Chapter 4

FPN based RAM for Planning Phase
Chapter 4

FPN BASED RISK ASSESSMENT MODEL IN
THE ERP PLANNING PHASE

4.1 Introduction

The chapter four is the first chapter on analysis of data. In other words, this is the first in a series of five chapters which provides the analysis of data relating to the planning phase of ERP adoption using fuzzy Petri nets to realise the research objective which is to develop, build and implement a comprehensive risk assessment model useful to ERP projects in small and medium enterprises. In this chapter, section 4.1 presents the introduction; section 4.2 explains the general regulations for the assessment of risks using the fuzzy Petri net concept and these principles will hold good for the assessment of all the other four stages of ERP adoption in SMEs under study. Section 4.3 describes the risks and risk factors that are contained in the planning phase of ERP adoption and presents the FPN model for risk assessment in the planning phase. This section continues to assess and measure the risks based on the fuzzy production rules. The assessed risk factors are then segmented based on the risk categories as discussed in chapter 3 (please refer to table 3.4) and also levelled on the foundation of linguistic terms and values in chapter 2 (please refer to table 2.30) on the ground of which findings are translated.

4.2 Rules for Risk Assessment and interpretation of results

In this section we present the rules of the FPN model based on the fuzzy production rule system and also general rules for interpretation of the results arrived out of the FPN based risk assessment model.

4.2.1 Rules for risk assessment using FPN
In this research, we have engaged in an attempt to use FPN model the respondent’s perception about a risk factor towards the ‘contribution’ or ‘no contribution’ to a particular risk and in turn predict the shock of that risk on the implementation stage of ERP in SMEs. From the proposed fuzzy Petri Net model the following definitions have been derived.

Fuzzy Petri Net: This represents fuzzy production rules of a rule-based system. It comprises two types of node; places and transitions wherein circle represented place and the bar represents transitions. Each situation may or may not contain token associated with a truth value between 0 and 1. The transition has a certainty factor associated between 0 and 1 and directed arcs connect places to transition.

A fuzzy Petri net structure can be defined as an 8-tuple

$$\text{FPN} = (P, T, D, I, O, f, \alpha, \beta)$$

Where

- $P = \{p_1, p_2, \ldots, p_n\}$ is a finite set of places
- $T = \{t_1, t_2, \ldots, t_m\}$ is a finite set of transitions
- $D = \{d_1, d_2, \ldots, d_n\}$ is a finite set of propositions
- $P \cap T \cap D = \emptyset$, $|P| = |D|$,
- $I: T \rightarrow P^\infty$ is the input function, a mapping from transitions to bags of places,
- $O: T \rightarrow P^\infty$ is the output function, a mapping from transitions to bags of places,
- $F: T \rightarrow [0,1]$ is an association function, a mapping from transitions to real values between 0 and 1
- $\alpha: P \rightarrow [0,1]$ is an association function, a mapping of places to real values between 0 and 1
- $\beta: P \rightarrow D$ is an association function, an objective mapping of places to propositions

Fuzzy Production Rule: It explains the fuzzy relationship between two propositions.

- If $d_{j1}$ or $d_{j2}$ ..... $d_{jm}$ then $d_k$ ($C.F = \mu_1$). This rule type is modelled in fuzzy Petri-net and the fuzzy reasoning process of this type of rule is modelled figure 4.1.
- If $d_{j1}$ and $d_{j2}$ ..... $d_{jm}$ then $d_k$ ($C.F = \mu I$). This rule type is modelled on fuzzy Petri Net and the fuzzy reasoning process of this type of rule is modelled in figure 4.2.
The fuzzy Petri Net based model developed for the risk assessment of ERP adoption in SMEs is explained in figure 4.3.

At the place $P_0$, $d_0$ is the risk of failure in the distinct phase (each of the five distinct phases, namely planning, acquisition, implementation, usage and extension) of ERP Adoption.

At place $P_i$ ($i = 1, 2, \ldots, 7$). $D_i$ represents Risks identified that are associated with an ERP adoption phase. These factors will collectively lead to validate the risks of failure.

At place $p_{ij}$ ($i = 1, 2, \ldots, 7$), ($j = 1, 2, \ldots, n$), $d_{ij}$ represent the risk factor and $n$ represents the number of risk factors identified to explain the risks.

