of sensors and other appliances within the building to make buildings future proof.

Influences of IoT on the construction process

IoT can be used in the different phases of the building processes. One of the most thought of implication is the use of IoT to monitor the structural health of buildings. By monitoring the buildings continuously through the use of sensors placed inside, the building`s predictive maintenance can be optimized. A database can be made based on the gathered data which can be used to reduce the need for expensive periodic structural testing and will allow targeted and proactive maintenance and restoration actions. Building parts will only be replaced or renovated when the data proves that this is really necessary. By using sensors it is also possible to map a physical structure or geology of an area very easily. This could make the (re)design process for new or renovated buildings easier since a model of the structure or area can be built in a matter of minutes. By combining such IoT systems and 5D BIM applications (3D BIM model connected to planning and cost applications) the feasibility of projects can be determined more easily. The IoT can also automate the way real estate managers manage and benchmark their building portfolios. IoT enables buildings to monitor their performance through sensors and even let the building change their behaviour automatically. It might even be possible to let buildings within a building portfolio communicate about interventions and learn from the interventions from other buildings within their ecosystem.

Other IoT implication within the construction sector aim at the logistic side of a building process. Logistics is a big expense during the building process, by using IoT it is possible to lower these cost. Examples of how to use IoT to make this happen include the use of RFID tags that manage warehouse stocks, or systems that automatically orders materials based on a BIM model, construction planning and

Open Sesame - A do it yourself IoT project

Are you always searching for your keys, or are you a bit oblivious sometimes and you are not sure whether you closed the door when you are already in the train on your way to friends you would spend the weekend with? In those cases it would be very nice if you would have an app that allowed you to open and close your door by only using your smartphone wouldn't it? If you agree then this IoT do it yourselves project is very useful for you! Charif Mahmoudi develop an IoT system, named Open Sesame, that enables you to do open and close your door by only using your smartphone, and shared how to do it on Hackster.

Open Sesame enables you to share access to your room, house or apartment, from anywhere instantly. You can control Open Sesame whether from Ainside your place or outside using a local wireless network or from anywhere in the world using the Amazon IoT platform. All you need is a raspberry pi, a servo motor, zip ties, a smartphone, a door you want to remote control and some programming experience (although every line of code is explained on Hackster). If you are interested just open google and search for "open sesame + Charif Mahmoudi + Hackster" and you can start your own IoT project! Good luck!!!!

information about warehouse stocks. In offices RFID tags or other kind of tracking chips can also help in locating employees. This is especially useful in New Way of Working offices. Furthermore the data that is generate through the use of these tags or chips can in return be used to monitor or optimize the use of buildings. Big data generated through the IoT environment enables us to use data we never had to (re)designed buildings.

A combination of other emerging technologies and IoT also show great opportunities. A combination of VR and IoT is already used in Japan and China. In a Virtual Living Lab environment data from OpenStreetMap and traffic information systems are combined to simulate the real time traffic situation (Vaccari, n.d.). The system can be used for simulating driving behaviour or to study the effect of interventions on the environment and behaviour of people. Although IoT and VR are a synergizing combination it is also possible to just use the data gather about an environment (without VR) to study the effects of interventions on human behaviour.

Because of the incorporation of ICT in our built environment it is expected that the construction management of projects will become considerably more complicated. Buildings will need much more ICT infrastructures and installations. On top of this, buildings need to be able to accommodate the growing need of people to connect all their devices to the internet and thus building designs must be WiFi friendly to avoid WiFi dead zones. In order to ensure buildings meet all the requirements needed to integrate IoT technologies, it is expected that building process will become more integrated (WTM, 2016). The iincreased use of ICT, creation of data and more integrated building processes also causes that the demand for highly educated personnel will increase in the future. Heijmans, for example, tells that currently almost half of all the jobs within their company require at least an HBO education. Ten years ago this was totally different. This of course is a nice perspective for CME students and alumni!

View of the construction industry on IoT

Also in practice IoT is a buzz word and increasing attention is given to the subject. IoT is a subject that gets attention from companies working in every phase of the building process. Companies are working on formulating IoT strategies and they are examining their view on IoT and what will be the impact of IoT on their business.

