# Aspects of the BPRIM Language for Risk Driven Process Engineering

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**Abstract.** Nowadays organizations are exposed to frequent changes in business environment requiring continuous alignment of business processes on business strategies. This agility requires methods promoted in enterprise engineering approaches. Risk consideration in enterprise engineering is getting important since the business environment is becoming more and more competitive and unpredictable. Business processes are subject to the same quality requirements as material and human resources. Thus, process management is supposed to tackle value creation challenges but also the ones related to value preservation. Our research considers risk driven business process design as an integral part of enterprise engineering. A graphical modelling language for risk driven business process engineering was introduced in former research. This paper extends the language and handles questions related to modelling risk in organisational context.

**Keywords:** risk modelling, business process modelling, meta model, methodological framework, enterprise integration.

## 1 Introduction

Enterprise engineering is concerned with the design of projects, which aim to improve the structure and behaviour of organisations. It develops approaches based on modelling techniques, particularly on business process modelling in order to assure the quality and the global consistency of the project portfolio. Risk consideration in enterprise engineering is getting important since the business environment is becoming more and more competitive and unpredictable. In fact, business processes, the main objects of enterprise engineering, are fields for various business interactions. Thus, processes are source or target of incidents, which may even imply business interruptions. As a consequence, processes are subject to the same quality requirements as material and human resources. Process management is supposed to tackle value creation challenges but also the ones related to value preservation. Improving the interactions between the process management cycle and the risk management cycle is a possible approach to handle these requirements.

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In [1] a methodological framework known as the BPRIM ("Business Process-Risk Management – Integrated Method".) methodology has been introduced. It consists of the BPRIM framework, the BPRIM process, the BPRIM conceptual models and the BPRIM modelling language. The BPRIM process focuses on risk driven business process design as an integral part of enterprise engineering. The BPRIM language for risk driven process engineering supports the graphical modelling of business processes and risk. This paper introduces the risk context diagram and the risk diagram, which are part of the BPRIM language initially introduced in [1, 2].

First, our vision of risk driven process engineering is explained before introducing the BPRIM process, which shall legitimate the kind of diagrams one must deal with. Then, the selected two kinds of diagrams shall be introduced.

## 2 Risk and Its Relation to Business Process

### 2.1 Understanding Risk

There are many definitions of risk [3, 4]: "*combination of the probability of an event and its consequence*" [5]; "*variance of return*"[6]; "*the possibility that an event will occur and adversely affect the achievement of objectives*"[7].

Beyond the multitude of definitions, risk need to be conceptualized (fig. 1) in order to be understood: risk shall is defined with regard to two perspectives, the causal aspect and the consequence. The causal aspect consists of risk factors that are favourable for the occurrence of a given risk event. This risk event is considered being the root cause of a risk situation, which describes a possible state of the system of analysis. The state is evaluated in terms of impact (positive or negative). The causality and the impact are interpreted by a set of actors while considering their interests: this information is setup in the context of risk.

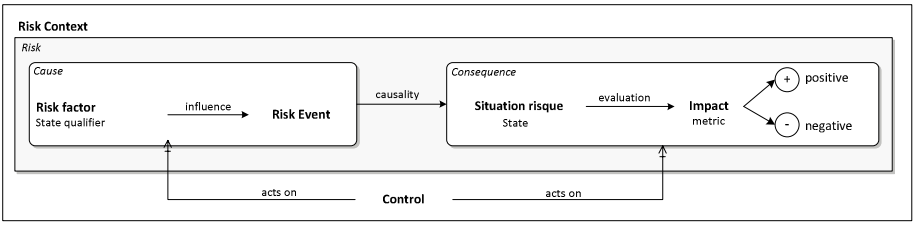



**Fig. 1.** A generic model of risk [1]

Any risk may have variable time and logical inter-relationships and relationships to other objects. Understanding these characteristics in order to manage risk to be acceptable is the intention of risk management. This is achieved by making decisions with regard to establishing control mechanisms affecting the cause or the consequence.