At place $p_{ijk}$ ($i = 1, 2, \ldots, 7$), ($j = 1, 2, \ldots, n$) ($k = 1, 2, \ldots, 4$) where $d_{ijk}$ represents the responses (options) for a risk factor viz., strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD) and $k$ represents the number of options (here 4) for recording the response to a risk factor. In other words

- $i$ = Number of risks in each phase
- $j$ = Number of risk factors per risk
- $k$ = Number of response options = {SD, D, A, SA}

which implies for $i^{th}$ risk, $j^{th}$ risk factor the options are as follows

\[
\begin{align*}
d_{ij1} &= \text{SD} \\
d_{ij2} &= \text{D} \\
d_{ij3} &= \text{A} \\
d_{ij4} &= \text{SA}
\end{align*}
\]

SA and A are defined as negative which implies that they will contribute/lead to risk while D and SD are defined as positive because they will not contribute/lead to risk.
Figure 4.1 Fuzzy Production Rule – First proposition

Figure 4.2 Fuzzy Production Rule – Second proposition
From the above model it can understood that $d_{ijk}$ ($i = 1, 2, \ldots, 11$), ($j = 1, 2, \ldots, n$) ($k = 1, 2, \ldots, m$) where $d$ represents the percentage of responses (ratio of number of responses to an option to the total responses recorded for all the options). If the percentage of responses are evenly spread in all the four options, namely SA, A, D & SD or if the sum of the response proportion of negative and positive options is equal $(SA+A) = (D+SD)$ then that factor may or may not contribute towards risk. If for a risk factor, the proportion of responses in SA and A is greater than D & SD, then that element will contribute towards risk and vice versa.

$\mu_i$ ($I = 1, 2, \ldots, 9$) represents the certainty factor, $\mu_i \in [0, 1]$ that is the intensity of the belief in the principle.

$T_i$ ($i = 1, 2, \ldots, 9$) represents the transition from input place to output place.

$\mu_{ij}$ ($I = 1, 2, \ldots, 9$), ($j = 1, 2, \ldots, n$) where $\mu$ represents the certainty factor of the responses to fire a risk factor.

Several research works have used a certainty or confidence factor (Looney, 1988; Chen et al., 1990; Gomes, & Steiger-Garção, 1995; Pedrycz and Gomide, 1994; Kouzehgar et al., 2011) or a truth-value (Garg et al., 1991) or a truth function (Bugarin and Barro, 1994) associated with the transitions. As a transition in a FPN corresponds to a rule in production systems, the firing of a sequence of transitions, considering the confidence factor of each one, defines a fuzzy firing sequence which is more or less likely to be fired (Cardoso et al., 1996).

In this study, for experimental purpose 9 (as a proportion 0.9) is fixed throughout, because the respondents are well informed and are fully cognizant of the context and their reactions can be extremely reliable. Using the notations and algorithm the pictorial representation of the FPN model is shown in Figure 4.3.
Figure 4.3 An illustration of FPN based Risk Assessment for ERP Adoption
4.2.2 General rules for interpretation of results

The analysis of the data provided critical findings at three different and interrelated levels, namely the risk factor level and the risk level and the adoption phase level.

**Figure 4.4 Interrelated levels for risk findings and interpretations**

At the **RISK FACTOR LEVEL** the maximum impact value is arrived based on the following rules.

1. The proportion of responses with regard to *strongly disagree, disagree, agree* and *strongly agree* is codified as 1, 2, 3 and 4 respectively.
2. The proportion of each of these four responses mentioned is multiplied by the certainty factor which is fixed at 0.9 the product of which will be the “weighted response value” (WRV).
   \[
   WRV = \max \left( (\%SD*0.9), (\%D*0.9), (\%A*0.9), (\%SA*0.9) \right)
   \]
3. The WRV will be considered for risk assessment purposes only if it is arrived from the responses *agree* and *strongly agree*. This is because Strongly Agree and Agree WILL contribute to RISK while, Strongly Disagree and Disagree WILL NOT contribute to RISK.
4. The maximum of these WRV amongst all the given risk factors is defined as the most impactful risk factor.

