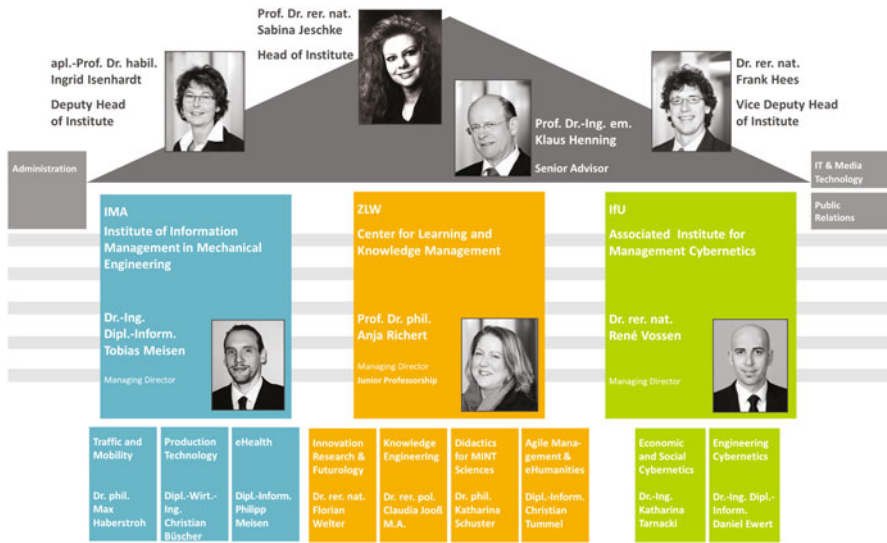


Foreword

Dear Reader,

We are very proud to present to you the third instalment of our book series “Automation, Communication and Cybernetics”. This series brings together our scientifically diverse and widespread publications from July 2012 to June 2014. Almost all publications are peer-reviewed and have been published in recognised journals, books or conference proceedings of the various disciplinary cultures. In the last edition we presented you the new organisational structure of our institute cluster IMA/ZLW & IfU. Below you can see an updated version, where the cluster is headed by the three directors with Sabina Jeschke as Head of Institute and Ingrid Isenhardt and Frank Hees as her Deputy and Vice Deputy. The former head Klaus Henning still provides us with advisory support. The cluster itself consists of three institutes; the **Institute of Information Management in Mechanical Engineering IMA**, the **Center for Learning and Knowledge Management ZLW** and the **Associated Institute for Management Cybernetics e.V. IfU**, which are managed by Tobias Meisen, Anja Richert und René Vossen respectively. Our research activities are arranged in nine different research groups whose activities are described further below.



Although the structure itself has not changed the people or their statuses have. Our Deputy Head Ingrid Isenhardt is now an adjunct professor at the Faculty of Mechanical Engineering at the RWTH Aachen University. With Tobias Meisen the IMA got a new Managing Director. He takes over from his predecessor Daniel Schilberg who has left us by now to become a full professor in Bochum. The IfU is now directed by René Vossen.

- Within the IMA there are three research group leaders: Max Haberstroh for the group **Traffic and Mobility**, Christian Büscher for **Production Technology** and Philipp Meisen for **eHealth**.
- In the ZLW Christian Tummel took over the research group **Agile Management & eHumanities** which replaced the former group of Career Research. Claudia Jooß heads the group **Knowledge Engineering**, Katharina Schuster the group **Didactics for MINT Sciences** and Florian Welter the team **Innovation & Research Futurology**.
- At the IfU the heads of the research groups are now Katharina Tarnacki and Daniel Ewert for the groups **Economic and Social Cybernetics** and **Engineering and Cybernetics** respectively.

With 80 % of our research group leaders now being PostDocs our reorganisation proved to be very successful since this was one of the main motivations for the restructuring. Below we will give a more detailed description of our research activities in the individual research groups.

The scientific core of the Institute of Information Management in Mechanical Engineering – IMA consists of three research groups:

- The scope of the research group **Production Technology** is to provide innovative research regarding information management in virtual production and production.

