Informationsveranstaltung
28.03.2017, HIL E 6, 17.00 Uhr

Masterarbeiten und Masterprojektarbeiten am Institut für Bau- und Infrastrukturmanagement

Prof. Dr. B. Adey und Prof. Dr. G. Habert
Need infrastructure to supply city activities
Need infrastructure to supply city activities
Need infrastructure to supply city activities

Need to build infrastructure to protect us

Need to protect infrastructure

From our activities

PROPOSED: TYPICAL

PROPOSED: STORM

Aging

Natural hazards
Build infrastructure to supply goods

Operate infrastructure and buildings to sustain our activities

Manage waste generation at the end of life of products

Supply

Construction

Use

Operation

Treatment

End of Life
How can we promote sustainable practice for the construction and operation of our built environment?

Sustainable practice: environmentally, socially and economically relevant models

Built environment: Buildings and infrastructure

Promotion: Planning
Future projects for next semester
Projektarbeiten – FS 2017


- Der Arbeitsaufwand für eine Projektarbeit entspricht abgeleitet von den 9 dafür vorgesehenen ECTS-Kreditpunkten total ca. 225 bis 270 Arbeitsstunden.

Termine

- Festlegung der Themen im FS 2017
- Veröffentlichung der Themen durch das Studiensekretariat Ende April
- Das Anmeldetool wird Anfang Mai geöffnet
- Anmeldung durch die Studierenden bis Ende FS 2017 (02.06.2017)

- Ausgabe der Projektarbeit: 2. Semesterwoche HS 2017
- Abgabe der Projektarbeit: Letzte Semesterwoche HS 2017
Die Master-Arbeit bildet den Abschluss des Master-Studiums.

Die Studierenden sollen mit der Master-Arbeit ihre Fähigkeit, selbständig, strukturiert und wissenschaftlich zu arbeiten, unter Beweis stellen.

Es ist ein Thema aus einer der beiden gewählten Vertiefungen zu bearbeiten.

Die Master-Arbeit dauert 16 Wochen und wird mit einem schriftlichen Bericht und einer mündlichen Präsentation abgeschlossen.

Termine

- Festlegung der Themen im FS 2017
- Einreichen der Bestätigung auf dem Studiensekretariat: bis spätestens 02.06.2017 (Ende FS 2017)
- Ausgabe: 25.09.2017
- Abgabe: 29.01.2018
Fonds Bau und Infrastrukturmanagement -Förderungspreis der ETH Zürich

Ziel:

- hervorragende Master- und/oder Doktorarbeiten aus dem Bereich „Bau- und Infrastrukturmanagement“ mit einem Preis auszuzeichnen
- Interesse für Probleme im Bereich des Bau- und Infrastrukturmanagements bei der heranwachsenden Ingenieurgeneration wecken und die Innovationsfreudigkeit für Weiterentwicklung von Bau- und Infrastruktursystemen gefördert werden.

Ermittlung der Kandidaten:

- Durch die Bau und Infrastrukturmanagement-Förderungspreis Kuratorium

Preisverleihung:

- im Wert CHF 2‘000 CHF / 5‘000 CHF
„Helbling-Preis“

Ziel:
- Masterstudierende für die Themen des lebenszyklus-orientierten Planens, Bauens, Betreibens und Erhaltens von Infrastruktur mit einem besonderen Fokus auf Nachhaltigkeit zu begeistern
- ambitionierte Masterstudierende, die exzellente Leistungen im Bereich Bau- und Infrastrukturmanagement erbracht haben, auszuzeichnen

Ermittlung der Kandidaten:
- Eine Mindestnote von 5.5
- Eine Jury aus zwei Professoren des IBIs und einem Vertreter von Helbling Beratung+Bauplanung AG entscheidet über die Vergabe

Preisverleihung:
- Kann einmal pro Semester erfolgen
- in der Höhe von CHF 5‘000.–
<table>
<thead>
<tr>
<th>No.</th>
<th>Themes</th>
<th>Direct supervisor</th>
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<tbody>
<tr>
<td>1.0</td>
<td>Benchmark for building component to be used in LCA and LCC</td>
<td>Alexander Hollberg</td>
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<tr>
<td>2.0</td>
<td>Parametric LCA tool for BIM</td>
<td>Alexander Hollberg</td>
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<tr>
<td>3.0</td>
<td>Diversity in the built environment and biodiversity in the environmental systems</td>
<td>Sasha Cisar</td>
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<td>4.0</td>
<td>Radical innovation in concrete construction</td>
<td>Francesco Pittau</td>
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<td>5.0</td>
<td>Carbon capture in bio-based insulation and structures</td>
<td>Francesco Pittau</td>
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<tr>
<td>6.0</td>
<td>Scaling up clay concrete</td>
<td>Deepika Sundar</td>
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</table>
The Chair of Sustainable Construction intends to ground sustainability in all disciplines involved in the built environment and to promote appropriate application of construction materials during the entire life cycle of buildings and infrastructure.

