Risk management in PPP maintenance projects of communal street networks

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ABSTRACT
The public sector aims to raise the efficiency of public procurement and services through implementing Public Private Partnerships (PPPs). The development is driven by contradicting requirements: on the one hand by the demand for high quality service to maintain the attractiveness for industry and dwellers and on the other hand by budget constraints. Communal street maintenance, in particular, includes complex and interactive risks arising from the interaction of various street-related services and the uncertainties and problems caused by political, technical, natural and anthropogenic influences.

A methodical assessment tool for systematically analyzing and evaluating the risk potential is under development at ETH Zurich in collaboration with major Swiss cities to ensure the optimal distribution of risk among the PPP partners and the long-term economic efficiency of PPP.

KEYWORDS
Public Private Partnership, Risk management, Risk Identification, Risk Analysis, Risk Load Resistance Capacity, Risk Distribution

1 INTRODUCTION
Alongside PPP initiatives in Great Britain, France or Germany, attention for this innovative project delivery form has also now attracted attention from
cities and communities in Switzerland. Cities in developed countries, such as Switzerland, are increasingly facing the competitive pressure to be attractive for modern industries and their qualified employees in the globalized competition for major business regions. However, budget constraints make it very difficult for them to assure high-quality performance of the requisite public service works. Nowadays, local authorities have to fight to defend their site advantages and must offer convincingly high quality infrastructure in terms of supply and disposal and communication coupled with more favorable cost and performance structures. This holds particularly true for road infrastructures with regard to high network quality and minimized costs and risks. As a result, the political public is increasingly demanding improved efficiency on the part of the public services.

PPP is one approach to increasing public efficiency. The efficiency improvement results from the partnership combining entrepreneurial and managerial knowledge with public service experience and responsibility. Besides other critical success factors (Girmscheid and Dreyer, 2007) for long enduring partnerships, sound risk identification, risk evaluation and the proper criteria to distribute the risk to the partners involved are also crucial.

2 STATE OF RESEARCH

Numerous standard literature exist about the subject of risk management (Chapman and Ward, 1997; Busch, 2003; Girmscheid and Busch 2005). They focus on tools and methodologies of risk management, in particular on the identification and the assessment of risks.

International literature and guidelines for PPP are containing basics of risk management processes only for PPP related life cycle projects like buildings and infrastructures (Akintoye et al., 2003; European Commission, 2003; BMVBW, 2003; Queensland Government, 2002). These guidelines include recommendations, in which way typical risks of life-cycle building procurement PPPs (Girmscheid and Dreyer, 2007) are allocated between the partners in practice.

The existing literature does not consider risk management and risk distribution schemes for service provision PPPs (Girmscheid and Dreyer, 2007) and, particularly, not for maintenance and rehabilitation of communal street networks. Further, in literature and science no systematic multi-variant criteria are available in order to achieve a cost minimum by the optimal distribution of risks. But in science as well as in practice a risk distribution model for the client is required to identify and to assess the risks connected with service provision PPPs, to evaluate who has the technical, juridical, contractual and performance-related means to remove the impact of risks at minimum of cost. Further, it is necessary to evaluate and measure the risk load resistance capacity of the private partner (Girmscheid, 2006).

The research project “Risk distribution by PPP maintenance of communal street networks” at the ETH Zurich in collaboration with two
major Swiss cities focuses on

- risk identification,
- risk assessment and the criteria of risk allocation to the partners with regard to
  - influencing the cause and emergence of risk,
  - reducing the risk impact cost

under consideration of the financial risk load resistance capacity of the partners.

This applies especially to the maintenance of existing communal street networks, where the complexity of the issue arises from the interaction with the other public service providers, such as gas, water, sewage in the streets and the wide ranging of uncertainties caused by political, technical, natural and anthropogenic incidents.

It is therefore crucial to the long-term success that the local authorities are striving to achieve in symbiosis with the private sector that they protect themselves by considering the potential opportunities and risks. This can only be achieved by clearly and transparently analyzing the risks and risk costs right from the concept phase of the project.

3 PPP RISK ASSESSMENT AND DISTRIBUTION (RAD)-MODEL

The aim of the research project is to develop a multidimensional risk assessment and distribution model, which considers four modules for risk distribution (see figure 1).

The first module is called “PPP Risk identification and assessment”. This part relates to well known processes and required tools (Girmscheid and Busch, 2005). But the specific risk categories still have to be empirically identified.

The second module of the model is called “PPP Risk influence and control by partners”. In this part each risk group will be analyzed with regard to the partner’s capability to influence it:

- Who can most effectively reduce or eliminate or control the cause of risks to reduce the risk cost?
- Who can most efficiently reduce the impact cost of risk in case of it occurrence?

The third module “PPP Risk load resistance capacity evaluation of partners” sets up dimensions and methods for doing this. Because of the outside view of the private partners with regard to risk load capacity, the internal review (Girmscheid and Busch, 2005) method can not just be adapted.

But it is necessary to formulate a criteria catalog and assessment tools to determine the probable risk load resistance capacity of the partner. It is necessary to stipulate KO criteria for risks which exceed the capacity of
the partner as well as KO criteria for PPP performance of the public task.

