RISK MINIMIZATION IN OUTSOURCING OF MECHANICAL SYSTEM DESIGN

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Abstract: Outsourcing of Mechanical System Design is employed in order to achieve a competitive advantage via cost reductions and improved market responsiveness, also when a particular work cannot be performed by the industry itself. Although there a number of risks involved in the process such as Confidentiality Risk, Operational Risk, Geographical Distance Risk, Cost Estimation Risk, Incomplete Work Specification Risk and Loss of Core Professionals Risk, which adversely affect the performance of outsourcing. The main objective of this paper is to understand the mutual interaction among the above specified risks and to identify the critical risks among them, which effect outsourcing of mechanical design components the most. Authors have identified various risks from the literature reviews of previous papers.With the help of the information gained, an integrated model using Interpretive Structural Modeling (ISM) for risks involved in outsourcing of mechanical system design is developed and the structural relationships between these risks are modeled. Further, a driving power and dependency diagram is developed, using the MICMAC analysis to unfold the direct and indirect effects of each risk on outsourcing. From the methodology it is concluded that the strongest drivers effecting the process are Geographical Distance Risk and Loss of Core Professionals Risk.

Key words: outsourcing, mechanical system design, risk, interpretive structural modelling.

I. INTRODUCTION

In order to achieve a competitive benefits via cost reductions and improved market responsiveness, organizations are increasingly employing outsourcing as a major component of their supply chain strategies. Outsourcing is the process in which a company makes a contract with a third party vendor. In the contract, the vendor agrees to use its resources to perform the acquired activity. Now a days outsourcing is popularly known as system management, system operation and facility management. Since small and medium companies can not afford the expense of in-house production and designing, they find outsourcing to be the best option. With the help of effective outsourcing the cost of designing may be reduce to half. The vendor generally provide adequate and well trained staff.The confidentiality monitoring is done all the time.The efficiency of the design would increase to a great extent.It would further allow a firm to save the cost of the infrastructure and technology.Many risks are present in Mechanical system design outsourcing including confidentiality risk, operational risk, geographical distance risk, cost estimation risk, incomplete work specification risk and lack of core professionals risk. These risk may adversely influences the benefits of outsourcing.

Objective of this paper:

The main aims of this paper are as follows:

1. To identify both established and emerging risks involved in outsourcing of mechanical system design.
2. To develop a contextual relationship between these identified risks using interpretive structural modeling
3. To propose a structural model for risks of mechanical design system outsourcing
4. To classify the identified risks

II.Literature Review

There are various risks factors which arouse the performance of outsourcing of mechanical system design. Few such factors with literature review are illustrated below.

1.Confidentaility Risk

When an organization outsources any project to outsource organization then confidentiality and privacy of the organizational data and customer's privacy is also at stake because a lot of confidential data has to be provided to the external organization. Sometimes due to secrecy, security or to minimize risk the things are not provided in black & white form so due to this the result never meet up to the maximum. This may cause loss or damage to the prestige of the parent organization. (Haider et al., 2016)

S.No.	Risk	Definition	References
1.	Confidentiality Risk	Confidentiality risk is where information that is private and confidential is revealed or disseminated against the contract.	(Currie et al., 2008), (Moralı et al., 2009), (Moral & Wieringa, 2010), (Djemame et al., 2011), (Kiran et al., 2011), (Wieringa et al., 2012), (Chou et al., 2011), (Herrmann & Morali 2010), (Hamzah et al., 2013), (Haider et al., 2016)
2.	Operational Risk	Operational risk is the risk of loss resulting from weak or failed internal processes, people or systems, or from external events.	(Currie *et al*., 2008), (Gómez et al.,2017), (Alberts 2006), (Gewald & Hinz, 2004), (Perlekar & Thakkar, 2019) (Youngdahl & Ramaswamy, 2008), (Ellram *et al*. 2008),
3.	Geographical Distance Risk	Geographical distance risk is the risk arising due to distant location involving country risk, infrastructure, human capital and government policies.	(Erickson & Evaristo,2006),(Graf et al.,2005),(Khan et al.,2010), (Chauhan et al., 2017), (Stringfellow et al., 2008).
4.	Cost Estimation Risk	Actual cost is more than the estimated cost due to unexpected transition, management costs, switching costs, costly contractual amendments, disputes and litigation, service debasement, cost escalation, and hidden service cost.	(Chou et al., 2009),(Lacity et al.,1993),(Chauhan et al., 2017) (Nicholson et al., 2006),(Handley and Benton, 2013).
5.	Incomplete Work Specification	The contact between the partners are lacking in specifications, or specifications need constant updating and changes	(Ellram et al., 2008), (Langfield-Smith et al.,(2003),(Chauhan et al., 2017),(Bhattacharya et al., 2013),(Gorla and Somers, 2014)
6.	Lack of core Professionals	The loss of critical knowledge is seen as the greatest source to workforce-related outsourcing risk.	(Carmel & Agarwal, 2002), (Quélin & Duhamel, 2003), (Ellram *et al.* 2008), (Lacity *et al.*, 2008), (Chou & Chou, 2009), (Hertah & Kishore, 2009), (Jensen, 2012),(Tayauova, 2012),(Aron *et al*., 2005),(Pfannenstein & Tsai, 2004)

2.Operational Risk

The risk of loss of value in terms of quality, cost or speed of delivery, caused by the fact that actual losses, incurred from inadequate or failed internal processes, people or systems.

