SCIENTIFIC COOPERATION ENGINEERING IN THE CLUSTER OF EXCELLENCE INTEGRATIVE PRODUCTION TECHNOLOGY FOR HIGH-WAGE COUNTRIES AT RWTH AACHEN UNIVERSITY

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Abstract

Interdisciplinary scientific cooperation plays a decisive role for the generation of new knowledge. The augmenting dynamic and complexity of scientific forms of cooperation require new approaches for interlinking people and knowledge from different disciplines to enable people for succeeding in interdisciplinary cooperation. Concerning the case of the cluster of excellence *Integrative Production Technology for High-Wage Countries* at RWTH Aachen University this challenge is addressed by cross sectional processes (CSP). CSP are supporting networking processes and strategic cluster development by means of learning and knowledge management. Through cross-sectional activities, a new method for knowledge and organizational development was identified – *scientific cooperation engineering.* It aspires to support the transfer of highly complex, dynamic and interdisciplinary research cooperation into sustainable and robust structures. The design of *scientific cooperation engineering* will be outlined in this position paper.

Keywords: Knowledge and Cooperation Engineering, Interdisciplinary Innovation Management, Diversity Management, Performance Measurement.

1 INTRODUCTION

Scientific cooperation engineering depicts a new method enabling knowledge and organizational development for interdisciplinary clusters of excellence. The latter are part of the German excellence initiative[1]. The two main objectives of the case study – the cluster of excellence *Integrative Production Technology for High-Wage Countries* at RWTH Aachen University – are:

- the resolution of the polylemma of production[2] from a complexity and socio-technological perspective,
- and the design and operation of economically, ecologically and socially viable production systems in high-wage countries [1].

[1] The excellence initiative was started in 2005 by the government and federal states. It is divided into three funding lines: graduate schools, clusters of excellence and future concepts for top-level research.

[2] The resolution of the polylemma of production considers two dichotomies. The first dichotomy: scale and scope describes the contradiction between the realisation of a high variety of customised products and the cost-effective manufacturing of mass products. A second dichotomy exists between plan orientation (the objectives of lower-level entities are highly synchronised) and value orientation (highly dynamic production systems).

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The research consortium of the cluster comprises 25 principal investigators/professors from five departments of RWTH Aachen University and associated institutes [1; 2; 3]. The fusion of different competences, knowledge, heterogeneous objectives of institutions and actors (e. g. professors, chief engineers or research assistants), a wide range of scientific experience as well as different cultures concerning scientific and operative working, are cluster-specific characteristics. Due to these characteristics, *scientific cooperation engineering* is implemented to interlink different research areas aiming at establishing sustainability concerning the aspects: people, science and structures.

2 CLUSTER-SPECIFIC SECTIONS OF SCIENTIFIC COOPERATION ENGINEERING

Core activities of *scientific cooperation engineering* are generated from results of an accompanying research project in the first funding period of the examined cluster [3; 4; 5]. Here, a prototype model[3] was developed specifying design elements and cluster-specific measures for the management of cross sectional processes (CSP). The initiated measures are supporting the stabilization of the cluster of excellence and the efficiency of the scientific working processes. Within the accompanying research project of the prototype model e.g. one research question dealed with the challenge of high staff turnover. The latter has to be considered during the entire funding period.

Thus the overall objective of *scientific cooperation engineering* is to set up sustainable personnel and organizational structures for scientific cooperation leading to the super-ordinated research question [1]: *Which actions are necessary to support the transfer of highly complex, dynamic and interdisciplinary research cooperation of the cluster of excellence into sustainable and robust structures?(cf. Fig. 1).*

Fig. 1. Sections of scientific cooperation engineering in the cluster of excellence

To cope with this challenge the following tailor-made sections of *scientific cooperation engineering* were identified for the cluster of excellence *Integrative Production Technology for High-Wage Countries*: knowledge and cooperation engineering, interdisciplinary innovation management, diversity management and performance measurement (cf. Fig. 1).

2.1 Knowledge and cooperation engineering

Knowledge and cooperation engineering comprises the interaction of data, information and knowledge on all organizational levels to support sustainable personnel and organizational structures.