**Figure 1** Risk management model
The fourth module “PPP Risk distribution” integrates in a numerical value benefit assessment model the three risk load distribution criteria in a holistic view to generate the cost minimum approach.

In a long-term partnership, risks must be distributed and reimbursed fairly. If this fairness and transparency is not given, the disadvantaged partner will behave opportunistically to the detriment of all participants involved in the contract. In order to share risk adequate and fairly among the partners, it is absolutely essential that:

- the types of risk are identified,
- the risks are evaluated,
- the risk load resistance capacity of the partners is assessed,
- the risk influenceability of the partners is assessed,
- the risks are distributed in line with risk resistance and influenceability criteria and
- the risk costs are determined.

4 RESEARCH METHODOLOGY

In order to obtain scientific findings for decision making tools in construction business management, the hermeneutic research paradigm (Guba and Lincoln, 1994) is being adapted leading to the constructivist (von Glasersfeld, 1998) and interpretativist (by Weber (1922) and Girmscheid (2004)) research methods. The constructivist research approach is used to structure a new socio-technical system-based decision making model for risk distribution in PPP projects.

The risk identification, assessment and the primary risk influence and control by stakeholders are determined using the qualitative empirical method developed by Mayring (1999) and Yin (1994) by means of literature study, interviews and workshops with the involved local authorities (Zurich, Lucerne). The results are being subsequently analyzed using the interpretativist research method (by Mayring (1999) and Girmscheid (2004)). The requisite risk load model and the model for analyzing the risk resistance capacity of the partners is being developed using the constructivist research approach (by Piaget (1973), von Glasersfeld (1998) and Girmscheid (2004)) with financial-mathematical frame. The ensuing risk distribution concept will be developed using a logical-deductive and constructivist research approach with stipulation of KO criteria out of the risk load resistance capacity and to develop a multi-variant PPP-distribution value benefit analysis.

The research project is embedded in the innovative research approach to PPP projects developed by the Chair for Construction Management and Process Technology at ETH Zurich and is being subdivided into:

- analysis of the risk loads and risk resistance capacity of the individual project partners,
- concept for alternative risk distribution,
financial and management evaluation of the alternative approaches to risk distribution.

The risks will be distributed using a multi-dimensional concept aligned to the possibilities of influencing risk and of minimizing risk costs and the risk load resistance capacity of the individual partners.

The triangulation (Yin, 1994) is completed by realizability test to validate the PPP Risk distribution model, where the theory-based constructive-deductive process model is subjected to constructive analytic testing to evaluate whether the forecast input-output relation can be achieved (review of the input-output relation).

5 MODULE 1 – PPP RISK IDENTIFICATION AND ASSESSMENT

The risks associated with service provision PPPs e.g. maintenance of communal street networks need to be captured in a structured form. To capture such risks or risk groups an empirical research approach with literature review and partially structured qualitative interviews and workshops was chosen.

The risk groups have been related to the classified according to the main causes of risks, such as political, contractual and operational (see figure 2).
Some examples of risk groups and risk types / single risks are stated as follows:

**Risks of changes in law**
e.g. from changes in legislative, changes in government policy, changes in taxation

**Risks of contractual changes**
e.g. from errors in the tender, changes to the general project conditions, management decisions, ambiguities in contract formulation, unforeseen technical requirements of structure inspection or maintenance

**Risks of partner related incidents**
are triggered by the new partnership delivery form
- incidents/problems triggered by the private partner
  (e.g. bankruptcy, failure of the partner to perform the requisite quality)
- incidents/problems triggered by the public partner/municipality
  (e.g. delays in granting permits, supplementary works that were
forgotten, obstacles or additional requirements / increased performance quality)

**Risks of natural incidents**
are triggered by forces of nature  
(e.g. storms, floods, lengthy winters with disproportionate amounts of snow on long periods of frost)

**Risks of man-made / anthropogenic incidents**
are triggered by the users or operator  
(e.g. demonstrations, festivals, street parades, carnival processions, sports events, such as marathons or football world cups)

**Risks of performance and quality**
- Annual operating maintenance and structural operating risks  
e.g. from increased annual maintenance expenditure by increased traffic loads, changes to the structural condition
- Usability restrictions / availability  
from one-off incidents, e.g. reduced availability due to maintenance failure, unplanned municipal measures, traffic restriction due to maintenance failure, problems such as bridge / collapses due to negligence of maintenance
- Risks caused by the opportunistic behavior  
(performance default of the partner e.g. to late snow removal, risk of amendment on projects)

The structured risks (see figure 2) will be analyzed and assessed. The risks must be assessed with regard to the occurrence probability (P) and the impact cost (T).

\[
R_{E,i} = T_{E,i} \times P_i
\]

\(R_{E,i} = \text{Expected risk costs} ; T_{E,i} = \text{Expected impact costs} ; P_i = \text{occurrence probability}\)

The risks will be registered in lists (see table 1).
Table 1 Summary list of assessed risks

