HECTOR SCHOOL
Technology Business School of the KIT

KIT Karlsruhe Institute of Technology

Executive Master Program

Mobility Systems Engineering & Management

Technology + Management

The HECTOR School is the Technology Business School of the Karlsruhe Institute of Technology (KIT). It is named after Dr. Hans-Werner Hector, one of the co-founders of SAP SE.

The school aims to provide professionals with **state-of-the-art technological expertise and management know-how within part-time education programs**. The HECTOR School fosters lifelong learning within industry. Participants are supported in their career development with executive master degree programs, certificate courses, and customized partner programs.

The benefits of the executive master programs are numerous for participants as well as for the companies they work for:

- Unique Holistic Approach: A combination of technology expertise and management know-how.
- State-of-the-Art Knowledge: Direct transfer from the Karlsruhe Institute of Technology (KIT) research.
- Part-Time Structure: Allows participants to continue with their demanding careers whilst acquiring new skills.
- Master Thesis to set up Innovation Projects: Companies gain outstanding added value through the consultation of such projects by professors from KIT.
- Excellent Networking Opportunities: Professional networking is fostered across industries and on an international scale.

Portrait of the HECTOR School
on our YouTube Channel

Key Facts: Part-Time Master of Science (M.Sc.) Programs

Program Structure

- Part-time, 10 x 2-week modules
- Duration: part-time lecture period of ~15 months
- Master thesis: project work in the company, 9 months
- 5 Engineering and 5 Management Modules
- Teaching language: English
- Yearly program start: October

Academic Degree

Master of Science (M.Sc.) from the KIT (90 ECTS)

Admission Requirements

- A first academic degree: e.g. Bachelor, Master or Diploma
- At least 1-2 years work experience (depending on the level of the first degree, recommended > 3 years)
- If English is not your mother tongue nor has it been the language of instruction for the last five years, language proficiency test certificate (e.g. TOEFL score of at least 570 PBT; 230 CBT; 90 iBT or IELTs at least 6,5 points).

Accreditation

The KIT is system-accredited by AAQ. All HECTOR School master programs are accredited by the internal quality assurance system of the KIT.

aaq
swiss agency of accreditation and quality assurance

Master Program

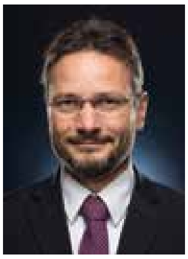
Mobility Systems Engineering & Management (MSEM)

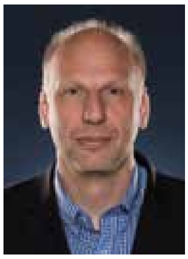
SAFETY & SECURITY CYBER PHYSICAL SYSTEMS BIG DATA HANDLING AUTOMOTIVE STANDARDS & APPLICATION TESTING 2.0 DATA COMMUNICATION PROCESS MATURITY LEVEL ASSIGNMENT FINANCE & VALUE ENERGY SUPPLY, STORAGE & CONVERSION CHARGING MANAGEMENT IOT & INDUSTRY 4.0 SYSTEMS LIFE CYCLE PROCESSES STRATEGY & PEOPLE POWER TRAIN CONCEPTS MODELLING & SIMULATION INTERNATIONAL PROJECT MANAGEMENT WORLDWIDE RELEASE & CONFIGURATION MANAGEMENT CAR-TO-X COMMUNICATION INNOVATION & PROJECTS AUTOMOTIVE RADAR TECHNOLOGY DRIVER ASSISTANCE SYSTEMS VEHICLE TRAFFIC INTERACTION MARKETING & DATA DECISIONS & RISK

Prof. Dr.-Ing. Eric Sax
Institute for Information Processing Technologies, KIT

Prof. Dr. Stefan Nickel
Institute of Operations Research, KIT

Program Directors

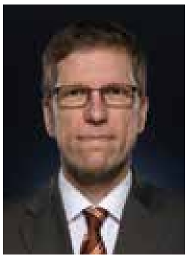


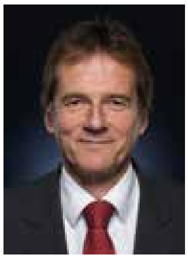


Prof. Dr.-Ing. Martin Doppelbauer
Institute of Electrical Engineering, KIT

Prof. Dr. rer. nat. Frank Gauterin
Institute of Vehicle System Technology (FAST), KIT

Heads of Specializations





Electronic systems are omnipresent. Currently they range from portable devices such as smart phones to large stationary installations like the systems controlling of power plants. Communication - stationary or over-the-air – of these particular systems form a network of control, sensing and influencing the environment. A cyber physical system is the result.