3.Geographical Distance Risk

Geographical distance may become an obstacle while a firm outsource its products to other firm.Due to geographical distance there may be lack of communication between the firm which is outsourcing and the firm which is outsorced.

4.Cost Estimation Risk

The hidden cost are normally the biggest problem of outsourcing, the hidden transition costs include setup costs, redeployment costs, relocation costs, and parallel-running costs. The hidden management costs refer to the human resources that have to be set into managing an outsourcing contract. And the hidden service costs are those costs that the client assumed were included in the contract (baseline), but which, in fact, were not.

5.Incomplete Work Specification

This risk arises when a firm outsource a product and does not provide proper specification of product to be manufactured.The improper specification may lead to dimensioning defects and inferior quality of product.

6.Lack of Core Professionals

The risk of loss of good workers of firm due to outsourcing of products to other company. Firm looses skills that may prove critical to firms long term competitiveness.

METHODOLOGY

INTERPRETIVE STRUCTURAL MODELLING(ISM)

The presence of indirectly or directly related complicates the structure. It becomes difficult to deal with a system where structure is not clearly defined.Hence, a methodology needs to be developed which aids in the identification of a structure within a system.Reachibility and Transitivity are two basic concepts which are essential to understand the ISM methodology.ISM approach starts with an identification of risks, which are relevant to the problem , Then a relationship is developed and a structural self-interaction matrix (SSIM) is developed based on pairwise comparison of variables.Now,SSIM is converted into a reachability matrix (RM) and its transitivity is checked.Then,the partitioning of the elements and an extraction of the structural model called ISM is derived.With help of structured interviews of executives, important risk factors in outsourcing with respect to vendor's perspective and their interrelationship are listed out in table.The desired output of joint coordination of client organization and service provider organization of industries are affected by the above listed factors related to Risk factors in outsourcing with respect to vendor's perspective.The risk which is more influential in individual manner should be reduced.

DEVELOPMENT OF SSIM(Structural self interaction matrix)

A contextual relationship is developed between different types of risks which is represented in form of structural self interaction matrix. While developing this contextual relationship V represent that risk i influences risk j, A represents that risk j influences risk I,X represents that both the risks influences each other and O represents that both risks do not influences each other.SSIM is shown in table-1.

Structural Self Interaction Matrix

S. NO.	Variables(Risks)	2	3	4	5	6
1.	Confidentiality risk	A	A	O	V	A
2.	Operational risk		A	V	X	A
3.	Geographical distance risk			V	V	O
4.	Cost estimation risk				A	O
5.	Incomplete work specification risk					A
6.	Loss of core professionals risk					

TABLE-1

DEVELOPMENT OF FINAL REACHABILITY MATRIX(FRM)

Final reachability matrix is obtained by using transitivity concept and shown below in table-2.

S. NO.	Variables (Risks)	1	2	3	4	5	6	DRIVING POWER
1	Confidentiality risk	1	1	0	1	1	0	4
2	Operational risk	1	1	0	1	1	0	4
3	Geographical distance risk	1	1	1	1	1	0	5
4	Cost estimation risk	0	0	0	1	0	0	1
5	Incomplete work specification risk	0	1	0	1	1	0	3
6	Loss of core professionals risk	1	1	0	1	1	1	5
DEPENDENCE POWER		4	5	1	6	5	1	

TABLE-2

PARTIONING OF FINAL REACHABILITY MATRIX

After the development of final reachability matrix, reachability and antecedent sets are determined for each risk, the intersection of these sets is derived for all the risks and levels. The variables for which the reachability and the intersection are identical are given the highest level in the ISM hierarchy. This procedure is continued till all levels of the structure are found. These identified levels help in the development of the model.ISM based levels of variables is shown in table 3 below.

ISM BASED LEVELS OF VARIABLES

S. NO.	Variables	Levels
1	Confidentiality risk	III
2	Operational risk	III
3	Geographical distance risk	IV
4	Cost estimation risk	I
5	Incomplete work specification risk	II
6	Loss of core professionals risk	IV

TABLE-3

DEVELOPMENT OF DIAGRAPH

A final diagraph is developed by using iterations and final reachability matrix.It is represented by nodes and lines of edges.Final diagraph is developed by removing transitivity.If risk A influences risk B then it is represented by arrow drawn from risk A and pointing towards risk B as shown in figure-1.

