AN EFFICIENT RISK ANALYSIS IN REQUIREMENT ENGINEERING

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***Abstract*—The requirement engineering is one of the emerging sections in software engineering. The main factors that a requirement engineering process considers are business requirements and user requirements and provide solutions according to it. We have proposed a requirement engineering model based on the Tropos goal model. A modified Tropos goal model is used in the proposed goal risk model. The goal risk model consists of three layers, and in the top level goals to be achieved by the process is plotted and in the second level, the events that triggers the goals and in the bottom level, the supporting parameters for the goal and events are plotted. The risk analysis of the proposed GR model is conducted based on one analyses i.e. the cost to risk analysis. The experimental evaluation is carried out on a case study considering a software development company. The risk affinitive value is calculated from the different set of risk parameters, which is set like high, medium and low. The risk parameters clearly evaluate the affinity of that event to a particular set of goals. This parameter reduces the limitation in the previous work, like occurrence of same cost to risk values. According to the proposed approach distinct cost to risk values are achieved. Finally, the candidate solutions with low cost are selected**

***Keywords—Requirement Engineering,* Tropos *Goal model*,Candidate solutions,Goal layer,Event layer,Support layer**

I. INTRODUCTION

Requirements engineering is a process based method for defining, realizing, modeling, relating, documenting and maintaining software requirements in software life cycle that help to understand the problem better [1]. It has been shown that a large proportion of the publications in software development can be related back to requirements engineering (RE) [2]. RE is the process of discovering the purpose in the software development, by identifying stakeholders and their needs, and documenting these in a form that is amenable to analysis, communication and subsequent implementation [3]. Failures during the RE procedure have a significant negative impact on the overall development process [4]. Reworking requirements failures may take 40% of the total project cost. If the requirements errors are found late in the development process, e.g. during maintenance, their correction can cost up to 200 times as much as correcting them during the early stages of the development process [5]. Adequate necessities are therefore essential to ensure that the system the customer expects is produced and that unnecessary exertions are avoided.

According to Goal-Oriented Requirements Engineering, analysis of stakeholder goals leads to substitute sets of functional requirements that can each accomplish these goals. These alternatives can be evaluated with respect to nonfunctional necessities posed by stakeholders. In the previous paper, they propose a goal-oriented approach for analyzing risks during the requirements analysis phase. Risks are analyzed along with stakeholder interests, and then countermeasures are identified and introduced as part of the system's requirements. This work extends the Tropos goal modeling formal framework suggesting new concepts, qualitative reasoning techniques, and methodological procedures. The approach is based on a conceptual framework composed of three primary layers: assets, events, and treatments.

In the field of software engineering, the requirement engineering is getting special attention as it is based on the stakeholder's interests. The main factors that a requirement engineering process considers are business requirements and user requirements. The requirements are used to enhance the development of the software product with low cost and the time it should satisfy all the requirements. One of the sensitive areas, which every software development process concentrate is the risk involved with the process. So, particular assessment measures have to be taken in order to minimize the risks in software development process. Yudistira Asnar and Paolo Giorgini [9] have proposed a method for risk analysis in requirement engineering. The method deals with a software development method called, Tropos Goal Model and with a Probabilistic Risk Analysis (PRA). Inspired from their work, we are planning to propose an approach on extending the Tropos model with risk analysis feature. Tropos goal model consists of three layers, mainly Goal layer (GL), Event layer (EL) and Treatment layer (TL). The GL consists of set of goals that has to fulfill by the process and EL contains the constructs which helps to achieve the goals. The TL is working as the input, which helps in achieving the goals. We developed a modified Tropos goal model, in which the evidence of satisfaction and denial of the goal is calculated from the likelihood of the events corresponding to the goals.

II. RELATED WORK

Jac Ky Ang et al [6] has developed an expert system that has least focus on requirement engineering. In facts, requirement engineering is important to get all the requirements needed for an expert system. If the requirements do not meet the client's needs, the expert system is considered fail although it works perfectly. Currently, there are a lot of studies proposing and describing the development of expert systems. However, they are focusing in a specific and narrow domain of problems. Also, the major concern of most researchers is the design issues of the expert system. Therefore, we emphasize on the very first step of success expert system development – requirement engineering. Hence, we are focusing in the requirement engineering techniques in order to present the most practical way to facilitate requirement engineering processes. In this paper, they analyze expert system attributes, requirement engineering processes in expert system developments and the possible techniques that can be applied to expert system developments. Next, we propose the most appropriate techniques for the expert system developments based on the analysis. From this paper, a set of techniques for expert system development will be provided.