These trends fundamentally influence industry (industry 4.0) and mobility, mainly vehicles for automated driving, electrical drive trains and car-2-x communication. As a consequence, sustainable mobility concepts are increasingly using embedded electronic systems to maximize efficiency, enable automation and reduce pollution.

Challenges start with new processes, methods and tools of systems engineering that are needed to design and validate these networks of embedded systems. Agile programming (e.g. Scrum) for self-learning functions up to artificial intelligence will find its way into conservative mechanical engineering and enhance the more or less established life cycle models such as the "V". In addition validation will step beyond X-in-the-Loop and demand for data analytics of a large number of sensor data. But what is the right method for the right challenge? Am I using the appropriate tool or am I horribly over-loading the simple task? Assessments will answer these questions, currently we rely on CMMI and SPICE, which will surely be enhanced for the upcoming hypes.

Also electronic systems are designed to do some specific tasks, rather than be a general-purpose computer for multiple tasks. Some also have real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs. Standards (e.g. ISO 26262 for functional safety) will influence the design decision process.

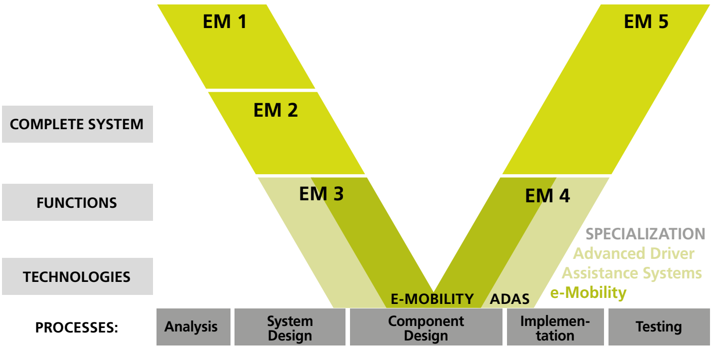
The story goes on with reducing the size and cost of the product, increasing the reliability and performance of electronic components such as sensors and controllers enables more and more digital applications. And does not end here. As a consequence the demand for innovations by society and the raise of new technologies in universities and large scale research institutions offer tremendous opportunities to overcome "historic" electronic development thinking. The Master Program in Mobility Systems Engineering and Management, starting in October 2018, offers a unique combination of courses in emerging technologies, systems engineering know-how and methods as well as management tools tailored for those challenges of mobility: e-drive, auto-drive, communication-over-the-air, and worldwide release and configuration management. Within the master program specifications in those area can be chosen.

With its long tradition in mobility, electrical, information and communication programs, the Karlsruhe Institute of Technology (KIT) provides an ideal environment. Building on the long-established reputation for excellence in business engineering, our master program combines an in-depth knowledge and understanding of fundamental concepts in business, finance and management with the latest developments in Electronic Systems and Mobility Systems Engineering.

With the new master program participants will acquire tools that will guide their career in this exciting area.

Engineering Modules (EM)

State-of-the-Art Technology Expertise in Mobility Systems



EM 1: Processes, Methods and Tools of Systems Engineering

In EM 1 an introduction to embedded systems & software engineering is given. Processes, methods and tools from object oriented approaches via the V-model to agile methods are presented (e.g. Scrum). Among those, HW-/SW-Co-design and rules how to decide which way to go are explained. How to assess these approaches according to process maturity levels (e.g. SPICE and CMMI) and how to follow the demands of safety (relying on ISO 26262 and ASIL) and security is introduced focusing on the transportation industry. Data of sensing and communication are the base for nearly all upcoming new functions of mobility. The importance and methods of their analysis such as anomaly detection is introduced. A case study based on the implementation of a two wheeled transportation platform ("Segway") gives a hands-on impression on the complexity of mechatronics system design.

