Advanced Construction and Building Technology

Automation, Robotics, Services
Master of Science M.Sc.

Content

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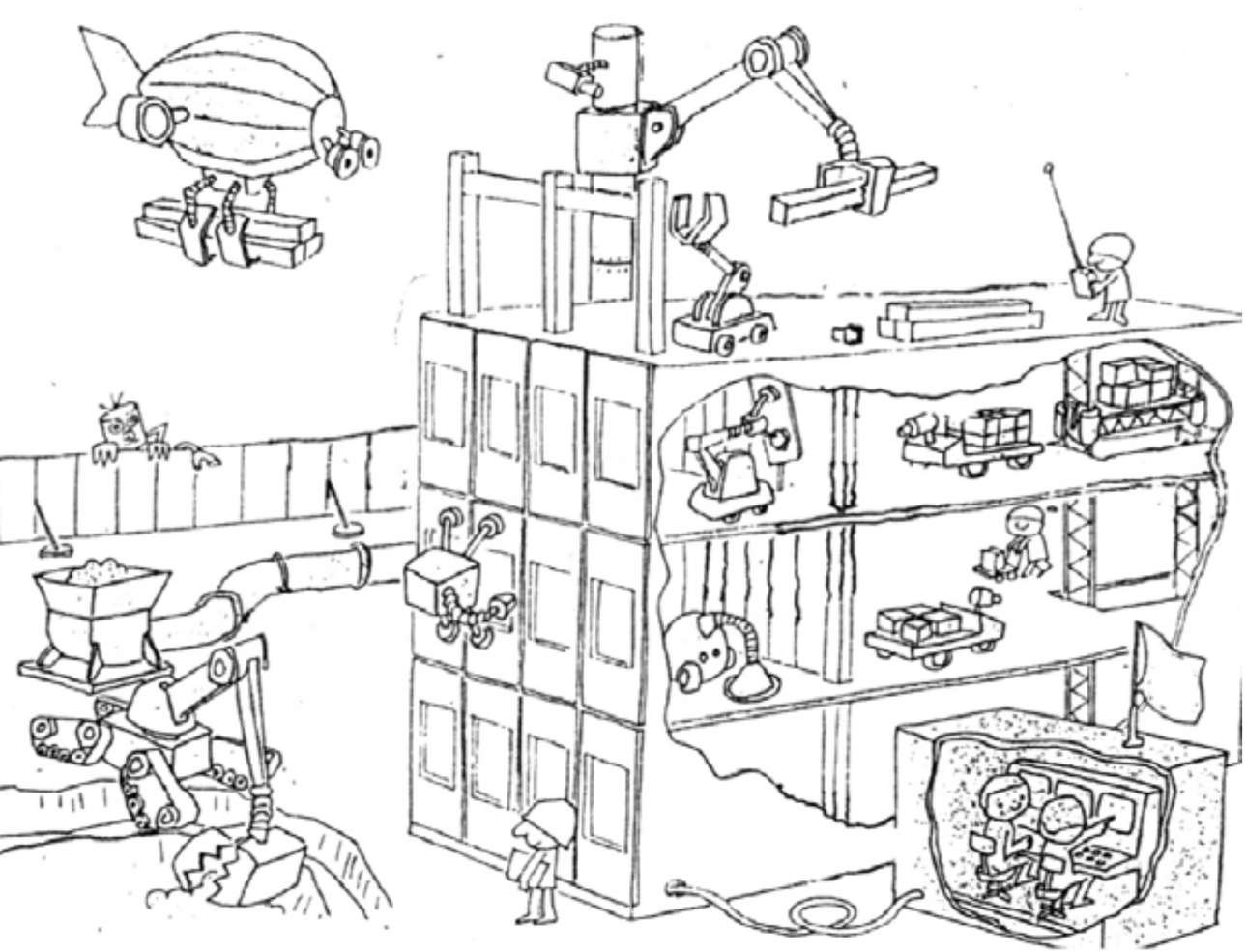


Introduction

„Nothing is permanent except change“ *Heinrich Heine*

Frontier engineering sciences increasingly breed innovations. These innovations are driven and amplified by globalization, closed loop resource utilization, transformation of technological potentials, environmental and demografic challenges.

Global competition brought inflationary labour capacities resulting in decreasing labour costs. But to achieve welfare and culture any society needs sufficient income. To provide sufficient income for creating wealth and culture one has to be efficient. “One has to be good to be expensive”: High income is based on high tech, if you can’t just sell natural resources. The demographic change requires even more efficient socio-economical and socio-technical processes to be affordable.

The notion of “Made in Germany” is internationally famous for its cars, machines, industrial facilities, and medical and environmental technologies. Its success is based on research and innovation, stressing that future wealth can only be generated by innovational leaps and radically new types of value design and engineering. Half of total investment is allocated in built environment, infrastructure, and facilities, signifying the strategic importance of the construction sector.

The Master of Science in *Advanced Construction and Building Technology* is tailored to offer solutions to the above mentioned challenges. The future construction sector will expand to new business fields by absorbing advanced technologies from various disciplines. Its success will depend on its innovation leap ability of the complete value chain of the artefactual engineering and built environment by enbedding ICT, automation, robotics and services. This approach will create new markets, qualifications, skills and professions.

Even though architecture and construction are the focal points of this Master Course, it crosslinks considerably to other disciplines and faculties such as potential psycho-social health transformation of future societies and incubates it into augmented skill formation for socio-technical qualifications of next generation engineers.

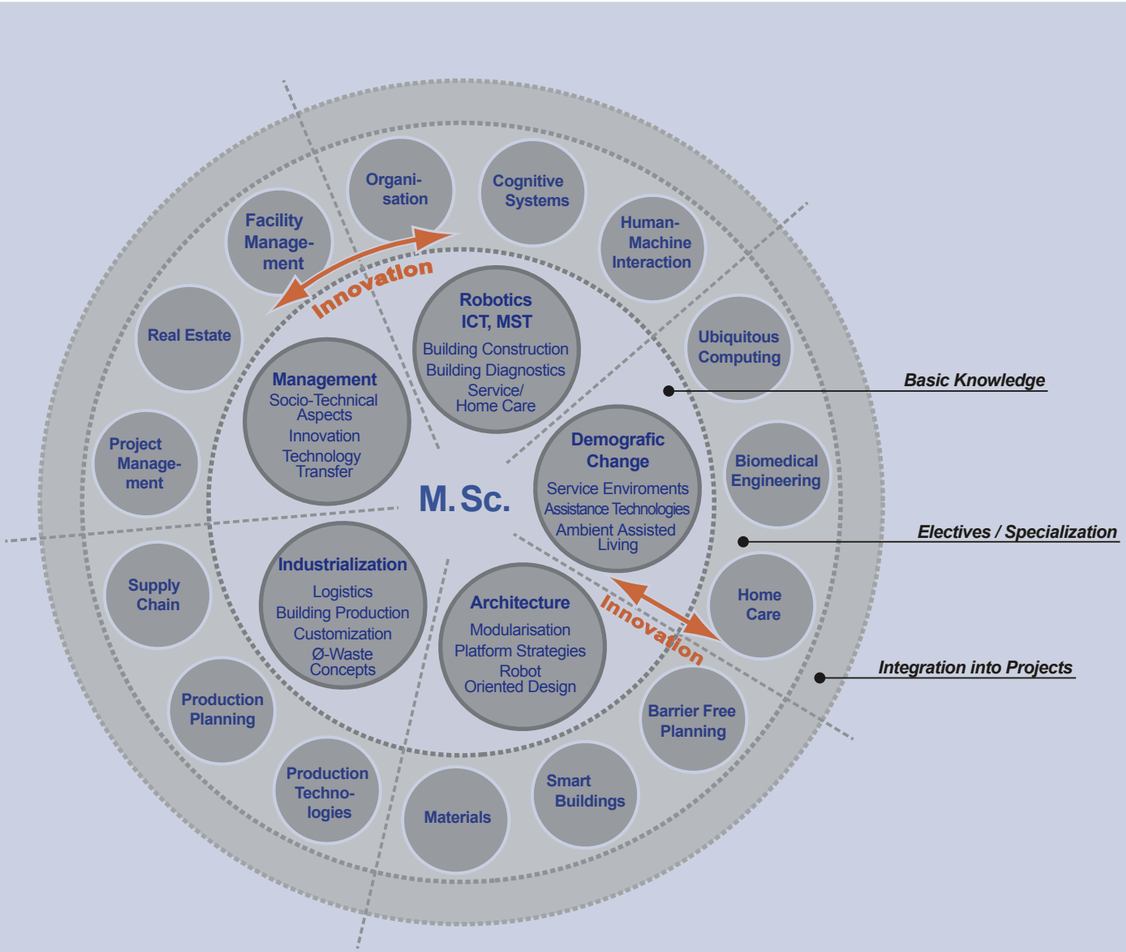
Future socio-ecologic engineers will be prepared to tackle yet unknown challenges by designing solutions for future technology, economy, ecology and society. They apply frontier science competence and define crossdisciplinary domains permanently. The Master Course of *Advanced Construction and Building Technology* can be considered as an incubator for strategic design and development of continuous improvement and innovation for life long learning.