“Sustainability is a value word and like all value words – Freedom, fairness, beauty, justice it is subjective, nearly impossible to define, but possible to sense (or to sense its absence), and vitally important.”

Donella Meadows

The fundamental work of the chair is therefore to translate this sensation into a framework of indicators that allow to implement sustainability in practice.
The Chair of Sustainable Construction intends to ground sustainability in all disciplines involved in the built environment and to promote appropriate application of construction materials during the entire life cycle of buildings and infrastructure.

More specifically, the research work is aligned on the following phase:

• The identification of the relevant parameters that influence the environmental impacts of buildings and infrastructures at the international, national and regional levels

• The quantification of the improvement potential for each specific materials/structure during the various stages of its life cycle

• The implementation of these sustainable practices throughout the proposition of innovative constructive techniques based on a detailed analysis of the technical, economic and socio-cultural situation
1.0 Benchmarks for Building Components to be used in LCA & LCC

- **Supervisors:** Alexander Hollberg
- **Goal:** Define typical values for GWP, primary energy and other environmental indicators to be used in early architectural design
- **Main Tasks:** Analysis of environmental indicators and costs of typical building components, development of ranges and average values, establishment of a catalogue with these values
- **Prerequisites:** basic knowledge of LCA
- **Students:** 1 student

![Box plots showing GWP for different building components](image)
2.0 Parametric LCA Tool for BIM

- **Supervisors:** Alexander Hollberg

- **Goal:** Develop of an easy-to-use tool for environmental analysis in early design stages using BIM.

- **Main Tasks:** Design a concept for the integration of LCA in BIM, develop a plug-in for Dynamo/Revit. Conduct a case study to prove the applicability

- **Prerequisites:** Experience with Revit & Dynamo

- **Students:** 1 Master project/thesis
Supervisors: Sasha Cisar (cisar@ibi.baug.ethz.ch)

Goal: To develop diversity indicators on the functioning of the built environment as a system.

Main Tasks: Concepts of diversity from different fields, e.g. complex systems, spatial economy and biology are considered to describe the built environment and its functioning. The concepts are mathematically modelled and applied to a case study (Zürich). The case study is then assessed and results are used to develop indicators on the different diversity concepts to allow a novel quantitative approach to define the functioning and sustainability of the built environment.

What someone will learn if they do the project: Model complex systems and learn a novel approach to assess the built environment.

What will be considered a successful project: Clearly defined and robust indicator based on clear reasoning and strong results.

Prerequisites: Mathematical modelling (Excel, Python), GIS, discussion with the supervisors before registration. Interest in sustainability of built environment.

3.0) Diversity of the Built Environment and Biodiversity in Environmental Systems
4.0 Radical innovation in concrete construction

**Supervisor:** F. Pittau ([pittau@ibi.baug.ethz.ch](mailto:pittau@ibi.baug.ethz.ch))

**Goal:** Cement production in Switzerland contributes to a significant share of the total national energy consumption. The project aims to evaluate alternative concrete solutions through a life cycle assessment (LCA) in order to significantly decrease the amount of energy needed during manufacturing, use, demolition and final disposal of the products.

A large scale analysis on Swiss building & infrastructure stock will be addressed in order to better understand the potential of the alternative concrete solutions in the reduction of carbon emissions and energy consumption.

**Information:** Max 1 student

**What you will learn in this project:**
LCA of concrete / Material flow analysis of the building stock.

**What will be considered a successful project:**
Identify contribution of innovative structure to Swiss energy strategy in term of MJ and CO2 savings.