EM 2: Systems Design

In order to realize an embedded system in EM 2 a concrete EE-architecture is designed to modularize the complete functionality. Controllers and processors or ASICs and FPGAs will implement the applications and interact among each other. Data Communication Topologies and Technologies (e.g. CAN, Flexray or wireless/car2x, Ethernet) are appropriate for that. The interfaces to the environment are enabled by actuators and sensors. All these technologies will be explained in this module and the vision of mobility of the future is described conceptually.

EM 5: Systems Integration & Validation

Finally implementation and integration leads to testing the overall system according to the early requirements. During the overall process of engineering, testing has been prepared and done in order to check the maturity level. Quality assurance has been executed in simulations and prototyping environments. At the end of those phases, the real system can be tested for the first time to finally check the user requirements in a hardware-in-the-loop environment or even in real test scenarios.

Case study based on the implementation of a two wheeled transportation platform ("Segway") gives a first impression on the complexity of mechatronics system design.

Specialization E-Mobility

EM 3: E-Mobility - Political & Technical Framework

New concepts and new infrastructures are needed for the local supply of electric energy to plug-in and for full electric vehicles. Energy management starts with the generation of energy, which should ideally be done locally, and includes topics like energy storage and energy distribution, as well as intelligent new charging concepts that are geared towards momentary electricity production and consumption. NVA (noise, vibration, harshness) becomes increasingly challenging as the reduced noise level of electric drives makes sound sources audible that have hardly played a role in conventional vehicles. Charging technologies & recuperation strategies play an important role in increasing the limited driving range. EM 3 provides an overview of the boundary conditions for electric and hybrid electric traction vehicles, including transportation market policies, well-to-wheel climate impact analysis, energy management, and distribution.

EM 4: E-Mobility - Components & Technology

The electric power train (i.e. the mechatronic integration of energy storage, power & signal electronics, drive control, and electric motor) is the most innovative and important new part of hybrid and full electric vehicles compared to conventional combustion engine cars. High-speed electric motors become more and more powerful in recent years with new technologies like rare earth magnets and field weakening operation. The power-to-weight ratio of modern traction motors is more than a magnitude better compared to industrial electrical machines. EM 4 focuses in detail on the technical components of electric and hybrid drive trains, namely the electric machine, power electronics (both hard- and control software), gearboxes, driving resistances and energy consumption and energy storage systems (batteries and fuel cells).

Specialization Advanced Driver Assistance Systems (ADAS)

EM 3: Data Communication Technologies & Systems

Autonomous driving will redefine the automotive world. Vehicles will become able to perceive their environment and react autonomously to reduce the risk of accidents, to improve driving efficiency and comfort. Autonomous driving has the potential to improve traffic flow, reduce traffic congestions and save energy. Enhanced traffic management systems will increase the ability of the driver to interact with the car and the surrounding traffic. EM 3 will focus on the functions.

The most important control system in the car remains the driver. To get the driver´s acceptance it is very important to create attractive vehicle concepts where the control systems delivers an understanding for its sensation, cognition and action. This module addresses different aspects of the driver vehicle interaction. The drivability deals with the driver's usability of a vehicle, including ease of use, fulfillment of the driver's expectations concerning a safe, comfortable and efficient drive, degree of complexity of the driver-vehicle interface, and predictability of the vehicle's action and reaction. Many different methods to evaluate the driver's needs, benefits and acceptance exist and will be presented. Additionally, models of traffic flow and traffic management are introduced. Traffic demand modeling as a core concept for modern traffic management will round up the topic.

EM 4: Components & Technologies of ADAS

Modern vehicles have become more and more intelligent. Sensors and cognitive control units detect and communicate with the environment, recognize other vehicles and other traffic participants. They interpret and predict their behavior and improve road safety dramatically. Based on detailed road, infrastructure and traffic data and by using predictive green routing and vehicle operation management, a comfortable, energy and time efficient drive is realized.

Many components of actual and future cars are coming along with properties, which differ significantly from those in classical vehicles, such as high torque at zero speed, limited cruising range, need for additional battery charging infrastructure and cost accounting systems, high voltage safety requirements, different noise and vibration, autonomous actions etc. Consequently, new vehicle concepts and operation strategies are needed, which also affects the human to machine interaction. Also perception systems play an important role for the safety, comfort, and efficiency of mobile machines. Therefore fundamentals of sensor technologies are introduced and an overview on methods for scene perception is given to enable students to assess the uncertainties associated with these.