### 2.2 Risk and Business Process: The Relation

A business process is "*a str5uctured, measured set of activities designed to produce a specific output for a particular customer or market*" [8]. Hammer stated that "*a business process is a collection of activities that takes one or more kinds of inputs and creates outputs that is of value for the customer*" [9]. For F. Vernadat, "*a business process is a sequence … of enterprise activities, execution of which is triggered by some event and will result in some observable or quantifiable end result" [10].*

Considering most definitions, value creation seems to be a main characteristic of business processes. However, the concept of value seems to be ignored while conceptualizing business processes. In general, value designates the assessment of a value object by a given stakeholder [11-13]. This assessment is quantitatively or qualitatively evaluated in terms of level of value. The conceptualization of fig. 2 is defined based on this definition.

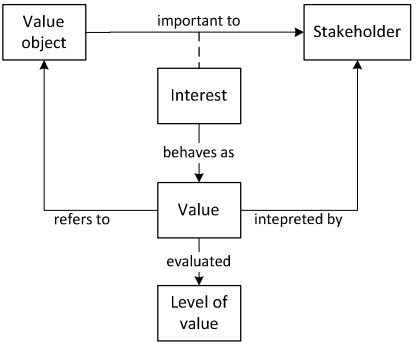



**Fig. 2.** The concept of value [1]: value describes the interest of a stakeholder for a given object. It may be evaluated in terms of level of value. Value refers to an object and is interpreted by stakeholders.

Since a business process is a place for value creation, many objects would have different values for different stakeholders. The performance is for instance important for the process owner, while compliance is relevant to quality manager and work security to the performing actor. Further, it is possible to categorise value objet while considering the input, control, resource and output dimensions of business processes.

As shown in (fig. 1), the consequence part of risk is evaluated in terms of impact. Since, risks are able to cause value modification; it is easy to link business process to risk by defining the impact of risk as a perception of the variation of the level of value: considering business processes, a risk is able to modify the level associated to a value interpreted by a set of stakeholders. A risk may cause for example performance, quality or compliance variations. Risk driven process engineering is expected to provide means for mastering these variations.

## 3 Risk Driven Process Engineering

The BPRIM process is a lifecycle model integrating the process of risk management and business process management [1]. The model consists in synchronizing steps of

process management with those of risk management while considering the conceptual and operational levels. The former is the risk driven process engineering, which consists of risk driven process design and risk driven process configuration. In this paper the emphasis is on the design step (fig. 3):

- **Contextualise:** The process models are defined. The information, organization, resource and functional aspects of the process models will provide information for managing risk by establishing the context of risk. This is performed by enriching process models with statements about object of value, stakeholder and the relations in terms of interest including the stakeholders' risk appetite.
- **Analyse:** First, risks are identified. Then processes are analysed with regard to their properties such as capability and stability. Qualitative and quantitative evaluation of risks is subsequently launched. The process models shall be enriched with risks models.
- **Treat:** Based upon information from the previous phase, selected risks are treated by defining control mechanisms. The mitigation may imply process changes.