At the **RISK LEVEL** the minimum value of risk (MVR) to be foreseen is arrived based on the following rules.
1. The WRV is adjusted with the certainty factor and the minimum of the adjusted WRV is defined as the minimum value of the risk.

\[ \text{MVR} (P_1 \ldots P_7) = \min ((\text{WRV of each of all the risk factors} \times 0.9) \]

2. All the values arrived as above will be listed at the phase level.

At the PHASE LEVEL the maximum risk contributor is arrived by selecting the maximum values of all the risks as arrived from the risk level determinations.

### 4.3 Risks and risk factors in ERP Planning

This section provides a sound understanding of the risks and the associated risk factors that form part of the planning phase of ERP adoption. One of the major reasons for this is the deficiency of awareness of IT adoption. Manual data entry and spreadsheet based working environment is widely exercised in the SMEs as found in the field. Most of the SMEs which participated in the study extensively used spreadsheets in their operational procedure. This affects the efficiency of data flow in a bulk of SMEs and till recently, ERP is just recognized as a slice of software or IT application and not as a strategic IT enabler amongst the SMEs. The foremost and foremost crucial stage is the planning stage of ERP Adoption for an SME. Small and Medium Enterprises in the auto component cluster are facing what we call as a double-decker challenge. The foremost challenge is that the SMEs are pressurized of time, quality, and cost containment requirements of their larger counterparts who are purchasers of parts for automotive assembly at their large manufacturing plants. The second challenge is the process standardization requirements prescribed by their larger counterparts. In today’s business environment, we have found that SMEs not only want an integrated ERP system to standardize their core business procedures but also adhere to the environmentally positive business practices prescribed by the larger buyers. According to the study by IFS in 2010, it was found that without a committed and sustainable mandate from its top management nothing much can happen from initiatives like ERP. The survey found that most of these companies lack the
technology for streamlining their core business operations. This takes us to a very crucial decision point while planning for an ERP system. It is really important for SMEs to plan their ERP initiative in such a fashion that the functionalities of ERP system should not alone be capable of integrating their operational business process, but also be able to track and evaluate the terms of cost, effort and time, the expected savings ensuring operational efficiency (Bharathi et al., 2013).

Table 4.1 Risks and risk factors in the planning phase

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Risk</th>
<th>Code</th>
<th>Risk Factors</th>
<th>Code</th>
</tr>
</thead>
</table>
| 1      | Lack of awareness | P₁ | Lack of interest ERP  
ERP treated cost and not as investment  
Power-centric approach by the Owners  
Lack of Owners’ commitment | P₁₁  
P₁₂  
P₁₃  
P₁₄ |
| 2      | Lack of business process interrelationship | P₂ | Disparate core functional processes  
No or less functional interactions | P₂₁  
P₂₂ |
| 3      | Ineffective communication with user | P₃ | Information flow is passive  
Decision Making is reactive  
No formal channels for information flow from decision makers | P₃₁  
P₃₂  
P₃₃ |
| 4      | Ineffective definition of ERP scope | P₄ | Lack of clarity in identifying and prioritizing core functions  
Unrealistic expectation from the owners or partners | P₄₁  
P₄₂ |
| 5      | Resistance to change | P₅ | Traditional mind-set  
High degree of impatience on ERP outcomes | P₅₁  
P₅₂ |
| 6      | Lack of adequate knowledge of technology | P₆ | Limited Technical Manpower  
High dependence on manual processes | P₆₁  
P₆₂ |
| 7      | Inadequate financial management | P₇ | Lack of understanding the components of costs in ERP (Capex & Opex)  
Lack of awareness on available financing options  
Lack of knowledge on Return on ERP Investment | P₇₁  
P₇₂  
P₇₃ |
Established along the extensive critique of literature (please refer to chapter 2) and the insights from the qualitative analysis (please refer chapter 3) we define a circle of seven risks that constitute the planning phase. Eighteen risk factors have been identified and grouped into each of the seven risks in the planning stage of ERP adoption. We found that due to the limited range and size of the operations of the SMEs in the auto component cluster, IT adoption in general and ERP in particular is perceived just as installing applications to automate certain key functional processes which just show a short view of ERP adoption by the sample units. This signifies that the awareness about ERP as a holistic system enablement to enhance the overall business efficiency is not comprehended so far. The table 4.1 presents the risks and the risk factors that impact the planning phase of ERP adoption in SMEs.

