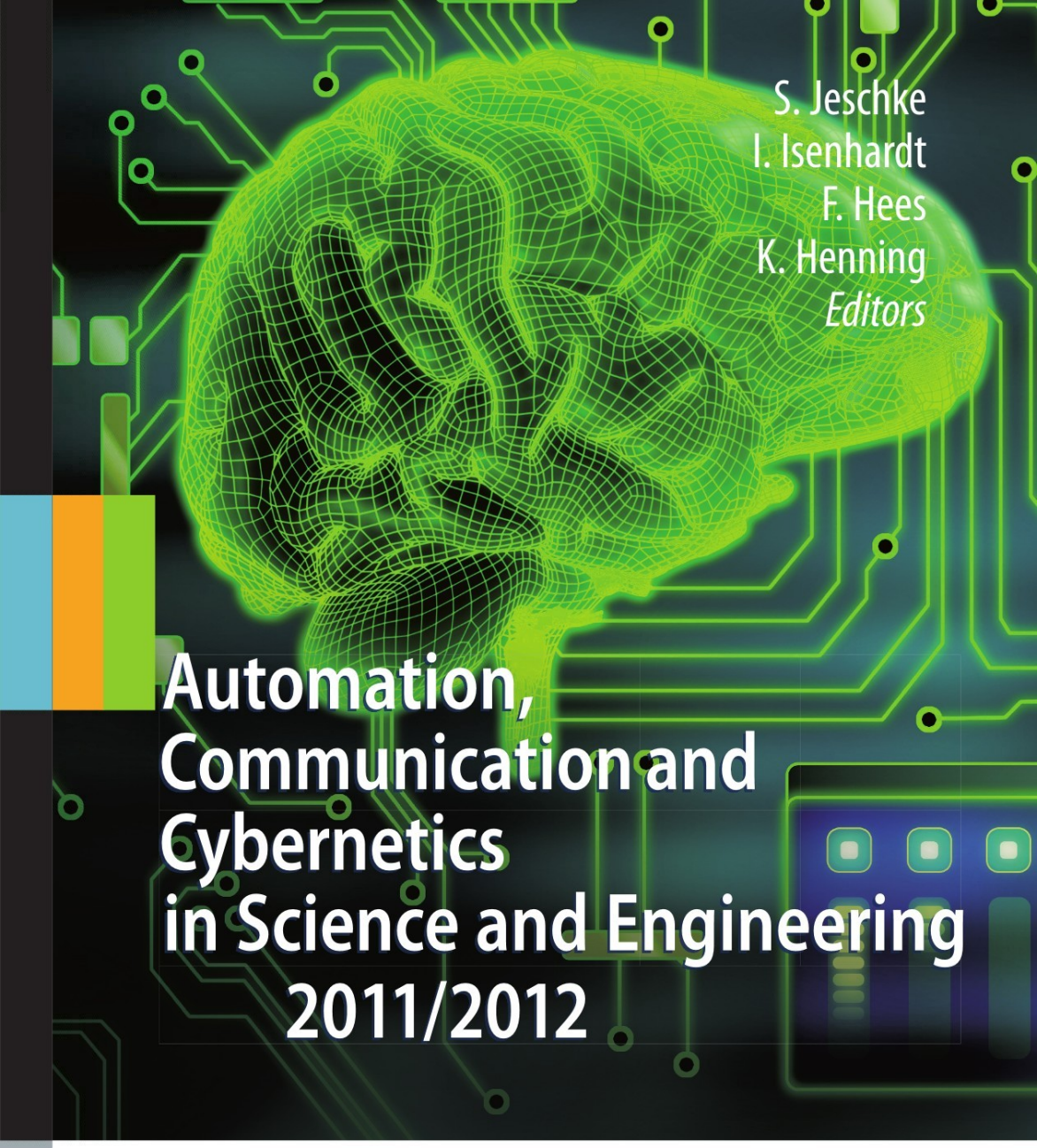

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Editors

Automation, Communication and Cybernetics in Science and Engineering 2011/2012

RWTH AACHEN UNIVERSITY

IMA ZLW IfU

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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.