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Risk category</th>
<th>P</th>
<th>T</th>
<th>P * T</th>
<th>Group</th>
<th>Possibility of reduction - an element of risk remains</th>
<th>Risk assessment</th>
<th>Expected risk costs R_{E,i}</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Operational risk (Privater)</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>PPP</td>
<td>20% 50'000 10'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>Maintenance-Risk</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>PPP</td>
<td>40% 50'000 20'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td>Risk of costs</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>PPP</td>
<td>40% 50'000 20'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>Risk of resources</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>PPP</td>
<td>20% 30'000 6'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R5</td>
<td>Common tax-change-risk</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>PPP</td>
<td>40% 30'000 12'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R6</td>
<td>Interface-risk</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>PPP</td>
<td>20% 30'000 6'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R7</td>
<td>Risk of wrong or incomplete tender documents</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>PPP</td>
<td>20% 50'000 10'000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ R_{PPP} = R_{PPP,nat} + R_{PPP,anth} = 84'000.00 \]

The risk cost (R) is a variable, which depends on the independent parameters of occurrence probability (P) and the impact cost (T). The seriousness of a risk can be analyzed either using a portfolio chart with the indicated risk acceptance areas (see figure 3) or an A-B-C Expected Risk Cost accumulation chart (see figure 4) (Girmscheid and Busch, 2003).

Figure 3 Portfolio analysis with regard to occurrence probability and impact of risks (Girmscheid and Busch, 2003)
Based on the risk structure of module 1, the next step is a logical-deductive approach to determine the partners who can influence:

- cause of risk and
- impact of risk with regard to cost minimization.

For example anthropogenic / man-made risks with regard to the volume of performance can be influenced by the communal administration:

- by approving street parades / demonstrations,
- by building new football stadiums

or applied to other events like exhibitions etc..

Natural events, such as storms, floods etc. cannot be influenced by either party in the partnership. Identifying the partner who can minimize the risk cost / impact cost after the risk occurrence is much more difficult. However the following criteria can be applied to such an evaluation:

- Who has the means to eliminate the impact of the risks?
- Who can do it most cost efficiently?

The risk load resistance capacity of the private partner is of significance in a long-term PPP relationship due to the fact that the private partner can not further perform for example due to insolvency high cost will arise by the public administration. In such cases, temporary measures are necessary to maintain public service, e.g. by selecting a private firm. Furthermore a new tender phase is required at substantial cost. For this reason the risk load
resistance capacity of the private partners needs to be thoroughly evaluated. The means will be adapted from banks and insurances which are providing performance guarantees. This part of research is still under “status nascendi”.

8 MODULE 4 – PPP RISK DISTRIBUTION

The risk will be contractually distributed by the public administration using a multi-criteria concept. The distribution concept is structured in:

- KO / OK criteria with regard to the load resistance capacity of the private partner
- risk cause influencing concept
- risk cost mitigation concept
- procedure to eliminate the impact of risk occurrence

The first criterion prevents the transfer of risks with magnitudes which cannot be carried by the partners. This prevents the illusion that extreme risks can be transferred. In cases where risk impacts exceed the risk load resistance capacity of the private partner, the risk must be carried by the public sector or the PPP concept abandoned.

If the risk meets the KO / OK criteria, a multi-variant value-benefit analysis is required. The value-benefit analysis (Girmscheid, 2007) enables the transfer of the qualitative criteria into dimensionless evaluation parameters. The risk distribution will be analyzed according to the multi-variant criteria:

- Who influences causes of risks?
- Who has the means to eliminate the impact of risk
- Who can eliminate the risk impact at minimal cost?

Each risk will be subjected to the multi-variant value-benefit analysis to determine if the private partner or the public should bear the specific risk. The risk distribution must then clearly be stipulated in the contract.

7 CONCLUSIONS

A long lasting partnership will only provide a win-win situation for all parties if the associated risk is properly identified, assessed and fairly distributed. Transparency right from the start of tender preparation is necessary to ensure a successful PPP without unanticipated risks. This will establish partnership trust between the client and owner right from the beginning at the tender stage and at the subsequent PPP contract stage.

The PPP Risk distribution model is still under development. It is based on the findings of the research projects focusing on risk management (Girmscheid and Busch, 2005) and PPP projects for communal street maintenance (Girmscheid and Dreyer, 2007). The PPP-risk distribution represents a complete risk-based tool for assessing the long-term, complex
and interactive risks of PPP. It enables the project partners to identify and appropriately control the consequences of their proportional risk load in order to enable a standardized economic comparison.

Tools are being developed to enable an evaluation of the risk load and risk resistance capacity, together with possible approaches to risk distribution in line with the economic minimum principle. In addition, the project partners are made aware of the impacts of their various decisions in terms of the distribution of the risks to the risk costs with the aim of defining a project-specific solution.

This ensures that companies can evaluate the possible risks in terms of costs and propose appropriate measures in their bids. The risk management model helps both local authorities and companies to ensure a long-term and fair partnership, such as is crucial for a PPP form of communal street network maintenance. It is the only means of ensuring the performance of such longer-term partnerships virtually without any conflict.

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