Engineering Modules

EM 1: Processes, Methods & Tools of Systems Engineering

Courses: Fundamentals of Systems Engineering, Modeling & Simulation, Process Models & Associated Assessments, Case Study in Embedded Systems Development (incl. Rapid Prototyping), Big Data Management, Introduction Concept Study

EM 2: Systems Design

Courses: Control Systems Development, Embedded Systems Computer Architecture, Electronic Systems Synthesis (Hardware & Software) incl. Case Study, Concept Study: The Car of the Future

EM 5: Systems Integration & Validation

Courses: Quality Assurance Management & Cost of QA of Electronic Systems, Testing Automotive Systems (XiL, virtual testing,…) & Case Study, Release-, Configuration- & Update-Management of Self-Learning Functionality

Specialization Advanced Driver Assistance Systems

EM 3: Functions of Advanced Driver Assistance Systems

Courses: Driver Assistance Systems, Auto Control Systems, Driveability, Traffic Engineering & Control, Car-to-X-Communication

EM 4: Components & Technologies of ADAS

Courses: Automotive Radar Technology, Optical Actors & Sensors, Mobile Perception Systems, IT Safety & Security, Hands on Training: Platooning

Specialization E-Mobility

EM 3: E-Mobility: Political & Technical Framework

Courses: Introduction into Requirements, Solutions & Challenges of E-Mobility, CO2-balances: Well to Wheel, Transportation Market Policies, Energy Distribution & Management, Noise, Vibration & Harshness for E-Mobility, Case Study

EM 4: E-Mobility: Components & Technology

Courses: Electric Drive Trains, Power Electronics, Energy Conversion & Output, Energy Storage: Batteries & Fuel Cells, Energy Storage: H2-Storage

Curriculum may be subject to change.

Crash Course: Selected Topics of Electrical Engineering
We highly recommend all applicants to participate in the course to update the technical knowledge, as it might be the crucial factor for a successful degree at HECTOR School.

Management Modules (MM)

Economic Know-How for Successful Managers

Management Modules

MM 1: Marketing & Information

Courses: Designing and Selling Solutions (incl. Negotiation Training), Information Systems Management, Big Data Methods, Legal Aspects of Information

MM 2: Finance & Value

Courses: Management Accounting, Financial Accounting, Strategic Financial Management, Case Studies

MM 3: Decisions & Risk

Courses: Decision Modeling, Risk Aware Decisions, Interactive Decisions, Robust and Stochastic Optimization

MM 4: Innovation & Projects

Courses: Technology Driven Innovation, International Intellectual Property Law, Project Management, Multi-Project Management in an International Setting

MM 5: Strategy & People

Courses: Business Management, Managerial Economics, Business Organization and Corporate Law, Strategic Human Resource Management, Leadership and Conflict Management

Curriculum may be subject to change.

Order your free course guide book with detailed contents of the Master Program!

MM 1: Marketing & Information

Many of today's most successful businesses excel in satisfying customer needs, because their decisions are based on data instead of gut feeling. This is what this module is about. One week looks at how to use data for designing customer solutions (and get paid according to their value). The other week looks more generally at issues surrounding the use of (big) data for business decision-making.

MM 2: Finance & Value

Modern corporate governance is based on the creation of values. In the Finance & Value module, students learn essential methods of measuring, processing, and communicating the value added by corporate decisions that enable effective planning, management, and monitoring of corporate activity and corporate units. External value-based communication makes it possible to win stakeholders who are committed to the company over the long term.

MM 3: Decisions & Risk

Management implies making decisions. A valid data warehouse forms the basis for these decisions. The aim of this module is to give students a toolkit of various quantitative decision-making models, so that the possibilities and limitations of methodical decision-making support (among others also optimization methods) can be used efficiently in the day to day running of projects.

MM 4: Innovation & Projects

Numerous paradigm shifts are currently being driven by the development and extensive use of new technologies. Profound changes in rapidly changing markets flow directly from this. Consequently, apart from classic project management, new management tools and methods are required, because agility and innovation are some of the success factors in the current business climate. The module thus focuses on one of KIT's unique selling points: technology-driven innovation.

MM 5: Strategy & People

The key to corporate success lies in the correct strategy. But how do you recognize opportunities, develop a viable concept, and successfully implement it? In times of scarce human capital, it is more important than ever before to ensure employees are a perfect fit for their position and to motivate them to implement the strategy together. The module imparts state-of-the-art management techniques and know-how on evidence-based human resources management, people analytics, and leadership approaches.

