

# Short Report

## “Life-Cycle-Oriented Risk Management for PPP-Projects in Public Real Estate“

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The responsibility for the content of the report rests with the author.

## 1 OBJECTIVE OF RESEARCH TASK

Hardly any other sector in the planning and implementation of a Public Private Partnership project<sup>1</sup> has such a significant effect on project success as that involving the identification, assessment, management, allocation and monitoring of risks. The importance of risks in life-cycle projects mainly derives from the long-term nature of the contracts and the complexity of the projects. The project risks have to be calculated in advance of a 20 to 30-year service period, and subsequently monitored and controlled throughout the contract term. Another factor is the project scope, which typically includes planning, construction, financing, maintenance, operation and in some cases re-use. Each stage of the value chain is associated with specific risks. For this reason, the public contracting authority and the private partners need strong methodological skills in order to manage the assumed risks effectively and efficiently.

The literature contains significant research findings on risk management in PPP projects. However, it has been found that the research is confined to specific aspects of risk management and barely touches on a holistic approach to the subject. This means that many publications are limited to one phase of the risk management process or to a selected contractor. The number of publications on the various procedural and methodological aspects of the phases of risk management differs considerably; a relatively small number of publications deal with the phases of risk mitigation, risk monitoring and risk controlling.<sup>2</sup>

However, risk identification phase is the subject of numerous research papers<sup>3</sup>. The primary focus of this research has tended to be the risks which occur in PPP projects, and how they can be categorized.<sup>4</sup> Comparing these various research works, it emerged that there is no common understanding of how individual risks are defined and how they can be distinguished from each other. Therefore, the development of a generic list of risks which is equally valid for all parties forms one part of this research project. The risks involved in this list are comprehensively described and defined in order to facilitate a common understanding.<sup>5</sup>

Some research deals with the process and methodology of risk analysis and assessment in PPP projects.<sup>6</sup> A large proportion of the international research analysed focuses on the allocation of risks and examines existing PPP project contracts in order to derive standard risk allocations.<sup>7</sup> However, the use of standard risk allocations appears only as an initial indication of the reasonable structuring of a project; this is because PPP projects, with their respective characteristics and the various institutions involved, have to be considered individually. This research work therefore develops a structured risk-management process model, which allows an optimum project-specific risk allocation within the given scope of action<sup>8</sup> of each contract party.

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<sup>1</sup> The abbreviation PPP is subsequently used for Public Private Partnership.

<sup>2</sup> cf. Grimsey/ Lewis (2004).

<sup>3</sup> cf. Perry/ Hayes (1985); Tiong (1990), Wang/ Dulaimi et al. (2004), Tinsley (2001), Ng/ Loosemore (2007), Zou/ Wang et al. (2008), Ke/ Wang et al. (2009).

<sup>4</sup> cf. Wang/ Dulaimi et al. (2004).

<sup>5</sup> This list formed the basis of the empirical studies and has been continuously modified as a result of new findings of the research project.

<sup>6</sup> cf. Grimsey/ Lewis (2002), Wibowo/ Kochendörfer (2005), Ye/ Tiong (2003), Wibowo (2004), Zhang (2005), Ehrlich (2010).

