



Management of an Industry-University-Cluster: ruhrvalley

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Abstract

The Ruhr Valley (or Ruhr Area – Ruhrgebiet) is one a Europe's largest and most important metropolitan regions. As the former industrial heartland of Germany it has undergone a tremendous structural change. It is an example of a multi-centre, diverse city cluster and therefore an excellent case study for urbanization as the pre-dominant organizational pattern for human ecosystems. The university-industry-cluster *ruhrvalley*³⁸ has been founded to foster the development of the Ruhr Valley with a focus on sustainable, efficient and modern mobility and energy by using the means of the digital transformation. For future metropolitan mobility and energy systems it is crucial to promote and support the cooperative work of interdisciplinary teams of scientists, engineers, but also business experts, ecologist, politicians, and – finally – the citizens. Therefore, a joint understanding of such systems and a development process with inclusion of all relevant stakeholders is a key issue. The joint efforts of ruhrvalley in doing so are based on a holistic view on mobility and energy systems inspired by a very general architecture model of socio-technical systems and a respective systems engineering methodology. The cooperation in ruhrvalley is orchestrated by a portfolio of cooperation projects of industry partners and university researchers. In addition, educational formats, information and communication activities and social engagement events with citizens are implemented. The finances are based on a combination of public and private funding. Consequently, the management of the cluster is based on a *projectized* approach and supported by project portfolio management, professional project management and controlling and the design of a variety of innovation and education formats. The management is conducted by a central project office which works in close interaction with the companies, the research institutes, the university administration, the public authorities and a high number of supporting organizations. In addition, formats for legal entities for the long term cooperation are developed. This paper will present the assumptions and the concept for the cluster management, as well as the different project and cooperation formats and the strategic portfolio and project management approach.

Keywords: *Public-Private-Partnership project management, university-industry-cooperation, triple-helix-systems, innovation projects*

Introduction

The Ruhr Valley has undergone a tremendous structural change in the past decades [10,18]. It used to be the steel and coal region of Germany, dependent on a few resource intensive industrial conglomerates. This socio-economic system went down already 50 years ago. Politics placed a number of universities and research institutes into the region, beginning in the 1970's. The aim of this approach was and is to transform one of the largest and most important metropolitan areas of Europe into a modern, science- and technology oriented region. Therefore, it is part of the mission of the Ruhr universities to participate in this development and to be a driver of change, transformation and innovation. Forming industry-university-clusters on certain topics and combining it with research, education and the so-called "third mission" of universities [1][3] is a proven way of fostering the necessary transformation. Universities of

³⁸ see www.ruhrvalley.de, the author is currently speaker of the university-industry-partnership



Applied Sciences (German: Fachhochschule (FH)) have a specific role within the innovation system, since they put a natural focus on third mission topics [15, 20]. Their main focus is the transfer of innovative scientific findings into application by educating people and doing transfer oriented research. With this mission they form a bridge between science and industry (and society). The educational profile put an emphasis on job-related programmes, mainly in Bachelor's and Master's education. This leads to an excellent employability of graduates and a strong stimulus into the regional innovation system. It is complemented with transfer oriented research in close cooperation with industry. The regional profile of the Fachhochschule lowers the barriers for technology oriented start-ups and small- and midsize enterprises (SMEs) in cooperation. Therefore, universities of applied sciences are strong in the main domains of the "Third Mission" [1,3] of universities: 1) Technology Transfer and Innovation, 2) Continuous Education and 3) Social Engagement.

For the transformation of the Ruhr Valley it is straightforward to assign the role of intensive industry-university-cooperation to the local universities of applied sciences. This assignment is not in competition but in addition to the strong research and cooperation activities of the much larger classical and technical universities of the region (e.g. TU Dortmund, RUB Bochum, University Duisburg Essen, who are members in the University Alliance Ruhr (UAR)) and the various research institutes. Universities of applied sciences can add to this elaborated regional innovation system due to their focus on applications of scientific results and their openness for smaller projects and partners. In addition, the common concern about commercialisation and profit taking precedence over the creation of wider societal value added [2] is usually easier to solve in the very concrete cooperation formats. Therefore, universities of applied sciences live the Triple Helix [4,13] system on a regional scale already since two decades. Nevertheless, they still need an institutional framework for these activities which allows them to change from regional educational institutions into real Mode 2 [4] institutions that put transdisciplinarity [6] into their DNA. Moving outwards of the university into the regional socio-economic system and becoming a real partner within the ongoing transformation and change process is a challenge even for the larger universities of applied sciences and therefore an interesting topic for research about how to approach this challenge.

