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Fuzzy Model for Risks Assessment in a Healthcare Supply Chain

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Abstract

Diabetes is a major health challenge in South East Asia. The disease management require wide spectrum of medicine including oral medicine, insulin and antibiotics; which makes the supply chain complex. The medicine supply chain faces diverse risk in geographically diverse country like India. The disruption due to these risks can be costly; and hospitals aim to minimise these risks. For effective management of these risks, hospitals need a comprehensive method to quantify all of their significant supply chain risks. We worked with a speciality hospital in diabetes-care to map their supply chain for a few representative medicines. The disruption risks accounted in the study are due to supplier bankruptcy, natural disasters and geopolitical events. The study develops, a fuzzy model for risk assessment for the diabetes clinic. The quantification of value- at- risk of a hospital in its supply chain gave them a clearer picture of where hospital needs to focus risk management efforts.

Keywords: Diabetes drugs, Supply Chain Risk, Supply Chain Disruption, Value-at-Risk

Introduction

A healthcare supply chain is fragmented and complex in developing countries like India. The complexity of healthcare supply chain lies in fact that people's health requires adequate and accurate medical supply according to the patient's needs (Beier, 1995). Managing healthcare supply chain for hospital involves managing suppliers and ensuring drugs and equipment delivered in time. In this process physical goods and information about product and services go through number of independent stakeholders, including manufacturers, distributors, wholesalers, retailers of hospital pharmacies. The supply accounts for 25-30 percent of operational costs for hospitals (Roark, 2005). The disruption in supply chain can have adverse effect on cost of medicine for the patients.

The hospitals are generally opened in urban and densely populated areas, while the medicine manufacturing companies are located in remote areas (Gangolli et al, 2005). The reason behind this phenomenon is low cost infrastructure and benefit. In developing countries like India, there is long lead-time to transport the medicine to hospital and intermediaries have less robust infrastructure to protect against and recover from natural disaster. The drug supply chain is exposed to increased geopolitical risks from regional conflicts, criminal violence, and corruption. The hospitals should be able to quantify and visualize the risk in their supply chain in order to effectively manage it (Heckmann et al, 2015).The researchers across globe have made significant efforts in the past to quantify the value-at-risk in supply chains due to the effects of natural disasters (Network, R.R., 2011).