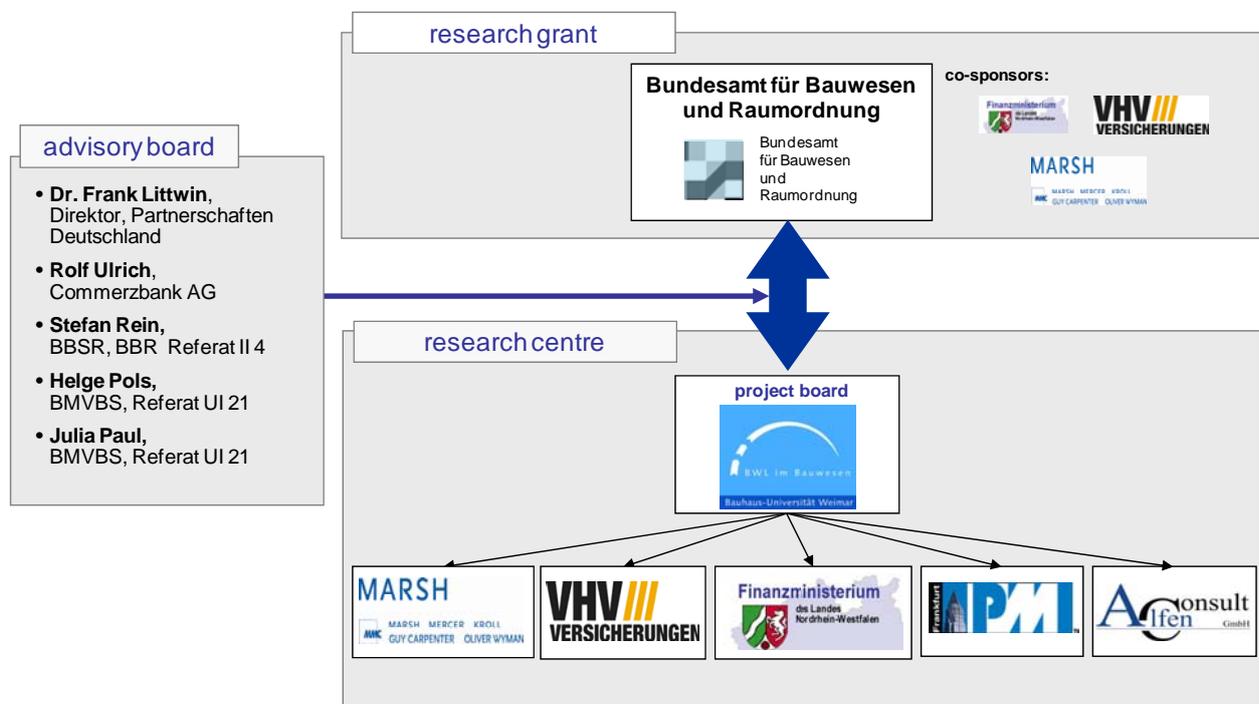
<sup>7</sup> cf. Merna/ Khu (2003), Medda (2007), Abednego/ Ogunlana (2006), Jin/ Doloi (2008), Rouboutsos/ Anagnostopoulos (2008), Sudong/ Tiong (2003), Fischer/ Alfen (2009b), Li/ Akintoye et al. (2005);, Ke/ Wang et al. (2009), Ng/ Loosemore (2007), Zou/ Wang et al. (2008).

<sup>8</sup> The given scope of action applies to the specific conditions of the project / organization and includes information available to the user, as well as risk management measures and their characteristics, such as the available market prices for works or services.

The ultimate aim of the project is the development of an integrated risk management system that will enable the PPP partners to develop a focused and efficient means of dealing with the risks included. In addition, the system must enable the development of a project-specific and optimum risk allocation within the given scope. The formulation of action and design recommendations for all phases of risk management in PPP projects should represent a contribution towards extending the incipient standardization in the German PPP-market to the field of risk management.

## 2 IMPLEMENTATION OF RESEARCH TASK

The research project is financed by the Federal Office for Building and Regional Planning as part of the research initiative "Zukunft Bau". The research centre is the Chair of Construction Economics at the Bauhaus-Universität Weimar, which is also responsible for the development and publication of the research findings. The project is carried out in cooperation with, and with financial support of the PPP Task Force NRW, MARSH GmbH, VHV Versicherung AG, PMI Frankfurt Chapter and Alfen Consult GmbH. The following chart shows the organisation of the research project.



**fig. 1: Organisational structure of the research project**

The advisory board, which is shown in fig. 1, supports the research project by providing expert practical knowledge and experience and represents an important element of quality assurance.

The following challenges must be comprehensively and systematically reflected if one is to develop an integrated risk-management system:

- the creation of an integrated risk-management process model over the project life cycle by means of the integration of the various phases of the risk-management process into the existing organizational structure of the PPP partners
- the methodological embodiment of the integrated risk-management process model.

The adaptation of the processes and methods to the specific organization of the institution, i.e. the definition of responsibilities, specific operating procedures and software support, have to occur in practice and does not form part of the research project.

The research project used two empirical studies and a detailed research of national and international literature to achieve the above objective. The first empirical study consisted of a qualitative exploratory study based on twelve problem-focused expert interviews with representatives of the various PPP partners and a subsequent quantitative survey in the form of a questionnaire. Its aim was to analyse the current state of risk management of the PPP partner. Within this context, the particular organisational structure of risk management, the interests, the available risk-specific control and monitoring capabilities of the partners, and the interaction between them were all analysed.

Process flow charts describing the project life cycle of the single PPP partners were subsequently structured on the basis of this knowledge. This was carried out in internal research-group workshops. In the PPP processes in which risk management activities are necessary, the individual components of the risk management process were integrated theoretically and empirically. These drafts of process flow diagrams were depicted explicitly and formed the first approach to the integrated risk-management process model. The organizational structure was not included because a standardized delineation fails to do justice to the variety of the possible forms.

