

Chapter 31

Risks Assessment using Fuzzy Petri Nets for ERP Extension in Small and Medium Enterprises

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ABSTRACT

In this paper a Fuzzy Petri Net model (FPN) is developed and tested to assess the risks involved during Enterprise Resource Planning (ERP) adoption in Small and Medium Enterprises (SMEs). This model pertains only to the risks and risk factors identified in the extension phase of ERP adoption in SMEs. In other words, this work studied only the risk perception relating to extending the ERP integration between the supply chain partners. This paper addresses the problems of risk identification and assessment during the extension phase. There are two motives for this research namely, one to define the ERP extension risks and two to assess and quantify the risks in a simple yet robust model. The uniqueness of this paper is three dimensional because in addition to presenting and quantifying the risk values in FPN, the risks are categorized and further graded for decision support to SME stakeholders. Realignment and standardization of SMEs business process, lack of support from larger enterprises and incompatibility issues are perceived to be most critical risk factors.

1. INTRODUCTION

This paper presents an assessment model for risks and the associated risk factors that need to be considered while extending the Enterprise Resource Planning (ERP) functionalities of the Small and Medium Enterprises (SMEs) with their larger counterparts in the automobile industry. This paper is set on the premises of the automobile sector in India, where there is extensive depending on the SMEs for raw materials, component supplies and subcontracting. While that large firms place ERP adoption from an overall business perspective, the SMEs is found to confine such initiatives only at the process layer. Given the tier-wise structure of the automobile industry comprising of players from the large multinational to a very small firm there is a strong need for the SMEs to collaborate in process integration, because larger companies will call for the readiness in their smaller counterparts during supplies (Bharathi et al., 2013). Hence it becomes imperative to study the risks and the embedded risk factors on behalf of the SME segment in order to sensitize them about the risks. SMEs need to examine the barriers during their approach in ERP extension to their supply chain partners (de Búrca et al., 2005). SMEs will have to enhance their maturity in learning the right expectation out of the ERP during the supply chain integration (Lenny Koh et al., 2006). The SMEs need to come out of the traditional mindset of decentralized system and go for a more integrated planning approach to collaborate with the schemes of their supply partners. Yet the SMEs are not really confident to draw out their collaborative support due to the lack of understanding about business process integration. SMEs need to see the relationship between ERP benefits and its impingement on the supply chain performance (Yang and Su, 2007). The SMEs are however not very sure as to what are the risks that could impact in such an integration initiative. The demand for integrating ERP with supply chain management (SCM) has been emphasized to strengthen the existing body of knowledge particularly from the SMEs perspective. The challenges faced by SMEs in ERP adoption and then also trying to reach out the ERP functionality to the supply chain partners are still evolving according to many research studies. Several factors that pose a challenge to such integration are compatibility issues, extent of dependencies between the systems in the material flow, business relationship, percolation ERP usage in SMEs, etc. It was also found that SMEs need to approach and plan the extension strategically keeping the proper balance between its business and IT competencies. Just then the expectations of operational efficiency process integration, customer and supplier integration, etc., can be realized (Chien et al., 2007; Ho et al., 2004; Su and Yang, 2010; Braglia and Frosolini, 2014; Goh, 2002; Nishat et al, 1996).

2. LITERATURE REVIEW

Fuzzy Petri Nets (FPNs) have widespread application in identifying and analyzing parallel and concurrent behaviour of many physical and societal arrangements. A host of control problems has used FPN to model various issues which include control of CNC-milling machines (Hanna et al., 1996), control of nuclear instrumentation for safety (Son and Seong, 2000), autonomous vehicle control (Parhi and Mohanta, 2011, Rigatos 2003, Wai and Liu 2009, Zouaghi et al., 2014), railway traffic control (Fay 2000, Cheng and Yang 2009), control of excavation robot (Wang 2004) etc.

FPN is a fuzzy production rule based system enables us to perform consistency checks using tools for analysis of FPN. This will facilitate the creation of appropriate algorithms while defining the maximum or minimum thresholds of risks in any given phase of ERP adoption. FPN can be built as a graphical

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