A HECTOR School Master: Leadership Know-How for Demanding Careers.

»The five engineering modules offer deep insight into the new challenges of the automotive industry. Highly experienced lecturers show state-of-the-art research on the topics of electro-engines, batteries, but also cognitive systems and embedded systems. This broad variety of subjects combined with the five management modules with a lot of case studies are the perfect fundament for further personnel development. On top, you are still able to continue your current job and to introduce the new methods to your daily business life.«

Alexander Spies
Master in Green Mobility Engineering, now part of MSEM
Behr GmbH & Co. KG

Alumni Voices
on our YouTube Channel

Academic Calendar

September 2019

Mon	Tue	Wed	Thu	Fri	Sat	Sun
						01
02	03	04	05	06	07	08
09	10	11	12	13	14	15
16	17	18	19	20	21	22
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MM1						

October 2019

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November 2019

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EM1		13	14	15	16	17
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December 2019

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30	31					

January 2020

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EM2		15	16	17	18	19
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28	29	29	30	31		

February 2020

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MM2		19	20	21	22	23
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March 2020

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MM3		25	26	27	28	29
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April 2020

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May 2020

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EM3		06	07	08	09	10
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June 2020

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29	30					

July 2020

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EM4		08	09	10	11	12
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August 2020

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31						

September 2020

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MM4		16	17	18	19	20
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October 2020

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EM5		28	29	30	31	

November 2020

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December 2020

Mon	Tue	Wed	Thu	Fri	Sat	Sun
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MM5		09	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

MM Management Modules
EM Engineering Modules
Exams

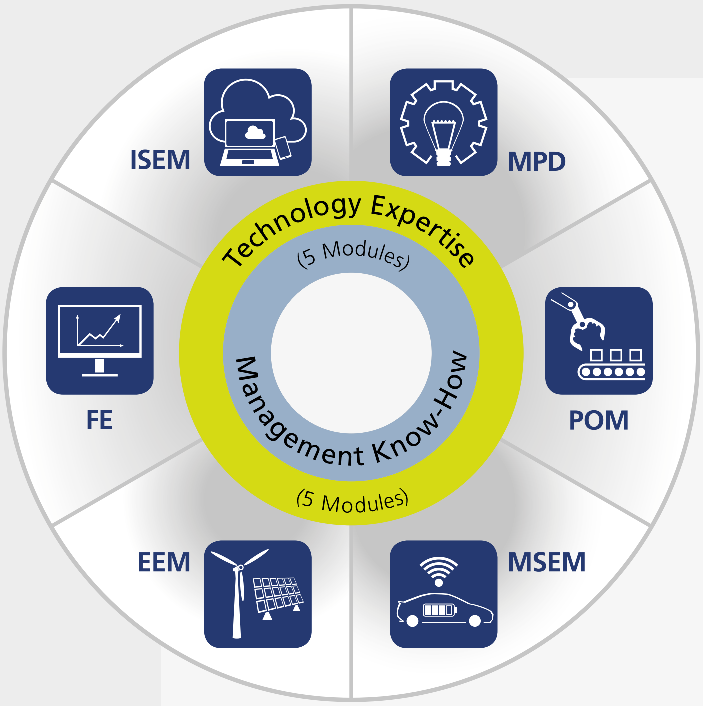
Crash Course *5-day seminar in Selected Topics of Electrical Engineering*

Please note: Dates are subject to change.

The academic calender for each program starts annually in October. It consists of 10 modules, each with a duration of 10 days. All programs conclude with a master thesis.

>> **Master Thesis:** 9 months project work

More Master Programs



Six Part-Time Master of Science Programs in

- Management of Product Development (MPD)
- Production & Operations Management (POM)
- Mobility Systems Engineering & Management (MSEM)
- Energy Engineering & Management (EEM)
- Financial Engineering (FE)
- Information Systems Engineering & Management (ISEM)*

In addition to the master programs, the HECTOR School also offers **certificate courses** (3 - 5 day seminars on state-of-the-art technology topics) and **partner programs**.

**Subject to the approval procedure of KIT and the Ministry for Science, Research and Art in Baden-Württemberg*

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Order your free course guide book with detailed contents of the master program!

Our Social Media Channels

Imprint

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