How to Better Identify and Mitigate Risks in Call for Tenders: Towards a Dedicated Risk Ontology

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How to better identify and mitigate risks in call for tenders : towards a dedicated risk ontology

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Abstract - **When preparing a commercial offer concerning technical systems, suppliers working in engineer to order can either make a detailed design job or just decide key solution choices. With a detailed design, if the customer accepts the offer, the supplier has a good confidence in its ability to provide a solution matching offer contents because requirements have been studied in details. With key technical choices, it is not the case, and the supplier takes the risk of not being able to provide an adequate solution because requirements have been just superficially studied. The goal of the communication is to propose and discuss the key knowledge elements in order to manage this kind of supplier risk when preparing the offer. By management we mean, according to ISO 31000, identifying, assessing and processing risk. The proposed key knowledge elements are a risk taxonomy and a risk mitigation action taxonomy. Actually, risk management relies fully on human expertise, these modeling elements will allow companies to design a knowledge-based system that can assist the human in charge and improve commercial offers quality.**

Keywords - **Customer-Supplier Relationship, Offer Definition, Engineer to Order, Risk Mitigation, Ontology.**

I. INTRODUCTION

The goal of this article is to present the very first ideas about a kind of classification of risks [6] with their mitigation actions that should be considered when a supplier is defining a commercial offer for technical systems. Risk knowledge will be identified and discussed following the ideas of [2]. Furthermore, we consider a business to business (B2B) customer-supplier relationship, in order to deal with engineer to order (ETO) situations [9] which is one of the main sources of risks in customer-supplier relationship. In ETO, the supplier can follow two behavior tendencies, either (i) it designs in detail a solution before defining the commercial offer, or (ii) it just makes key design choices without any detailed analysis. The second approach is of course much more subject to risk. If the customer accepts the offer, the supplier has no guarantee that it will be possible to finalize design and produce a system that will fulfill all customer's requirements. Consequently, the goal of this paper is to identify and to structure all the risks that can lead the supplier of being unable to deliver the technical system that he promised in his commercial offer. In addition, we propose to identify and to structure main risk mitigation actions. As far as we know, we has not found any scientific work that proposes this kind of typology. If [3] or [4] are quite close to our problem with risk management propositions, they do not propose any risk knowledge typology. The great interest of this typology is to allow to establish a risk checklist that avoids the "white page problem" to the person in charge of risk engineering when defining a commercial offer.

The remaining of the paper is as follows. The second section identifies, discusses and structures the main risk concepts. The third section do a similar work for risk mitigation actions. The last section discusses the proposed elements.

II. RISK ONTOLOGY

In this work, we consider the risk as an event driven nature entity [8] that can modify some delivery process task metrics as cost, duration, carbon footprint, system quality or performance [7]. We consider in our case that the delivery process starts once the customer has accepted the offer and finished when the system has been fully delivered. This delivery process gathers operations like: finalizing design (because we are in ETO), source components, manufacture, assemble, test, transport and install the system [2]... Next sub-section introduces the two parameters that allow to structure the risk identification. Then the risk typology is proposed.

A. Risk structuration parameters

The first one is relevant to the fact that ETO situation can be at the source of the risk:

- When the risk is ETO specific, this means that some key design choices made in order to define the system and its delivery process for the commercial offer were either inadequate or wrong! In other word a more detailed analysis could have prevented the error.
- When the risk is not ETO specific, this means that any failure of hazards in the delivery process is not a consequence of a bad design choice made during offer elaboration.

The second structuring parameter aims to indicate which kind of entity of the delivery process is at the source of

the risk. For that, we propose to associate the risk with the 5 M of Ishikawa [5]:

- Man or human resources,
- Machine or technical resources,
- Material or consumable materials, components, task inputs,
- Method or way of completing process and documents,
- Medium or environment.

Given these two parameters, the next section presents our risk typology.

B. Risk typology for non ETO specific risk

This risk typology is shown in the left part of figure 1. These risks are conventional operational process risks that exist in any delivery process. However, they can be classified in three sub-categories according to their situation:

1. "break or accident",
2. "entity error"
3. "entity not available".

These three categories intersect the 5 M of the process. It can be seen on the left of Fig. 1 that the M "method" is not subject to a "break or accident" situation and that the M "Medium" does not follow the three previous sub-categories.

C. Risk typology for ETO specific risk

This risk typology is shown in the right part of Fig. 1. These risks are the result of key design decisions during offer elaboration. Two sub-categories have been identified:

1. "inadequate process entity",
2. "KPI entity out of range".

The first one indicates that the selected process element is not adequate for the delivery process operation. The second one indicates that process key performance indicator (cost, duration, carbon footprint, quality…) will not be respected.

As before these two sub-categories intersect the 5 M of the process. It can be seen in the right of Fig. 1 that the M "Medium" cannot be the subject of any ETO specific risk. Finally, in the lower right of Fig. 1, we can see the most critical ETO risk explaining that the finalization of the system design itself cannot be achieved. In other words, the supplier is unable to design the system that has been sold!

The next section proposes a typology of risk mitigation actions that closely related to the previous risk typology.