The actuality of the IoT and ICT discussion within the construction sector can be underlined by the recent appointment of a new Director Digital Construction, Menno de Jonge, within construction-service company BAM. BAM's aim by using ICT in the building process is to reduce failure costs, inefficiencies in the design and construction process and lack of collaboration in the supply chain. Technologies that will be used for this include, next to IoT systems and Big data, BIM, robotics, laser scanning, drones, 3D printing, virtual and augmented reality, and modular/offsite construction. An interesting BAM concept in which IoT technology is used is the renovation concept "de Stroomversnelling". By using IoT technology in renovation projects, building installation can be monitored and maintenance predictions can be made. In order to remain one of the industries's leading construction and service companies BAM embraces the digitalization and its transforming effect on the construction industry and the built environment. By embracing digitalization BAM aims on becoming a leader in digital construction in the International construction industry.

Also Heijmans is positive about the use of ICT solutions in the building process. The director of Strategy and policy of Heijmans tells us that IoT and Big data are real game changers in the construction sector. He expects that the impact of IoT will be the greatest in the installation sector. In order to anticipate on IoT usage within buildings Heijmans already installs a standard building automation package within all new buildings. Heijmans expects that by embracing new technologies, such as BIM, IoT or 3D printing, construction cost can be lowered significantly.

Also consultancy firms try to incorporate current trends and future applications of technology within their working field. Within the Healthcare division of AT Osborne, for example, the aim when (re) designing hospitals is to transform the current care process into one that is optimized for the current situation and with the future 20 years in mind. AT Osborne sees digitalization and IoT as important trends that heavily influence the building design since these technologies change the way future buildings are used and how healthcare is delivered. Take for example the possible improvements that can be made with IoT to the nursery department of a hospital:

- The information system that registers patients and their room can communicate directly with technical installations. This way technical installations such as heating, lighting and air conditioning are only activated when a room is occupied by a patient. The patient room is always conditioned to the preferences of the patient even after moving.
- Physical objects become sensors to improve the patient care. A bed can become an instrument to diagnose bedsores, detect a patient falling out of his bed, poor sleep and wetting.
- Walls become more dynamic with improvements of digital displays and smart lights. By projecting a familiar environment a patient feels more at home, which improves his recovery.
- Wearable sensors give the patient the possibility to signal help anywhere. It gives doctors rich health monitoring through the collection of granular health data. And it gives nurses the ability to know when a patient has tripped or fallen or is wandering.

For some applications it is hard to imagine of their existence, however, they will soon become a reality. Although they are still unknown, we can be sure they will see the light of day. AT Osborne sees it as their task to prepare hospital buildings for the moment the technologies arrive.

Although the construction sector is often considered to be conservative, new technologies are gradually being embraced. By embracing these innovations labor productivity can grow and processes and building designs can be optimized. Embracing these technologies is a necessity in order to prevent that construction and process cost will become too high.

Esther Penders
MSc student CME

DR. GAMZE DANE

Research and education link between CME and ISBE at TU/e

In order to enable students and companies to better understand the research of the Information Systems group within the built environment (ISBE), to which the CME master is linked, the different Phd students and researchers of the group have been asked to shortly describe their projects and research fields. By getting insight in the research conducted at the ISBE group the CME direction in Eindhoven is made more clear for future CME students and companies looking for CME graduates.

The master's degree program Construction Management and Engineering (CME) is offered by the Built Environment (BE) and Industrial Engineering & Innovation Sciences (IE&IS) departments, with their distinctive research-driven and project-oriented approach to education. In this interdepartmental program, the focus is Construction Management & Urban Development: using urban/building sciences and management and innovation sciences to develop solutions for urban development with particular emphasis on smart cities. Within the faculty of BE, CME is linked to Information Systems in the Built Environment (ISBE) group, which is focused on the research areas: energy neutral cities, urban management and building information modeling.