The fuzzy Petri net model for modelling the risk assessment in the planning phase is shown in figure 4.5.
Figure 4.5 FPN for risk assessment in the planning phase of ERP adoption in SMEs
4.3.1 Analysis of FPN based RAM for the planning phase of ERP adoption

In the planning phase of ERP adoption (P$_0$), the risk called lack of awareness (P$_1$) is explained by means of four risk factors, namely disinterest in ERP (d$_{11}$) (Plant & Willcocks, 2007; Soja, 2006; Somers & Nelson, 2004; Umble, et al., 2003), ERP is treated as a cost absorber and not as an investment (d$_{12}$) (Somers & Nelson, 2004; Umble, et al., 2003), owners’ power-centric approach (d$_{13}$) and lack of owners’ commitment (d$_{14}$) (Jarvenpaa & Ives, 1991; Parr and Shanks, 2000). The values for predicting the risk is based on the responses which range from strongly agree to strongly disagree (d$_{111}$, ..., d$_{114}$) given by the respondents. We find that for d$_{11}$ 17% of respondents say agree and the value of d$_{112}$ is 0.17, 39% of the respondents say disagree, then the value of d$_{113}$ is 0.39 and 44% of the respondents strongly disagree, then the value of d$_{114}$ is 0.44. The durability of responses or truth value is denoted by $\mu$, the value of which is the weight assigned based on the reliability of the answers. The $\mu_{11}$ is assigned a value of 0.9 which implies a high degree of dependability of responses. The value $y_{11}$ is the maximum of (0.17*0.9), (0.39*0.9), (0.44*0.9) which is 0.396. This value is arrived from the response option SD. As said earlier, since SD and D denotes positive it implies that disinterest in ERP (d$_{11}$) will not be leading to risk of Lack of Awareness about ERP (P$_1$).

Similarly the values of all the other three risk factors, namely ERP treated as a cost and not an investment (d$_{12}$), the power centric approach of the owners (d$_{13}$), and lack of owners’ commitment (d$_{14}$) are arrived based on the proportion of responses. The maximum of the proportion-of-response values multiplied by the $\mu_{11}$ value determines whether a risk factor would contribute to the risk or otherwise. Consequently it can be found that $y_{12}$ has a value of 0.402 arrived from the response option SA. The value of $y_{13}$ is found to be 0.318 and is based out of the response option SD and $y_{14}$ has a value of 0.563 which is arrived out of A. Based on the FPN rule first proposition, we can state that lack of owner’s commitment has the maximum y values amongst the four risk factors and hence will be the most impacting factor in the risk.
of lack of awareness ($P_1$). This risk of lack of awareness will at least contribute to the risk in the planning phase to the extent of 0.286 ($d_1$) which is arrived by the value of $y_{13}$ by the $\mu_1$ value of 0.9. The FPN model for risk $P_1$ is given in figure 4.6.

![Figure 4.6 FPN based RAM for the risk $P_1$](image)

Lack of interrelationships between Business Processes ($P_2$) is attributed through two risk factors, namely disparate core functional processes ($d_{21}$) (Gurbaxani, 2000, Akkermans & Van Helden, 2002; Aloini, et al., 2007) and no or less functional interaction ($d_{22}$) (Gargeya & Brady, 2005; Plant & Willcocks, 2007; Soja, 2006; Somers & Nelson, 2004). Through the responses ranging from strongly agree to strongly disagree ($d_{121}, \ldots, d_{124}$) we predict the value of risk factors. For $d_{21}$, we find the value of $d_{121}$ is 0.36 (SA) and the value of $d_{122}$ is 0.43 (A), the value of $d_{123}$ is 0.10 (D) and the value of $d_{124}$ is 0.11 (SD). The $\mu_{21}$ is assigned a value of 0.9, which means that the value $y_{21}$ is the greatest of ($0.36 \times 0.9$), ($0.43 \times 0.9$), ($0.1 \times 0.9$) and ($0.11 \times 0.9$) which is 0.39. The value of 0.39 is maximum and it is arrived from option agree (A). As defined earlier, A is negative which denotes that disparate core functional processes ($d_{21}$) will lead to risk of Lack of inter-relationship between Business Processes ($P_2$).
Likewise the value of other risk factor $d_{22}$ is arrived based on the ratio of responses. The maximum of the proportion-of-response values multiplied by $\mu_{11}$ value will result in a value of 0.606 corresponding to the response option agree (A) hence the risk factor no or less functional interaction will also contribute to the risk ($P_2$).