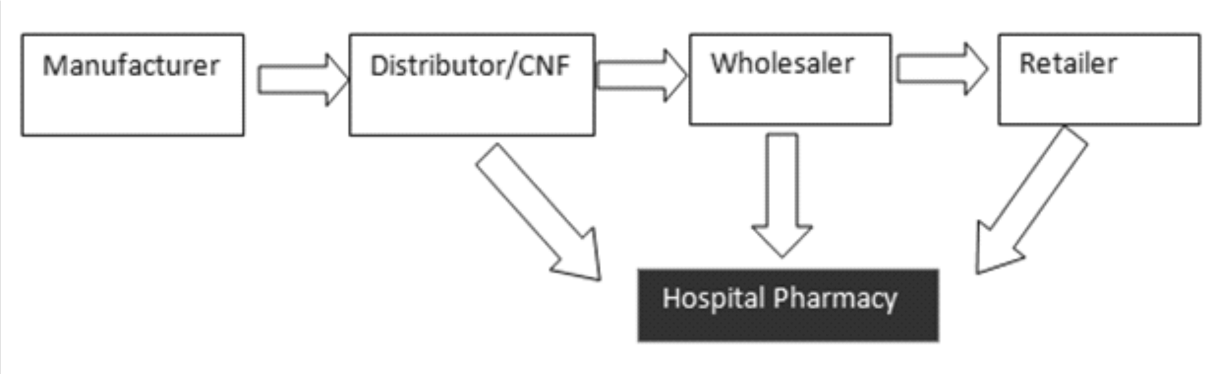
Literature Review

The increase in communication and transportation technologies has helped supply chain eliminate excess inventory and adapt a just-in-time supply chain strategy (Presutti, 2003). However, there is a trade-off between eliminating excess inventory and the cost of disruptive risks (Kleindorfer & Saad, 2005). For effective management of inventory, a hospital need not to minimise cost of inventory but also the value-at-risk. Value –at-risk, a term borrowed from financial engineering, is a useful construct in estimating the economic implications of supply chain risks and in implementing the best strategies for supply chain risk management (McCormack et al, 2008). Supply Chain disruption is caused by various sources, such as geopolitical, financial, environmental, and other accidental events, and rate of increase in disruptions is increasing day-by-day (Myerson, 2016). The risk management company Aon reports increasing level of supply chain disruption due to geopolitical risk in recent years (AON, 2017). There has been a marked increase in both the frequency and economic losses from natural and man-made catastrophes (Stecke & Kumar, 2009). Despite well documented advantage of supply chain management practices in risk and cost reduction, healthcare industry has been slow in embracing these practices (McKone Sweet et al, 2005). There is no study focused on measuring the value-at-risk for healthcare supply chain for a diabetes clinic from risks such as the risk of natural disasters, geopolitical events, and suppliers' financial instability.

Diabetes Care Industry

Diabetes is one of the major chronic diseases in India; as such a large healthcare and treatment industry has built up around it. According to IDF report, there were 69.1 million cases of diabetes in India in 2015. This chronic disease develops over time and develops complications like neuropathy, retinopathy, diabetic foot, nephropathy and cardiac risk (Mishra et al, 2017). The comorbidity involved in the disease makes prescription complex and dynamic (Hodgson& Cohen, 1999). Thus demand for the drugs can't be forecasted with accuracy hence inventory holding doesn't mitigate the risk effectively. More over medicines require special stoking infrastructure and they come up with an expiry date. The diabetes care supply chain includes oral drugs, diagnostic items, insulin and equipment necessary for living with diabetes. The hospital pharmacy receives supply from various players of the supply chain (Fig 1). This helps them in mitigating supply chain risk and reducing the cost but this switching between supplier results in less commitment and increased lead time (Richardson, 1993).

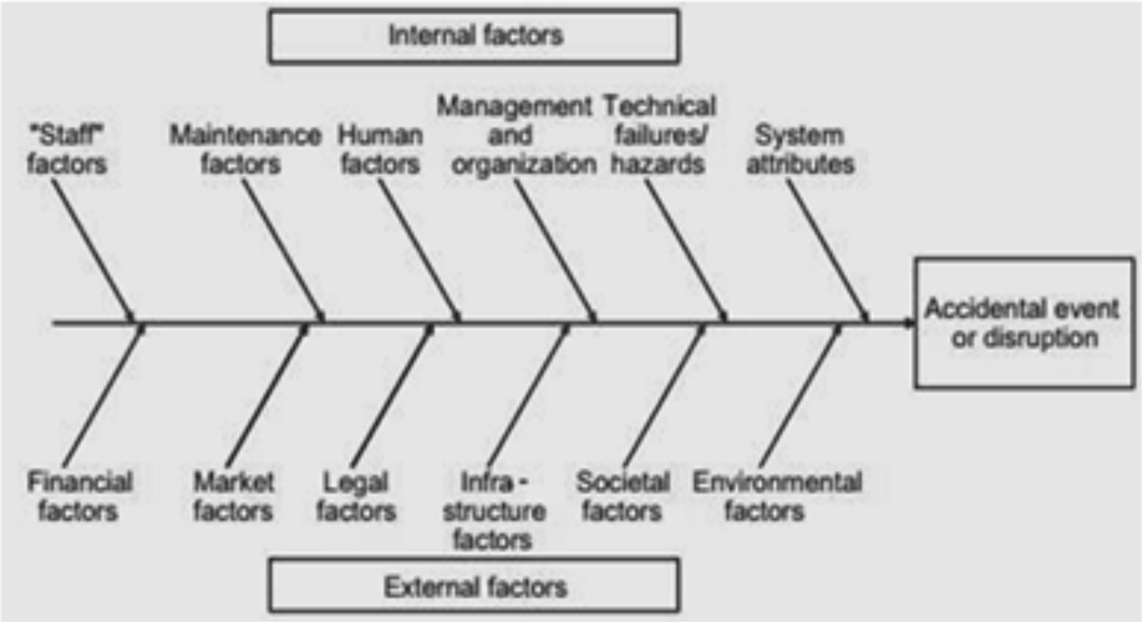
Figure 1: Hospital Pharmacy Supply Chain