The Master Course at a Glance

Name of the Course:	**Advanced Construction and Building Technology**
Type of Degree awarded:	**M. Sc.**
Hosting Faculty:	**Faculty of Architecture**
Leading Chair:	**Chair for Building Realization and Robotics Prof. Prof. h.c./SRSTU Dr.-Ing./Univ. Tokio T. Bock**
Advising Chair:	**Prof. Dipl.-Ing. F. Musso**
Course Type:	**Full time**
Duration:	**4 Semesters**
Credits:	**120 ECTS**
Language used:	**Englisch**
Tuition:	**State of Bavaria standard tuition**
Starting Date:	**Fall/winter term 20011/12**
Interdisciplinatity:	**Computer Science, Electrical Engineering, Mechanical Engineering, Economics, Medicine, Civil Engineering**
Internationality:	**Asia, Americas, Europe**
Uniqueness:	**Innovation by cross disciplinary teaching and research interaction of 7 disciplines for frontier engineering sciences**

The implementation of this Master Course is subject to confirmation by the Bayerisches Staatsministerium für Wissenschaft, Forschung und Kunst, expected until Ferurary 2011

Topics of the Master Course



The topics of this Course aim at expanding the professional core competence in construction while responding to changing technological, social and ecological circumstances:

- **New technologies, processes and strategies for designing and producing of buildings**

  Faster return on investment through implementation of rapid project delivery and zero defect construction by robot oriented design and automated construction systems.

  The students who take the Master Course in *Advanced Construction and Building Technology* acquire a complementary knowledge in design, production, assembly, logistics, and management, emphasizing on information, communication, automation, robotics, mechatronics, and service technologies.

- **Integration of intelligent systems in daily life and environments**

  Microsystems and microelectronics increasingly form a part of our everyday's life. Its miniaturization allows its incorporation in domestic systems and appliances. Simultaneously we want to deal with a standardized and compatible network of synergetic subsystems rather than detached island solutions.

  On top of conventional construction planning, engineering, and management, these new technologies require an even more complex project management capacity for interfacing the various frontier science disciplines.

  In order to incorporate mechatronic technologies in intelligent living environments the students acquire basic knowledge of these advanced ICT.

- **Life cycle management, value engineering and design, innovation**

  The Master Course follows a holistic approach: The deployment of new technologies is considered in each phase of life cycle originating in marketing and project development till re-use and disassembly. Due to the elementary approach of open systems and subsystems, the life cycle of a building can be extended by upgrading or repairing one element without destroying the whole system. This approach is common in aero space industries. In construction industry a secondary ressource utilization helps increasing the total resource efficiency of building performance.

  The students apply management of technology, processes and projects, its technological interdependencies and socio-economical boundary constraints. By studying intercultural cases in design, production, and management, the students get acquainted to crosscultural experiences for future professional international career.

Course Modules and Details

Advanced Construction and Building Technology
M.Sc.

1. SEMESTER	2. SEMESTER	3. SEMESTER	4. SEMESTER
Basic Knowledge	Projects, Elective Courses	Projects, Elective Courses	Master Thesis
MODUL P 01 pP Preproject Ambient Innovation Robotics AR 6 ECTS	MODUL P 06 iP1 Integrated Project 1 AR 9 ECTS	MODUL P 10 iP2 Integrated Project 2 AR 9 ECTS	MODUL P 13 MTh Master Thesis 30 ECTS
MODUL P 02 Robo Robotics Knoll (Burschka) 6 ECTS	MODUL P 07 MOI Methodology of Industrialization Musso / Bock 6 ECTS	MODUL P 11 Inc Incubator Project Implementation $(br)^2$ Laboratory Bock (Ellmann) 6 ECTS	
MODUL P 03 ARC Automation & Robotics in Construction Bock 6 ECTS	MODUL P 08 USE Ubiquitous Systems Engineering Kranz / Knoll (Burschka) 6 ECTS	MODUL W 12 TUM Free choice from interfac. TUM Course Catalog in coordination with mentors AR + TUM 15 ECTS	
MODUL P 04 BSP Building System Performance Bock (Linner) 6 ECTS	MODUL W 09 TUM Free choice from interfac. TUM Course Catalog in coordination with mentors AR + TUM 9 ECTS		
MODUL P 05 FEM Frontier Engineering & Management Zimmermann (Eber) / Bock 6 ECTS			
Σ 30 ECTS	Σ 30 ECTS	Σ 30 ECTS	Σ 30 ECTS

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Module P 01 pP: Preproject
Ambient Innovation Robotics

Short Description

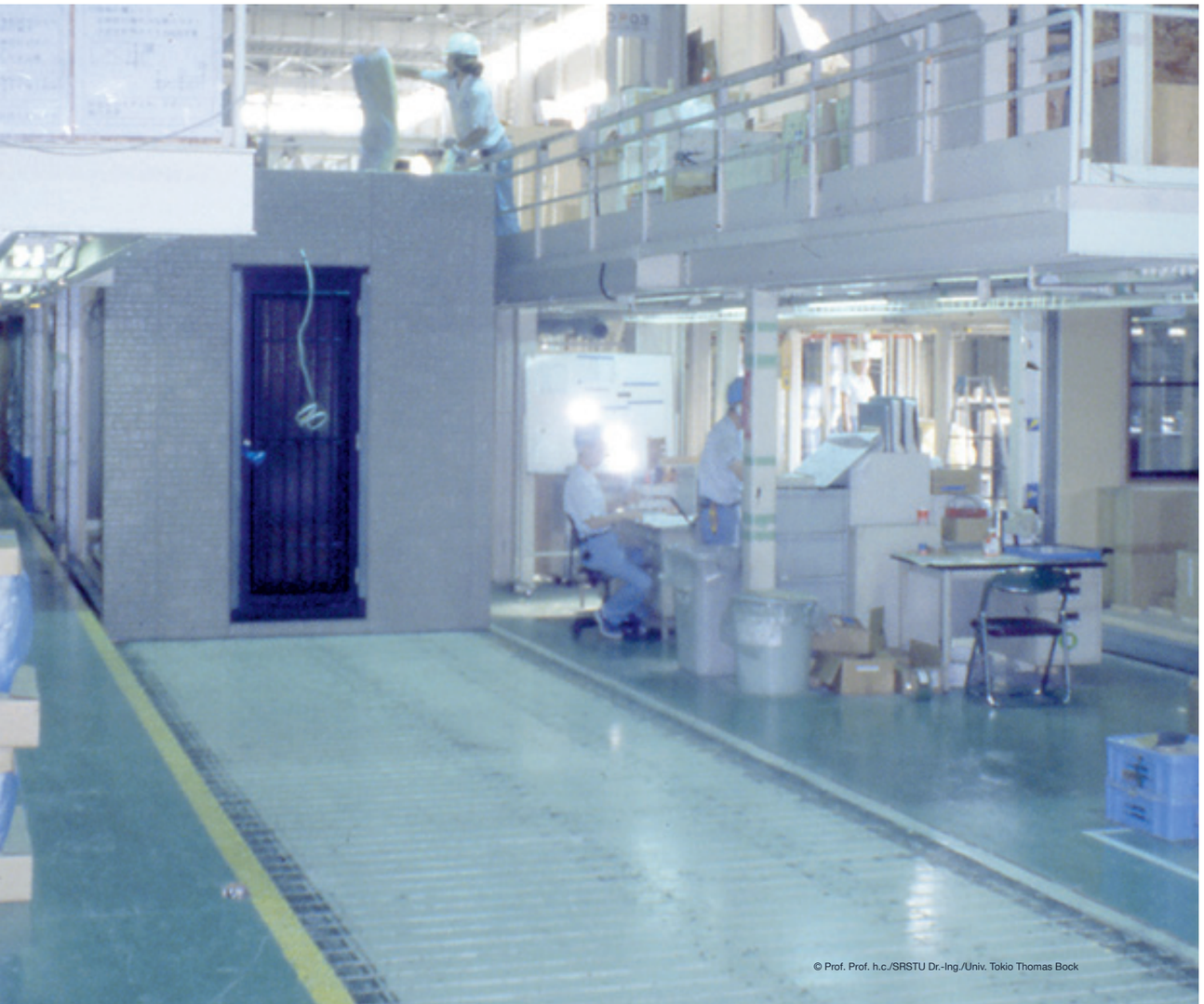
In “Ambient Innovation Robotics” problems are systematically solved by analysis methodology. It is a simulation project in which the participants learn to develop solutions so as to apply basic knowledge for further expansion and specialization. The students learn to blend knowledge from various disciplines by organizing its synthesis. General knowledge acquisition strategies as well as individual methods may be applied in order to uncover and experience one’s personal weak and strong points. It is the aim to empower the participants for lifelong learning and designing one’s own and proper comprehension.