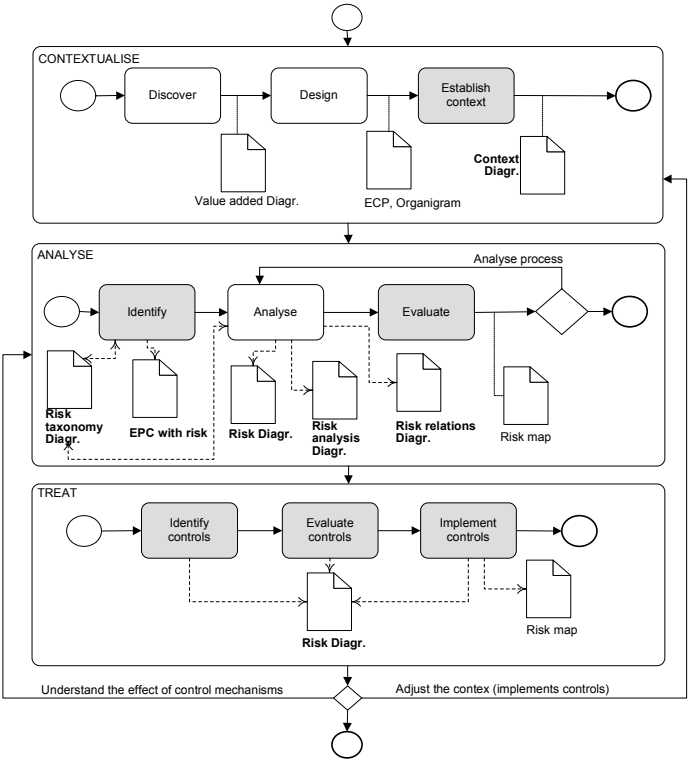



**Fig. 3.** Extract of the BPRIM process: the lifecycle for risk driven process design consists of three phases each of which is a three stepped process. The risk management activities are dark. The outputs of activities are listed. The activity "discover" creates for instance a "value added diagram".

# 4 The BPRIM Language

The BPRIM language is designed to support the BPRIM process and shall enable process models enrichment with risk models. Some of the diagrams such as the EPC and the organigram are defined in the ARIS method [14]. Other diagrams, like the context diagram, risk diagram and risk analysis diagram need to be introduced. The BPRIM modelling language considers this issue while extending process modelling capabilities with risk modelling. At the conceptual level, the language extends ISO/DIS 19440 with concepts related to risk management. It is a generic language. We provide a visual notation, which illustrates how to support this language with regard to the extended Event-driven Process Chain (eEPC) [14].

## 4.1 A Vocabulary for Risk Modelling

The following tables illustrate the graphical notation for risk modelling. There are graphical symbols for concepts, relations and operators. Given the intention to couple processes and risks, an effort is made to re-used representation formalism of process modelling languages; mainly the eEPC notation. Here the syntax of operations is extended while new concepts and relations are introduced.

This set of elements is sufficient for the representation risk in relation to business processes. However, information about the actual relations between enterprise concepts and risk will be missing.

**Table 1.** Graphical notation for risk modelling

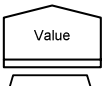
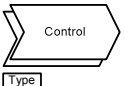
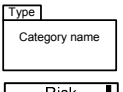
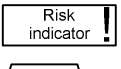
| Symbol | Description |
|---|---|
|  | Risk factor: characteristics of the system affecting the cause or the consequence of risk. |
|  | Risk situation: the state in which a risk event may lead the system. |
|  | Value: a graphical representation of a value. |
|  | Risk: the possibility of a situation affecting an asset. |
|  | Control mechanism: activities planed or executed in order to face a risk: |
|  | Category to classify risk, event or factors. |
|  | Concept that represents a risk indicator |
|  | A concept that represents an event |
|  | A concept that represents a stakeholder |

**Table 2.** Graphical notation of relations in the visual risk modelling language

| Notation | Description |
|---|---|
| | Influence relation of a factor on an event. |
| | Inter-event influence relation. |
| | Classification relation. |
| | Aggregation relation between risks. Aggregation is a parameterized relation, which can be customized by defining an aggregation criterion. |
| | Generalisation relation |
| | Causality relation between an event and a risk situation. |
| | Impact relation between risk situation and asset. |
| | General association relation between concepts. |
| | Relation between risk and process concepts (process, activity, and object): the direction indicates the target component. |
| | Interest relation between a stakeholder and an asset. |
| | Treatment relation between risk and risk treatment measure. |

**Table 3.** Graphical notation of operators in the visual risk modeling language

| notation | Description |
|---|---|
| ∧ | AND operator |
| ∨ | OR Operator |
| XOR | XOR Operator |

## 4.2 Diagrams for Risk and Process Modelling

During the execution of the BPRIM process (fig. 3), elements of process vocabulary and risk vocabulary are combined in various stages in order to produce diagrams.

The following simple business case shall illustrate the diagrams. At the enterprise level the domain "Make Desktop PC to Stock" produces "Desktop PC" and achieves a perfect order fulfilment. This objective is defined in terms of time and quality related goals. The achievement of the objective is qualified thanks to performance indicators such as the manufacturing reliability. The domain is under the authority of the manufacturing department. At the business process levels, the "Manufacture Desktop PC" process consists of activities such as "Assemble Computer Components". The later is triggered once components are issued to assembly.