In the second survey, the drafts were used as a basis for the explorative expert interviews with the goal of optimisation. A number of new experts from the various contractors were involved, in addition to experts from the first empirical study. The process flow diagrams were presented to the interviewees, who then reflected critically on them. After the interview results had been incorporated into the drafts, they were presented to the respective interviewees for final validation.

Through intense theory literature reviews relevant methods of risk management were identified and analysed with regard to their characteristics as a basis for the future methodological embodiment of the integrated risk-management process model.

Finally, the standard process risk allocation was methodologically designed using the results of the method analysis, as this allows an efficient risk allocation and enables the PPP partners to develop a focused and economical management of the risks involved in a PPP project.

### **3 SUMMARY OF RESULTS**

The research report is divided into four parts, which represent the results of the research project in a logical order. The results of the individual parts are presented successively in the following sub-chapters.

#### **3.1 Part I**

Part I, with its theoretical and empirical track record of the current state of risk management in PPP projects for public real estate, forms the basis for further analysis and results of the research project.

First, the understanding of the research group of risk management, the concept of risk used and the procurement method Public Private Partnership is shown. Furthermore, the PPP contractors are described in terms of their function within the structure of a PPP real estate project; their interests and goals have also been analysed.

The relevant risk groups/fields for PPP projects in public real estate are systematised on the basis of risk lists from the literature and business best practice. They are subsequently described and transferred to a generic list of risks.

The relevant laws and risk standards were researched and studied in order to establish the current legal and normative requirements for a risk-management system. It was found that the current laws fail to address all forms of organisation. Moreover, they do not sufficiently enable successful participation in PPP projects. Therefore, the continuative design of PPP-specific risk management processes on the basis of the investigated laws and standards is a crucial point in the interests of a simplified and standardized implementation of a structured risk-management system in PPP projects.

The analysis of the current state of risk management of the PPP partner consisted of a qualitative survey comprising twelve expert interviews and a quantitative survey in the form of a written questionnaire. The results of the expert interviews formed the basis of the structuring of the questionnaire. Furthermore, the results in terms of the operational and organisational structure of the risk management of the PPP partners were used to define the integrated risk-management process model in Part III.

The quantitative survey was able to show that the various PPP partners display significant differences in terms of the degree of integration of corporate and project risk management into value creation. The debt provider and the equity provider display the most advanced degree of integration, whereas the public authorities in their function as project initiators have the lowest. It can be seen that some methods are greatly preferred and regularly used in the processes of risk management, whereas other perfectly appropriate methods are viewed with significant reservations.

Ranking	Significance of risks from the perspective of PPP partners			
	Public Authorities	Debt Provider	Equity Provider	Constructor/ Operator
1	risks of demand	insolvency risk on the part of the contractor	technical performance risk	planning risks
2	tendering and procurement risks	del credere risk on the part of the awarding authority	insolvency risk on the part of the contractor	technical performance risks
3	site risks	revenue risks	risks on the part of management	technology risks
4	force majeure	risks of demand	financing risks	inflation risks
5	risks of amendments and changes in standards	financing risks	operational risks	risks of amendments and changes in standards

**tab. 1: Significance of risks from the perspective of PPP partners**

Furthermore, the willingness of each PPP partner to carrying and accordingly control certain risks was demonstrated. Selecting from a predetermined risk catalogue, each PPP partner selected risks they would take as part of a PPP project and which risks were critical for the success of their project. Tab. 1 summarizes these results.

From the point of view of the public authorities, a change can be seen in their awareness of target risk allocation. The majority of public authorities aspire not to the maximum transfer of project risks to the private partner, but rather to an optimum and cost-efficient distribution of risk in terms of the partner-specific risk-management expertise.

In terms of risk controlling, significant differences could also be detected between the PPP partners. All Debt Providers participating in the survey monitor their risk exposure cyclically, whereas only about 33 percent of participants from the public authorities do so.

## 3.2 Part II

Part II delivers a toolbox of methods for risk management as part of this research project. The toolbox contains established procedures for revealing risk-related findings or practical results. The results of part II serve as a methodical arrangement of the risk-management process model (part III), as shown for the standard process of risk allocation in part IV.

A total of 17 methods of identifying risks are analysed and described from a user point of view. None of the analysed methods can ultimately be deemed the ultimate method for PPP projects, nor can any of them be rejected as ineligible. The right mix of identification methods is advocated as a means of delivering the desired results. It is necessary to choose and combine a set of identification methods in the light of the specific application. The results of the analysis of identification methods and their relevant features to be chosen for the identification of risks are then summarised.