Content

The project deals with programming, development and design of innovative processes, production and products to ameliorate built environment. New life style, demographic, and sustainability trends ask for unconventional delivery of building systems and subsystems and their optimization during product life transformation. We consider not just the hardware, but also the software of built environments and its subsystems such as structure (primary system), interior walls (secondary systems), HVAC and building control systems (tertiary system). The varying life cycles of building sub systems are decided by its economical life cycle and by choice of materiality, system geometry, system functionality and physiology. The performance specifications of such components follow strategies of non construction industries such as space craft, air craft, shipbuilding, car and computer industry, or any industry that uses advanced strategies of industrialization. We analyze best practice case studies from any nonmanufacturing or manufacturing industry in order to solve future problems related to technology, environment, entrepreneurship, usability, serviceability and demographic change.

Overview

- *Language:*
  Englisch
- *Credits:*
  6 ECTS
- *Type of Exam*
  Intermediate presentation + final presentation (continuous evaluation) + final homework
- *Duration of Exam:*
  Continuous evaluation
- *Intermediate Homework:*
  No
- *Final Homework:*
  Yes
- *Intermediate Presentation / Final Presentation / Defense:*
  Yes
- *Interwiew:*
  Yes



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Module P 03 ARC: Automation & Robotics in Construction
Thematic Field 1: Industrialized Customization in Architecture

Short Description

The significance of industrialized production is gaining momentum originating from the level of materials, parts, and pieces culminating in the final assembly of whole structures and buildings. Early 50ies and 60ies industrialization was based on mass production, from the 1970ies on quality was the focus and modern manufacturing technologies such as precut technologies allow since the 80ies to customize the production of buildings and its components in order to respond to esthetic demands of a unique architectural design: The former schism between rationalized mass production and individual character of buildings has been overcome. As soon as the customer has designed his dream house using VR technologies the Toyota production system manufactures just in time and in sequence the necessary sub modules of the house. Even though each house is automatically produced, it has its own characteristic design. Industrially produced houses are affordable, customized and rapidly available. By applying modern manufacturing technologies we can improve the efficiency of resources to achieve a sustainable economy. Major Japanese house makers have already introduced zero waste concepts in housing

Content

- Prefabrication of linear, 2-dimensional and 3-dimensional products and elements.
- Industrialized manufacturing for the production of steel frames space frames, wood and timber frames and space frames, precast concrete columns, beams, girders, elements and spatial units, masonry wall, floor and roof elements
- Basics of flexible manufacturing systems
- Assembly process and rapid joining systems for on-site construction
- Systematic and prefabricated installation systems
- Ø-Waste-factories
- Systematic disassembly: reverse logistics, re-customization

Overview

- *Language:*
  Englisch
- *Credits:*
  6 ECTS
  for both topics
  of Module ARC
- *Type of Exam:*
  Intermediate presentation +
  final presentation
  (continuous evaluation) +
  final homework
- *Duration of Exam:*
  Continuous Evaluation
- *Intermediate Homework:*
  No
- *Final Homework:*
  Yes
- *Intermediate Presentation / Final Presentation / Defense:*
  Yes
- *Interwiew:*
  Yes

Module P 03 ARC: Automation & Robotics in Construction
Thematic Field 2: Logistics/Site Automation & Robotics


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Short Description

In many industrial sectors we commonly use information and communication technologies, automation, and robotics. Those countries that are characterized by high labor cost, labor shortage, adverse working conditions, high occupational disease, accident and death rates, excessive claim management, construction time/cost overrun, limited immigration, lack of natural resources, high land prices, high interest rates, etc use advanced manufacturing technologies for staying competitive. In construction most civil engineering sites progressed from mechanization to automation such as tunneling, dam, bridge, and road construction. Since early 1980ies first construction robots had been tested and applied at selected sites. Since early 1990ies automated building construction sites had been tested and implemented. In the first decade of 21st century humanoid robots and exoskeletons were developed and tested on site.

The first decade of 21st century ended with the first automated disassembly of 2 high rise buildings in center Tokyo. The systematic deconstruction achieved a 90% resource efficiency which will be paramount for solving future challenges on limited resources on an ever crowded planet. The second decade starts with the first automated and robotic site in South Korea. All in all, over 100 construction robots and 20 automated sites were running in Japan, Singapore, South Korea, and Sweden.