### The Risk Context Diagram

A risk context model states to what extend a given value is relevant to a given stakeholder. The risk appetite of the stakeholder and the risk tolerance of the value object are defined in this model. A shown in fig. 5, at the conceptual level, a risk

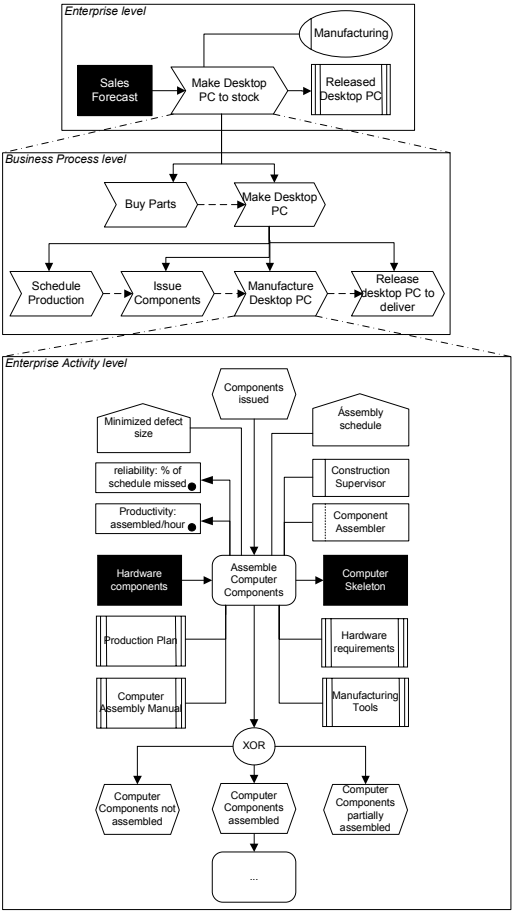



**Fig. 4.** Sample enterprise models for building computer to stock

context is a mapping of concepts related to value toward the organisational model of the enterprise. We have selected the meta models developed in ISO/DIS 19440 for enterprise modelling. In fig. 5, concepts such as enterprise activity, business processes, and functional entity or enterprise objects are mapped to value objects; i.e. objects, which may be evaluated by a stakeholder as being of value. In addition, other concepts such as organisational unit or functional entity are mapped to stakeholder.

We consider the example of building computer to stock and illustrate a risk context diagram in the fig. 6. Here, the objective "assemble schedule" is considered being of value for the assembly operator (operational role) and the assembly supervisor (organizational role). The assembly operator and supervisor are willing to accept a schedule variation of 2 hours/day. Fig. 7 is the meta model of the risk context diagram.