**Prerequisites:** Matlab modelling, interest in sustainability

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A. Wood-concrete composite flooring structure; B. CFRP prestressed HPC facade beam; C. Ultra high performance concrete with synthetic fibers (UHPFRC).
5.0 Carbon capture in bio-based insulation and structures

**Supervisor:** F. Pittau ([pittau@ibi.baug.ethz.ch](mailto:pittau@ibi.baug.ethz.ch))

**Goal:** ZeroCarbon is a Swiss company that is developing Zoë, an innovative construction technique based on a modular preassembled system with timber, straw, earth and reeds.

The environmental benefit in terms of reduction of carbon emissions along the whole life cycle of a building is relatively high due to the intensive use of fast growing materials. The aim of this project is to evaluate through new LCA models the potential of carbon sequestration by promoting a large penetration of the product in the European market, both for new constructions and energy retrofit.

**Information:** Max 1 student

**What you will learn in this project:**
LCA of biobased material / Material flow analysis of the building stock.

**What will be considered a successful project:**
Quantify carbon storage in the built environment for Europe

**Prerequisites:** Matlab modelling, interest in sustainability
6.0 Scaling up the clay concrete

**Supervisor:** Deepika Sundar

**Goal:** Move the innovation out of the lab

**Main Tasks:** Identify critical barriers and find solutions to overcome them

**Prerequisites:** Knowledge on materials science

**AND knowledge on experimental work**

**Information:** Max 1 student
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<thead>
<tr>
<th>Principal Area of IM Process</th>
<th>No.</th>
<th>Direct Supervisor</th>
<th>Title</th>
<th>Master Projekt</th>
<th>Master Arbeit</th>
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<tr>
<td>Establish process</td>
<td>1.1</td>
<td>Clemens</td>
<td>Fault tree models for risk assessment of infrastructure objects</td>
<td>YES</td>
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<td>1.2</td>
<td>Jürgen</td>
<td>Lifelines</td>
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<td>1.3</td>
<td>Clemens</td>
<td>Usefulness of UAV for conducting visual inspections</td>
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<td>YES</td>
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<td>1.4</td>
<td>Jürgen</td>
<td>UAVs and infrared cameras for bridge inspection</td>
<td>YES</td>
<td>YES</td>
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<td>Determine intervention strategies and programs</td>
<td>2.1</td>
<td>Jürgen</td>
<td>Optimal intervention strategies for bridges</td>
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<td>YES</td>
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<td></td>
<td>2.2</td>
<td>Jürgen</td>
<td>Evaluating the use of hydrophobic treatments</td>
<td>YES</td>
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<td>2.3</td>
<td>Claudio</td>
<td>Estimating intervention, safety and availability costs due to a railway network</td>
<td>YES</td>
<td>YES</td>
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<td>2.4</td>
<td>Claudio</td>
<td>Determination of optimal building design approach using real options: application with real-data in London</td>
<td>YES</td>
<td>YES</td>
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<td>2.5</td>
<td>Claudio</td>
<td>Model the long-term uncertainty on infrastructures’ requirements of a pharmacological enterprise</td>
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<td>2.6</td>
<td>Claudio</td>
<td>Buried vs accessible pipes: long-term cost analysis considering the development of automated systems</td>
<td>NO</td>
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<td>Control process</td>
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<td>Clemens</td>
<td>Reasons for variations in spending on the operation and routine maintenance of roads</td>
<td>YES</td>
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<td>Project Planning and Management</td>
<td>4.1</td>
<td>Jeff</td>
<td>Construction site management</td>
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<td>Impleania</td>
<td>Machine learning in bridge management systems based on Bayesian network</td>
<td>NO</td>
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<td>4.3</td>
<td>Impleania</td>
<td>Knowledge-based engineering in infrastructure design</td>
<td>NO</td>
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<td>4.4</td>
<td>Impleania</td>
<td>Model based quality management for large infrastructure construction sites</td>
<td>YES</td>
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<td>Impleania</td>
<td>Model based site logistic and material flow control</td>
<td>YES</td>
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<td>4.6</td>
<td>Impleania</td>
<td>Model based scheduling optimization of large infrastructure projects</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
1.1 Fault tree models for risk assessment of infrastructure objects

- **Supervisors:** C. Kielhauser ([kielhauser@ibi.baug.ethz.ch](mailto:kielhauser@ibi.baug.ethz.ch))
  Prof. Dr. B.T. Adey

- **Goal:** to develop fault tree models to be used to conduct a failure risk analysis for infrastructure objects