Within the dense innovations system of the Ruhr Valley it makes sense to form alliances for that. The three largest universities of applied sciences in the Ruhr Valley (Hochschule Bochum, Fachhochschule Dortmund, Westfälische Hochschule) with 7 research institutes and together with more than 40 companies have formed an industry-university-cluster targeting both research and education – called *ruhrvalley* [20,21]. It addresses the great challenges of a metropolitan region since the Ruhr Valley is one of the largest agglomerations of Europe [19]. Urbanization is the pre-dominant organizational pattern for human ecosystems [18]. The focus of the *ruhrvalley* cluster is the transformation of mobility and sustainable energy for such de-central, highly diverse and distributed environments. The digital transformation is a major driver for this change. Apart from technical solutions, the aim of *ruhrvalley* is a more comprehensive approach integrating the citizens, the socio-economic change, the relevant business models and the respective target setting structures. At the end, *ruhrvalley* strives for a holistic systems engineering methodology for metropolitan mobility and energy system,

Management Process for Socio-technical Systems



The joint efforts of ruhrvalley in fostering innovations for future metropolitan development are based on a holistic view on mobility and energy systems inspired by [12][16]. Ropohl developed a very basic analysis and structuring of *systems* in his description of a systems theory of technical systems (called “Technology at large”) [16]. He provides a three-layer-model (see Fig. 1) of a general activity system – which can be a technical system, any ecosystem or even a biological system. The basic execution system deals with the “things” or the interaction with the “real world”. The information system could be IT or a nervous system in biology. We can easily guess that it would be the layer connecting the things in the Internet-of-Things (IoT). The target setting system is a kind of a “brain”. In technical systems, it can be seen as the place where data analytics (in some case with “big data” methods – another buzzword) or artificial intelligence methods find their place. It can be the place where the user or the socio-economic system comes in. In general – for a metropolitan mobility and energy system – the execution system would contain the producers and consumers (or prosumers, if combined) of energy and mobility, meaning the technical systems (things) as for example cars, solar panels, charging stations or heat pumps. The information system would deal with the secure and reliable exchange of information, e.g. where energy is needed, where cars are stuck in traffic jams, or who has to pay what to whom. This “system” contains technical parts but also business models. The target setting system is not necessarily just a technical analytical or decision making tool. It can be a political or regulatory system, too.

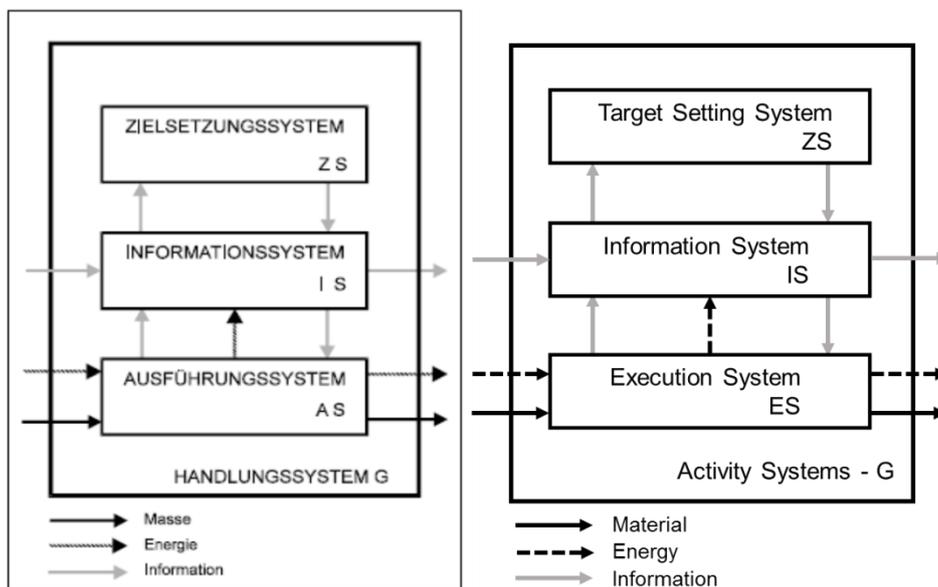


Fig. 1: **Original German version (left) of the technology stack according to Ropohl [16] and own English translation (right).**

