Innovative method for data collection and risk analysis during the bidding process

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Abstract

This paper presents a method for risk assessment during the bidding process and the required data acquisition. An information system for data collection (corporate memory) and analysis (algorithm) supports the presented method. Data acquisition is based on structured risk sheets that maintain all the required information for the analysis. Processing is based on three managerial roles required by the method: The Risk Manager, the Bid Manager and the Knowledge Manager, each one using his expertise to analyse information and fill in the method’s risk sheets.

Risk assessment algorithm is based on two different scales in order to be adaptable to specific industrial needs. The quantitative scale assesses risks in terms of money and the qualitative in terms of an indicator.

Introduction

Risk knowledge is fuzzy, unstructured, insufficient, tacit (in people minds only for example), forgotten as a solved ancient history, transformed afterwards, insufficiently organised and not or incompletely catalogued, underestimated,
However, risk is the key factor for project failure and should be confronted with great care and moreover, it should be regarded as a strategic competitive factor [7]. One of the most critical phases of a project’s lifecycle is the bidding itself, where risk management should be taken into consideration [8]. The scarce available information during this early phase of a potential project complicates the determination of the project baseline in terms of budget, schedule and performance, making in this way hard the development of an efficient proposal [9].

Aim of this paper is to propose an information system and a framework for risk identification and assessment during the bidding process. The system consists of a Corporate Memory Module ruled by Knowledge Management techniques [10], a Risk Management Processor for Bidding and an accompanying Risk Assessor. The rest of the paper is organised in four basic sections. In the first section the Corporate Memory Module is discussed and an approach for risk formulation and description is proposed. In the second section the risk management procedures are described (Risk Management Processor). Moreover, specific roles of the people involved in the risk management of the bidding process are determined and their responsibilities are analysed. In the third section the assessment algorithm (Risk Assessor) is presented. In the last part the conclusions and further research topics are presented.

Methodology

Risk Management Corporate Memory

The Risk Management Corporate Memory (RMCM) supports corporate knowledge management of risk at business level [6]. Risks are organised into categories and an organisational risk management “referential” is constructed. The referential is consisted of all the risks concerning bidding that have been identified in the company, structured as shown in Figure 1. Depending on the available information, a risk can be described in two different ways, a short and a long one.

In Figure 1, each block represents an ontology related to risk. Each ontology is described by a specific characteristic, appearing in the elliptic scheme. More precisely the definitions are described below [1]:

- Risk is a hazard or opportunity for the bid. Risk severity is described by its exposure. The Exposure is calculated by taking into account the probability of the cause(s) and the gravity of impact(s) related to the risk (see Algorithm).
- Cause is any uncertain event that may lead to the appearance of the risk and it is described by its probability of occurrence. A risk might have several causes.
- Impact is the effect of the risk on the bid and it is described by its gravity. A risk might have several impacts.
- Action is the way in which the proposal team can cope with the risk and it is described by its cost. The actions are either preventive or corrective.
Preventive actions are those who aim at the probability of occurrence of the cause and corrective those that aim at the gravity of the impact. The short way of describing a risk is to give just its exposure, most of the times coming from experts' opinion. Possible actions to mitigate the risk are also referenced.

The long way of describing a risk is by taking into account a more complete reasoning mode about the risk, called the complete causal chain. The complete causal chain is composed of risk, risk cause(s), risk impact(s) plus the action(s) to mitigate the risk. All the important information about the causal chain is stored in the RMCM in the form of a risk sheet [2], such as the one shown in Figure 2.
The risk sheets stored in the RMCM are managed by a knowledge manager and are used by people, which hold a specific role within the bidding procedures.

**Procedures and Roles**

In the following lines the basic risk management procedures during the bidding phase are described and roles are attached to each procedure. The basic procedures are Risk Identification, Risk Assessment, Risk Prioritisation, Risk Mitigation and Risk Follow Up.

**Risk identification**

The identification of risks is based on the risk referential. The referential is reviewed and the risks that can be related to the bid under investigation are selected. Moreover, new risks that are identified for the first time in the current bid are also taken into account and enhance thereafter the referential. The bid manager is entirely in charge of the risk identification. The referential is used as an auxiliary help and the bid manager is authorised to adapt it to his own context. In other words, the referential aids the bid manager to reuse the risk manager’s knowledge. Identification of risks associated to a specific bid can be made in several ways (by list, category or bid element), depending on the level of existing knowledge. The existing Knowledge is organised in two dimensions as in Figure 2. The first one concerns the amount of information, which is the level of detail for a risk (short or long description). The second dimension concerns the organisation of Knowledge. There are three levels of organisation. The first one, where there is only an unstructured list of risks. The second, where
the risks are classified into categories such as managerial, financial, etc. The last and most meaningful, where risks are attached to a specific bid element such as a specific technical item or a resource, etc.

