

Foreword

Dear Reader,

We are very pleased to present you the second book of our new series of the institute cluster IMA/ZLW & IfU named “Automation, Communication and Cybernetics 2011/2012”. As is the characteristics of the series, this anthology brings together our scientifically diverse and widespread publications over a time period of 24 months (July 2010–June 2012). Almost all publications are peer-reviewed and have been published in recognized journals or conference proceedings of the various disciplinary cultures. In spring 2011 we changed the organizational structure of our institute cluster IMA/ZLW & IfU.

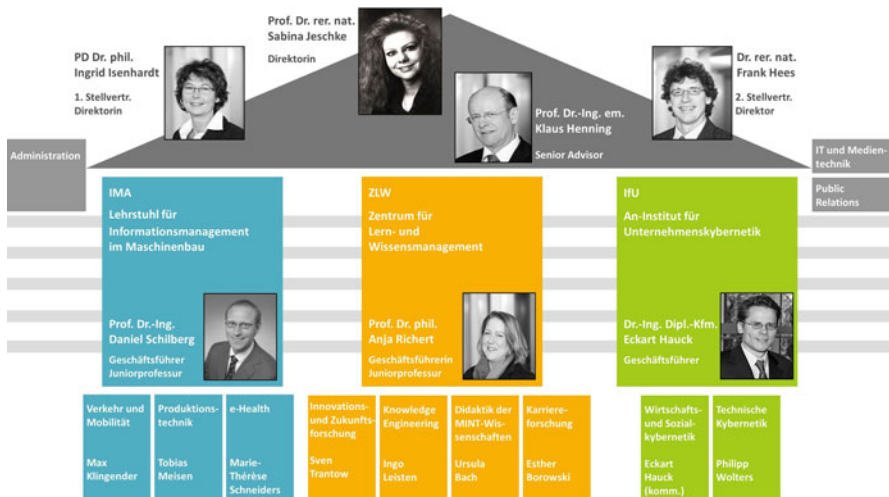


Fig. 1 Organizational structure of the institute cluster IMA/ZLW & IfU, RWTH Aachen University

After many successful years with a two-staged managing structure consisting of institute and division directors, the structure was changed on the 1st of April to a three-staged one – heads of institute, managing directors and research group leaders. There are many reasons for this reorganization, but the three main motives are: growth potential, implementation of a comprehensive PostDoc strategy and the focus of the research profile of the institute cluster.

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

- The aim of the research group “**Production Technology**” is to implement modern information technology concepts into production technology by combining skills of engineering and computer science as well as mathematics and sociology. A main focus of the research group is the development of methods and tools to integrate heterogeneous sensors, simulation and application data and to enable a consolidated and consistent analysis. The so called Virtual Production Intelligence makes use of these methods and tools to facilitate the transfer of information between human, machine and technology. Another focus of the research activity is the development of barrier-free user interfaces for web and automation systems. The aim is a user-centered software development process supporting the requirements of accessibility for users with disabilities or limited technology. Furthermore the research group addresses the integration of intelligent controls in technical production systems. Therein scientific findings from artificial intelligence, knowledge-based systems and cognitive research are adapted and optimized for the application field “production technology”.
- The research group “**Traffic and Mobility**” is working on solutions for accident-free driving, on the multimodal freight traffic of the future and on barrier-free mobility. In doing so, the interdisciplinary team includes current requirements like a higher resource efficiency and improved user integration into their solutions. Thereby competences of different disciplines are combined such as engineering science, computer science, sociology and economics. The research activities of the group “Traffic and Mobility” lead to concrete solution hypotheses for these solutions. The vision of accident-free driving could be achieved by heterogeneous networks of (semi-)automated vehicles. To reach the ideal of efficient freight traffic of the future, modular, worldwide usable loading units with appropriate transport carriers could be utilized. The applied methods of the research group range from driving simulation over dual design and acceptance/stress analysis up to the holistic consideration of the three recursion dimensions: human, organization 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** consists of engineers, economists as well as human and social scientists who research and develop information technology based

on solutions for medical care. Developing telematic support systems which are especially used in emergency medical services, the research group focuses on approaches of user-centred requirement management and develops appropriate system architectures as well as software solutions for the display of information. At the same time aspects of IT security risk management are considered and controlled. Another research focus is the scientific analysis of implementation processes of technologies and the use of prototypes in complex field tests.