- **Main Tasks:**
  - Fault Tree Model (FTA) development
  - Calculation, validation and discussion

- **What you will learn:**
  - How to conduct FTA and gain an in depth knowledge how infrastructure objects can provide an adequate level of service

- **What is a successful project?:**
  - The successful completion of a risk analysis of an infrastructure using fault trees

- **Prerequisites:** IM2: Evaluation tools
1.2 Lifelines

- **Supervisors:** J. Hackl ([hackl@ibi.baug.ethz.ch](mailto:hackl@ibi.baug.ethz.ch))
  Prof. Dr. B.T. Adey

- **Goal:** the identification and assessment of current lifelines in the Canton of Grisons, and their evaluation in regard to the open questions mentioned above.

- **Main Tasks:**
  - Identify Lifelines
  - Analyze Lifelines

- **What you will learn:**
  - how to conduct a network risk assessment, based on a real world example in the Canton of Grisons, and how this fits into the bigger picture of infrastructure management.

- **What is a successful project?**:
  - An analysis of the Lifelines in the Canton of Grisons

- **Prerequisites:** IM2: Evaluation tools
1.3 Usefulness of conducting visual inspections with UAVs

- **Supervisors:** C. Kielhauser (kielhauser@ibi.baug.ethz.ch), Prof. Dr. B.T. Adey
- **Goal:** to determine the feasibility of conducting visual inspections with UAVs
- **Main tasks:**
  - to propose a process to conduct an inspection of a pedestrian bridge using UAVs
  - to conduct the inspection, and
  - to compare the results in terms of costs and the accuracy of information obtained.

- **What you will learn:** How to
  - inspect bridges with and without an UAV
  - compare inspection processes with respect to accuracy and costs
- **What is a successful project?:** a clarification of the situations in which a drone would be useful to inspect bridges
- **Prerequisites:** IM1: Process,
  - inspections and drone training (to be done at institute)
  - discussion with the supervisors before registering
1.4 UAVs and infrared cameras for bridge inspection

- **Supervisors:** J. Hackl (hackl@ibi.baug.ethz.ch), C. Kielhauser (kielhauser@ibi.baug.ethz.ch), Prof. Dr. B.T. Adey
- **Goal:** to determine the feasibility of conducting inspections with UAVs and infrared cameras
- **Main tasks:**
  - to propose a process to be used to conduct an inspection of a pedestrian bridge using UAVs
  - to conduct the inspection, and
  - to compare the results in terms of costs and the accuracy of information obtained.
- **What you will learn:** How to
  - inspect bridges with an UAV
  - compare inspection processes with respect to accuracy and costs
- **What is a successful project?:** a clarification of the situations in which a drone would be useful to inspect bridges
2.1 Optimal intervention strategies for bridges

- **Supervisors:** J. Hackl ([hackl@ibi.baug.ethz.ch](mailto:hackl@ibi.baug.ethz.ch))
  Prof. Dr. B.T. Adey

- **Goal:** to determine an optimal intervention strategy for a bridge in the Canton of Grison taking into consideration risk.

- **Main Tasks:**
  - Conduct risk assessment
  - Calculation, validation and discussion

- **What you will learn:**
  - How to conduct a risk assessment,
  - How bridges provide adequate levels of service,
  - How to devise monitoring and intervention strategies taking into consideration risk

- **What is a successful project?:**
  - The development of an optimal intervention strategy

- **Prerequisites:** IM1: Process
2.2 Evaluating the use of hydrophobic treatments

- **Supervisors:** J. Hackl (hackl@ibi.baug.ethz.ch)
  Prof. Dr. B.T. Adey
- **Goals:**
  - to conduct a cost-benefit analysis of intervention strategies that include the use of hydrophobic treatments.
  - To propose a strategy of how the use of this technology should be evaluated
- **Main Tasks:**
  - To develop possible strategies of intervention and including hydrophic treatments, and
  - To devise a process to conduct a cost-benefit analysis of such strategies
- **What you will learn:**
  - about hydrophobic treatments and how this can be used for engineering structures, how to develop strategies for quality assurance, and how to monitor the success or adapt the strategies, respectively.
- **What is a successful project?:**
  - To develop a hydrophobic treatment strategy.
- **Prerequisites:** IMP
2.3 Estimating intervention, safety and availability costs due to a railway network