**Risk assessment**

The assessment is based on a scale of risk. Scaling a risk must be homogeneous inside a company. Scale parameterisation is specific to each company, for example the highest level of risk could be estimated in human deaths or millions of Euros. In the method presented in this paper, the scale is divided into two major sub-scales in order to be as much adaptable to specific industrial needs as possible. The first sub-scale is quantitative, expressed in terms of money and the other one is qualitative, based on a specific indicator. The model covers two basic needs of a company:

- It gives the possibility to describe the risk in terms of money. This is a benefit for the company as the risk could be compared to ROI measures. Moreover, bank, loans and financing, needs terms of money to proceed.
- On the other hand, most companies use qualitative systems because it is faster and easier to produce and it does not require so detailed information. However, it lacks processing capabilities and it boxes up less information.

Risks are considered as both hazards and opportunities. The cumulative effects of uncertain occurrences, which affect the project’s objectives positively, are considered as opportunities (positive risks). Events with potential for harmful consequences to the design, operation or environment of a system are considered as hazards (negative risks).

Knowledge state and knowledge progress about values of risks (i.e. first estimation at the beginning of the bid, second after the implementation of a mitigation action, third return from experience, etc) are managed in the method presented, within four states which describe cause’s, impact’s and risk’s assessment:

- The estimated value is an evaluation of the risk manager at the beginning of the bidding process concerning the causal chain element in regard to the specific proposal.
- The initial value – before any mitigation action has been implemented is the bid manager’s opinion at the beginning of the bidding process, after taking into account risk manager’s opinion about the specific causal element.
- The reduced value is the estimation for the causal chain element after the implementation of mitigation actions. The bid manager fills in this value during the bidding process.
- The actual value is obtained from return of experience. It is the value of the last occurrence. The knowledge (risk) manager provides that information at the end of the bid.

When the evaluation of the identified risks is completed a global exposure for each proposal is calculated. In that way, each proposal for a specific bid ends up with two indexes. The first is the cumulative result of the money scale (overall
calculations can be done only when numeric information exists) and the second is a list of the qualitative assessed risks prioritised by their linguistic exposure (high, medium, low).
The manager in charge, based on these two indexes can make the comparison of the existing proposals of a bid.

**Risk prioritisation**
The prioritisation of risks is judged from their exposure. The prioritisation is a descending sorting of exposures. When the quantitative scale (exposure in money) is used, the Bid Manager is responsible for determining an exposure threshold alarm. This threshold is used to express the limit above which risks are regarded as important.

When the qualitative scale is used, three different results for the exposure are given. The prioritisation is an order of “unacceptable” (high), “to be examined” (medium) or “non important” (low) risks.

**Risk mitigation**
The important risks (unacceptable – to be examined) that occurred after the assessment process should be closely examined and treated, by defining the appropriate mitigation actions. An action can affect on a cause of a risk – by reducing (or increasing for opportunities) its probability of occurrence - or on an impact – by reducing (or increasing for opportunities) its gravity. Bid Manager has the responsibility to evaluate the possible actions and judge for their effectiveness in regard to their cost.

**Risk follow-up**
Risk follow-up during the bidding process is usually very difficult because of the normally short period of time between the issue of the RFP and the proposal submission. However, there are many cases where risk exposure changes during this short period. Aim of the Follow Up procedure is the updating of information concerning the risk causal chain (risk, cause, impact and actions), as well as the monitoring of the efficiency of mitigation actions.

**The Algorithm**

The scope of this part of the paper is to describe the method used for the implementation of the algorithms concerning the Risk assessment process. As stated earlier, the assessment of risk and consequently the algorithm is distinguished into quantitative and qualitative forms, as described below.