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

- The research group “**Knowledge Engineering**” addresses the interaction between data – information – knowledge on the levels individual, team, organization, network and society. Thereto structures and processes are modeled and implemented which support and develop communication and cooperation. This application-oriented research leads to services and products, whereby customers and users are integrated iteratively and cooperatively into the solution process. The simultaneous design of the dimensions Human-Organisation-Technology enables a holistic, tailor made and systematic approach. Current fields of action include management and governance of clusters, diversity management in innovation processes and in the organization of work, measurement of performance as well as intellectual capital. Moreover, technical aspects of knowledge management such as semantic search and the design of (multimedia) learning environments are focused. The research group also provides consulting, moderation and coaching in organizational and strategy development as well as cooperation design and knowledge management.
- The research group “**Innovation Research and Futurology**” analyzes the socioeconomic trends, opportunities and challenges of tomorrow’s world of economy and work. Based on this knowledge, target-group-specific and practice-orientated concepts are developed to enable organizations, networks and teams to generate innovations and thus to ensure sustainable competitiveness. In doing so, all kinds of innovations are considered systematically, i.e. as complex interrelations between the dimensions human, organization, and technology. The development of customized and individual communication concepts allows an efficient transfer of research knowledge into economic practice. The research group provides support for scientific, economic and political organizations as well as individuals in the following topic areas: sustainable establishment and fostering of innovative capacity, monitoring of trends and foresight, holistic innovation management, organizational as well as communication development, support of social and organizational innovations, intellectual capital and knowledge balancing as well as transfer of knowledge and communication management.
- In an interdisciplinary team of communication and political scientists, engineers, sociologists and economic geographers 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 tutors, students, employers, intermediate organizations and other experts on university didactics, are integrated in our research activities.

- The interdisciplinary research group “**Career Research**” addresses the development and active organization of careers in research and industry. A special research focus is on the academic career and its further development in university and beyond as well as in the industrial context. Moreover, prevalent career structures, aspects of diversity as well as careers in different disciplines are focused. The research group “Career Research” also analyses the individual development of competences, especially the development of junior scientific staff and offers the continuous qualification of the scientific staff of the RWTH Aachen University for quality assurance in research and teaching.

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 the industrial practice. We develop solutions for complex problems in conjunction with industrial and research partners. In interdisciplinary research projects our rudiments are directly converted and evaluated by the involved companies. The focus is on analysing organizations with the aid of system models and the development of valuation methods to endorse decisions for example in investment or reorganization projects. Furthermore, the team deals with the development of operating business games which are used for the development and support of change processes. In conjunction with the research team of Technical Cybernetics these business games are technically converted.
- The research team “**Technical Cybernetics**” is a part of the Institute for Management Cybernetics at the RWTH Aachen University. It deals with the research and the development of technical solutions for complex systems. The focus is on controlling autonomous systems, cooperative robotics, technical implementation of business games and the optimization of complex systems in general. We explore how technical systems observe their environment through suitable sensory and how they may react on the environment through control loop based algorithms. Therefore, the research group focuses not only on individual and homogenous systems, but also on automated communication and coordination of heterogeneous systems. The harmonious cooperation of human and technology is a very important aspect. It plays an important role with regard to business games. Here the research team “Technical Cybernetics” deals with the development of platforms to facilitate integratively knowledge contents.

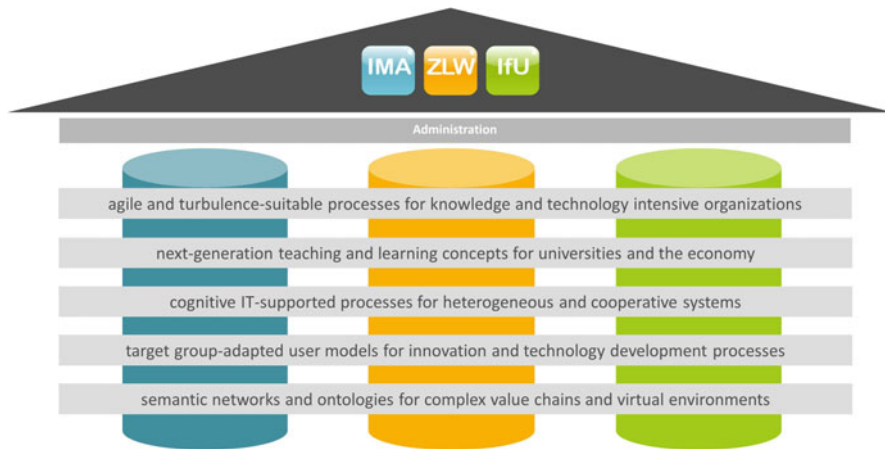


Fig. 2 The research fields across the institute cluster

As depicted in the upper matrix we maintained the concept of research fields that run across the institutes – horizontal to our organizational structure. These fields combine our competences in our interdisciplinary institute cluster and help us to structure the topics presented in this book. Our special appreciation goes to our team. It is their dedication, their passion, their scientific curiosity und last not least their dauntlessness which make this institute cluster to what it is.

Aachen, August 2012

Sabina Jeschke
Ingrid Isenhardt
Frank Hees
Klaus Henning

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