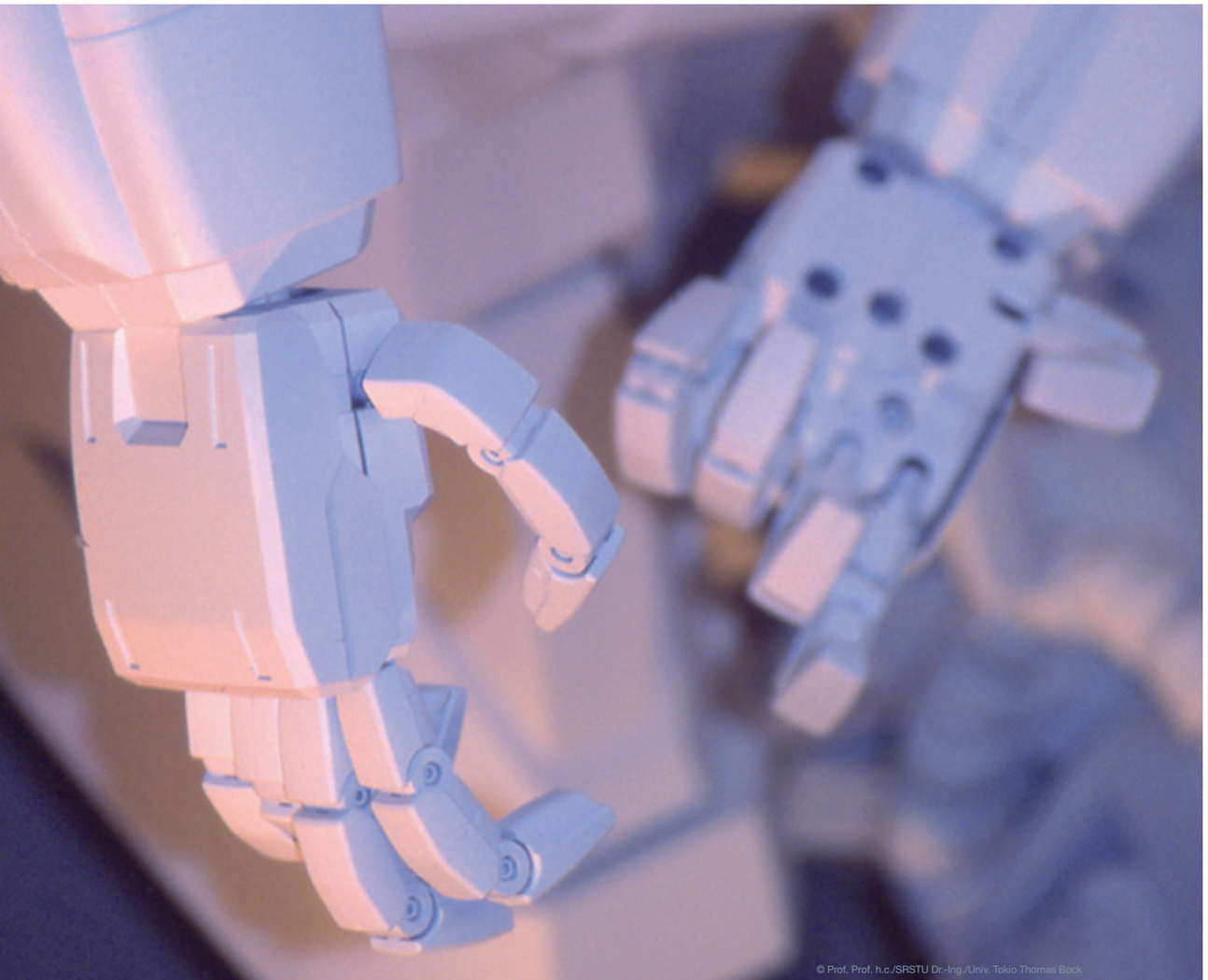
Content

- Logistics, process control off-site / on-site
- Industrial construction logistics land, sea, air
- Logistics and ICT-based enterprise resource planning
- Innovative methods of construction logistics (e.g. RFID)
- Overview construction automation and robotics systems (on-site)
- Automated and robotic construction robot systems
- Automated sites, systems und typologies
- Modular production systems
- Man-machine-cooperation on-site, „Exoskeleton“-systems
- Sustainable sites: Automated deconstruction, urban mining, and recycling

Overview

- *Language:*
  Englisch
- *Credits:*
  6 ECTS
  for both topics
  of Module ARC
- *Type of Exam:*
  Intermediate presentation +
  final presentation
  (continuous evaluation) +
  final homework
- *Duration of Exam:*
  Continuous Evaluation
- *Intermediate Homework:*
  No
- *Final Homework:*
  Yes
- *Intermediate Presentation / Final Presentation / Defense:*
  Yes
- *Interwiew:*
  Yes

Module P 04 BSP: Building System Performance
Thematic Field 1: Service Science & Robotics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Short Description

Buildings are characterized by a long life cycle. This fact is not just economically and ecologically significant, but also relevant for the quality of life of its occupants. In order to generate added value of future real estate, a forward looking design is required so as to ensure numerous high performing living environments.

Similar as the increasing share of electronics in cars we will experience more ICT, microelectronics, and microelectronic or mechatronic systems for future life adaptable architecture.

Future buildings will provide more services. Specialists like Bill Gates predict that ICT based services will enhance our daily life and increase its market share as the personal computer did in the 1990ies. The success of future real estate will depend on the blending of passive architectural with active microsystem technological functionalities.

Content

Basics:

- ICT and ambient assisted living, microsystem technologies, mechatronics, robotics all in daily life, cross disciplinary knowledge
- Overview AAL-Application scenarios and AAL-Products/Assist systems
- Demographic design scenarios for 50+ customers

Living Environment Design:

- Passive systems: Barrier free, accessibility, universal design
- Active high-tech system categories: Home care, social interaction
- Health and wellness
- Information and learning
- Professional world, mobility
- Technology assisted care and assist systems in Japan
- Application typologies for assist-/service systems: Body area, house area, town area, smart city/e-city
- Service robot systems: Cleaning, safety, maintenance, diagnosis, assistance, home care

Overview

- *Language:*
  Englisch
- *Credits:*
  6 ECTS
  for both topics
  of Module BSP
- *Type of Exam:*
  Intermediate presentation +
  final presentation
  (continuous evaluation) +
  final homework
- *Duration of Exam:*
  Continuous Evaluation
- *Intermediate Homework:*
  No
- *Final Homework:*
  Yes
- *Intermediate Presentation / Final Presentation / Defense:*
  Yes
- *Interwiew:*
  Yes

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Module P 04 BSP: Building System Performance
Thematic Field 2: Demographic Change Design

Short Description

Macroeconomic systems are changing due to socio technical functions in relation to primary, secondary or tertiary working system. Technological innovations grow only under certain socio economic conditions. Vice versa technological innovations may cause changing social structures.

Technology transfer strategies from other disciplines, industries, sectors, or cultures may advance innovation in the construction sector as long as one considers the soft and social factors of technology transplantation in the new embedded environment.

These socio technical aspects are decisive for the development of life support systems or ambient assisted living of any built environment:

What will be the future life style, how will our cities look if we face demographic changes, migration, globalization, and environmental disasters?

How can we profit from synergies between technology, social structures, and economical systems?

How can we design customized high-tech living environments for accessibility, health care, and usability and ensure its future constructible and buildable adaptation or remodeling-renovation-recycling?

Content

- Demographic change, migration and globalization, background information, social effects
- Life – age, living standard and life style-/city visions
- Individual life style/individual domestic care, high-tech assist systems: Ambient Assisted Living
- Implementation of high-tech assist systems in the house industry: Modularity, flexibility, industrialization, „Open-Building“-approach
- Remodeling, reconfiguration, renovation, rehabilitation, recycling, disassembly by flexible, modular systems („Un-Plug“, „Re-Play“)
- Customization/personalization of assistive living space (refer to Module P 03 ARC, Thematic Field 1: Industrialized Customization in Architecture)

Overview

- *Language:* **Englisch**
- *Credits:* **6 ECTS for both topics of Module ARC**
- *Type of Exam:* **Intermediate presentation + final presentation (continuous evaluation) + final homework**
- *Duration of Exam:* **Continuous Evaluation**
- *Intermediate Homework:* **No**
- *Final Homework:* **Yes**
- *Intermediate Presentation / Final Presentation / Defense:* **Yes**
- *Interwiew:* **Yes**

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Module P 05 FEM: Frontier Engineering & Management
Thematic Field 2: Robot Oriented Design

Short Description

Since early times mankind invented tools in order to save time and efforts. Those new tools resulted in new processes and products. The steam engine triggered an industrial revolution in factories and mobility. The automobile unfolded its customizable mobility when it became more than just a horse carriage fitted with a combustion engine and when it became a ubiquitous vehicle through the road network. When the first construction robots were developed in Japan, they copied typical tasks of construction workers, but the advantage of construction robots was unfolded not before the perimeters in construction such as management, planning, design, detailing, logistics, training, education, quality, attitude, skills, formation, business relations, etc. adjusted to the new tool of the construction robot. The notion of Robot Oriented Design (ROD) supports not only the efficient use of construction robots, but also helps to improve the productivity, efficiency, and quality of conventional construction methods.