**Quantitative assessment**
The method provides the calculation of the estimated, initial and reduced exposure of each risk. Each impact and risk is expressed quantitatively in terms of money.
The exposure of a risk *(estimated, initial or reduced)* is calculated by the multiplication of “cause probability” times “impact gravity”. In case a specific risk is linked with more than one cause then the “cause probability” is calculated...
by using the appropriate probabilities laws [4]. As far as this algorithm is concerned, the “cause probability” is calculated by the eqn (1):

\[ P = P_1 \cup P_2 \cup \ldots \cup P_n = 1 - \prod_{i=1}^{n} (1 - P_i) \]  

(1)

Where, \( P_i \) is the probability of occurrence of the i-th cause, for \( i=1,2,\ldots,n \) and \( 0 \leq P_i \leq 1 \).

For \( n=2 \) the eqn (1) reduces to

\[ P_1 \cup P_2 = P_1 + P_2 - P_1 P_2 \]  

(2)

In case a specific risk is linked with more than one impact, the “impact gravity” is the sum gravity of the impacts linked to the risk, as follows:

\[ G = \sum_{i=1}^{n} G_i \]  

(3)

Where, \( G_i \) is the gravity of the i-th impact, for \( i=1,\ldots,n \).

Thus, in general each type of exposure is being calculated by using the following equations:

**Estimated exposure:**

\[ E_E = P_E \times G_E \]  

(4)

Where, \( P_E \): cause estimated probability (using eqn (1))

\( G_E \): impact estimated gravity (using eqn (3))

**Initial exposure:**

\[ E_I = P_I \times G_I \]  

(5)

Where, \( P_I \): cause initial probability (using eqn (1))

\( G_I \): impact initial gravity (using eqn (3))

**Reduced exposure:**

\[ E_R = P_R \times G_R \]  

(6)

Where, \( P_R \): cause reduced probability (using eqn (1))

\( G_R \): impact reduced gravity (using eqn (3))

Concerning the calculation of the global exposures for a specific proposal of a bid the following equations are used:

**Total Initial Exposure:**

\[ TIE = \sum_{i=1}^{n} E_{Ii} \]  

(7)

Where,

\( E_{Ii} \): the initial exposure of the i-th risk linked to a specific proposal, for \( i=1,\ldots,n \)

**Total Reduced Exposure:**

\[ TRE = \sum_{i=1}^{n} E_{Ri} \]  

(8)
Where, 

\[ E_{ri} \] : the reduced exposure of the i-th risk linked to a specific proposal, for \( i = 1, \ldots, n \)

Qualitative

A 5-scale measurement (suggestively: Very high, high, medium, low and very low) has been chosen to be used for the qualitative assessment. The scale has been adopted from the Project Management Institute [5]. The qualitative scale will be used if the risk manager is not able or does not want to estimate the risk in terms of money.

Each risk exposure will be assigned according to the following matrix:

<table>
<thead>
<tr>
<th>Probability</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>High</td>
<td>LOW</td>
</tr>
<tr>
<td>Medium</td>
<td>LOW</td>
</tr>
<tr>
<td>Low</td>
<td>LOW</td>
</tr>
<tr>
<td>Very low</td>
<td>LOW</td>
</tr>
<tr>
<td>very low</td>
<td>low</td>
</tr>
</tbody>
</table>

where, the probability of the cause and the gravity of the impact will be expressed by one of the linguistic values (Very low, Low, Medium, High, Very high).

The practical implementation of the algorithm, either quantitative or qualitative, requires also a set of ground rules, which are beyond the scope if this paper.

Conclusions – Further Research

The existence of a Risk Management Corporate Memory empowers the enterprise to acquire, store and reuse information coming from previous bids and projects. Moreover, the acquisition and analysis of such data may improve the forecasting capability of the enterprise and therefore, increase its confidence in the market due to the better approximation of the real outcome of the projects’ assigned, in terms of cost, time and performance. The organisation, classification and monitoring of risks that appear in projects place the enterprise at the “safe side” and increase its competitiveness.

In order to implement risk management during the Bidding Process it is claimed by the authors that specific procedures should be followed and roles should be assigned. By following this, it will be ensured that no step will be skipped or neglected and there will always be a responsible for each task.

The adopting of the proposed information system aids the efficient assessment and prioritisation of risks. In other words, it indicates which risks should be closely followed and treated first. The innovative point of the assessment methodology is that it is based on the opinion of three (rather than one)
managers, each one holding a different role within the bidding process. It integrates the point of view of the Risk, Bid and Knowledge Manager, as described in Risk Assessment sub-section.

The research effort has been now put on the construction of a Decision Support System (DSS) that will manage the information system described in this paper. The implementation of such a DSS will be able to handle different scenarios of risk management strategies and come up with the most efficient one.

References


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