Risk Identification

Supply chain risk is variation in the distribution of possible supply chain outcomes, their likelihood and their subjective values (March & Sapria, 1987). Zsidisin defines supply chain risk that correlates the occurrence of an incident with the inability of a supply chain to deal with that (Zsidisin, 2008). For assess and mitigate the risk decision makers need to quantify the risk. Standard deviation, mean-variance approach, value-at-risk are few measures have been used in quantifying the risk. There is lack of customised measures for quantifying the risk in supply chain hence measures used in financial engineering are applied in supply chain management also (Heckmann et al,2015). The widely used measures to assess supply chain risk like variance is under question because they consider lesser disruption than expected as also risk for the supply chain (Cox LA, 2012).Supply chain risk can be measured in term of disruption in supply chain at manufacturer, carry and forwarding (CNF) agent, distributor, wholesaler, retailer or during transit between any one of these. These risks can be dichotomised in to internal and external factors. The following figure (Fig 2) attempts to categorise risks in these two categories (Zsidisin, 2008).

Figure 2: Internal and External Risk Factors to the Supply Chain



This paper deals with the internal and external risk associated with a diabetes care supply chain management. In addition to the commonly identified risks in literature the study also include less obvious risk associated with healthcare supply chain, particularly supply chain pertaining to diabetes care.

Risk Impact

Ample research has done on assessing the impact of the supply chain disruption. It is critical for the organizations working in area of healthcare to manage the risk proactively otherwise it can cost human life. The events like Gujarat riots of 2002,Jat Reservation Agitation of 2016 or Jharkhand Rail Jam of 2016 can put supply chain stand still. The threat of terrorism and naxalism attacks, is affecting not only the 'physical' supply chain, but also the organizational dimension of the company, and it has forced them to completely rethink about whole corporate strategy (Sheffi, 2003). In July 2005, a brutal assault on striking workers in Gurgaon's plant of Honda Scooter and Motorcycle India (HSMI) disrupted the supply chain for many days. In March 2007, the West Bengal state of India, witnessed ugly tussle between government and agitators over compensation issue. The policy led to an insurgency in the region, followed by the death of 14 people by the Police Forces. This incident forced Tata Motors to shift their manufacturing unit to Gujarat, which resulted in delay of production of much hyped Nano Model of Tata Motors. The drug manufacturing sites in India are prone to heavy snow fall in winters and landslides during rainy seasons. The researchers (Xia & Liu, 2014) have measured the value –at –risk due to natural disaster; they also discuss strategy to create an economically resilient supply chain. There has been very little research in healthcare, which combines the risk from natural disasters, geopolitical events, and supplier's financial stabilities.

Risk Models

There are many measurement models for risk modelling but these models are limited to the specific are of the risk. The table below (Table 1) lists the various models and their area of applications.

Table 1: Various Supply Chain Risk Model and Applications

S/N	Supply Chain Risk Model	Area of Applications
1	AIR Worldwide Model	Risk of natural catastrophes.
2	Verisk Maplecroft Model	Risk of geopolitical risk
3	William Beaver Model (Beaver, 1966)	Financial bankruptcy prediction
4	Altman Bankruptcy Model (Altman,1968)	Bankruptcy Prediction in Manufacturing
5	Risk Rating Matrix (Fike ,2005)	Monitoring supply chain risks
6	Weighting and Scoring System for Risk Matrices (Beasley et al, 2006)	Supply Chain Risk Assessment
7	Bow-Tie Analysis of Supply Chain Risks(Aqlan & Lam,2015)	Probabilities of occurrence from the causes and estimation of value–risk