The industry-university-cluster ruhrvalley is not only trying to develop such a systems engineering approach. The aim is transfer into application. Therefore, it is crucial to enable the players in the region to use the process and it is crucial to tailor and adapt the *ruhrvalley systems*



engineering [21] in a way that makes it applicable within different domains. In technology development, ruhrvalley systems engineering connects to model based systems engineering for intelligent technical systems, as described in [12]. The Operator-Controller-Module (OCM) system stack is a kind of an instantiation of the technology stack according to Ropohl. The connections to mechatronics systems development or to cloud- and IoT-based IT are clearly visible [21]. In addition, the Ropohl model connects very well to target driven innovation management [11]. For ruhrvalley – as a holistic approach – the connection to the management and change process for socio-economic systems is crucial, too. Especially modern participative methods for decision making, target setting and development have to find a seamless connection. Stakeholders such as customers, citizens and decision makers become co-producers [17] of the solutions. The management and development of the industry-university-cluster ruhrvalley needs to be synchronized with the systems engineering since ruhrvalley serves as a case study for the methodology, a training ground for all partners and a tool for promotion. The industry-university-cluster is the means to put the ruhrvalley systems engineering into application and to make it a success.

Requirements for the Management of an Industry-University-Cluster

The management of the industry-university-cluster ruhrvalley supports its role as a test bed and development environment, as an innovation incubator, as a training ground for the players and as a driver for cooperation. To make the cooperation successful, an intensive interaction between all partners within strategically chosen cooperation formats has been designed. It is orchestrated by a portfolio of cooperation projects of industry partners and university researchers. In addition, educational formats, information and communication activities and social engagement events with citizens are implemented. The finances are based on a combination of public and private funding.

The underlying operation principle of the industry-university-cluster ruhrvalley is following to some extent existing examples, e.g. the EIT Knowledge and Innovation Communities (KIC) [8] or the Germany's Leading-Edge Clusters/Spitzencluster [5]. The aim is to define cooperation and interaction formats for the partners, to get their commitment and involvement and to make them drivers of the cluster by assigning target setting and decision making to them. This leads again to the definition of a "system" which can be addressed with the 3-layer-model (Fig. 1).

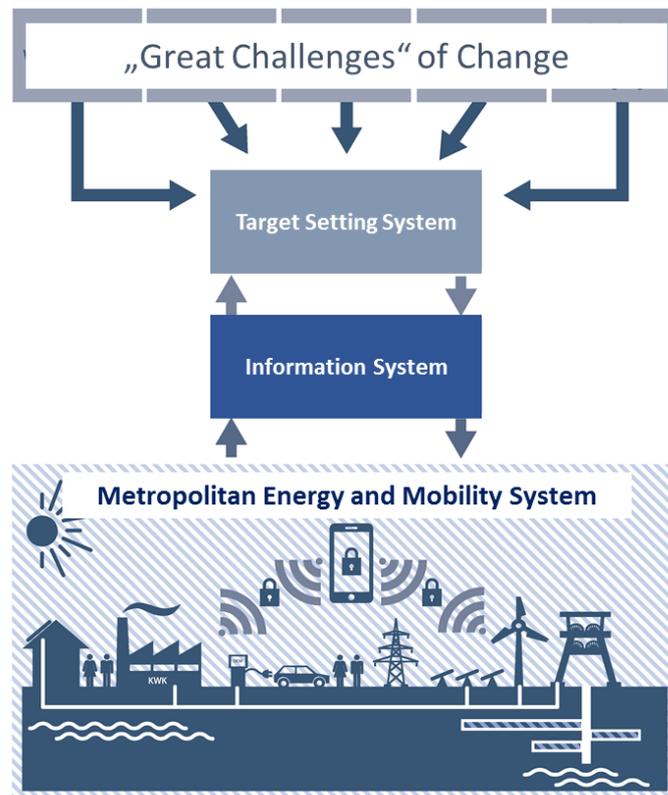


Fig. 2: System stack for “metropolitan energy and mobility systems” acc. to Ropohl [16]

For ruhrvalley, this leads to a number of requirements for the management system:

- ruhrvalley is organized in a “projectized” way. Reaching the goals is assigned as targets to projects. The partners interact in projects. Projects deliver results (to other projects, to the partners, to customers, to ruhrvalley). This leads to the requirement of having different types of projects and a professional, effective and efficient project management.
- The strategy is implemented into a project roadmap. Projects are defined, executed and controlled within a project pipeline. This project pipeline and the respective stage-gate-process for moving the projects through the pipeline serve as an innovation funnel (as successfully used in the previous PIMES research team [23]). A trend radar helps to identify and prioritize what needs to be fed into the project pipeline next.
- The ruhrvalley approach is not just about generating innovations. For a sustainable partnership development the innovation transfer via people development is a very important. Therefore, the industry-university-cluster is combined with the Ruhr Master School [22] and further programmes in continuous education.
- To develop the partnership, it builds practice and trust by generating a high density of interaction amongst the partners with tailored cooperation and interaction formats.