Research area 1: Energy Neutral Cities

Cities are responsible for a significant part of greenhouse gas emissions as they generate emissions and use fossil fuel based energies. Therefore, cities should be seen as significant means for climate change mitigation. This can be done by considering alternative methods to generate, consume, store and distribute energy, however these methods are limitedly investigated in cities. The research in ISBE group focuses on these alternative methods by making the connection between technology, people and urban environment. Thus, our aim is to contribute to more reliable and comprehensive models to reduce energy demand, to generate renewable energy and efficient use of available resources by using static and dynamic data. ISBE group is involved in on-going funded European research projects which aim to reduce energy consumption at individual and district level by using smart solutions such as using smartphone apps and sensors. Additional to the EU projects, there are also several PhD research projects in ISBE group within the energy neutral cities context.

Research Projects

-TRIANGULUM is a large consortium European project including partners from UK, Sweden, the Netherlands and China. Eindhoven is one of Triangulum flagships cities, which is served as a test bed for innovative projects, focusing on sustainable mobility, energy, ICT and business opportunities. From Eindhoven, the main partners in the project are: City of Eindhoven, Royal KPN NV, VolkerWessels, Woonbedrijf and TU/e. In this project, flagship cities demonstrate smart city solutions and facilitate and replicate these solutions in follower cities (Contact person: Dr. Dujuan Yang and Prof. Dr. Bauke de Vries).

-DESENT is a European project under the context of "Smart cities and communities" and includes partners from Norway, the Netherlands and Austria. This project aims the development, application and dissemination of an integrated decision support system for energy use of buildings and transport, ensuring maximum efficiency with respect to supply and distributed energy generation (Contact person: Dr. Dujuan Yang).

PhD research

-"A district level energy management model" (contact person: Ren Xin, Dr. Gamze Dane): The purpose of this research is to develop a platform for citizens' energy management at the neighborhood/district level based on a model that utilizes a variety of data sources including traditional, static data and emerging dynamic data (i.e. smart grid, sensors).

-"Locating electric vehicle charging stations using a multi-agent based dynamic simulation" (Contact person: Seheon Kim, Dr. Dujuan Yang): The purpose of this research is to develop an agent-based framework for forecasting the spatial and temporal charging demand using activity-based travel demand model, finding the optimum number and location of EV charging station in short-term and long-term dimension, examining the trade-off between provider's interest and planner's interest, and assessing the impact of charging policy scenarios (such as delayed charging scheme, increase of charging cost, etc.).

-"Adapting to future climate through land use planning" (contact person: Hongchu Chen, Dr. Qi Han): The purpose of this research is to adapt the urban area to the future climate and react to the global warming phenomenon, this project analyzes the dependency of land use and land surface temperature (LST) in Eindhoven area through 2000 to 2010. Moreover, interaction between land use, energy consumption and LST on the city scale is explored to provide recommendations for future land use composition.

-"Low-carbon city development based on the land use planning" (contact person: Gengzhe Wang, Dr. Qi Han) Cities are the main engines of economic growth and social change, at same time the main producer of the emission of greenhouse gas. In this project, the relations among carbon emission, energy consumption and land use areas assessed and the low-carbon city development scenarios will be explored.

Research area 2: Urban Management

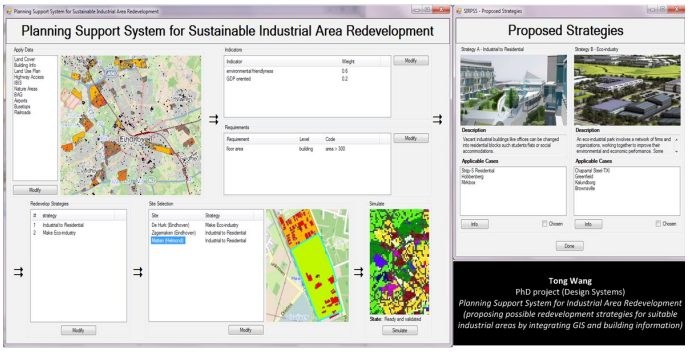
Cities are inherently complex and dynamic systems with many different stakeholders and long term policies. Nevertheless, the fast