Risk Mapping

A risk profile attempts to find out vulnerable are of supply chain where management need to focus its attention (Christopher, 2016).

$$Supply\ Chain\ Risk = Probability\ of\ disruption * Impact$$

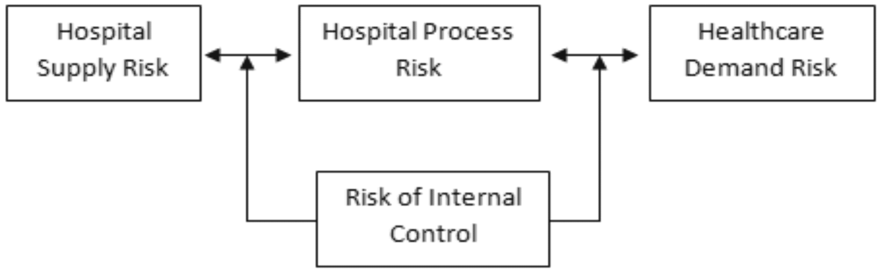
To identify the risk profile a hospital need to undertake an audit of risks pertaining to supply chain (Table 2).

Table 2: Risk profile of Healthcare Supply Chain in India

S/N	Type of Risk	Definition	Exposer for Healthcare
1	Supply Risk	How vulnerable is the hospital to disruption in Supply?	The supply chain is ill managed and heavily relies on key suppliers.
2	Demand Risk	How volatile is the demand?	The medicines are stocked before the peak season , government policy speculation lead to delay the purchase decisions in India
3	Process Risk	How resilient is your process?	Healthcare providers are unaware of process risk most of the decisions are taken by th e ill-informed management
4	Control Risk	How likely are disturbance can be caused by own control system?	To get better price medicines are always purchased in bulk from distributors as hospital supply.
5	Environmental Risk	Where is our supply chain vulnerable to environmental risk?	Supply chain in India is exposed to natural disaster, terror attack and geopolitical risks.

The risk profile is directly and indirectly impacts the strategic decision of the organization. The risk profile of a healthcare organization can force it to increase the number of supplier or change the supplier. Figure 3 summarises the connection between the five sources of risk in healthcare supply chain.

Figure 3: Source of risk in healthcare supply chain



Source: Adapted from (Mason-Jones & Towill, 1998)

Rather than including all possible risk of supply chain, a healthcare organization need to understand its processes in order to pin point most critical threats. The six steps in developing the risk profile are 1) Prioritising the drivers 2)Identify critical infrastructure 3) Locate vulnerabilities 4)Model scenarios 5) Develop responses and 6) Monitor the risk environment (Mitroff & Alpaslan,2003). The mapping is a useful tool for visualise the supply chain risk. The visual depiction of risk forces us to notice the unexpected risk in the healthcare supply chain (Tukey, 1997). This study proposes a method for calculation for risk vector for the node of clinic under study.

Risk Mitigation

Unmitigated risk can put not only the value-at-risk in healthcare supply chain but can also cost life. A Risk Rating Matrix approach can be used by risk audit team to mitigate the risk in the network (Fike, 2005). Most of the researchers have used mitigating risks based on quantifying the value of specific methods like Return-On-Asset (Huang & Liu,2014) and visualisation of supply chain risk (Xia & Liu,2014). Another research reports that risk should be measured and mitigated not only at a single node but across whole supply chain (Buscher & Poyato, 2015).

The clinic under study is concerned with maintaining very high level of fill rate even if disruption occurs. The clinic is involved in a business where stock out can put life at risk. Presently the company mitigate the risk using over stocking. To add much to their chagrin, the patient's behaviour is very unpredictable. Based on past experience, the patient response in case of stock out can range anywhere between total lost-sales to total back-order. This paper uses identifying, quantifying, and visualizing diabetes speciality clinic supply chain risks an approach very similar to Xia and Liu (2014).

Research Objective

The objective of this research is to develop an approach to quantify the combination of conventional and unconventional risks in diabetes clinic's supply chain. The research further tries to calculate the value at risk for the diabetes clinic using a case study and discusses the measures to mitigate it.