The group is specialised in methods and procedures to integrate, to consolidate and to propagate data generated in these domains. In addition, their research focuses on visualisation and interaction techniques to enable the user to analyse the retrieved information in an explorative and interactive way. Thereby, their research covers a broad range of different areas especially virtual and automated production. Meeting the challenges of information management within these areas, the group studies information integration, descriptive and predictive analysis using a variety of techniques from artificial intelligence like regression, machine learning, natural language processing and data mining as well as interactive and explorative visualisations. Regarding the domain of virtual production, the group has shaped the concept of the Virtual Production Intelligence to collaboratively and holistically support product-, factory- and machine planners. The work of the group provides essential basics to facilitate the realisation of cyber-physical production systems and therefore is a cornerstone of information management in Industry 4.0.

- The research group **Traffic and Mobility** is working on concepts for multi-modal freight transport and urban mobility, intelligent transport systems and on the design of user-friendly and barrier-free mobility solutions and human-machine-interaction. In its projects, the research group investigates concepts for autonomous vehicles, advanced driver assistant systems and the interactions and interdependencies between humans, organisation and technology. In order to develop holistic solutions, the interdisciplinary team combines skills and knowledge from engineering, computer science, sociology and economics. The applied methods of the research group range from simulator and real-life testing, over usage-centered design, empirical studies and acceptance or mental stress and strain analysis. One approach to reach the ideal of efficient freight traffic of the future is to use modular, worldwide usable loading units with appropriate transport carriers. All research is based upon the holistic consideration of the three recursion dimensions: human, organisation and technology. The activities of the research group include the research and development of new technologies as well as the development of methods and tools for the product development process in the above mentioned application fields.
- The research group **eHealth** focuses on research considering information management supporting healthcare. The group is specialised to meet the challenges within the research fields predictive data analytics and visual analytics. The research group understands itself as an “integrator” within the eHealth domain: educating and providing experts in the mentioned research fields, but also understanding the importance of covering and dealing with problems of all phases (i. e. needs assessment, integration, evaluation, and deployment) of the information management cycle. Lately, the group focused on research topics occurring in scenarios of medical emergencies, thus developing an intelligent and reliable ad-hoc network structure streaming medical data in real-time from the case of incident to an expert. Predictive analytics is used to detect upcoming delays, future connection losses, or approaching quality reductions. The eHealth group coined the term “prescient profiling” which is used to describe an AI driven concept selecting

relevant laypersons to nearby medical emergencies. To determine relevancy the solution considers for example traveling speed, known behavioural patterns (i. e. trajectories), current circumstances, and infrastructural limitations. Currently, the group works on an algorithm to predict the emotions of a driver interacting with a navigation system to adapt the systems behaviour accordingly. In the near future, the group will also use its expertise to establish a complex and highly available information management system for rapidly changing ad-hoc infrastructures that are for example needed to ensure information availability in the case of major incidents.

The Center for Learning and Knowledge Management – ZLW has four research groups:

- The research group **Innovation Research and Futurology** focuses on two fields. Innovation research concentrates on a concept of innovation management, which not only comprises planning, realisation, and design of processes and structures to create innovation, but also stresses the innovative capability. The first research field focuses on innovation systems with various dimensions like regional and national innovation systems as well as their relevant subsystems, which are created and analysed from a cybernetic perspective. This is achieved by a holistic consideration of the system-intrinsic dimensions “human, organisation and technology”, in order to produce innovative capability of the involved actors under competitive and sustainable conditions. The second field of the research group depicts futurology. Here, a monitoring approach is applied for different research, development and funding programs. Consequently, a range of future trends, scenarios and development strategies is derived for respective target groups. This expertise is supplied to experts in science, economy and policy.
- The research group **Knowledge Engineering** comprises engineers, human and cultural scientists, social scientists, economists, geographers, and computer scientists who work in the field of cooperation research. Together, they examine which structures and processes need to be modeled and implemented in order to capture, support and develop communication and cooperation. The research currently focuses whether and why the knowledge production can be promoted within inter- and transdisciplinary research alliances e. g. the Clusters of Excellence. Thus, the research group advocates a knowledge engineering approach addressing the interaction between data, information, and knowledge on all organisational levels. It then leads to services and products that iteratively and cooperatively integrate customers and users into the solution process. Current fields of action deal with the management and governance of research alliances, the diversity management in innovation processes and the organisation of work, the measurement of performance as well as the intellectual capital. Another focus is put on the technical aspects of knowledge management, such as the semantic search and the design of (multimedia) learning environments. Furthermore, the research group conducts consulting, moderating and coaching activities for the organisational and strategy development as well as the cooperation design and knowledge management.