Knowledge and cooperation engineering refers to engineering methods e. g. originating from product development, service engineering and user centered design to develop tailor-made measures by integrating the cluster-specific end users in an iterative manner. The section addresses the scientific elaboration of knowledge retrieval concepts as well as the development of automated knowledge retrieval processes and ontology-based tools. This e.g. includes web-based knowledge maps to promote a multiple and digital form of scientific interlinking and to reduce individual efforts for searching cluster-specific information. The initiation and editorial assistance of a cybernetic cluster method suite (containing all cluster-internal methods used) as well as the implementation of approaches supporting the definition of common terminologies like an interactive glossary will be developed. Moreover, the conception and organization of e. g. cluster-specific colloquia and strategy workshops – partly opened for external stakeholders – will be executed. To collect and exchange

[3] The prototype model was composed by the synthesis of a literature analysis as well as an empirical approach triangulating cluster-specific data resulting from direct and indirect evaluations and structured interviews. This enabled the identification of tailor-made sections of *scientific cooperation engineering*.

interdisciplinary knowledge, standardized methods will be implemented and evaluated as cluster-wide tools. One of the first tools to be implemented is based on a *Flow-Chart* approach combined with a small set of *Research Questions* orientated on the specific problem.

2.2 Interdisciplinary innovation management

Interdisciplinary innovation management measures, visualizes and manages the integration of experts from different scientific cultures and disciplines within the cluster.

Therefore the trade-off between disciplinary and interdisciplinary excellence has to be balanced. In order to promote and support possible synergetic opportunities, collaboration interfaces of actors have to be identified. With a qualitative and quantitative method suite participant positioning, publication strategy as well as disciplinary and interdisciplinary method competence and composition are individually determined, abstracted and generalized and integrated into an adaptive interactive model of the cluster's configuration and performance. In order to generate findings from this model and provide customized feedback a visualization suite is constructed. Thereby rules of successful interdisciplinary cooperation are derived and fused into a set of interactive interventions, such as method trainings, interdisciplinary publication workshops and change of perspective seminars. This process will converge into the so-called interdisciplinary school of methods addressing research-, communication- as well as cognitive methods.
The interdisciplinary school of methods focuses on cybernetics as an overall methodological approach of all scientific partners within the cluster. Seminars will be offered for different groups of actors in dependence of their respective level of experience. They will focus on operative skills for working in interdisciplinary environments, scientific methods for researching and publishing in interdisciplinary environments as well as cybernetic methods to expand the high quality of scientific cluster outcome.

2.3 Diversity management

Diversity implies the terms age, gender and culture. It aspires to establish diversity as a source of innovation and a measurable and utilizable competitive factor for science and production.

The successful development of interdisciplinary solutions is supported by a high level of heterogeneity concerning the actors and institutions involved in the cluster. Therefore a fundamental new understanding of the product and production technology linkages of the stakeholders involved is necessary. Whereas diversity was defined by aspects like age and gender in the first funding period, the CSP expand the term diversity management with the aspect of culture in scientific teams. Within the cluster of excellence, researchers from different countries and with various scientific backgrounds need to be supported enabling a level of debating and strategy to succeed. An empirical study will be designed to evaluate the performance of these multinational and interdisciplinary teams. Based on publications from the first funding period, the influence of mixed cultural and professional teams on the manner of publication is to be analyzed. A subsequent expansion of the study to other clusters and major research facilities is imaginable. The results shall serve to recommend methods for performance measurement and optimization in international task groups and thus install diversity as source of innovation and measurable and utilizable competitive factor for science and production.

2.4 Performance measurement

Performance measurement aspires to contribute to steering and regulation the integrative research processes and outputs in order to support sustainable cluster structures.

Preliminary, performance depicts the consequence of efficient and effective actions on all service and decision-making levels of an organization to satisfy plural interests concerning multidimensional objectives such as finances, quality or processes [6]. Additionally, it concerns the quality of benefits for stakeholders [7]. Performance measurement constitutes a process of quantifying efficiency and effectiveness of an action [8]. In the context of scientific cooperation engineering, performance measurement aims to support the management, steering and regulation of highly complex scientific cooperation. Thus far, the implemented prototype of the cluster-specific prototype aspires that this goal can be achieved by three approaches:

- a cluster-specific Balanced Scorecard for cluster-internal performance measurement [9],
- a benchmarking approach for cluster-external performance measurement [7]
- and the development of methods and concepts analyzing quantity and growth of intellectual capital and knowledge gaps within the cluster of excellence [10].

The iterative development of the three approaches will complement the previous prototype. It is aspired to culminate this into an integrated strategy planning tool facilitating an advanced management of the entire cluster of excellence in future.

3 OUTLOOK

Scientific cooperation engineering contributes to the resolution of the polylemma of production by interlinking people and knowledge from different disciplines to enable people for succeeding in interdisciplinary cooperation. The next step of *scientific cooperation engineering* is to initiate a further development considering the main principals of cybernetics [11; 1]. To support sustainable and robust structures the approach of *scientific cooperation engineering* will also face the challenge of transfer to other clusters of excellence and comparable forms of collaborative research, bearing in mind that a combination of generic and tailor-made elements is necessary.

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