Content

The Module ROD is dealing with the transformation of the construction sector by robotics and other new technologies. The goal is a new kind of design approach applying methods, strategies such as complex relations between programming, conception, implementing, standardizing, modularization, industrialization, assembly, disassembly, reconfiguration, upgrading, etc. of built environment. ROD aims at increasing the resource efficiency and performance of any construction or building product or process through the whole life cycle by advanced robotics. In order to achieve this new management, production, and product strategies are required.

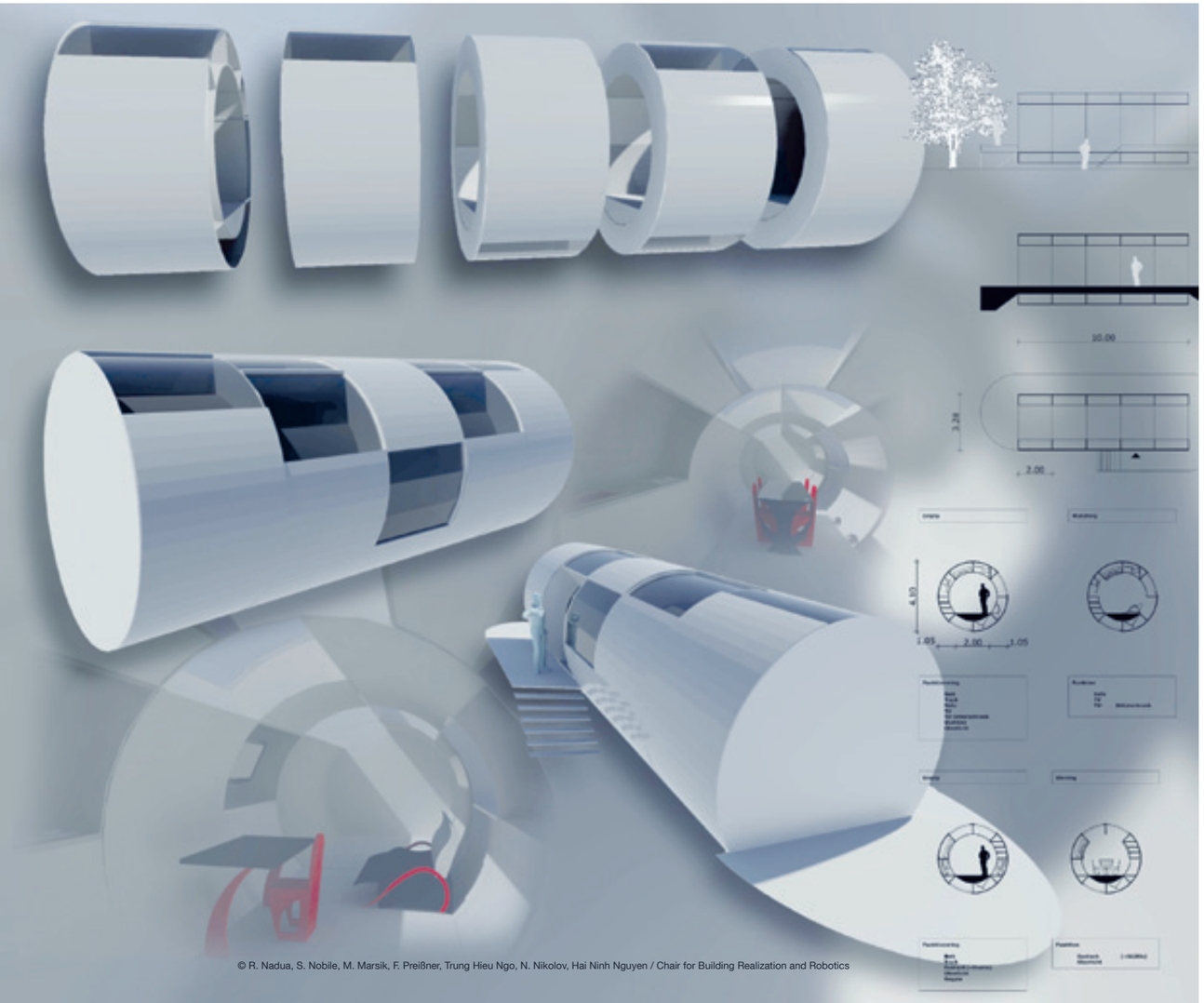
Automation and robot oriented design (Processes, manufacturing):

- History, standardization, robotics und automation system
- Robotics und automation system in construction: State of the art and future trends
- Automation and robot oriented design of building systems and subsystems, compliant design
- Design for assembly, design for logistics

Overview

- *Language:*
  Englisch
- *Credits:*
  6 ECTS
  for both topics
  of the Module FEM
- *Type of Exam:*
  Exam +
  Homework
- *Duration of Exam:*
  90 min
  for both topics
  of the Module FEM
- *Intermediate Homework:*
  Yes
- *Final Homework:*
  No
- *Intermediate Presentation / Final Presentation / Defense:*
  No
- *Interview:*
  Yes

Module P 06 iP1/P 10 iP2: Integrated Project 1/2



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Short Description

The analysis of the industrial development and its prognoses for the next 30 years shows that new interdisciplinary technologies and manufacturing processes will change the sector of architecture and civil engineering fundamentally. The master course Advanced Construction and Building Technology seizes these developments and approaches them with an orientation towards a distinctly practice-related paradigm: The concrete applied approach goes hand in hand with faculty-comprehensive contents and with the focus on creativity-enhancing strategies as a precondition for a succeeding synthesis of analytically purchased knowledge.

Consultants like McKinsey also emphasize the need of study contents, which are oriented towards the individual tendencies of the students and which offer the possibilities of dealing with complex technologies and issues in a creative way. Emphatically advocated is the possibility of students developing their own innovations during their studies with the aid of professional consulting.

The project modules aim at developing socio technical systems.

Content

The project seminars P 06 iP1 and P 10 iP2 deal with the development of specific buildings, innovative building types, construction systems, construction system typologies, unitized finishing and installation systems, infrastructure systems, manufacturing processes, and assistive, flexible high-tech life surroundings and residential concepts. First we analyze case studies and advanced application scenarios of construction automation and robotics and second the specific use of advanced technologies in construction, material and technology. The reference framework is task specific and can range from the urban large-scale context to the personal, individual scale. For this elaboration of the solution within the scope of the project seminar the students are supposed to find a thematic priority during the 2nd semester and to consider the thematic coherences, complementarities and synergies from the compulsory subjects in the 3rd semester. With this P 10 iP2 requires even more than P 06 iP1 the integration of different aspects into a conclusive overall concept. The elaboration happens according to the task in terms of planning approaches, descriptions, drawings and models. The project task will be handed out at the beginning of the semester and is oriented towards the solution of present architectural, social, and technological issues.

Overview

- *Language:*
  Englisch
- *Credits:*
  9 ECTS
  for each P 06 iP1 und P 10 iP2
- *Type of Exam*
  Intermediate presentation + final presentation (continuous evaluation) + final homework
- *Duration of Exam:*
  Continuous evaluation
- *Intermediate Homework:*
  No
- *Final Homework:*
  Yes
- *Intermediate Presentation / Final Presentation / Defense:*
  Yes
- *Interwiew:*
  Yes

Elective Courses

Thematic Field 1
Informatica & Robotics

- **Grid Computing ***
- **Advanced Practical Course in the Field of Technical ComputerScience ***
  Prof. Bode, IN
- **Project Organisation and Management in Software Engineering ***
  Prof. Brügge, IN
- **Fundamental Algorithms ***
- **Design Patterns in Software Engineering ***
  Prof. Bungartz, IN
- **Environmental Modeling and Decision Support Systems ***
  Prof. Struss, IN
- **Principles of Computer Vision ***
- **Introduction into the digital Signal Processing ***
- **Real Time Systems ***
- **Cognitive Systems ***
  Prof. Knoll, IN
- **Embedded Systems ***
  Prof. Chakraborty, EI
- **Human-Machine-Communication ***
- **Pattern Recognition ***
  Prof. Rigoll, EI
- **Microelectronics in the Mechatronics ***
  Dr. Tille, EI