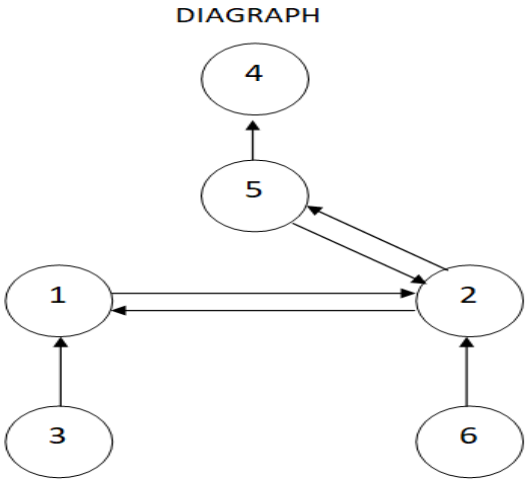

FIGURE-1

DEVELOPMENT OF ISM MODEL

The diagraph is converted into an ISM model by replacing the nodes with name of risks as shown in Figure 2.

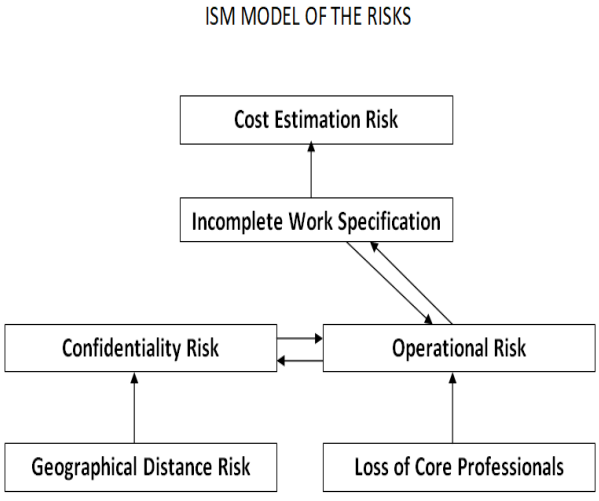

FIGURE-2

MICMAC ANALYSIS

MICMAC Analysis is done to identify the key risks that drive the systyem.MICMAC analysis is to analyze the driver power and dependency of the variables.The risks have been classified into four categories on the basis of driving power and dependence power and these risks are as follows:

(1) Autonomous risks:Risks having weak driving power and weak dependence power are known as autonomus risks.

(2) Linkage risks: Risks having strong driving power and strong dependence power are known as linkage risks

(3) Dependent risks: Risks having weak driving power and strong power dependence power are known as dependent risks.

(4) Independent risks: Risks having strong driving power and weak dependence power are known as independent risks.Risks having strong driver power falls into the category of independent or linkage risks. Figure 3, represents the results of MICMAC analysis.

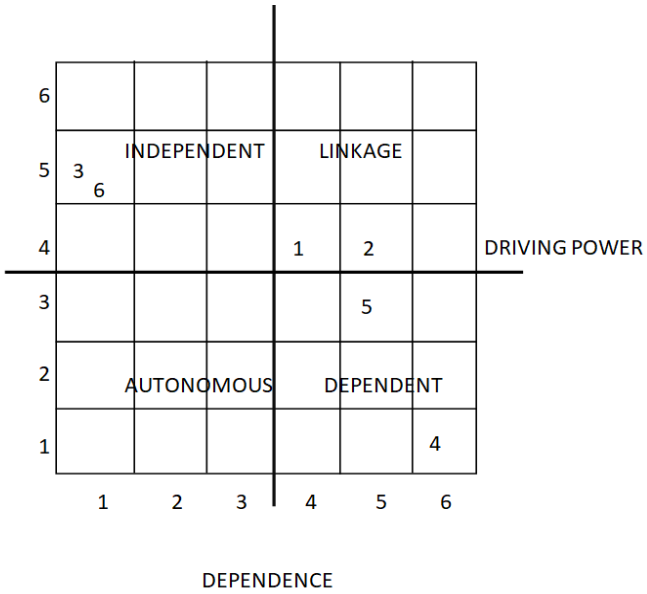

FIGURE-3

FINDINGS

The main objective of this paper was to identify risks involved in outsourcing of mechanical system design and to establish a relationship between these identified risks using interpretive structural modeling. Some of the valuable findings from the study are as under:

-The observations made from the driving power and dependence diagram display that two risks, namely geographical distance risk (3) and the loss of core professionals risk (6) have strong driving power and are less dependent on other risks. Hence these risks are classified as strong drivers and should be treated as the root causes for all risks.

-It is also observed that cost estimation risk (4) and risk due to incomplete work specification (5) are both weak drivers but strongly dependent on the other risks. These risks are at the top of the ISM hierarchy and therefore high priority must be given to resolve them for achieving success in the process of outsourcing of mechanical system design

CONCLUSION

By thoroughly reviewing the literature, six risks were identified that affect the performance of outsourcing mechanical system design. Further to articulate the relationship between these risks in a clear way an ISM model and MICMAC approach was used. Based on the results obtained from them, the risks can be classified into four categories i.e. independent (geographical distance risk and loss of core professionals), linkage (confidentiality and operational risk), dependent (cost estimation risk and incomplete work specification) and autonomous (no risk in this case). Finally the outcome of ISM was used to identify the driver and dependence power of risks related to outsourcing of mechanical system design.

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