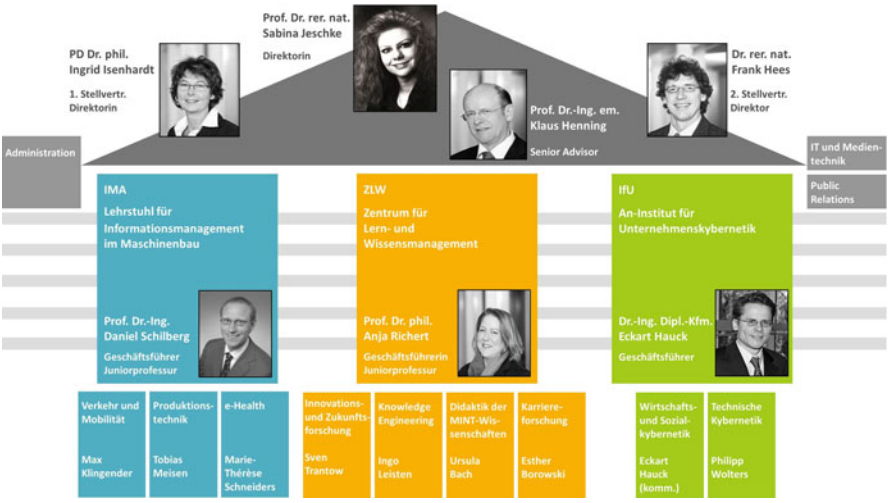

Fig. 1 Organizational structure of the institute cluster IMA/ZLW & IfU, RWTH Aachen University

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 hypothesises 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 socio-economic 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.

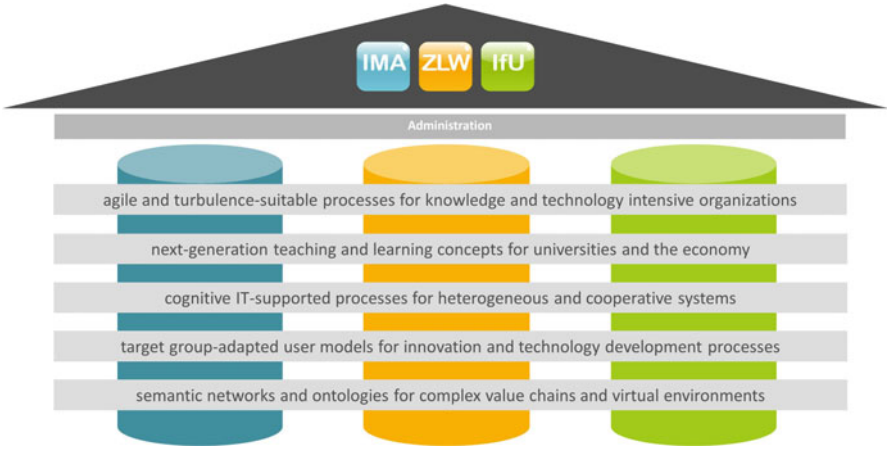

Fig. 2 The research fields across the institute cluster

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

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Part I
Agile and Turbulence-Suitable Processes for Knowledge and Technology Intensive Organizations

I Know Something, that You Do Not Know

Transfer in the Research Field Occupational Health and Safety

Ursula Bach, Ingo Leisten

Abstract Research on Occupational Health and Safety can look back on a long history. Unfortunately, the results of this research are not manifested in public consciousness. Today, the biggest challenge to a scientist is to guarantee successful transfer between the research field "Occupational Health and Safety" and the actors in the sphere of practice. We cannot face the challenge by producing still more knowledge and research results, instead we need to restructure the whole transfer and the process of researching. In German research you may find different best practice that helps to optimize knowledge management. These best practices build on a new understanding of knowledge transfer, so called "transfer engineering", and make use of systems theory and network management. Thus, research plans are structured in a novel manner, utilizing instruments of transfer in breadth and depth between scientists and practitioners and raising the visibility of a funding priority through its joint efforts on a topical core. These instruments of network management and transfer engineering will be the topic of this paper.

Key words: Occupational Health and Safety Research, Transfer, Knowledge Engineering

1 Introduction

Innovative research structures provide a possibility to better address and appeal to new stakeholders within the topic of Preventive Occupational Health and Safety, as for example health insurance, chambers of commerce or ministries. This means visibility of the research community can be increased at the network and society level. To reach the goals "better visibility of the research community", "improving

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integration of partners within research groups" and "avoidance of 'fragmenting' of a research community", the founding priority Preventive Occupational Health and Safety applied different network management methods [HLBH09]. The choice of network management methods is based on the needs of a research network in three specific network phases: phase of initiation, phase of stabilization and finally the phase of permanence. Every phase offers different challenges to network management. To support the efforts of the network, a transfer project was initialized. This special research meta-project StArG (Strategischer Transfer im Präventiven Arbeits- und Gesundheitsschutz, engl. Strategical Transfer in the field of Preventive Occupational Safety and Health) provided research results on transfer in breadth and depth for network management and research communication.