Thematic Field 2
Automation & Industrial Manufacturing

- **Industrial Safety and Operating Safety**
  Prof. Einhaus, MW
- **Projectmanagement for Engineers**
  Prof. Göttel, MW
- **CAD und Machine Design I and II**
- **Flow of Material and Logistics**
- **Logistik**
- **Simulation of Logistics Systems**
  Prof. Günthner, MW
- **Assembly, Handling, and Industrial Robots**
- **Plant Planning**
- **Methods of Corporate Management**
- **Industrial Robots Internship**
  Prof. Reinhart, MW
- **Industrial Solftware Development for Engineers**
- **Model Building and Simulation**
- **Internship Automation Technology**
- **Internship Simulation Technology**
  Prof. Vogel-Heuser, MW
- **Quality Management**
- **Manufacturing Technologies**
- **Manufacturing Technologies Tutorial**
- **Joining Technology**
  Prof. Zäh, MW
- **Fuel Cells in Energy Technology ***
- **Principles of Energy Conversion ***
  Prof. Stimming, PH

Thematic Field 3
Home Care & Medicine Technology

- **Biomedical Engineering 1**
- **Biomedical Engineering 2**
- **Advanced Seminar Medical Electronics**
- **Telemedicine – Telematical Medicine**
- **Bioelectronical Systems**
  Prof. Wolf, EI
- **Microtechnological Sensors/ Actuators (Microtechnology)**
- **Seminar Applied Microtechnology**
- **Seminar Mechatronical Medicine Technology**
- **Medical Home Care: Systems, Procedures, and Applications**
- **Medical Home Care: Systems, Procedures, and Applications Tutorial**
  Prof. Lueth, MW

Thematic Field 4
Technology, Economy & Society

- **Computer Aided Facility Management and Geoinformation Systems**
  Dipl.-Ing. Haller, WI
- **Marketing and Innovation ***
  Prof. Henkel, WI
  Prof. v. Wangenheim, WI
- **Organization and Human Resource Management ***
  Prof. Welpe, WI
- **History of Science and Technology**
- **Product Innovation and Consumer Culture ***
- **History of Consumer Goods ***
  Prof. Wengenroth, WI
  Prof. Zachmann, WI
- **Real Estate Project Development**
- **Real Estate Financing**
- **Property and Facility Management**
- **Seminar Real Estate Development**
- **Project Studies Real Estate Economy**
  Prof. Zimmermann, BV
- **Business Concept and Market Business Plan Basic Seminar 1 ***
- **Business Concept and Market Business Plan Basic Seminar 2 ***
- **Innovative Contractor – Leading of Growth-Oriented High-Tech Companies**
  UnternehmerTUM
- **Intercultural Aspects of Working in Global Teams ***
  Prof. Krcmar, IN

Thematic Field 5
Architecture, Design & Management

- **Building Materials Parameters**
- **Building Materials Technology**
- **Durability of Building Materials**
- **Construction Materials**
  Prof. Gehlen, BV
- **Basics of Simulation**
- **Construction Economics 2**
- **Industrial Safety and Health Protection in Building Construction and Civil Engineering**
- **Redevelopment of Portfolio Properties**
- **Tender – Placing – Settlement**
- **Business Process Management in the Building Sector**
  Prof. Zimmermann, BV
- **Construction for Elderly and Disabled**
  Prof. Marx, AR
- **Analog und Digital Display Methods**
- **Architectural Data Management**
- **Computational Design**
  Prof. Petzold, AR
- **Industrial Design (1 and 2) ***
  Prof. Frenkler, AR

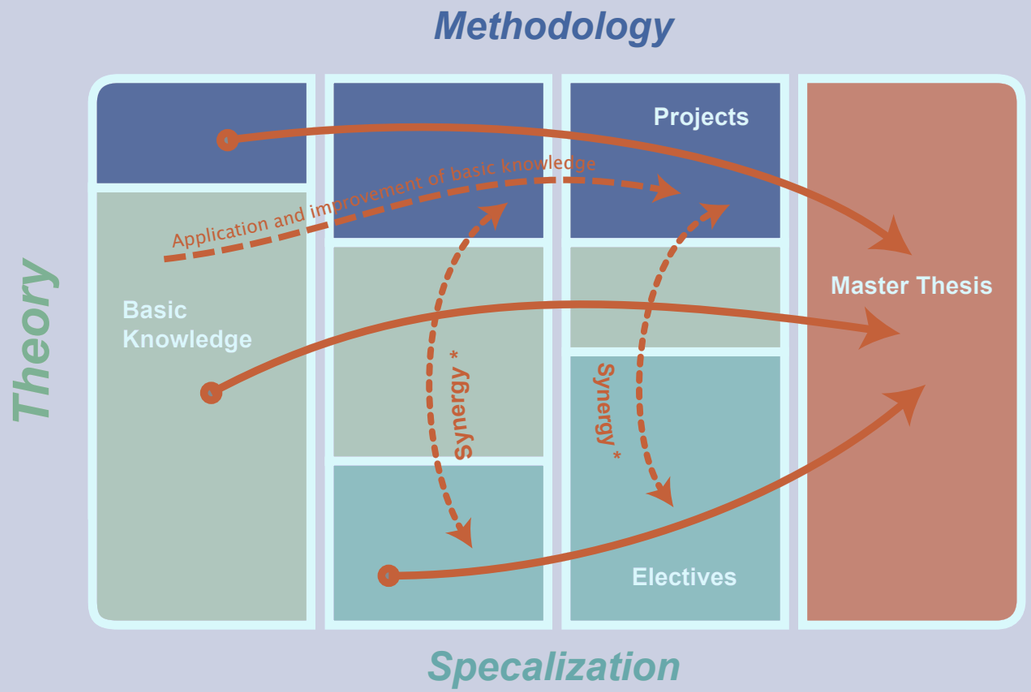
The students may choose from over 70 elective subjects, which they can select according to their interest. Throughout two semesters 24 ECTS have to be covered overall, based on this catalogue.
(Cf. page 12)

In order to have a better overview of the choices the classes are subdivided into five Thematic Fields in this illustration, whereas the different Faculties and Chairs are offering classes which are fitting to different Thematic Fields. There is no obligation for the students to cover all the five Thematic Fields. This means that they are free to specialize already during their studies on a thematic field in the wider context of architecture or to choose a widespread education. At the itemization of an appropriate study plan, the students are actively supported by the mentors.
(Cf. page 51)

*) denotes classes given in English

Effective September 2010

Course Cycles



* Synergy between projects and electives: On the one hand, concrete projects provoke demand for specialization, on the other hand the content of the electives can be applied within the projects. In order to deliberately achieve this synergy, every student's curriculum should be created in cooperration with the Mentors and International Consultants (Cf. page 51).

A wide-spread theoretical basic knowledge (theory), the impartation of methods and tools for problem solution and project realization (methodology), and the possibility to acquire problem and interest specific knowledge (specialization) is the foundation of the Master Course.

During the first Semester ...

primarily basic knowledge is imparted. The basic knowledge is content wise wide-spread and ranges from construction systematic basics (P 03 ARC) over logistics and manufacturing-/ construction-processes (P 03 ARC, P 05 FEM) to life-cycle relevant technologies and assistive systems in buildings (P 03 ARC, P 04 BSP). Basics in innovation development (P 04 BSP, P 07 MOI) and socio-technological aspects (P 04 BSP, P 05 FEM) are also imparted. A small Preproject (P 01 pP) is supposed to introduce the students to the project work and to help them to realize their strengths and weaknesses at an early stage.

During the 2nd and 3rd Semester ...

the project work is given priority. The tasks are set in a way that the students are able to use their learnt basic knowledge and to develop them further so they become personal approaches. The problem oriented approach shall motivate the students to acquire specific knowledge through the elective subjects. Interdisciplinary basics are also imparted in an integrated way by „learning by doing".