Research Methodology

Diabetes is group of metabolic disease and results in comorbidity as the disease advances (ADA, 2010). A speciality diabetes clinic manages large number of stock keeping units (SKU). This study selected anti- diabetic, anti-hypertensive, insulin and lipid lowering drugs for the study as they are most critical for the diabetes care supply chain.

The drug supply chain in India involves more than hundred different risk categories. The diabetes clinic under study helped us in selecting most significant source of supply chain disruption from their perspective: natural disasters, geopolitical events, and supplier financial instability. After deciding upon the type of disruption the study selects criteria for quantifying those risks.

The attribute for the risk assessment in supply chain include geopolitical risk, natural disaster risk and risk due to financial bankruptcy of the supplier. A focus group of eight members, containing hospital management and managers of pharmaceutical supply chain was created to select criteria for the three attribute suggested by the literature. The focus group was asked to select three most important criteria for each of the attributes. The disruption at each location is assumed to be independent of each other.

4.1 Fuzzy Model for Risk Assessment

Assume n nodes of supply chain connecting the manufacturer to the diabetes clinic to be assessed and ranked make up a set:

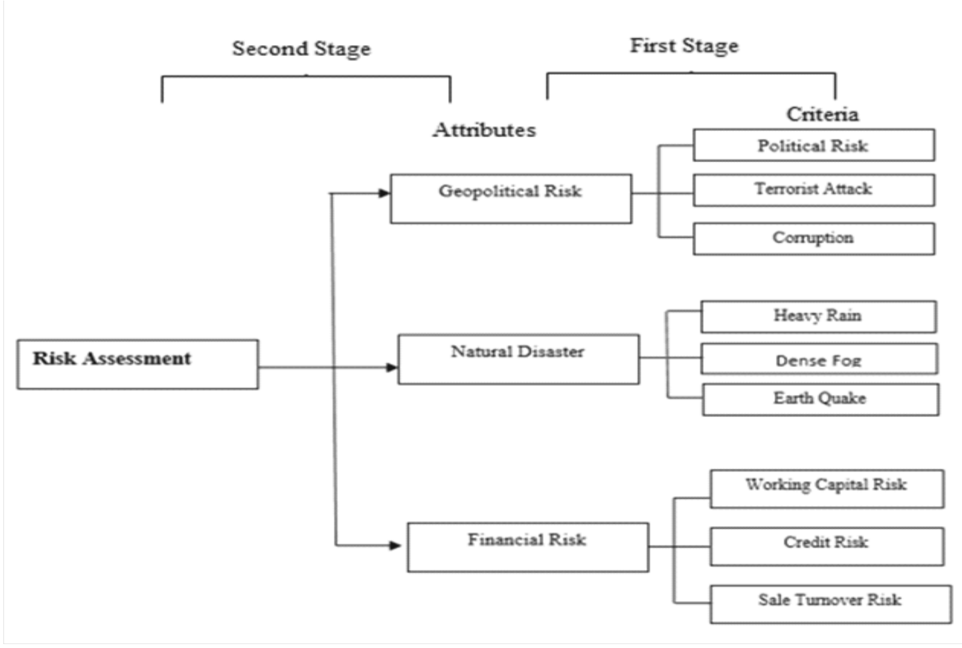
$$X = \{x_1, x_1, \dots \dots \dots, x_n\} \quad (1)$$

Suppose there are l attributes at the second stage and the k-th attribute is related to m-criteria at the first stage. For k-th attribute, the features of its m criteriafor n node at first stage may be expressed as a feature matrix of the criteria.

$$_kX = \begin{bmatrix} {}_kx_{11} & {}_kx_{12} & \dots & {}_kx_{1n} \\ {}_kx_{21} & {}_kx_{22} & \dots & {}_kx_{2n} \\ \dots & \dots & \dots & \dots \\ {}_kx_{m1} & {}_kx_{m2} & \dots & {}_kx_{mn} \end{bmatrix} = ({}_kx_{ij})_{m*n} \quad (2)$$

Where ${}_kx_{ij}$ is the feature of the i-th criteria of the j-th node for the k-th attributes at the first stage, and $i=1,2,\dots.m;\ j=1,2,\dots.,n;\ k=1,2,\dots.,l$

The process of risk assessment and ranking for the nodes in the supply chain follow properties of fuzziness and relativity. The risk at any node is a fuzzy concept and can be expressed as membership grade, while risk at any node is assumed to be independent of the risk on other node. The risks in supply chain propagate downstream with a multiplier, which may have a multiplicative or damping effect. But to figure out the most critical node we need to assess the independent risk of each node.