![Figure 4.7 FPN based RAM for the risk $P_2$](image)

Based on the FPN rule first proposition, we state that no or less functional interaction has the maximum $y$ values amongst the two risk factors considered and hence will be the most impacting factor in the risk of lack business process relationship ($P_2$). This risk will at least lead to the planning phase to the extent of 0.351 which is arrived by the value of $y_{24}$ by the $\mu_1$ value of 0.9. The figure 4.7 shows the FPN model for the risk $P_2$.

*Ineffective communication with users ($P_3$) is held with three risk factors, namely passive information flow across the span of control ($d_{31}$) (Parr and Shanks, 2000; Mandal and Gunasekaran, 2003), reactive decision-making ($d_{12}$) (Mandal and Gunasekaran, 2003; Grant, 2003; Finney & Corbett, 2007) and no formal channels of*
communication from decision-makers (d_{33}) (Finney & Corbett, 2007; Kumar, Maheshwari, and Kumar, 2002). Based on respondents’ perceptions ranging from strongly agree to strongly disagree (d_{131}…, d_{134}) we arrive at the value of risk factors. For d_{31} 13% of respondents strongly agree the value of d_{131} is 0.13, 50% of them agree so the value of d_{132} is 0.50, 25% of them disagree so the value of d_{133} is 0.25 and only 11% of them strongly disagree, hence the value of d_{133} is 0.11. µ_{31} value is assigned in 0.9 so the value of y_{31} will be the maximum of (0.13*0.9), (0.5*0.9), (0.25*0.9) and (0.11*0.9) which is 0.45. The value of 0.449 is arrived out of the response option agree hence it is understood that the risk factor passive information flow (d_{31}) will contribute to the risk of ineffective communication with users (P_3). Likewise, maximum value of y_{32} and y_{33} of other two risk factors d_{32} and d_{33} is calculated as a product of proportion-of-responses value and µ_{31} to which is arrived as 0.523 (response option disagree) and 0.559 (response option agree) respectively decide the positive or negative perspectives. It denotes that reactive decision-making (d_{32}) will not contribute, but no formal channels of communication from decision-makers (d_{33}) will contribute to the risk (P_3). This risk will at least lead to the planning phase to the extent of 0.404 which is arrived by the value of y_{33} by the µ_{1} value of 0.9. The figure 4.8 shows the FPN model for the risk P_3.
Ineffective definition of ERP scope ($P_4$) is defined through two risk factors, namely lack of clarity in identifying and prioritizing core functions ($d_{41}$) (Gargeya & Brady, 2005; Plant & Willcocks, 2007; Soja, 2006; Somers & Nelson, 2004) and unrealistic expectation from the owners ($d_{42}$) (Soja, 2006; Somers & Nelson, 2004; Umble, et al., 2003). The values of the risk factors are arriving from the responses ranging from strongly agree to strongly disagree ($d_{141}$,..., $d_{144}$). For $d_{41}$, 3% of respondents strongly agree, so the value of $d_{141}$ is 0.03, 17% of them agree so the value of $d_{142}$ is 0.17, 54% of them disagree so the value of $d_{143}$ is 0.54 and 26% of them strongly disagree, hence the value of $d_{144}$ is 0.26. $\mu_{41}$ value is assigned as 0.9 so the value of $y_{41}$ will be the maximum of (0.03*0.9), (0.17*0.9), (0.54*0.9) and (0.26*0.9) which is 0.489. The value of 0.489 is arrived out of the response option disagree, hence it is understood that the risk factor $d_{41}$ will not contribute to the risk of the ineffective definition of ERP scope ($P_4$).
In the same way the value of other risk factor \( d_{42} \) is calculated along the basis of response proportion. The value of \( y_{42} \) is the maximum of proportion-of-responses and \( \mu_{42} \) of 0.9 of that risk factor which is arrived at 0.532. This value is derived from the response proportion agree which is a negative attribute as defined earlier will determine and hence will contribute to the risk \( P_4 \). This risk will at least contribute to the planning phase to the extent of 0.440 which is arrived by the value of \( y_{42} \) by the \( \mu_1 \) value of 0.9. The figure 4.9 shows the FPN model for the risk \( P_4 \).