The elective subjects are the second focus in the 2nd and 3rd semester. Through these the students can „line" their projects and bring in their personal tendencies. In addition further obligatory subjects are deepened concerning the thematic fields of industrialization strategies (P 07 MOI), life-cycle relevant technologies and assistive systems in buildings (P 08 USE) as well as innovation development (P 11 Inc).

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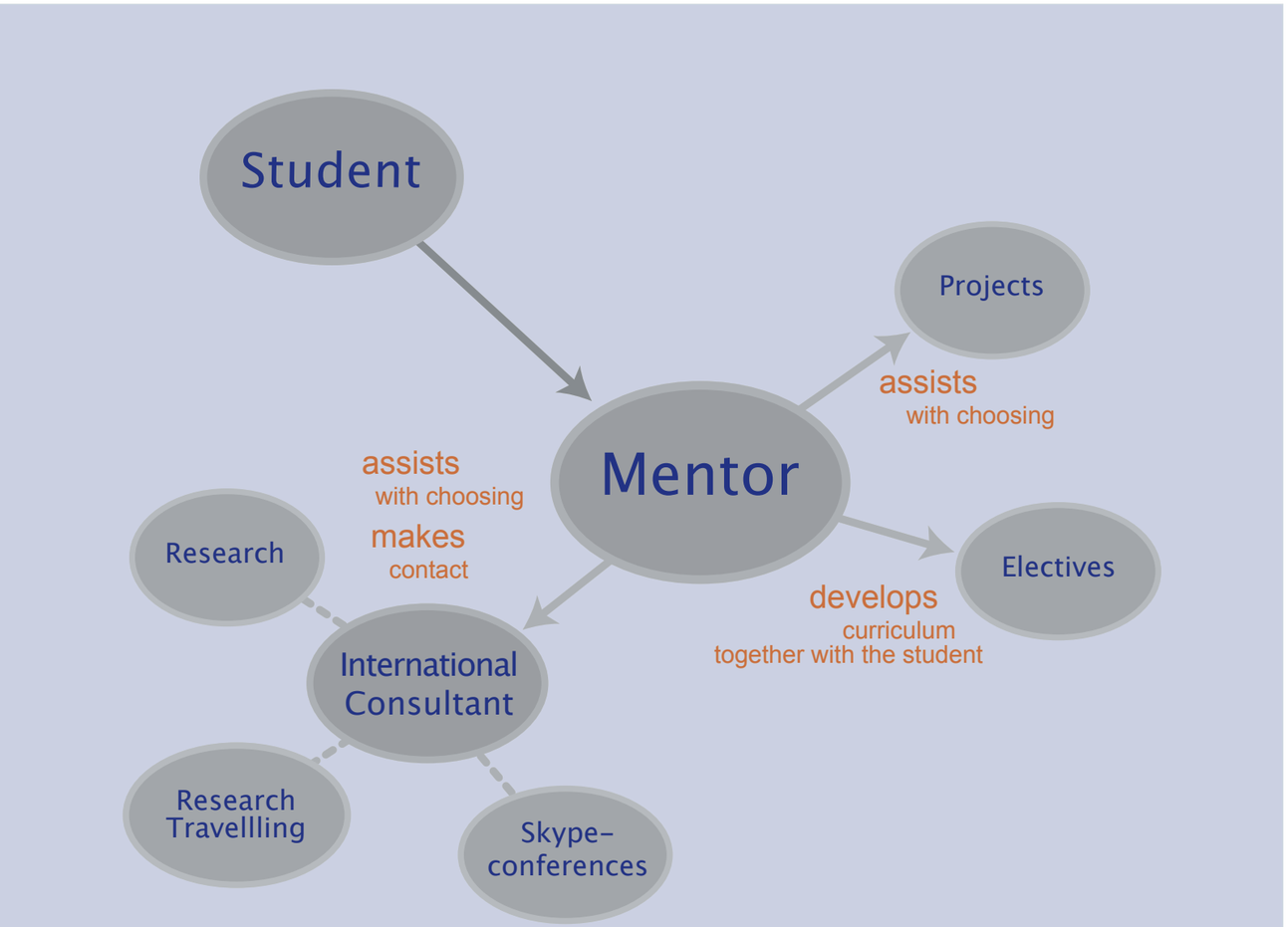
In the Master Thesis ...

the learned basic and specific knowledge as well as the learnt skills and methods are flowing together. According to interests and skills of the students the task can equally involve aspects of theory, methodology / project, and specialization or it can focus on one topic. The elaboration of the Master Thesis can take place as a pure project or as a pure scientific-theoretical discourse, which are the two „extremes" in the spread of possible configurations. Usually a balance is aspired in order to fulfill the principle of the equally wide-spread and varied education.

Course Coaching



Since the Master Course is mostly characterized by being interdisciplinary, the knowledge is primarily imparting the handling with complex issues. On the one hand it offers a multi-option, but on the other hand it also requires problem-oriented work for the projects. This is why it is so important to offer several reference points and a clearly regulated course coaching to the students.

The Master Course relies on a course coaching, in which advisors from two categories are allocated to each student: Mentors and International Consultants. They assist the students during their studies as well as during the elaboration of the Master Thesis.

Mentors:

The Mentors are the main reference persons and consultants during the whole study, concerning the professional as well as the organizational matters. A mentor is allocated to each student. The mentors offer support in choosing elective subjects and projects and supervise the projects also content wise, just as the Master Thesis. Besides that, they give advise concerning the choice of international consultants. For respective technical discussions the students should not only make use of face-to-face-meetings, but also telephone conferences, Skype conferences, et cetera.

If necessary, mentors can participate in field trips or organize intermediate and final presentations for the individual credits.

International Consultants:

International Consultants take on the consulting of the students concerning technical issues in the project phases and during the Master Thesis. These consultants are an addition to the mentors. The International Consultants ensure the contact to the professional world on the one hand and they are important reference persons to international students on the other hand. The individual communication can, according to the circumstances, take place in conferences, research travelling, telephone conferences, Skype conferences or email.

Learning by Researching

The Master Course *Advanced Construction and Building Technology* is of high relevance to the involved Chairs, to the faculty, as well as to the TUM, and it offers a chance to expand existent first-class positions. Basically two important fields can be distinguished:

- **Robotization and Automation in Building and Construction Industry:**

  Robotization and automation in the building and construction industry is a research field, which has been internationally established for around 30 years now. Numerous international conferences (for example the ISARC International Symposium on Automation and Robotics in Construction), CIB-workgroups (TG 57 Industrialization; W 104 Open Building Implementation, W 96 Architectural Management), but also exhibitions (New York MoMA: Home Delivery, 2008; Pinakothek der Moderne: Wendepunkt(e) im Bauen, 2010) and initiatives (Zukunft Bau, BMBF; Bayern Innovativ) emphasize the importance of this research field. The expertise of the holder of the Chair for Building Realization and Robotics, Prof. Thomas Bock, in this field is pertinent. He has been doing research in the field of building robotics for 26 years, is considered to be one of the co-founders, was among others the president of the „International Association for Automation and Robotics in Construction“ until 2007 and has more than 300 publications, predominantly in this field, to his name. The term „Robot Oriented Design“ was initially published by him in May 1988 in Tokyo, since then his work was the foundation for more than 50 building-robotic systems, 25 automated building sites and several service-robotic systems. Prof. Bock is a member of prestigious editorial boards like „Robotica“, (Cambridge University Press), „Automation in Construction“, (Elsevier), “academie”´(RAACS) and many more.

  Since architecture is also increasingly the nucleus of crystallization for embedded technologies in built life-surroundings, the thematic fields of „intelligent surroundings“ and „interaction with intelligent surroundings“ are another focus in the science and research of the Chair for Building Realization and Robotics. The special content wise positioning of the Chair lies in the combination of architecture, informatics, robotics and integrated system technology.