- With an interdisciplinary team of communication scientists, engineers, psychologists, sociologists and computer scientists the research group **Didactics in STEM Fields** is dealing with challenges of didactics, especially those of the STEM Fields, including mathematics, computer sciences, engineering and technics. To prove successful didactic concepts during its development, the involvement of every actor actively participating in education is needed. Therefore the groups of students, teaching staff, intermediate organisations and other experts on university didactics, are integrated in our research activities. The user oriented approach of the research focuses on learning in virtual environments, learning with natural user interfaces and VR-technology, remote and virtual laboratories and other forms of computer and web based learning. Moreover, social aspects of learning in a higher education context are investigated. Here, the focus lies on mentoring concepts, students' mobility and service based learning methods. In all its activities, the research group considers the whole student life cycle, from pupils, bachelor- and master students up to doctoral candidates.
- The research group **Agile Management & eHumanities** deals with the application of Big Data Technologies in social sciences and humanities. The major effort is the use of computer-assisted processes and the systematic use of digital resources in these disciplines. The main emphasis is set on the field of Big Data Analytics in the context of social media. In order to manage continuously increasing complexity and dynamic in organisational structures the field of Agile Management investigates the application and the implementation of agile methods, techniques, principles and values. In the application area of the research on competencies, one the focus lies on the analysis of the "digital footprints" from employers and staff, which allows drawing conclusions on hidden profile characteristics ("Recruiting 4.0"). The identification of these hidden characteristics and their significance for tomorrow's job market are up to date research topics in this field.

The Associated Institute for Management Cybernetics e.V. – IfU used the opportunity to extend its research focus once more:

- The research team **Economic and Social Cybernetics** deals with cybernetic methods and tools for industrial applications. The main research topics include the assessment of organisational culture and structure, business model innovation and development of decision support tools. In the context of evaluation and decision support enhanced economic assessment tools including uncertainty and soft aspects and sustainability assessment tools are generated. In interdisciplinary research projects cybernetic tools and solutions for complex problems in collaboration with industrial and research partners are developed. The employed methods include system dynamics, viable system model, organizational culture assessment instrument (OCAI) and business model canvas. Furthermore, cybernetic tools for the development of sustainable product strategies, design of efficient organisational structure, culture based implementation of quality management, and change processes are applied.

- The research team **Technical Cybernetics** is a part of the Institute for Management Cybernetics at the RWTH Aachen University. Its research objectives are intelligent planning and control algorithms for technical systems. The focus is on mobile robotics within intralogistic applications as well as process planning and industrial robotics. Here the group addresses aspects of human robot interaction and collaboration. The main goal is to endow the respective technical systems with autonomy and situational awareness in order to achieve more robust behaviour and an increased flexibility while at the same time simplifying the interaction with those systems. (Multi-) agent technologies, closed loop control systems and visual servoing, and natural interface technologies play an important role. The research group also maintains the institute's school labs.

Our deepest thanks go to our scientific staff that with their enthusiasm, interdisciplinary skills and capability to think outside of the box, push the institutes' research forward. We also would like to thank our support teams from administration and technology who always have our back in our daily drudgery with forms, regulations and IT-troubles.

Aachen, September 2014

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