The purpose of risk assessment of among the nodes is to determine the relative membership grade of each node such that:

$$U_A : X \rightarrow [0,1], x_j \mid U_A(x_j) \quad (3)$$

The risk of every criteria was transferred in membership grade using following rule:

$$_kr_{ij} = {_kx_{ij}} \,/\, \left(_kx_{i\,\max} + {_kx_{i\,\min}} \right) \quad (4)$$

Where $_kx_{i\,\max}$ and $_kx_{i\,\min}$ are the largest and smallest features of *i-th* criteria and *k-th* attribute among the *n* nodes respectively. The feature matrix can be transformed using above rule as:

$$_kR = (_kr_{ij})_{m*n} \quad (5)$$

Since the assessment and ranking is relative this study try to find out the riskiest and safest node is the supply chain. The membership grade of/criteria of riskiest and safest are made up of the largest and smallest membership grades of *m* criteria among the *n* nodes respectively. The membership grade vector of the riskiest node can be expressed as following:

$$_kg = [\max(_kr_{11}, \ldots.., {_kr_{1n}}), \ldots\ldots.., \max(_kr_{m1}, \ldots.., {_kr_{mn}})] = (_kg_1, {_kg_1}, \ldots\ldots.., {_kg_m}) (6.1)$$

Similarly, the membership grade vector of safest node can be written as:

$$_kb = [\min(_kr_{11}, \ldots.., {_kr_{1n}}), \ldots\ldots\ldots., \min(_kr_{m1}, \ldots.., {_kr_{mn}})] = (_kb_1, {_kb_1}, \ldots\ldots.., {_kb_m}) (6.2)$$

The *m* criteria are of varying importance and their importance weight vector is taken as ensuing:

$$_kw = \left(_kw_1, {_kw_2}, \ldots.., {_kw_m} \right) \quad (7)$$

The difference between the j-th node and riskiest node can be expressed by the General Hamming Distance (Xu & Yager,2006) as follows:

$$_kD_g = \| {_kw}(_kg - {_kr_j}) \| = \sum_{i=1}^{m} w_i(_kg_i - {_kr_{ij}}) \quad (8)$$

Similarly, the General Hamming Distance (GHD) between the j-th note and safest node is given as:

$$_kD_g = \| {_kw}(_kr_j - {_kb}) \| = \sum_{i=1}^{m} w_i(_kr_{ij} - {_kb_i}) \quad (9)$$

According to the fuzziness of risk assessment ,the *j-th* node X_j belongs to fuzzy set on risk of *k-th* attribute as membership grade $_kU_j$ and to fuzzy set on safety of *k-th* attribute as membership grade $\overline{_kU_j}$ such that $_kU_j + \overline{_kU_j} = 1$.

For solving $_kU_j$ and $\overline{_kU_j}$ are treated as GHD of the *j-th* node the riskiest and safest node respectively. We further tried to minimise the sum of square of the square of weighted GHD for the *n* nodes.

$$min\{F({}_kU_j)\} = [{}_kU_j\sum_{i=1}^{m} w_i({}_kg_i - {}_kr_{ij})]^2 + [(1-{}_kU_j)\sum_{i=1}^{m} w_i({}_kr_{ij} - {}_kb_i)]^2 \quad (10)$$