- **Supervisors:** Dr. C. Martani (martani@ibi.baug.ethz.ch), Prof. Dr. B.T. Adey
- **Goal:** develop a tool that will allow the estimation of the costs that a railway manager is likely to have in the future in terms of interventions to be executed, the safety costs and the availability costs
- **Main Tasks:** modelling their deterioration processes of infrastructures; estimating the effectiveness of the interventions on objects; determining a procedure to identify which intervention should and which should not be executed; and developing appropriate tool to support the procedure.
- **What you will learn:** How to estimate intervention costs, safety costs and availability costs for infrastructure objects over a defined period of time in a systematic and defensible way.
- **What is a successful project?** Clearly show the steps of the procedure and implement an application on a sample railway network.
- **Prerequisites:** IM1: Process, IM2: Evaluation tools
2.4 Determination of optimal building design approach using real options: application with real-data in London

- **Supervisors:** Dr. C. Martani (martani@ibi.baug.ethz.ch), Prof. Dr. B.T. Adey

- **Goal:** Determine the optimal design approach (i.e. with or without real options) for the groundfloor property units in downtown cities considering uncertainty on use transitions.

- **Main Tasks:**
  - modelling the uncertainty over variable parameters;
  - modify the existing model to include multiple sources of uncertainty;
  - run the simulations with the enhanced model;
  - compute the main impact of uncertainty on use transition on the long term.

- **What you will learn:** How to estimate the costs of interventions on buildings over a period, taking in consideration the impact of uncertain use transition uncertainty, given alternative design approaches (i.e. with or without real options)

- **What is a successful project?:** Developing further the established model to assess the business case of future option by (i) setting multiple variables, and (ii) considering more complex set of costs for use transitions than the ceiling only.

- **Prerequisites:** IM1: Process, IM2: Evaluation, discussion with Dr. Martani
2.5 Forecast the long-term infrastructure requirements of a complex enterprise

- **Supervisors:** Dr. C. Martani (martani@ibi.baug.ethz.ch), Prof. Dr. B.T. Adey
- **Goal:** Develop a model to forecast the long-term infrastructure requirements of a complex enterprise considering market trends and trend braking technological and regulatory developments.

- **Main Tasks:** modelling the relationship between production needs and infrastructure requirements; modelling the uncertainty over needs trend, modelling the uncertainty over production requirements; implement an existing Monte Carlo based model to simulate future evolution of infrastructure requirements.
- **What you will learn:** How to estimate the evolution of complex infrastructure requirements to implement effective future-proof design.
- **What is a successful project?:** Forecast a probability distribution over long-term infrastructure requirements of a complex enterprise, given the best current knowledge.
- **Prerequisites:** IM1: Process, IM2: Evaluation, discussion with Dr. Martani
2.6 Buried vs accessible pipes: long-term cost analysis considering the development of automated systems

- **Supervisors:** Dr. C. Martani (martani@ibi.baug.ethz.ch), Prof. Dr. B.T. Adey
- **Goal:** Define the cost effectiveness of accessible pipes over buried ones in the long-term, accounting for uncertain evolution of automated maintenance systems
- **Main Tasks:** implementing a costs analysis for the construction of buried and accessible pipes; develop an intervention program; compute long-term cost of interventions (including costs of traffic disruption) model the uncertainty over future tasks that can be conducted by in-pipe robots; compute the main impact of in-pipe robot evolution on the long term refurbishing costs.
- **What you will learn:** How to estimate the costs of interventions on infrastructures over a period, taking in consideration the impact of uncertain technological evolution.
- **What is a successful project?:** Demonstrate on an assigned case study the impact of in-pipe robot on the design and management of new pipes in urban areas.
- **Prerequisites:** IM1: Process, IM2: Evaluation, discussion with Dr. Martani
3.1 Reasons for variations in spending on the operation and routine maintenance of roads

- **Supervisors:** C. Kielhauser (kielhauser@ibi.baug.ethz.ch), Prof. Dr. B.T. Adey
- **Goal:** To explore the reasons for the different costs to operate and routine maintenance of community roads
- **Main Tasks:**
  - Evaluate the data from 45 communities to identify relationships between the numerous factors that affect cost
  - Propose a process to regular conduct such an analysis
- **What you will learn:**
  - The factors that affect the cost of the operation and maintenance of roads
- **What is a successful project?:** demonstration of the identifying factors and main reasons driving cost for available data
- **Prerequisites:** IM1: Process, IM2: Evaluation tools
4.1 Construction site management