For the purposes of risk analysis and risk assessment, all methods are analysed and presented from a user point of view. Distinctions are made between qualitative, quantitative and qualitative-quantitative methods of analysing and assessing single risks, as well as between methods of analysing and assessing the total scope of risk. A risk analysis and assessment complying with the requirements of a PPP project should also contain a mix of methods, as long as the total scope of risk can be quantified by a simulative method.<sup>9</sup> This implies that single risks are assessed in terms of probability distributions and that correlations<sup>10</sup> between various risks are analysed. For this reason a selection of common probability distributions, as well as heuristic and statistical methods for determining the correlations, are also presented. Risk analysis and risk assessment methods are thus summed up in terms of their relevant features to support the choice of methods from a user point of view.

The various strategies for dealing with risk are described (such as avoidance, minimisation, transfer and acceptance) and sample applications of risk-handling procedures for single risks presented. For the purposes of the research task, the risk-handling strategy of minimisation is divided into cause-driven and effect-driven minimisation, whilst the risk-handling strategy of transfer is divided into third-party transfer and insurance transfer.

In PPP projects, the implementation of an optimum risk allocation between public and private partners is crucial from the point of view of the public partner and is dependent on whether efficiency gains and value for money should be realized through a PPP instead of conventional procurement. Finally, allocation criteria based on real information scenarios of the PPP contract partners were defined. These form the foundation for the selection of advantageous risk-handling procedures, as well as for the proof of the advantageous acceptance of risks from the point-of-view of the private partners within their risk management process. Under these circumstances and with the given leeway, they allow for an optimum risk allocation.

The necessary components of an effective risk-monitoring process, as well as the basic requirements concerning their design, are described. The crucial importance of performance figures and measurement systems for the entire risk-monitoring process is demonstrated, and the most important figures of the various PPP contract partners are shown with regard to their individual intentions. Five methods are shown from a user point of view and analysed in terms of their applicability for each individual component of the risk-monitoring process.

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<sup>9</sup> With simulative methods such as the Monte-Carlo-Simulation, a large number of risk scenarios can be calculated and analysed. The resulting risk distribution of one parameter, such as the total scope of risk, shows the risk manager the degree of variation from the expected value of this parameter.

<sup>10</sup> e.g. by means of regression- and correlation-analyses or an effect-analysis.

Risk controlling is described as a superordinated process comprising the planning, management and control of the integrated risk-management system of an organization in a PPP project. It is also the interface to other systems of the organisation, for example controlling or enterprise risk management. In line with risk controlling, a system for assessing risk-bearing ability is developed for the institution. It is based on risk-adjusted performance measures and indicators that have to be set in an organisation-specific way. A risk-management manual containing all key parameters of risk management (processes, appropriate methods, responsibilities, flow of information, etc.) may be used. An information system is presented as a further methodological support of risk controlling. This consists of methods for data generation, management and processing. As a component of data generation, a risk inventory can, for example, be used; its data could be combined with other project data in a database. The database then enables the generation of reports in the context of knowledge management and the use of the information for the risk management of other projects.

### **3.3 Part III**

The third part of the research report includes the development of an integrated risk management process model for the whole lifecycle of PPP projects, taking into account the perspectives of all PPP partners.

In order to reduce the complexity of the risk management process model, all PPP partners are divided into the following groups<sup>11</sup> according to their functions in the project: Public Authority, Special-Purpose Vehicle, Equity Provider, Debt Provider and Constructor/Operator.

The empirical survey is then explained. It provides evidence for the definition of the risk-management process model on the following three levels:

Level 1: Map of processes over the entire lifecycle, including all PPP partners

Level 2: Map of detailed processes for every PPP partner

Level 3: Risk-management processes for every PPP partner

In the course of the research project, standard risk-management processes were developed. These included "risk controlling", "selection of projects /setting up of tender consortium", "risk allocation" and "contract controlling". These are recurring processes used by various PPP partners. The standard risk-management processes are mapped as process flow diagrams and described. Each process step is explained and the documents and information summarized in a table.

The standard "„risk controlling"" process is the only one which is used throughout all phases of the project life cycle by each PPP partner. The process includes the planning and controlling of the risk-management system and functions as a connection between corporate and project risk management.

The standard "risk allocation" process (abbreviation: ST\_AL) is central to the risk-process model because it is widely applicable by all PPP partners throughout all phases of the project. Its application allows the PPP partners to identify, assess, classify and quantify risks. The application of the process enables the determination of an optimum project-specific risk allocation under the given scope of action, as well as the selection of the optimum risk handling for risks within the context of a risk-controlling system. As basis for managing and allocating risks, a set of allocation criteria has been developed. This is elaborated on in Part II of the research report. The outcome of the standard "risk allocation" process is the aggregate overall risk for the whole project.