	(a) Non ETO specific risks concepts			*(b) ETO specific risk concepts*	
	Broken entity	**Entity not available**	**Error on entity**	**Inadequate entity**	**KPI entity out of range**
Man (human resource)	Accident	Human resource not available	Wrong human resource due to error	Inadequate h. resource due to design error	Human resource too costly or too slow
Machine (technical resource)	Machine failure or breakdown	Machine not available	Wrong machine due to error	Inadequate machine due to design error	Machine too costly or too slow
Material (consumable resource)	Consumable broken	Consumable not available	Wrong consumable due to error	Inadequate consumable due to design error	Consumable too costly or too slow
Method (documentation)	NA	Method not available	Wrong method due to error	Inadequate method due to design error	Method too costly or too slow
(c) Medium (Environment)	Environment crisis			NA	
No specific M				Design problem is harder than expected	

Fig. 1 Risk typology

III. *RISK MITIGATION TYPOLOGY*

This section is dedicated to the identification and characterization of risk mitigation actions. Following previous risk structure, we will propose migration actions according to:

- Non ETO and then ETO specific risk,
- the five risk sub-categories,
- the 5 M of Ishikawa.

Furthermore, we will consider preventive and curative actions. Curative actions are achieved only if the event associated to the risk occurs while preventive actions are systematically included in the delivery process.

In the following we begin with non ETO specific risk and deal after with mitigation actions for ETO specific risks.

A. Mitigation actions typology for non ETO specific risk

This mitigation action typology is shown in Fig. 2, where the left part shows preventive actions and the right part curative actions.

Preventive actions are identified with respect to the 5 M of Ishikawa and the three risk sub-categories "break", "not available" and "error". We can see that for the two sub-categories "not available" and "error" and the four first M, the mitigation action are quite similar; basically, prevention is achieved with improvement of process resource management. For the fifth M, in order to deal with environment crisis, prevention corresponds with some crisis management plan preparation.

Curative mitigation actions correspond mainly with resource substitution and/or subcontracting.

	Non ETO preventive action			*Non ETO curative action*		
	Broken entity	Entity **not available**	**Error** on entity	**Broken** entity	Entity **not available**	**Error** on entity
Man (human resource)	Human resources politic to sensitize accident prevention	Action on human resources management	Action on human resources management	Substitution with another person (same/other company)	Substitution with an other person: overtime/sub-contract	Substitution with an other person: overtime/sub-contract
Machine (technical resource)	Preventive maintenance	Action on technical resources management	Action on technical resources management	Machine repair or substitution	Machine substitution overtime/sub-contract	Machine substitution overtime/sub-contract
Material (consumable resource)	First article inspection	Action on supplier management	Action on supplier management	Consumable Repair or substitution	Consumable substitution, inventory picking / urgent order	Consumable substitution, inventory picking / urgent order
Method (documentation)	NA	Method or documentation prepartion/distribution	Method or documentation prepartion/distribution	NA	Method or documentation obtention urgently	Method or documentation obtention urgently
Medium (Environment)	Environment **crisis** plan preparation			**Crisis** plan application and/or crisis cell set-up		

Fig. 2 Mitigation actions typology for non ETO risks

B. Mitigation actions typology for ETO specific risk

The mitigation action typology for ETO specific risk cannot show preventive actions.

In ETO, a detailed design of both system and delivery process has not been achieved when the offer was defined. Consequently, the first task of the delivery process is always a detailed design for both system and delivery process.

As ETO risk are mainly the result of bad design choices, a possible preventive action can correspond only with a design correction that is in fact the first task of the delivery process.

Therefore, Fig. 3 shows only curative mitigation actions typology for ETO specific risks.

	Inadequate entity	**KPI entity out of range**
Man (human resource)	Replacement with a more competent human resource	
Machine (technical resource)	Machine replacement or update	Replacement with a less costly or quicker resource, according to what is more important for the customer between cost and duration.
Material (consumable resource)	Replacement with a more adequate consumable resource.	
Method (documentation)	Method or documentation correction and improvement	Replacement with a less costly or quicker method/documentation
Medium (Environment)	NA	

For specific risks concept "Design problem is harder than expected"

	Impossible design	**Too much KPI-**	**Wrong design decision**
No specific M	Customer negotiation	Design modification	Design correction

Fig. 3 Mitigation curative actions typology for ETO risks

Curative actions for the four first M are quite similar and correspond with some resource replacement either more technically adequate or better for KPI evaluation.

The lower part of Fig. 3 concerns the ETO key risk "design problem is harder than expected." In that situation the finalization of the system design itself cannot be achieved. In the less critical situation "wrong design decision" only a design correction is needed with no strong consequences. In the intermediate "too many KPI constrained", KPI cannot be respected, the design will be modified but the supplier will have to pay penalty. In the most critical one "impossible design" the supplier must negotiate requirement modifications with his customer.

IV. DISCUSSION AND CONCLUSION

The goal of this article has been to present the first ideas about a typology of risks with mitigation actions. The analyzed risk is on the supplier side and characterize the fact of being unable to design, produce and deliver a system that has been sold.

The interest of such a typology is to help the person in charge of the definition of commercial offers to think about potential risks and relevant mitigation actions. They avoid the "withe page problem" when questioning what could be the risk taken? and what could we do to prevent and mitigate them?

One of the main interests of the proposed typology is to consider engineer-to-order situations and two kinds of risks: ETO and non-ETO specific risks. In addition, risks and mitigation actions have been specialized in sub-categories and characterized with respect to the 5 M of Ishikawa.

These propositions have been established during a cooperative research project involving companies of the mechatronic system domain. They can be considered as a first tentative and must be validated on other industrial situations.

For future, we are working of a version 2 of these typologies with dependent risks and cascading effects on the delivery process.

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