Lukas Pilat et al[7] have proposed an approach for problem in requirements engineering is the communication between stakeholders with different background. This communication problem is mostly attributed to the different "languages" spoken by these stakeholders based on their different background and domain knowledge. We experienced a related problem involved with transferring and sharing such knowledge, when stakeholders are reluctant to do this. So, they take a knowledge management perspective of requirements engineering and carry over ideas for the sharing of knowledge about requirements and the domain. We cast requirements engineering as a knowledge management process and adopt the concept of the spiral of knowledge involving transformations from tacit to explicit knowledge, and vice versa. In the context of a real world problem, we found the concept of "knowledge holders" and their relations to categories of requirements and domain knowledge both useful and important. This project was close to become a failure until knowledge transfer has been intensified. The knowledge management perspective provided insights for explaining improved knowledge exchange.

Mina Attarha and Nasser Modiri [8] have adopted a critical and specific software systems last longer and they are ought to work for an organization for many years, maintenance and supporting costs of them will grow to high amounts in the upcoming years. In order to develop and produce special aimed software, we should piece, classify, combine, and prioritize different requirements, pre-requisites, co-requisites, functional and nonfunctional requirements (by using requirements engineering process, they can classify the requirements). Development and production of special software requires different requirements to be categorized (different requirements can be categorized using software requirements engineering). In other words, we have to see all requirements during the software's life cycle, whether they are important and necessary for our software at present time or they are not important currently but will become important in future. Requirements engineering aim is to recognize the stockholder' requirements and their verifications then gaining agreement on system requirements, is not just a phase completed at the beginning of system development not required any more, but includes parts of next phases of software engineering as well. To achieve this purpose, we acquired a comprehensive knowledge about requirements engineering. First, they defined requirements engineering and explained its aim in the software production life cycle. The main activities and purpose of each requirements engineering activity is described. Moreover, the techniques used in each activity are described for a better comprehension of the subject.

III. MOTIVATION BEHIND THE APPROACH

In the field of software engineering, the requirement engineering is getting special attention as it is based on the user's interests. The main factors that a requirement engineering process considers are business requirements and user requirements. The requirements are used to enhance the development of the software product with low cost and the time it should satisfy all the requirements. Similar to every software engineering process, the requirement engineering is also affected by the risk factors. The development of the software based on user requirements has higher risk factors. Recently, Yudistira Asnaret al. [9] have proposed a risk assessment in requirement engineering. The approach is characterized by a goal based software development methodology proposed by Tropos [9]. In their approach, a specific Tropos methodology is used for the risk assessment. A goal-relation model is developed to find the most relevant goals to achieve and the risk and cost to achieve the same. Inspired from their research, we have plotted modified Tropos goal model for the risk analysis in the requirement engineering.

IV. CASE STUDY

The case study includes the processing in a Software Development Company (SDC) for achieving maximum profit. The case study is proposed by considering the scenario like a client want to develop software from the company. An in-depth analysis of different process happening in developing software is detailed in the case study. The SDC goal model defines the three layers as goal layer, events layer and support layer. The goal layer contains the goals that have to achieve by the SDC.As discussed above the events layer are helping parameters for achieving the goals. The support layer, as the name specifies provides support for the events as well as goals. There are several uncertain events happen, which will restrict the successful achievements. Thus specific measures have to be taken to reduce the effect of these uncertainties. However, these measures imply extra costs.