Projectized Management System

The projectized interaction and cooperation system of ruhrvalley is based on the assumption that consortia and partnerships are formed by the interaction of “circles” of partners which are quite often long-term, mature and trustful groups or systems. These circles have their specific procedures, traditions, standards and modes of operation and cooperation. Innovation is generated, if these circles are put into contact and cooperation in new ways. This can be done by setting up joint projects. Nevertheless, due to the different traditions and procedures of the involved circles, the project formats need to be tailored to fit to the cooperation. In the beginning, this can be a bit “artistic”. Managing the interaction of the circles with all the different project and interaction formats is a kind of “project circus” which is orchestrated by the management system of ruhrvalley.

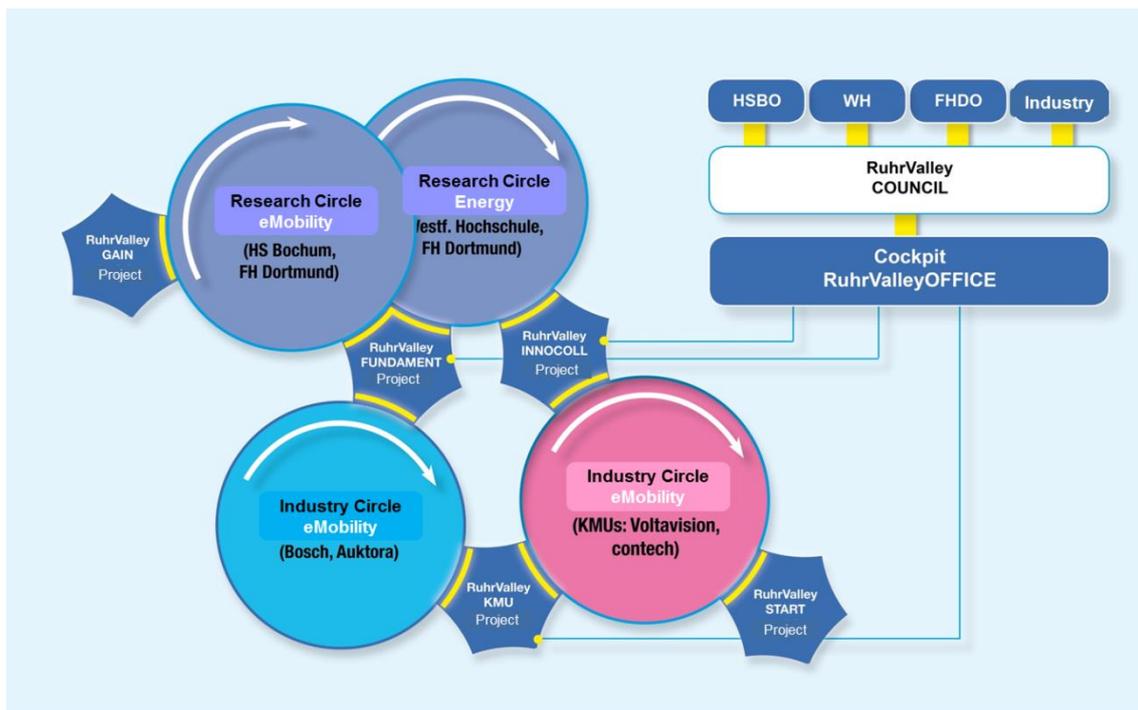


Fig. 3: „Project Circus“ as a projectized tool for university-industry cooperation [22]