- **Supervisor:** J. Hoffman ([hoffman@ibi.baug.ethz.ch](mailto:hoffman@ibi.baug.ethz.ch))

- **Goal:** To evaluate key processes and elements of Construction Site Management and determine which are the most effective

- **Main Tasks:**
  - Survey and interview several major site contractors with on-going operations and assess and measure their effectiveness
  - Prepare a matrix evaluation comparing and contrasting the effectiveness of the key processes and determine which site has the best approach

- **What you will learn:** How the key processes of site management are implemented and measured and how effective they are

- **What is a successful project?:** Demonstration of the effectiveness of key Construction Site Management processes and show how to measure the effectiveness

**Prerequisites:** None
4.2 Machine learning in bridge management systems based on Bayesian network

- **Supervisors:** Dr. B.T. Adey & Implenia BIM – D. Singer (dominic.singer@implenia.com)
- **Goal:** Develop a tool for probabilistic reasoning in a bridge management system
- **Main Tasks:**
  - Define input & output variables
  - Investigate probabilistic reasoning algorithms
  - Implement algorithms & proof approach based on test data
- **What you will learn:** How to develop a tool for machine learning in bridge management systems.
- **What is a successful project?:** Show a working prototype of the implemented system.
- **Prerequisites:** IM1: Requirement Definitions, IM2: Standards & Process, IM3: Evaluation tools
4.3 Knowledge-based engineering in infrastructure design

- **Supervisors:** Dr. B.T. Adey & Implenia BIM – D. Singer (dominic.singer@implenia.com)
- **Goal:** Develop a rule engine for capture and reuse of engineering knowledge
- **Main Tasks:**
  - Requirement definition for rule engine
  - Investigation of rule engine frameworks
  - Definition of domain and rule set for selected application field
  - Implementation of a prototype rule engine & UI
- **What you will learn:** Developing an effective rule engine to solve complex task in civil engineering based on previous captured knowledge
- **What is a successful project?:** A working prototype of a rule engine with useful UI for the selected application field
- **Prerequisites:** IM1: Requirement Definitions, IM2: Standards & Process, IM3: Evaluation tools
4.4 Model based quality management for large infrastructure construction sites

- **Supervisors:** Dr. B.T. Adey & Implenia BIM – D. Singer (dominic.singer@implenia.com)
- **Goal:** Develop a framework for model based quality management for large infrastructure construction sites
- **Main Tasks:**
  - Investigate processes & forms typically used in quality management on site
  - Define framework requirements & schema fitting the investigation results
  - Implement a html based plugin for a BIM model viewer for selected processes
- **What you will learn:** How to develop an effective model based management tool for construction site quality management.
- **What is a successful project?**
  - Show a prototype for an end-to-end solution for selected processes
- **Prerequisites:** IM1: Requirement Definitions, IM2: Standards & Process, IM3: Evaluation tools
4.5 Model based site logistic and material flow control

- **Supervisors:** Dr. B.T. Adey & Implenia BIM – T. Grob (tobias.grob@implenia.com)
- **Goal:** Develop a prototype for model based logistic and material flow control
- **Main Tasks:**
  - Investigate latest technologies and systems for site logistic and material flow
  - Develop a concept of an integrated solution between BIM and investigated systems
  - Implement a prototype in state of the art software solutions
- **What you will learn:**
  - How to develop an effective model based logistic and material management from concept to prototype
- **What is a successful project?:**
  - Show a prototype for a test case project
- **Prerequisites:**
4.6 Model based scheduling optimization of large infrastructure projects

- **Supervisors:** Dr. B.T. Adey & Implenia BIM – P. Knorr (patrick.knorr@implenia.com)

- **Goal:** Develop a framework for model based (4D) scheduling optimization of large infrastructure projects

- **Main Tasks:**
  - Requirement Definition for 3D Models and Time-Schedules to get an automated linking process
  - Develop and implement 4D Standards for 3D Modeling & Time-Scheduling software
  - Evaluation tool and define process to support the procedure

- **What you will learn:** Developing an effective steering tool by standardization and automation of construction working processes.

- **What is a successful project?:** To show the requirements and procedure of an automated connection process for 4D Simulation on infrastructure sample project.

- **Prerequisites:** IM1: Requirement Definitions, IM2: Standards & Process, IM3: Evaluation tools