Resistance to Change \( (P_5) \) is explained through traditional mindset \((d_{51})\) and the high degree of importance on ERP outcomes \((d_{52})\) (Mandal and Gunasekaran, 2003; Grant, 2003; Finney & Corbett, 2007). The risk-factors values are arrived from the given range of responses from strongly agree to strongly disagree \((d_{151}, ..., d_{154})\). For \( d_{51} \) we
found that 19% of the respondents strongly agree, so its value is 0.19 while 56%
agree the value is 0.56, 10% and 15% disagree and strongly disagree respectively.
The value of $\mu_{51}$ being 0.9 the value of $y_{51}$ will be the maximum of $(0.19*0.9)$,
$(0.56*0.9)$, $(0.10*0.9)$ and $(0.15*0.9)$ which is 0.501. In this outcome since 0.501 is
arrived out of negative attribute of responses namely agree this risk factor will
contribute towards the risk $(P_5)$. With the same assumptions made for the risk factor $(d_{52})$, we find that 30% of the
respondents strongly agree, 52% of the respondents agree, 10% of the respondents
disagree and 8% of respondents strongly disagree and so their values would be 0.30,
0.52, 0.10 and 0.08 respectively. $\mu_{52}$ being 0.9 the value of $y_{52}$ will be the maximum
of $(0.30*0.9)$, $(0.52*0.9)$, $(0.10*0.9)$ and $(0.08*0.9)$ which is 0.468. Since the
maximum value is based on negative attribute of responses, namely agree this risk
factor will also contribute to the risk $(P_5)$. This risk of resistance to change will at
least contribute to the planning phase to the extent of 0.422 which is arrived by the
value of $y_{52}$ by the $\mu_1$ value of 0.9. The figure 4.10 shows the FPN model for the risk
$P_5$. 
Lack of adequate knowledge of technology ($P_6$) is supported by two risk factors, namely limited technical manpower ($d_{61}$), and high dependence on manual processes ($d_{62}$) ([Lubbe & Remenyi, 1999; Nutt, 1999; Akkermans & Van Helden, 2002; Aloini, et al., 2007]. The values of these two risk factors are based on responses that range from strongly agree to strongly disagree ($d_{161}, \ldots, d_{164}$). Here for $d_{61}$ 30% of the respondents strongly agree while 52% agree, 13% disagree and only 5% strongly agree, then their values would be 0.3, 0.52, 0.13 and 0.05 respectively. The $\mu_{61}$ being 0.9 the value of $y_{61}$ is the greater of (0.3*0.9), (0.52*0.9), (0.13*0.9) and (0.05*0.9) which is 0.469. In this risk factor, since the value of 0.469 is arrived from the response option agree it denotes negative perspective and will contribute to the risk ($P_5$). Similarly, value of other risk factor $d_{62}$ is calculated on the basis of response proportion.

Figure 4.10 FPN based RAM for the risk $P_5$
The value of $y_{62}$ is arrived at the maximum of proportion-of-responses and $\mu_{62}$ of 0.9 of that risk factor which is 0.358 which is also arriving from the response option agree. Consequently, based on negative attribute as defined earlier the risk factor $d_{62}$ will also lead to the risk ($P_6$). This risk of resistance to change will at least contribute to the planning phase to the extent of 0.422 which is arrived by the value of $y_{61}$ by the $\mu_1$ value of 0.9. The figure 4.11 shows the FPN model for the risk $P_6$.