pace of urbanization causes burden on stakeholders and policy makers that are responsible for urban management. The research in urban management focuses on understanding dynamic urban processes and formulating policies on the development of sustainable and resilient cities. Urban management research contributes to socio-economic models that are needed to manage urban systems. They also forecast spatial effects and financial risks of policy measures by considering the emerging area of urban informatics (i.e. using sensors, gps, apps, location-based social network data for urban systems). Urban informatics utilizes urban Big Data to improve strategies for dynamic urban resource management, to gain insights on urban patterns and processes, to support and make innovations for urban management, public participation and policy analysis. Within this context, we have several European project applications that will be finalized and announced in early 2017 (contact persons: Dr. Gamze Dane, Dr. Qi Han). These project applications focus on both demand (i.e. users, citizens) and supply (i.e. developers, government) side of urban management in (re) development districts by applying combination of state-of-the art methods, big data and emerging technologies (i.e. virtual reality, augmented reality). Additionally, several PhDs are doing research on this topic.

PhD Projects

-"The influence of car-sharing and autonomous cars on urban land use" (contact person: Alice Wang, Dr. Gamze Dane): The new advances in transport technology such as car-sharing and driverless cars have taken too much attention in terms of their impact on transport operating systems, congestion and safety. However, potential behavioral shifts and resulting land use changes and environmental impacts have received little attention. Such advances are expected to reduce the need for parking spaces and vehicle ownership. Therefore, in the long-term, these will cause changes in how the urban land is used. To predict future conditions and developing policies, an agent-based simulation will be conducted for several case scenarios.

-"A Planning Support System for Regional Industrial Land Sustainable Redevelopment" (contact person: Tong Wang, Dr. Qi Han): To tackle the severe industrial redevelopment stagnating problems of the Netherlands, a planning support system framework for regional industrial land sustainable redevelopment is proposed. Four main functions are provided in the system, namely land use change modeling, scenario analysis, site design and sustainability evaluation. Thus, macro level scenario analysis of regional land use changes done by planners is combined with micro level real time 3D design by industrial land users on specific sites.



-"The impact of accessibility on land-use dynamics" (contact person: Zhongqi Wang, Dr. Qi Han): The process of urban land use change is dynamic in nature because the locations as well as the intensity of the different activities that take place in the city are continually changing over time. By exploring the mechanisms of land-use dynamics influenced by accessibility, local government can simulate specific part of the city development by increasing accessibility via constructing better transport network and facilities.

-"Mixed land use cities with low vehicle dependency" (contact person: Xiaoming Lyu, Dr. Qi Han): In this project the possibilities that residents can reach everyday needs by walking and bicycling will be investigated through generating integrated land use and infrastructure plans for a hypothetical city to experiment. Such a hypothetical city can be adjusted to reflect real city situation on an abstract level to provide policy recommendations.

Research area 3: Buildng Information Management (BIM)

Building Information Modelling (BIM) entails methods and data structures over the whole lifecycle of the building including the construction phase to facilitate efficient and accurate exchange and processing of all information related to the built environment. Information management is crucial for improving the effectiveness and efficiency of the Architecture, Engineering and Construction processes. The lack of integration and co-ordination between actors is a major factor for poor project performance and the overall low productivity index of the whole sector. Standardization of data structures and communication protocols in building modelling and city modelling are needed and should also integrate advanced communication and BIG data mining. A special focus among the on-going research in ISBE lies on how building related data can be connected across knowledge domains both within AEC and its neighboring fields using Linked Data and Semantic Web technologies, information models and structures to allow greater levels of information access and cross-domain interoperability.

As of late 2016, the ISBE group is involved in the following funded BIM-related research projects:

- Capturing and checking requirements for building using Linked Data technology (contact person: ir. Chi Zhang, Dr. Jakob Beetz)
- Efficient storage and processing of as-built data from laser scans and point cloud (contact person: ir. Thomas Krijnen, Dr. Jakob Beetz)
- Project "okstraOWL": a Linked Data representation of the German information model for roads. With this model information about roads can be shared between parties in the design, engineering, construction and maintenance stage. With TU Munich (contact person: Dr. Jakob Beetz)
- 3TU project 'ExcaSafeZone: prototyping rich urban maps for safe excavation': Predicting safe excavation zones in urban environments' with Twente and TU Delft (contact person: Dr. Jakob Beetz)
- Project " Bridging the gap between Geo and BIM. Developing a CityGML/IFC interface to integrate BIM models with Geo models" with TU Delft (contact person: ir. Thomas Krijnen, Jakob Beetz)
- Modeling and use of Building Information Models as Linked Data, co-chair of the "Linked Data Working Group" of the buildingSMART standardization organization (contact person: Dr. Jakob Beetz) http://www.buildingsmart-tech.org/future/linked-data
- Mapping CB-NL, bSDD and other structured vocabularies for the built environment (contact person: Dr. Jakob Beetz)

Dr. Gamze Dane
Assistant Professor TU/e

Resultancy: Create your career with Enginear

Enginear is an innovative intermediary which focusses on recruitment and job placements. It is a company that has emerged from knowledge and it has a network built from the more than 15 years of experience in career guidance. The well-tailored personal approach that Enginear uses in the communication with each individual client is the factor behind many successful matches between young professionals and companies in the AEC industry. Therefore, the following pages are presenting an interview with one of the CME alumni, who used the services of Enginear with the goal of finding the right path to his professional and personal development.

About Enginear

Enginear is a specialist in recruitment and job placement within the field of the built environment, in which we mainly focus on civil and building engineering. We connect young engineers and companies in a professional, efficient and transparent manner. We use our knowledge and experience daily in order to grow and develop the skills of students, engineers and companies, and most of all, to ensure that everyone is working together enthusiastically. Every engineer that contacts us seizes the opportunity to make career choices based on self-reflection and by doing this, creating a sound basis for their future. This approach is the key to the success of every match between a young engineer and a company. Enginear aims at being a leading intermediary for young professionals. Furthermore, we share our knowledge about the job application process, personal leadership skills and career development with new engineering talents that will enter the labour market in the coming years. Every student or young engineer can contact our company via social media, but it is also possible to sign up for one of our free training sessions, workshops or personal career advice meetings. Tim Maier contacted us just after he started his CME Master's degree in 2015. Tim was looking for a relevant student job and wanted to use Enginear's network in order to find one. During his CME master we kept in contact with him and at the end of his master we made a match between Tim and his current employer Flux Partners. In order to find Tim a suitable job, we invited him for an interview. During this meeting, Tim filled in our career test, as well as our motivations test, after which we discussed in depth his resume and of course, the goals he wanted to achieve in his career. For us, the personal approach of the appointment allowed us to fully understand Tim's experiences and knowledge, his motivation in his career and his strengths. We at Enginear believe that only once you get to know a person fully, you can help him or her with creating their career. To further showcase the services of Enginear, an interview has been held with Tim about his career path and job search.

Q&A interview with Tim Maier from Flux Partners

What is your professional background?

In 2011 I received my Master's degree in Architecture, Building & Planning from the Eindhoven University of Technology. The thesis that I wrote was focused on the interweaving of the morphological urban systems in the districts Oude Pijp (back-to-back housing) and Nieuwe Pijp (Berlage) in Amsterdam. Besides my graduation project, I was also the main editor of an encyclopedia presenting all forms of NAAST (NEXT) Architecture in the Dutch architectural history. During my studies I also did an internship at an architectural office and I followed an Erasmus semester at the KTH in Stockholm.

After having worked for some years as an independent and project architect at several prestigious architectural offices in both the Netherlands and also abroad (Polo Architects & The Zwarte Hond), I noticed my growing enthusiasm for interdisciplinary collaboration. However, in my role as an architect, it was rather challenging to accomplish a career switch. After an intensive collaboration with my personal network, the disturbing economic crisis and continuous pressure in the Architecture, Engineering and Construction (AEC) sector, I decided to create my own opportunities. In 2014, I enrolled in the master Construction Management and Engineering at the Eindhoven University of Technology. Even though it was a tremendous challenge, I combined my new master with enthusiasm for architecture and creativity by shaping new lessons and as an assistant lecturer at the Faculty of ADE.