<i>Project Format</i>	<i>Type</i>	<i>Description</i>
RuhrValleyFUNDAMENT	R&D	FUNDAMANT-Projects are typically 2-3 years R&D projects in consortia of industry and university partners. They have a clear development goal and a dissemination and exploitation plan to plan the transfer into application. The projects are also a training ground for cooperation amongst consortia.
RuhrValleyFLOAT	R&D	FLOAT-Projects have a strong research focus and are not necessarily close to application. They lay the foundations for later FUNDAMENT projects.
RuhrValleyGAIN	Recruit	The GAIN instrument puts a focus on getting the right experts into the ruhrvalley. It combines different instruments for attraction and recruitment.
RuhrValleyFREE	Experiment	The instrument FREE serves as a pool with several small tools for enabling innovations and projects. This can be headcount/time, money, technology (e.g. labs) and consulting.
RuhrValleyINNOCOLLEGE	Train	The INNOCOLLEGE is an instrument for training, continuous education and conversation. It is attached to the Ruhr Master School which serves as a major recruitment basis.
RuhrValleySTARTUP	Transfer	The format STARTUP combines consulting, training and finance for entrepreneurship and setting up new companies.
RuhrValleyKMU	Transfer	RuhrValleyKMU addresses small and midsize enterprises (SME) with specific project formats which allow the transfer of innovations from ruhrvalley into marketable products.
RuhrValleyMANAGEMENT-OFFICE	Manage	The MANAGEMENTOFFICE is the coordination centre of the activities in ruhrvalley. It is complemented with the RuhrValley CORE TEAM, the RuhrValley STEERING BOARD and the RuhrValley CONVENTION.

Table 1: Set of project and interaction formats for the orchestration of cooperation

The orchestration of the ruhrvalley is done by the MANAGEMENTOFFICE which serves as a project and programme office. The main duties are:

- The management of the project pipeline, including set up of new projects and doing reviews and decisions according to the stage-gate-process. This involves the reporting to the partners and to the public authorities in case of publicly funded projects. It involves reviews according to milestone checklists and release documentation.
- The controlling and monitoring of the activities including the financial controlling and reporting and the controlling according to the ruhrvalley scorecard.



- The support of the speaker of ruhrvalley who is the head of the CORE TEAM at the same time. He is supported by the managing director who is heading the MANAGEMENT OFFICE and driving the main operations.
- The support of the STEERING BOARD which involves representatives of the universities, the involved companies and public bodies (chambers of commerce, cities, foundations). It serves as a supervisory board and controls the activities of the speaker, the CORE TEAM and the MANAGEMENT OFFICE. It takes the strategic decisions for the further development of ruhrvalley.
- The support of the CORE TEAM which is headed by the speaker, with support of the managing director and relevant members of the MANAGEMENT OFFICE and the administration of the involved universities. Furthermore, the project managers of all projects in ruhrvalley are member of the CORE TEAM. It takes care of the operational tasks in managing ruhrvalley, e.g. granting milestone releases and submitting reports to public authorities. The vice presidents for science and research of the universities and the directors of the involved 7 university institutes are optional members of the CORE TEAM, too.

The 7 university institutes are the scientific foundation of ruhrvalley. They cover the whole technology chain of the 3-layer-systems architecture according to Ropohl [16] and also of the respective 3-layer Operator-Controller-Module (OCM) technology stack according to [12]. All institutes have a strong application driven R&D approach and all of them operate Master programmes within the Ruhr Master School [22]. They have set up more than 15 spin off companies in the past who are core members of ruhrvalley, too.