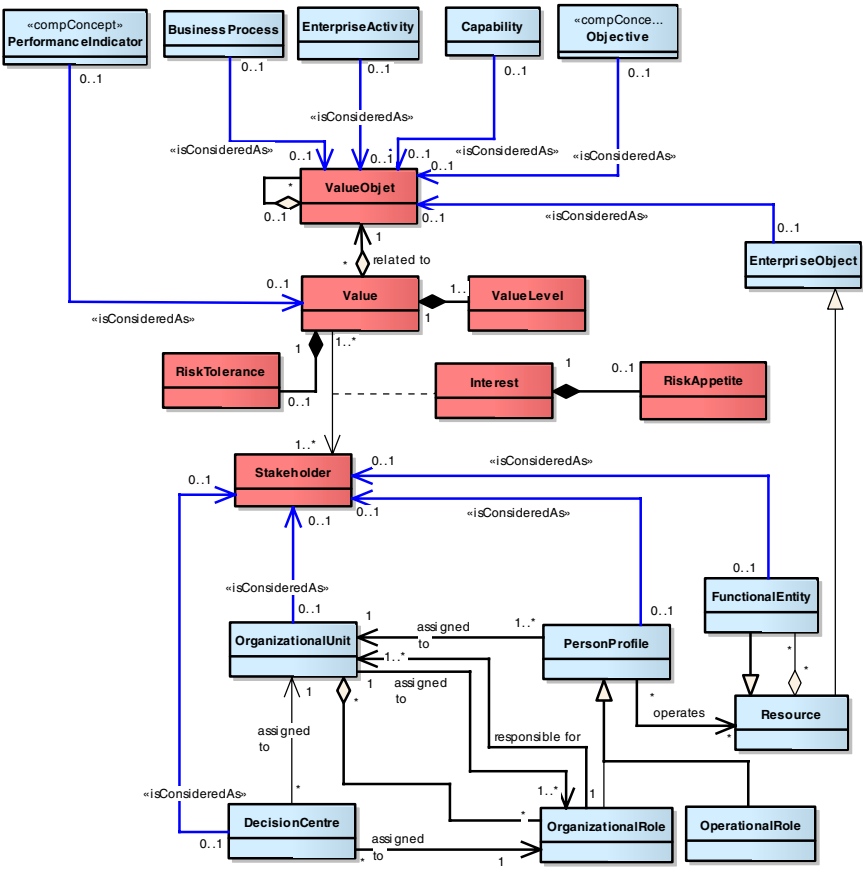



**Fig. 5.** Conceptual model of risk context (mapping of ISO/DIS 19440 to our conceptual model of value)

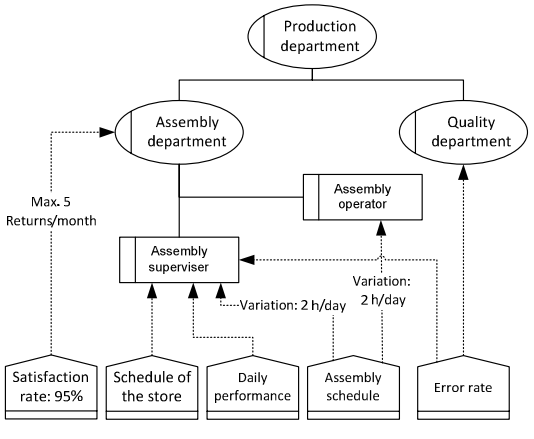



**Fig. 6.** Sample risk context diagram

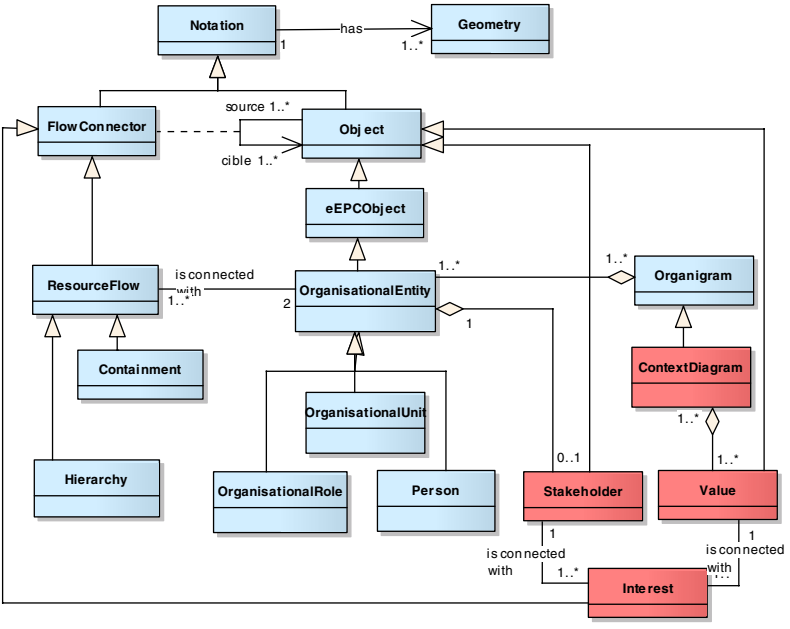



**Fig. 7.** The meta model of the risk context diagram

## The Risk Diagram

Identified and analysed, a risk is described by considering its environment. As shown in fig. 8, concepts such as risk indicator, risk owner, control mechanisms and the relations to business processes, enterprise activities and enterprise objects are defined.