2 Stakeholders of Preventive Occupational Health and Safety and Transfer in Breadth

Transfer in breadth is an important factor as it centers on the stakeholders of Preventive Occupational Health and Safety. The goal of transfer in breadth is to steer public discussion towards the need for Preventive Occupational Health and Safety to be integrated into entrepreneurial practice and thus to point out the need for action to the individual enterprises. According to Freeman [Fre84], the term "stakeholder" is defined as "any group or individual who can affect or is affected by the achievement of a [corporation's] purpose". The influence of the individual groups of stakeholders is strongly dependent on the framework conditions within the individual enterprise/project as well as on the interaction between the individual stakeholder groups [Bal]. Within Preventive Occupational Health and Safety, stakeholders are e.g. branch-specific and inter-branch interest groups and associations, public and political institutions, health insurance funds and companies or trade and workers' unions. All of these stakeholders have requirements and demands towards enterprises and their measures on Preventive Occupational Health and Safety. In order to design a target-oriented transfer in breadth, we have to identify such stakeholder groups as are individually relevant. Special efforts have to be made to incorporate intermediaries into the transfer process to make use of their potential to achieve a lasting awareness of the notion of prevention in all stakeholders. Measures for transfer in breadth should be aimed at these stakeholder groups to raise their awareness for requirements in the area of prevention and thus to strengthen their positions. Figure 1 shows examples of stakeholders and their requirements in Preventive Occupational Health and Safety. Enterprises will have to identify these stakeholders against the enterprise-specific framework conditions.

Embedding the notion of prevention into an enterprise is effected by matching enterprise-specific design components. The integration into business procedures and structures of aspects relevant to prevention necessitates redesigning the components of the social system consisting of the individual person, organization, technology, information, tasks, decision system, rewards and supervision [HM]. Here, all de-

Fig. 1 Depiction of new actor and institutional constellations based on the Transfer Diagnostic Workshops held by the StArG meta-project

sign components are verified regarding their relevance for Preventive Occupational Health and Safety and adjusted where necessary. As the individual design components are heavily cross-linked, an adequate complexity dimensioning of the components among themselves must be achieved [SH92]. Successful transfer in breadth of Preventive Occupational Health and Safety addresses enterprise-specific stakeholders at this very point. This is why the central task of actors within Preventive Occupational Health and Safety is to identify the individual stakeholders and to sensitize them through methods of transfer in breadth.

3 Research Network Preventive Occupational Health and Safety

3.1 Research Networks and Their Requirements

When choosing its management methods, the funding priority understood itself as a research network, as it shows network-specific characteristics. Network theory gives four characteristics research networks have to feature in order to be referred to as such [Jan04].

1a) Research networks consist of several individually disjunct network partners.
2a) These network partners are related through regulated prearrangements.
3a) The network partners have the possibility to use synergies, e.g. through resource sharing or knowledge exchange.
4a) The network partners have a technological or social subsystem.

Regarding the research network Preventive Occupational Health and Safety, these four characteristics can be translated as follows:

1b) The research network "Preventive Occupational Safety and Health" consists of 18 joint research projects and nine individual research projects that work on diverse research outcomes and approaches within various research institutions and enterprises from diverse scientific disciplines [the09].
2b) The content-related relationships of the various projects are regulated through the composition of the focus groups. The relationships built through the funding priority and supported by regular events are initiated, organized and carried out by the meta-project (for an overview on the activities of the funding priority see www.starg-online.de).
3b) The individual network and research partners have a multitude of possibilities to use resources within the funding priority, e.g. through joint surveys and synergetic public relations work or through annual conferences that serve as a platform for joint scientific work on topics of "Preventive Occupational Health and Safety".
4b) The social sub-system of the research network is created by the structures of the funding priority. The technological sub-system is created among others through the interactive exchange and discussion platform as well as through the material resources of the individual projects.

The following goals are generally intended when initiating research networks: Better integration of the joint research participants and "avoidance of 'fragmentation'" of a research community [Hue03]. In joint research, a better integration generally means a better cooperation between science and entrepreneurial practice. In the case of the funding priority "Preventive Occupational Health and Safety" broader-ranging aims are intended: To contribute to the competitive ability of German economy, to counter economic losses through insufficient preventive occupational health and safety measures and to stay abreast of changes in the modern work environment [BMB09].

The choice of network management methods thus has to allow for the project goals as well as the necessities of a research network during the individual network stages.

According to Ahrens et al. [Aea04], a research network, once approved, runs through three stages: the initiating phase, the stabilizing phase and the permanent phase. The initiating phase lays the foundations for joint work. Here, mutual trust is established and first attunements are made regarding thematic decisions, division of labor or structural agreements. The stabilizing phase is the most productive stage of a network. The chances for utilizing resources have become clear and trust can