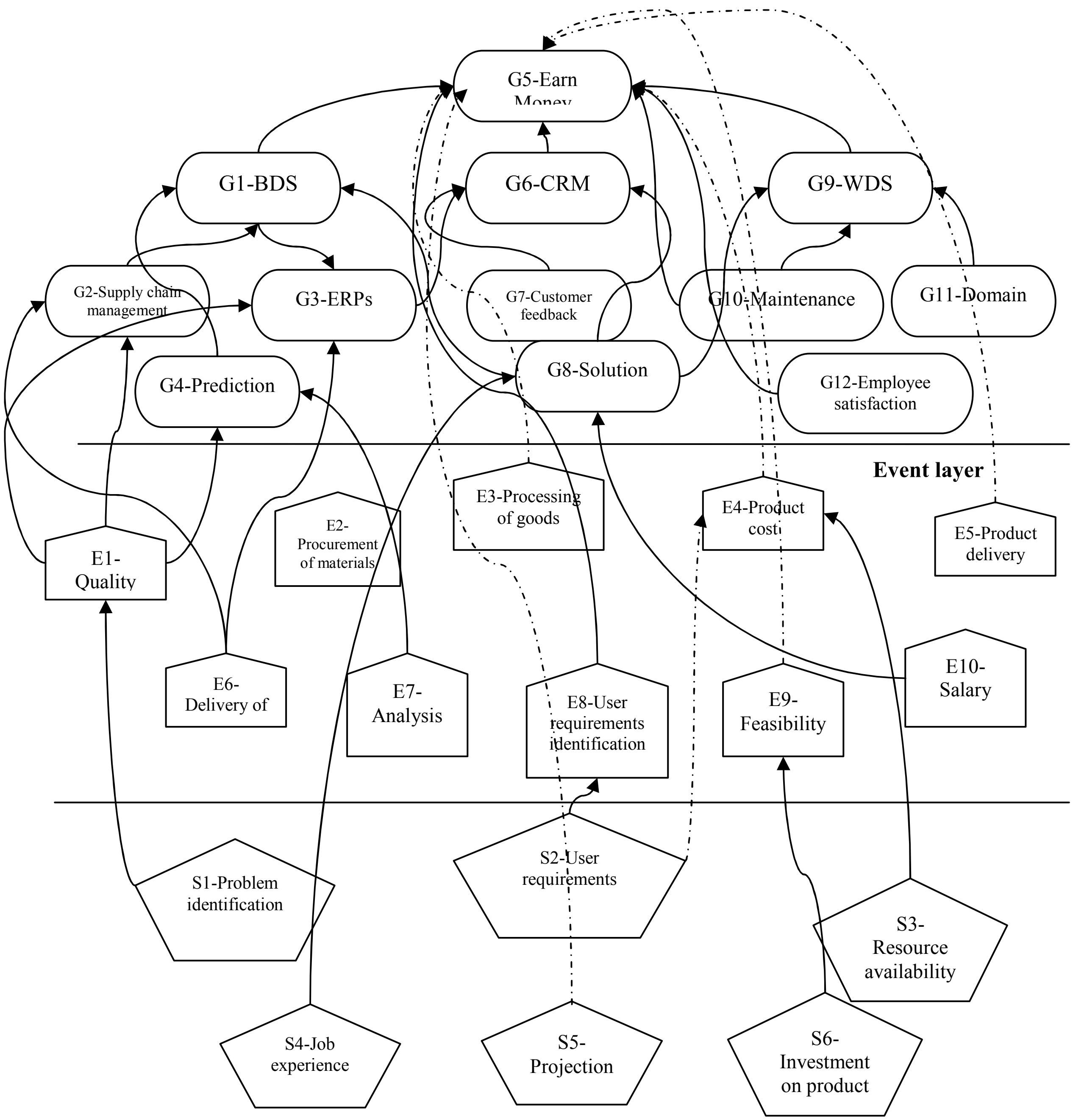

Figure 1. SDC goal- Risk Model

V. Experimental Analysis

This section describes the experimental evaluation of the proposed goal risk model. The experiment is conducted in Java runtime environment in system configured to a processor of 2.1 GHz, 2 GB RAM and 500 GB hard disk. The experimental evaluations are provided in the following section. The proposed goal risk models are used to judge the relevant candidate solutions.

In the cost to risk analysis phase, the cost and risk of the candidate solution for achieving the target goals are analyzed. The risk is calculated based on the DEN () value of the candidate solution under consideration. The denial rate of the candidate solution is based on the impact of events and support nodes of the solution. If the nodes are possessing high risk values or possessing high denial rate then the denial rate of the candidate solution will be higher. Consider the risk impact on the solution S3,

$$S3 \leftarrow G2\ G4\ G7\ G8\ G10\ G11,$$

Where, G2, G7 and G11 having partial denial values. Thus the risk can be calculated as the sum of the evidence DEN (S3). The risk values are ranging from 3, 2 and 1 for full, partial and null denials respectively. Thus the risk of S3 can be given by, Risk (S3) ➔ 2+2+2= 6, since DEN (G2) = DEN (G7) =DEN (11) = P. Similarly, the risks regarding all the candidate solutions are calculated and the graph is plotted based on the risk and cost values.