The above equation is differentiated with respect to ${}_kU_j$ and equated with zero we get the following equation :

$$dF({}_kU_j) / d_kU_j = 0 \quad (11)$$

Solving above equation we get:

$${}_kU_j = \{1 + [\sum_{i=1}^{m} w_i({}_kg_i - {}_kr_{ij})]^2 / [(\sum_{i=1}^{m} w_i({}_kr_{ij} - {}_kb_i)]^2\}^{-1} \quad (12)$$

The above equation is a fuzzy ranking model for risk assessment and ranking among the node of the existing supply chain for given ${}_kR$ and weight vector ${}_kW$ .Using this assessment model the assessment result of the first stage of each node belonging to the fuzzy set on the risk of the *k-th* attribute can be written as:

$${}_kU_j = ({}_kU_1, {}_kU_{2k}, \ldots.., {}_kU_n) \quad (13)$$

Similarly, if we calculate the risk for all l attributes, their assessment results can be written as a matrix of membership grades of the attributes for the second stage as:

$$U = ({}_kU_j)_{m*n} \quad (14)$$

Now if ${}_kU_j$ is denoted as r_{kj} the matrix U is equivalent to ${}_kR$ assume that importance weight of the m attributes at the first stage is represented as the vector form as:

$$w = (w_1, w_2, \ldots\ldots w_l) \quad (15)$$

Now using Fuzzy Ranking Model derived in earlier part of the paper the final result for membership grade for each node in the supply chain risk can be written as:

$$u = (u_1, u_2, \ldots\ldots, u_n) \quad (16)$$

Based on equation 17 and 19 and the principal of maximum membership grade, not only the order of the risk of potential source but also the order of the risk of disruption at n supply chain node can be calculated and ranked comprehensively.

4.2 Calculation of Weight

The fuzzy ranking method require the weights of criteria and attributes and at first and second stage respectively. The weight of the feature and attributes are calculated using Rank Reciprocal Weights (Sullivan,1989). If R_i is rank position of the attribute i (With 1 being highest rank) and l attributes ,then the weight for each attribute W_i may be calculated as:

$$W_i = (1/R_i) / \sum_{i=1}^{l}(1/R_i) \quad (17)$$

5. Case Study

Based on input of experts in focus group ten nodes were selected for the risk analysis. The name of the firms and drugs was masked to comply with the non-disclosure agreement with the partnerorganization. The experts were asked to rate the ten nodes on nine criteria on scale of 1 to 5(where 5 is maximum risk exposure). The risk score for a node is average of the score given by the eight experts. The details of the nodes selected on basis of expert opinion is mentioned in Table 3 below:

Table 3: Nodes Selected for the Risk Analysis

S/N	Node	Type of Node	Type of Drug
1	N1	Manufacturer	Anti-diabetic
2	N2	Manufacturer	Anti-Hypertensive& Lipid Lowering
3	N3	Manufacturer	Insulin, Lancet and Insulin Pen
4	N4	Distributor	Anti-diabetic
5	N5	Distributor	Anti-Hypertensive& Lipid Lowering
6	N6	Distributor	Insulin , Lancet and Insulin Pen
7	N7	Wholesaler	Anti-diabetic
8	N8	Wholesaler	Anti-Hypertensive & Lipid Lowering
9	N9	Wholesaler	Insulin
10	N10	Wholesaler	Diabetes Management Equipment

The Table 4 list the value of the weights and risk score for the attributes and criteria for the supply chain under discussion.

Table 4: Attributes and Risk of Criteria for the Nodes

Second Stage		First Stage		Supply Chain									
Attributes	Weights	Criteria	Weights	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Geopolitical Risk	0.19	Political Risk	0.54	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.6	2.63	2.63
		Terrorist Arrack	0.19	2.88	4	3.13	2.88	2.34	3	2	3	2.34	3.25
		Corruption	0.27	3.63	3	3.25	3	4	2.38	3.25	4	3.75	3.5
Natural Disaster	0.27	Heavy Rain	0.27	3.13	3.89	3.5	3.75	3.25	2.88	2.38	2.4	2.5	2.38
		Dense Fog	0.54	3.63	3.63	3.75	3.63	2.375	2.5	2.25	2.4	2.38	2.38
		Earth Quake	0.19	2.75	2.75	2.38	2.38	2.375	2.75	2.38	2.4	2.38	2.25
Financial Risk	0.54	Working Capital Risk	0.27	3.13	3	2	2.25	2.125	2.5	2.25	2.1	2.5	2.13
		Credit Risk	0.54	3	3.5	3.13	3	2.5	2.5	2.25	2.8	3.25	2.63
		Sale Turnover Risk	0.19	3.5	3	3	4.25	4.375	4.375	3.5	3.1	3.25	3.13