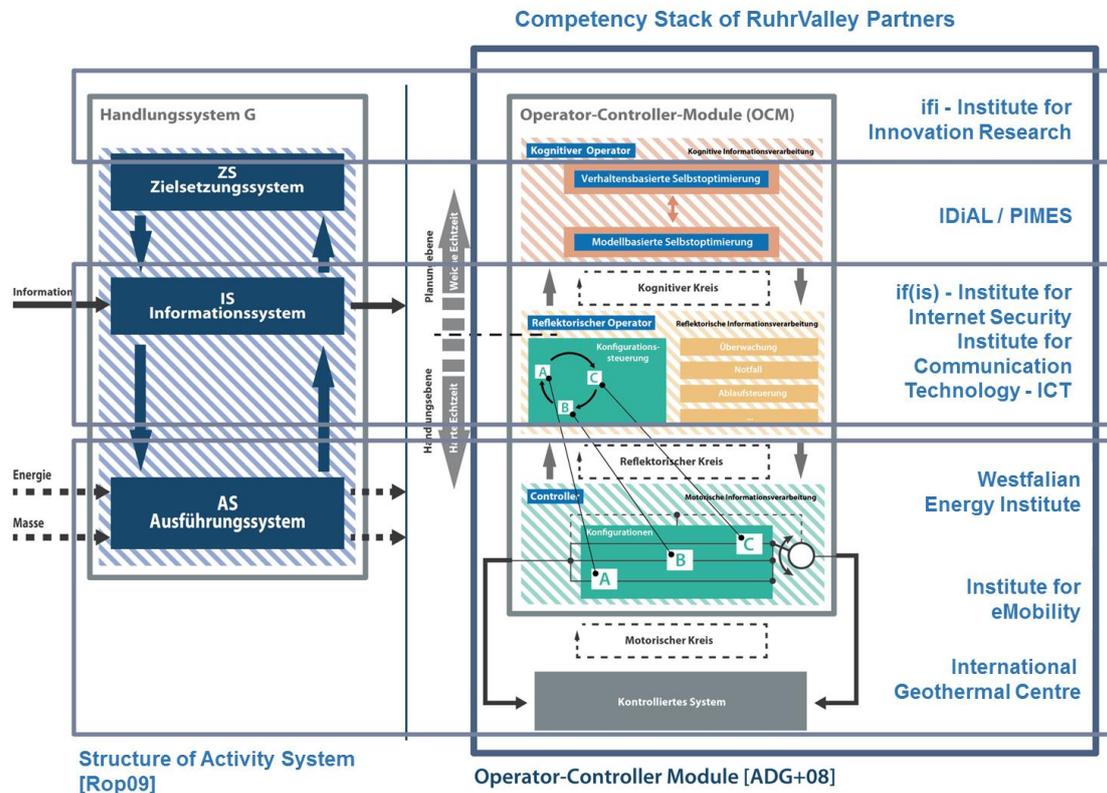


Fig. 5: **University-industry-cooperation “RuhrValley”**, based on 7 research institutes from 3 partner universities – covering the complete technology chain [21]

The management and organisation of ruhrvalley has several similarities to other industry-university-clusters or similar forms of cooperation:

- Germany’s Leading-Edge Clusters (Spitzencluster) set up by the Federal Ministry of Education and Research (BMBF) are (on a larger scale) combining national and regional enterprises with classical and technical universities and research institutes [5]. There are 15 clusters all over Germany addressing different technology domains and regions. The ruhrvalley cluster cooperates closely with two of the clusters, the EffizienzCluster on logistics in Ruhr Area and the cluster Intelligent Technical Systems OWL (where the OCM architecture models origins from). They have similar management structures with a management office and the different boards.
- The EIT Knowledge and Innovation Communities (KIC) of the European Research Area (ERA) [8] are larger than the German Leading-Edge Clusters and cover regions all over Europe based on an application domain (or great challenge). In addition to elaborated management structures they host Master Schools with a similar concept as ruhrvalley.
- The German Fraunhofer Institutes [9] form industry cooperations and put a strong emphasis on application domains. They organize similar concepts like ruhrvalley but usually within one institute and with a focus on commercial R&D. With the Fraunhofer-



Anwendungszentrum (application centre) they expand their regional footprint and address specifically SMEs.

- The Chinese Science and Technology Parks (e.g. with the Research Institute of Tsinghua University in Shenzhen (RITS) with their Leaguer Science and Technology Parks[14]) form a very elaborated pipelined system of innovation, finance and commercialisation. The finance component is much stronger than in the German clusters with a focus on successful IPOs of the start-up companies.
- The German “Gesellschaft für internationale Zusammenarbeit (GIZ)” has developed guidelines for innovation clusters formed by SME. Research institutes are additional partners while the SME govern and lead the cluster [7].

The industry-university-cluster ruhrvalley intends to learn from these examples and is striving to form an example, too. For that purpose, it is funded by the Federal Ministry of Education and Research (BMBF) after being selected as one amongst ten German clusters headed by universities of applied sciences (Fachhochschule) within the BMBF programme FH IMPULS. Nevertheless, ruhrvalley is not only funded by public money. In addition to the 5 Mio EUR from BMBF (for the first 4-year-cycle, afterwards another 4-years-cycle with the same funding) another 2.5 Mio EUR are provided by the company partners and a foundation. This combination of public and private funding is the basis for an intensive public-private-partnership going beyond the usual publicly funded university research.

Conclusion

Based on the experience of several successful examples of industry-university-clusters the 3 largest universities of applied sciences of the Ruhr Valley have set up long term cooperation with more than 40 company partners. The aim is to contribute holistic solutions for the future mobility and energy systems for metropolitan areas. To organize and manage the joint efforts, a system of project and interaction formats has been established which is orchestrated by a governance system based on a project-oriented approach. The cluster started beginning of 2017. It will evaluate and measure its effectivity and efficiency based on a score card and a number of key performance indicators. Within the first funding cycle it will develop sustainable institutions for long term cooperation and for the professional management towards commercialisation of the resulting innovations.

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