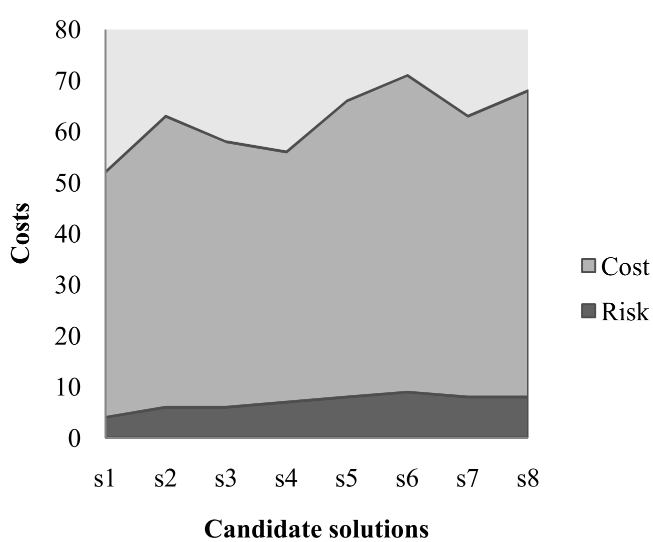

Figure 2. Cost to Risk analysis

The analysis of the graph plotted in figure 2, shows that the candidate solutions S1, S2, S3 and S4 are having acceptable costs and risk values. So for achieving the target goals, these solutions can be considered. Among the four solutions, the solution S3 is covering most of the source nodes with an acceptable cost with minimum risk. Thus we can state that the candidate solution S3 can achieve more profit with acceptable risk than other solutions.

VI. Conclusion

In analysis phase the cost and risk of the candidate solution are evaluated. The candidates solutions considered in the cost to risk analysis is the filtered solutions from the cost analysis phase. This phase is initiated in order to analyze the risk affect for each of the candidate solutions. The nodes taking part in the each of the candidate solution are analyzed thoroughly.

The analysis considers the following parameters, chance_of_risk, chance_of_acceptance and chance_of_denial. The chance_of_risk is based on the evidence of likelihood and severity of event which triggers target goals. I.e. if the likelihood of the event is high, it will affect in achieving the goal. The event which provides the high likelihood is a risk then the target goal will result in denial. Similarly, chance_of_acceptance is related to the SAT () value and the chance_of_denial is based on the DEN () value. The total risk is calculated by assuming Null=1, Partial=2, and Full=3 and summing up the DEN values for all top goals. This means that for the acceptable risk level. A cost to risk graph is plotted for the assessment of relevant candidate solutions. The results showed that the proposed goal risk model has attained solution with acceptable cost and risk.

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REFERENCES

[1] Roy GG, Woodings TL (2000) A framework for risk analysis in software engineering. In: Proceedings of the seventh Asia-Pacific software engineering conference (APSEC '00), IEEE Computer Society Press, Washington, DC, USA, p 441

[2] H.F. Hofmann and F. Lehner, "Requirements engineering as a success factor in software projects", *IEEE Software,vol 18, no* 4, pp. 58-66, 2001.

[3] B.A. Nuseibeh and S.M. Easterbrook, "Requirements engineering: A roadmap", Proc. of the 22nd Intl. Conf. on Software Engineering (ICSE '00), IEEE Computer Society Press, June 2000, pp. 35 – 46.

[4] T. Hall, S. Beecham and A. Rainer, “Requirements problems in twelve software companies: An empirical analysis”, IEEE *Software, vol 149, no.* 5, pp. 153-160, 2002.
[5] M. Niazi and S. Shastry, “Role of requirements engineering in software development process: An empirical study”, Proc. of the 7th Intl. Multi Topic Conf. (INMIC2003), IEEE Computer Society Press, Dec 2003, pp. 402-407.
[6] Jac Ky Ang, Sook Bing Leong, Chin Fei Lee, Umi Kalsom Yusof, “Requirement Engineering Techniques in Developing Expert Systems”, School of Computer Sciences Universiti Sains Malaysia, IEEE, symposium on computer science and informatics, 2011, pp.1-2
[7] Lukas Pilat and Hermann Kaindl, “A Knowledge Management Perspective of Requirements Engineering”, Institute of Computer Technology Vienna University of Technology Vienna, Austria, IEEE Conference: 19-21 May 2011, pp.1-12.
[8] Mina Attarha and Nasser Modiri, “Focusing on the Importance and the Role of Requirement Engineering”, Interaction Sciences (ICIS), 2011 4th International Conference, 16-18 Aug. 2011, pp. 181 – 184.
[9] Yudistira Asnar, Paolo Giorgini, “Risk Analysis as part of the Requirements Engineering Process”, Departmental Technical Report, 2007.