Besides my perseverance in both of the masters, I am continuously looking for variety in my work and exploring other interests. I have always had a high interest in the collaboration with other people and in the organization of activities. Therefore, I participated in various student associations and committees such as AnArchi and of CoUrsE!, in the organization of several events (conferences and exhibitions), and I was an editor-in-chief for the !ntervisiE magazine. I also participated in the organization of Race of the Classics and I have been active as a board member in the student sport association WETH (wind, kite and surfing).

In which year did you graduate and how long did it take you to find employment after your graduation?
In 2016 I completed the Master in CME. During my graduation project I wanted to combine the theoretical research methodology with a more practical approach within a company. Therefore, I chose to focus my graduation research on another important decision-maker in the multidisciplinary environment of the AEC sector through a graduation internship at the project developer SDK Vastgoed (Real Estate) in Eindhoven.

The graduation thesis focused on the investigation of “Overcoming the discrepancy in the office real estate market between demand and supply, through the intensification of emerging networks”. After my graduation I continued to work on several real estate concepts at SDK Vastgoed and I went traveling. After traveling, I created a job profile from my own work experience. Besides my personal job search, that was focused on the decision-makers in the AEC industry in the regions of Utrecht and Amsterdam, I also learned a lot from the approach of Enginear, which emphasized on specifying my personal job preferences.

In which way did you arrange your job search and did you have specific preferences towards a certain sector in the AEC industry or towards a certain type of company (consulting, contractor etc.) that you would like to work for?
My preferences regarding a future employer consisted primarily of finding a young company with a high potential for career opportunities. A company with a horizontal organization, in which the core principles of cooperation and diversity are imbedded. My preferences regarding a sector where the real estate sector and the civil engineering industry. The working experience as an architect, the collaboration with several contractors, and my graduation internship with the project developer SDK Real Estate contributed in defining my choice of a company profile, as well as the type of employer. The job search focused on a company in which there is a strong collaboration amongst colleagues within projects with a short deadline. From my personal experience I know that this facilitates a brief, diverse and intensified working process in which I can increase considerably both my network and my knowledge. Besides this, I also had a preference towards project management or consultancy because in these roles an individual is able to comprehend specific project information in a short time span. Furthermore, this offers the opportunity for constructing and reshaping the essential connections in both the process and project optimization.

Where are you currently employed and what are the unique selling points of the company?
In October 2016 I have started as a consultant at Flux Partners. The company is a resultancy company with a solution-oriented core approach. The overall commitment within Flux Partners consists of the achieving of an appealing final result. In collaboration with a wide range of clients, there is the continuous strive to define conclusive winning results in tenders, process and project optimizations, project management, process and organizational improvements. Flux Partners creates an environment in which clients are able to become leaders in the continuously adapting AEC industry. In projects we have the preference to position ourselves in an entrepreneurial and risk-bearing way and to expand in new businesses. We are active within the sectors of infrastructure, energy and industry. The services consist of Tender Management, Process Optimization, Project Management and Procurement & Contract advice. Some of the projects we have been working on are the Tunnel Alliance ProRail and the integration of the companies Koninklijke Smals. We have also closely collaborated with the municipality of Haarlem, where we had to perform work on a time and expense basis.

Currently, I am involved in the tender management practices of the company. The activities consist of the composition of qualitative tender documents based on BPKV-criteria (Best Price Quality Ratio, dutch BKPV). Flux Partners consists of a young team of professionals, where the team spirit is evident and much appreciated. The team spirit is apparent from the fact that we regularly have project-related discussions even around the ping-pong table.

Could you specify your job activities on a daily basis? What are your tasks, responsibilities and what have you learned so far?
The specific job description is Consultant Tender Management. Within my job, I support clients in the sectors energy, infrastructure, construction and water for the contract types DBFM, BVP and D&C tenders. In the work activities my responsibility is focused on the identification and determination of the actual demand of the customer and to converge this into a commercial offer. The next step consists of linking the problem identification and the interrelated BPQR-criteria with the most recent knowledge or technologies. By the means of interviews, creative sessions and a desk study I reshape the critical issues of the assignment into an offer of high quality with which the client will be satisfied. The combination of my creative and technical backgrounds contributes to the assessment of the arising results. Throughout the total process there is continuous dialogue with the client(s) in collaboration with specialists,

technicians and decision-makers in order to define distinctiveness in project and process optimization. The complexity of each project is to translate the accumulated knowledge and critical success factors into a paper-winning offer. Recently, I have been involved in a maintenance contract for traffic lights / lighting columns and a contract for the maintenance of asphalt.