The risk assessment and ranking of risk begins at first stage. The order of the ten nodes is assessed and ranked for the riskiness. Based on three criteria of the geopolitical risk the membership grade matrix

Table 5.1: Membership Grade Matrix for Geopolitical Risk

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
0.48	0.67	0.52	0.48	0.39	0.5	0.33	0.5	0.39	0.54
0.57	0.47	0.51	0.47	0.627	0.373	0.51	0.6	0.59	0.55

Similarly, based on their criteria the natural disaster and financial risk membership grade matrix ${}_2R$ and ${}_3R$ were calculated as:

Table 5.2: Membership Grade Matrix for Natural Disaster

0.5	0.62	0.56	0.6	0.518	0.459	0.38	0.4	0.4	0.38
0.59	0.59	0.61	0.59	0.388	0.408	0.37	0.4	0.39	0.39
0.55	0.55	0.48	0.48	0.475	0.55	0.48	0.5	0.48	0.45

Table 5.3: Membership Grade Matrix for Financial Risk

0.61	0.59	0.39	0.44	0.41	0.49	0.44	0.4	0.49	0.4
0.52	0.61	0.54	0.52	0.43	0.43	0.39	0.5	0.57	0.5
0.47	0.41	0.41	0.58	0.59	0.59	0.47	0.4	0.44	0.4

The Importance Weight Vector of the three criteria of the three attributes are calculated using equation (17):

The Importance Weight Vector of the three criteria of the three attributes are calculated using equation (17):

$$ {}_1W = (0.54, 0.19, 0.27) \qquad (18.1)$$

$$ {}_2W = (0.27, 0.54, 0.19) \qquad (18.2)$$

$$ {}_3W = (0.27, 0.54, 0.19) \qquad (18.3)$$

Using Membership Grade Matrix and Importance Weight Vector the Risk Exposer of the ten nodes for three criteria ${}_1U$,${}_2U$ and ${}_3U$ was calculated using equation (12) as follow:

$$ {}_1U = (0.98, 0.99, 0.94, 0.89, 0.23, 0.41, 0.12, 0.39, 0.19, 0.42) \quad (19.1)$$

$$ {}_2U = (0.98, 0.99, 0.94, 0.89, 0.26, 0.39, 0.13, 0.41, 0.22, 0.43) \quad (19.2)$$

$$ {}_3U = (0.65, 0.87, 0.62, 0.67, 0.43, 0.38, 0.20, 0.56, 0.64, 0.52) \quad (19.3)$$

Now using the Importance Weight Vector of attributes at first stage we can calculate the risk associated with each node as U:

$$ U = (0.80, \quad 0.74, \quad 1.55, \quad 1.57, \quad 1.22, \quad 1.13, \quad 0.37, \quad 0.81, \quad 0.52, \quad 0.78) \quad (20)$$

From equation (20) N4, N3, N5 and N6 are the riskiest out of all order in the given order. The value-at-risk is highest for the riskiest node and need measures for management of the risk.

Conclusion

The insulin supply chain feature twice in top four risky node list. Hence we need to take measures to mitigate the risk in insulin supply chain on priority basis. The drugs from all three categories feature in the top fours of risk nodes. Hence we can infer that the risk at a node is not dependent on category of the drug. The diabetes self-management equipment supply chain has moderate risk exposer. The diabetes clinic under study can mitigate the risk by either searching for substitute for the risky nodes or stock the inventory before the disruption occurs. The diabetes clinic under study can forecast the disruption and can take the preventive measures for the risky nodes.

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