- **Demographic Change, Ambient Assisted Living, High-Tech Assistive Systems:**

  The demographic change is a social challenge for the Scientific Community as well as it will unavoidably be a focus of political responsibility of the next generation. The TUM, the Faculty of Architecture and the Chair for Building Realization and Robotics are deeply committed to these research fields.

  The Master Course Advanced Construction and Building Technology lines up in a list of efforts to take up the relevance and potential of this topic. It particularly wants to go towards promoting the integration of assistive systems into the life and work surroundings of private and public spaces.

  The holder of the Chair for Building Realization and Robotics is, since the incurrence of the innovation field of „Ambient Assisted Living“ (abbr.: AAL), member of the program committee of the same-titled initiative of the „Bundesministerium für Bildung und Forschung“ (BMBF) and was represented on all German AAL congresses with his own sessions.

  The Chair and the Chair-comprehensive project group TUM AIR (Ambient Innovation Robotics) take up the topic of demographic change and try to utilize new (at the TUM developed) technologies for the support of the activities in daily life in the domestic surrounding. Several AIR-project-teams developed concepts and solutions for intelligent and adjustable life surroundings. Among the cooperation partners of the AIR group are the Chair for Applied Informatics / Cooperative Systems (Prof. Schlichter), the Institute for Media Technology / Distributed Multimodal Information Processing Group (Prof. Kranz), the Chair for Medical Electronics (Prof. Wolf, Dr. Friedrich), the Chair for Human-Machine-Communication (Prof. Rigoll) as well as the Chair for Robotics and Embedded Systems (Prof. Knoll).

The Master Course wants to play a part in contributing the concentrated study of highly qualified national and international students on the above mentioned research topics over the period of four semesters. Since the Master Course equally addresses students from different areas of studies, an enrichment of the whole architecture and construction oriented research is to be expected, which is able to deal with the increasing complexity of interdisciplinary research challenges.

International Relations

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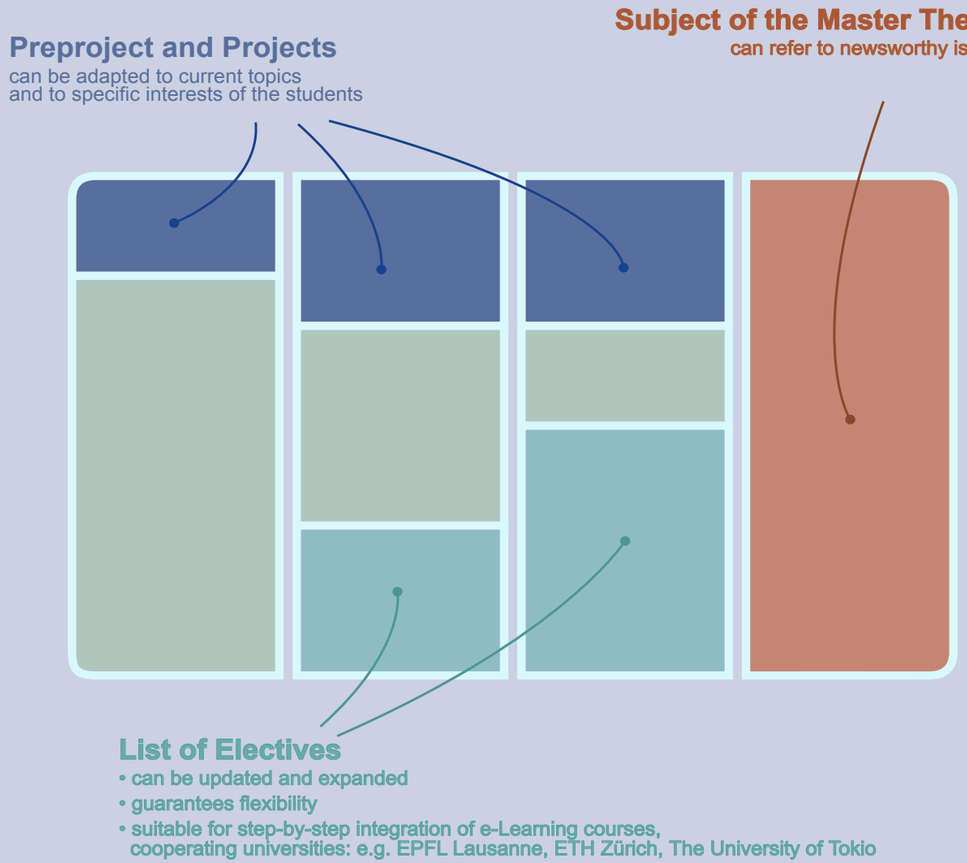
The Master Course equally addresses national and international students. As an approved High-Tech country and a prestigious university location, Germany – and especially Munich – traditionally attracts an international public. For the mutual interexchange with universities of other industrial countries plays a big part for that purpose, whereby the Chair for Building Realization and Robotics makes an attractive contribution towards tat:

In context of the ICI ECP „AUSMIP“ (Industrialized Countries Instrument Education Cooperation Program „Architecture and Urbanism Student Mobility International Program“) scholarships for a six- to eightmonthly stay abroad at a Japanese University (The University of Tokyo, Kyushu University, Chiba University) are to be given. The mobility project is already in the 3rd round. In the context of the first round (AUSMIP, 2003 bis 2007), the organizing professor consortium received an award as a „Best Practice“ example. A core topic of the extended, 3rd cooperation is „Demographic Change, Assisted Living and Assistive Technologies“.

Additionally to the travelling scholarships the incorporation of the Master Modules of the Course Advanced Construction and Building Technology to an international Master Course is designated. This international Master Course shall be formed in context of ICI ECP AUSMIP – R&DaR (Regular & Dispatched ausmip Rotation), in which the TUM, the Sint-Lucas School of Architecture, Belgium, and The University of Tokio, Japan, have been successfully participating for years now.

The AUSMIP Program is leadingly organized and conducted by the Chair for Building Realization and Robotics. Altogether 103.000 € are available to the Chair sole for student's mobility.

Japan and Germany are among the most badly affected countries with regard to the demographic-change, so both countries are firmly interested in the development of High-Tech assistive systems. Additionally, Japan, Korea, and Scandinavian countries are very advanced in the field of technologization of the building industry and it's utilization, and thereby attractive cooperation partners for the Faculty for Architecture at the TUM as well as for the Chair for Building Realization and Robotics. The personal technical network of the chair holder is focused on the above mentioned countries, so a distinctly productive collaboration is to be expected.



Sustainability

Based on the imparted basic knowledge as a platform, the Master Course offers the possibility for the continuous adaption and further development. Projects and elective subjects are investigations on this platform, which adapt to the changing needs of social, economic and technological requirements. They guarantee a permanent actuality of the Master Course. The preproject and project tasks can, for instance, be exchanged so that they refer to the basic knowledge on the one hand and react to current issues on the other. Also, the elective subjects in the list can be easily exchanged.

Step-by-Step Internationalization

Beyond that, the list of elective subjects qualifies for an integration of E-Learning offers and E-Learning cooperations with prestigious international universities. In order to make the internationally existent knowledge concerning industrialization, automation and building robotics available for the Master Course of the TUM, arrangements with numerous universities are currently being worked on in order to achieve a gradual construction of a mutual E-Learning pool.

IAARC: *International Certificate for Automation and Robotics in Construction*

The Board of Directors of IAARC (International Association for Automation and Robotics in Construction) initiated the establishment of the „IAARC Academy“, which offers an international Masters degree. The module structure will be similar to the structure of the here introduced Master Course. Thereby it should be possible for students of the M. Sc. *Advanced Construction and Building Technology* to study at a partner university for one semester, which also offers such a certificate, while international students participate in a semester of the M. Sc. *Advanced Construction and Building Technology* in return.

Until the complete realization of the international Master Course planned by the IAARC the certified advanced training offer „International Certificate for Automation and Robotics in Construction“ shall be realized, which will also be compatible to the Master Course *Advanced Construction and Building Technology*.

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