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<sup>11</sup> The explanations of this text are always targeted to this functional understanding, even when the term PPP partner is used.

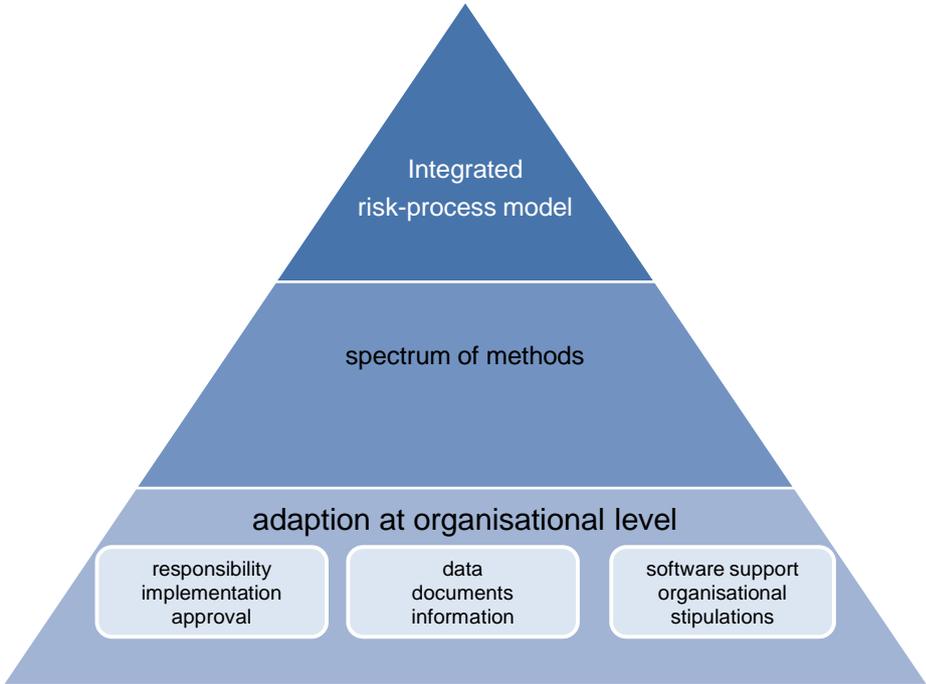
Based on the aggregate overall risk, PPP partners can control whether their risk-bearing ability and risk-return profile are sufficient for their own institution.

The standard “contract controlling” process implies a review of the implementation of the risk allocation as defined in the contract. The aim is, on the one hand, the rejection of unjustified claims and, on the other, the establishment of claims against parties in terms of risk allocation according to the contract. The standard “contract controlling” process includes the function of risk monitoring and is to be used by all PPP partners.

The more detailed second and third levels of the risk management process of the Public Authority, the SPV, the Equity Provider, the Debt Provider and the Constructor/Operator are presented. The risk map for each PPP partner is explained and the processes explained separately, together with their individual risk-management activities. Each process is described by a flow chart and a table containing the documents and information necessary for the processes. The interaction with processes of the other PPP partners is also explained.

**3.4 Part IV**

The fourth part of the research project shows the elements of the integrated risk management system (fig. 2). It consists of an integrated PPP risk process model, suitable methods and specific organisational stipulations such as responsibilities, operating instructions and appropriate IT support. To show how an integrated risk-management system works, the standard “risk allocation” process is shown as an example. The organisational stipulations and structures are not included because they are to be structured individually by every institution.



**fig. 2: Integrated risk-management system**

The standard “risk allocation” process (abbreviation: ST\_AL) describes an algorithm that enables the evaluation of an optimum combination of risk handling procedures and risk allocation for a defined performance package under the given scope of action. This process is central to the risk process model. During the process, a Monte-Carlo-Simulation is proposed in order to aggregate the accumulated risks. This method is also applicable when little statistical data is available, as with the cost-element-percentage method.

By using the Monte-Carlo-Simulation and applying probability density functions, realistic modeling is possible, and correlations between risks and their impacts are able to be assessed. Moreover, risk-adjusted as well as performance indicators can be created in order to evaluate the risk-return profile of the project.

This information forms the basis of sound decision-making in terms of the implementation of the project. This is because it needs to be taken into consideration when estimating the need for equity and liquidity for the SPV or company, or the additional cost in the case of the Public Authority.