How would you describe the match between your Master's degree in CME and your current job responsibilities?
The Master's in CME is a customized match with the current multidisciplinary environment of the AEC industry. More specifically, the role of a consultant matches perfectly because as a consultant you are able to decompose the critical issues and processes quickly and efficiently in order to formulate strategic solutions. Subsequently, the Master in CME and its variety of courses, such as marketing, business development, construction law, project and process optimization, has built a steady base introducing me to the different topics, as well as issues in the AEC industry. Therefore, the degree is a perfect match with my current career.

In addition, the Master in CME is focused on the much necessary collaboration within the interdisciplinary environment in large integrated projects. The skills that I have gained from the master projects are highly applicable in my current job activities. Especially my affinity with technical processes is important because I am able to quickly understand the essence of a highly complex integrated project. Subsequently, this is important for the direct impact on the operating costs of the clients. The main challenge consist of being continuously and actively involved in the processes, to (re)shape processes and to be in constant dialogue with the decision-makers for attaining for optimal results.

What are your future career plans? In what kind of job position would you like to grow within the next 5 to 10 years?
My determination to continuously steer my personal development is an important aspect of my motivation. Therefore, it is important for me that an employer provides learning opportunities to steer my personal development. In the organization of Flux Partners the further development of the resultants is embedded in the core values. For the development of the resultants the internal training program, the so-called Flux Academy, was established. Within this program I am able to accelerate my personal learning process at all stages in my career - from the introduction until becoming a partner at the company. Flux Academy is working together with several other companies which makes it possible to tailor the learning process for me.

In addition to this, within the Flux Academy, it is also possible to compose your personal learning program. Currently, I am focused on the side of the contractor. Within the nearest future I would like to combine this knowledge in order to focus more on the client side of a project. Within the current challenges in the AEC industry the combination of both sides is an unique value. Furthermore, within the building industry my expectation is that there are a lot of opportunities for tender management in the real estate sector. My goal is to create distinctiveness through the program of the NRP academy. This training is the stepping stone in becoming a specialist in the field of renovations and transformations. Subsequently, I want to specialize myself in project and process optimization in order to become a senior consultant within the next 5 years.

What is your opinion on the working method of Enginear and how have you experienced it?
I have perceived the working method of Enginear as very pleasant. The communication is clear and effective, the CV is personalized regarding the vacancy and there are in-depth sessions to define the core of your own abilities and skills.

In which way have you been introduced to Enginear?
I have been introduced to Enginear by fellow students. A few of my colleagues at university worked throughout their studies as a working student at Enginear. Their experiences contributed to my positive perception of the services that the company provides. Subsequently, I contacted Enginear in regards of these possibilities.

How have you perceived the guidance of Enginear throughout the job application procedures?
I have perceived the meetings, the career and motivations tests and the overall guidance throughout the application procedures as very positive. The guidance consisted of an in-depth interview with the experts of Enginear where the discussed topics included my company preferences, the current vacancies and my personal skills. This approach contributed largely to the optimal preparation for job interviews. In addition to this, after completing a job interview I was given a feedback in which both the perception of the employer and my personal perception of the interview were discussed. This contributed to the development of my soft skills and my understanding on how to present myself in front of people.

In which way did the selection of companies made by Enginear match with your own interests regarding your career development?
All applications and interviews that were introduced by Enginear were specifically tailored to my personal interests, sector of choice and my preference for the type of company. The dialogue with Enginear contributed to specify the company profiles more in depth. Subsequently, I was able to structure and organize my job interviews more efficiently and this resulted in a very cool job with a lot of opportunities in front of me.

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Flux Partners

Tim Maier
Advisor Tendermanagement

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