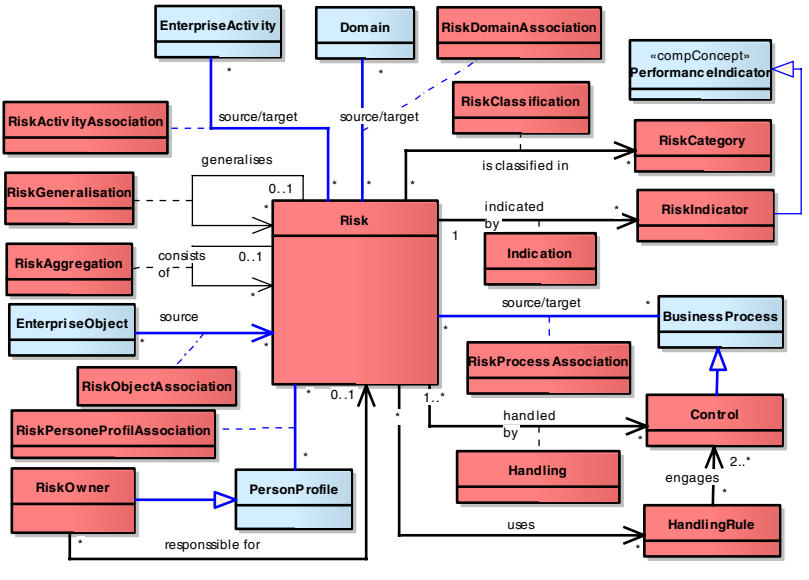



**Fig. 8.** Conceptual model of risk in its environment

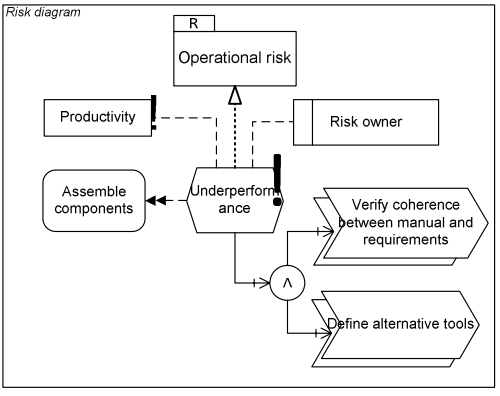



**Fig. 9.** Sample risk diagram with risk category, indicator, owner, business process and controls

Fig. 9 illustrates a risk diagram. The later is classified as an operational risk, which affects the activity "assemble components". The risk may be handled by considering 2 controls mechanisms associated with the AND operator. Since control inherits from business process (fig. 9), it may be defined using a language such as the EPC.

## 5 Related Work

The COSO proposed a framework for Enterprise Risk Management (ERM) [7]. Approaches to Business Continuity Management [16] also address process level risks. In [17], the authors integrated risk models in process models while modelling risk as an error occurrence.

Widely used in decision analysis influence diagrams and fishbone diagrams are related to our approach. In contrast to influence diagrams, which emphasizes scenario analysis, fishbone diagrams and other approaches to industrial events analysis (FMEA, FTA, ETA) supports systematic analysis of root causes of problems.

We adopted a model based approach and consider risk as a complex and structured concept, immerged in an environment, which may allow a positive or negative interpretation depending on the objects of interest. In addition to causalities, we consider perspectives of different stakeholders and provide a possibility to associate to each risk the corresponding control mechanism.

## 5 Conclusion and Future Work

Research communities investigated on quantitative approaches to risk management while qualitative ones seams to be neglected. However, quantitative approaches rely deeply on qualitative techniques. The former are based on analytical techniques

whereas the later are stakeholder driven. Both approaches are complementary. Our research is targeted to enhance this complementary by providing means to improve the quality and accessibility of quantitative risk management.

The BPRIM framework for the integrated management of business process addresses these issues.

This paper developed some aspects of the language while considering the risk context diagram and the risk diagram, which are extensions of pervious work. The risk context sets up the relations that are necessary for risk assessment. Actually, risk is perceived as being an eventual disequilibrium of the risk context. Identified and analysed, risks are extended with environmental information such as controls, indicators or categories. The risk diagram is designed to capture this knowledge.

We are working on industrial experiences. It is plan to investigate on tools for guiding the usage of the framework and its models in order to improve the quality of information required for quantitative risk management.

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