Inadequate financial management ($P_7$) is explained by means of three risk factors, namely no understanding about the cost components ($d_{71}$), not aware of the available financing options ($d_{72}$), and no knowledge on the ROI of ERP Investment ($d_{73}$) (Plant & Willcocks, 2007; Soja, 2006; Somers & Nelson, 2004; Umble, et al., 2003, Parr and Shanks, 2000; Mandal and Gunasekaran, 2003; Grant, 2003; Finney & Corbett, 2007). Based on respondents’ perceptions ranging from strongly agree to strongly disagree.
(d_{171}, ..., d_{174}) we arrived at the value of risk factors. It is found that for \( d_{71} \) 5% of respondents strongly agree the value of \( d_{171} \) is 0.05, 57% of them agree, then value of \( d_{172} \) is 0.57 and 30% of them disagree the value of \( d_{173} \) is 0.30 and 8% of strongly disagree, the value of \( d_{174} \) is 0.08. The \( \mu_{71} \) being 0.9 the value of \( y_{71} \) will be the maximum of \( (0.05 \times 0.9), (0.57 \times 0.9), (0.30 \times 0.9) \) and \( (0.08 \times 0.9) \) which is 0.514. The value of 0.514 is arrived out of the response option agree hence it can be realised that the risk factor no understanding about the cost components \( (d_{71}) \) will contribute to the risk of Inadequate Financial Management \( (P_7) \).

![Figure 4.12 FPN based RAM for the risk P_7](image)

Similarly, maximum value of \( y_{72} \) and \( y_{73} \) of other two risk factors \( d_{72} \) and \( d_{73} \) is calculated as a product of proportion-of-responses value to decide the positive or negative perspectives. It is found that both the risk factors also contribute to the risk of inadequate financial management and their values are arrived at 0.711 and 0.550 respectively. In other words, all the three components that fix the risk are perceived
by the respondents as risky. This risk of inadequate financial management will at least contribute to the planning phase to the extent of 0.463 which is arrived by the value of $y_{72}$ by the $\mu_1$ value of 0.9. The figure 4.12 shows the FPN model for the risk $P_7$.

### 4.3.2 Findings and Interpretations

The consolidated findings and interpretations are presented in table 4.2.

**Table 4.2 Findings and interpretation of risk assessment in planning phase**

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>WRV</th>
<th>+ / -</th>
<th>Risks</th>
<th>MVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of interest ERP ($p_{11}$)</td>
<td>0.40</td>
<td>+</td>
<td>Lack of awareness ($P_1$)</td>
<td>0.286</td>
</tr>
<tr>
<td>ERP treated cost and not as an investment ($p_{12}$)</td>
<td>0.40</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power-centric approach by the Owners ($p_{13}$)</td>
<td>0.32</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Owners’ commitment ($p_{14}$)</td>
<td>0.56</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disparate core functional processes ($p_{21}$)</td>
<td>0.39</td>
<td>-</td>
<td>Lack of business process interrelationship ($P_2$)</td>
<td>0.351</td>
</tr>
<tr>
<td>No or less functional interactions ($p_{22}$)</td>
<td>0.61</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information flow is passive ($p_{31}$)</td>
<td>0.45</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision Making is reactive ($p_{32}$)</td>
<td>0.52</td>
<td>+</td>
<td>Ineffective communication with user ($P_3$)</td>
<td>0.404</td>
</tr>
<tr>
<td>No formal channels for information flow from decision makers ($p_{33}$)</td>
<td>0.56</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of clarity in identifying and prioritizing core functions ($p_{41}$)</td>
<td>0.49</td>
<td>+</td>
<td>Ineffective definition of ERP scope ($P_4$)</td>
<td>0.440</td>
</tr>
<tr>
<td>Unrealistic expectation from the owners or partners ($p_{42}$)</td>
<td>0.53</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Traditional mind-set (p₅₁)**

<table>
<thead>
<tr>
<th>High degree of impatience on ERP outcomes (p₅₂)</th>
<th>0.50</th>
<th>-</th>
<th>Resistance to change (P₅)</th>
<th>0.422</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.47</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Limited technical manpower (p₆₁)**

<table>
<thead>
<tr>
<th>High dependence on manual processes (p₆₂)</th>
<th>0.47</th>
<th>-</th>
<th>Lack of adequate knowledge of technology (P₆)</th>
<th>0.322</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.36</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Lack of understanding the components of costs in ERP (Capex & Opex) (p₇₁)**

<table>
<thead>
<tr>
<th>Lack of awareness on available financing options (p₇₂)</th>
<th>0.51</th>
<th>-</th>
<th>Inadequate financial management (P₇)</th>
<th>0.463</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of knowledge on Return on ERP Investment (p₇₃)</td>
<td>0.71</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.55</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| * Negative (-) denotes that the answers relating to SA and/or A is greater than SD and/or D and hence will contribute towards risk. While positive (+) denotes responses relating to SD and D that will not conduce to the risk. The ‘y’ value with negative perspectives only is considered for risk measurement. Accordingly, out of the eighteen risk factors considered in the planning phase of ERP, we found that the risk perception to four factors namely p₁₁, p₁₃, p₃₂ and p₄₁ are positive so these do not contribute to the risk. |
At the phase level given in figure 4.13 the summary of the risks and their values are presented from both the propositions. The major risk contributor in the preparation stage of the work is related to inadequate financial management, which is arrived at the highest value from amongst the MVRs. We see that SMEs continues to believe that ERP is an investment centric initiative, the financial elements relating to ERP investments are all important to ERP adoption decisions. Hence inadequate financial management is perceived to be the highest risk contributor in the planning phase. They perceived factors like owners’ commitment, less functional interactions, the absence of formal information flow channels, unrealistic expectations, traditional mindset and scarcity of technical manpower can contribute significantly to the risks in ERP planning phase.

4.3.3 Categorisation and grading of risk factors

Finally to provide a better understanding on the risk factor the categorisation of the risk factors and the levelling of the risks are presented in table 4.3.
Table 4.3 Risk categorisation and levelling in planning phase of ERP adoption

<table>
<thead>
<tr>
<th>Risk factor codes</th>
<th>+ / -</th>
<th>Organisational</th>
<th>Managerial</th>
<th>Operational</th>
<th>Technological</th>
<th>Human</th>
<th>Risk Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>p11</td>
<td>+</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>p12</td>
<td>-</td>
<td></td>
<td></td>
<td>0.4</td>
<td></td>
<td></td>
<td>Fairly-low to medium</td>
</tr>
<tr>
<td>p13</td>
<td>+</td>
<td>0.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>p14</td>
<td>-</td>
<td>0.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p21</td>
<td>-</td>
<td></td>
<td></td>
<td>0.39</td>
<td></td>
<td></td>
<td>Fairly-low to medium</td>
</tr>
<tr>
<td>p22</td>
<td>-</td>
<td></td>
<td></td>
<td>0.61</td>
<td></td>
<td></td>
<td>Fairly-high</td>
</tr>
<tr>
<td>p31</td>
<td>-</td>
<td></td>
<td></td>
<td>0.45</td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p32</td>
<td>+</td>
<td>0.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>p33</td>
<td>-</td>
<td></td>
<td></td>
<td>0.56</td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p41</td>
<td>+</td>
<td></td>
<td></td>
<td>0.49</td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>p42</td>
<td>-</td>
<td></td>
<td></td>
<td>0.53</td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p51</td>
<td>-</td>
<td></td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p52</td>
<td>-</td>
<td></td>
<td></td>
<td>0.47</td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p61</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>0.47</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p62</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>0.36</td>
<td></td>
<td>Fairly-low</td>
</tr>
<tr>
<td>p71</td>
<td>-</td>
<td></td>
<td></td>
<td>0.51</td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>p72</td>
<td>-</td>
<td></td>
<td></td>
<td>0.71</td>
<td></td>
<td></td>
<td>Fairly-high to high</td>
</tr>
<tr>
<td>p73</td>
<td>-</td>
<td></td>
<td></td>
<td>0.55</td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
</tbody>
</table>

From the above table it can be interpreted that out of the total 18 risk factors considered planning phase of ERP adoption only 14 are risk contributors according to this survey. Out of these 14 risk factors, seven belong to organizational, three each is managerial and operational and one connects to the human category of risks. 8 out of the 14 risks are labelled as medium while the risk factor relating to financial management is levelled as fairly-high to high corroborating with the effect of fuzzy Petri net model.
4.4 Summary

This chapter has presented the rules for FPN based risk assessment model and also the rules for rendering of the answers. The analysis of the quantitative data is about the risk perceptions of the SME respondents relating to the planning phase of ERP adoption. The descriptive study showed clearly those factors which contribute and do not lead to the risks in this stage of ERP adoption. Further the contributing elements to risk were also categorized and graded to impart better understanding. We now proceed to the next chapter wherein the risk assessment analysis of the acquisition phase is carried out.