

Implementation of Supply Chain Management Information System and Organizational Success Factors

An Empirical Analysis of the Indian Automotive Industry

Manisha Seth*, D P Goyal** and Ravi Kiran***

Abstract

Companies are using information and communication systems in the supply chain due to the advent of globalization and fast changing environment. Supply chain management information system (SCMIS) offers several benefits like reduction in inventory costs, lead time for customers, increase coordination with suppliers and better material control. Huge cost and time is involved in implementation of these systems. Review of literature has revealed that the success in implementation of SCMIS is not very encouraging therefore research on critical success factors for the implementation has gained significant interest. This study aims to examine the influence of organizational factors in the successful implementation of SCMIS in Indian automotive industry. A questionnaire was designed and administered to executives of automobile companies, their suppliers and distributors. The conceptual model was developed and structural equation modeling was used to assess the measurement model and evaluation of convergent and discriminant validity of each of the measurement scales was done. The second stage of SEM process involves testing the structural model and the proposed model was examined using a software AMOS. The maximum likelihood method was employed to estimate all parameters and fit indices. The results identified four major organizational success factors namely top Management Support, change management, External support and Clear Business Plan and Vision. Based on the finding of the study various recommendations have been made so as to ensure successful implementation of SCMIS.

Keywords: Supply chain management information system, ERP II, organizational factors, critical success factors, implementation success, SEM, India

* Assistant Professor, Hierank Business School, Noida; sethmanisha11@gmail.com

** Professor, MDI, Gurgaon; dpgoyal@mdi.ac.in

*** Professor, Thapar University, Patiala; rkiran@thapar.edu

1. INTRODUCTION

In the contemporary world competitive advantage of an organization depends on the information sharing and flow of information across the supply chain with the help of information technology. Through the use of information based upon the use of information technologies, the efficiency and effectiveness of supply chains can be significantly enhanced. Thus IT plays an important role in integrating supply chain. Besides information flow it also helps in various decision making processes. At present focus is on integration of upstream and downstream partners through Supply Chain Management Information System (SCMIS).

SCMIS is an extension of Enterprise resource planning (ERP) which integrates companies beyond the boundaries of an organization and with the advent of globalization it has further gained more importance (Marwah, et al., 2012 and Gunasekaran, 2004). It has been recognized by many organizations as a strategy to attain business goals (Altekar, 2005; Chan and Lee, 2005). SCMIS involves managing and coordinating all activities associated with goods and information flows from raw material sourcing to product delivery and finally to the end customers (Wei and Chen, 2008). It provides high quality, relevant and timely information flow that effectively supports decision-making for inventory replenishment, capacity activation and for synchronizing material flows at all tiers within the supply chain. Thereby it plays an increasingly critical role in the ability of firms to reduce costs, increase responsiveness (Chopra and Miendl, 2005), gain competitive advantage (Dezdar, 2011) and achieve better coordination.

Manufacturing companies including automobile companies have already realised the importance of these systems as it needs to keep control over costs at every stage to remain competitive. The emergence of e-business has thus led to different way in which enterprise communicate, transmit and receive information with the suppliers upstream and customers downstream. Major OEMs have realized the benefits arising out of these systems; however, the achievement of these above mentioned benefits depend upon the effective implementation of the SCMIS. Implementing these systems is a complex, lengthy

and expensive process. These systems require huge commitment of funds, time and expertise (Motwani et al., 2008). There is a strong evidence in the literature that implementation of SCMIS projects were either not completed on time or did not bring about the planned effects (Holland, 1999) and even exceeded their estimated costs (Davenport, 1998). This was substantiated by studies of Zhang et al., (2005) which revealed that ERP projects implemented exceeded their budget as well as the time duration and delivered only 30 per cent of promised benefits and in the study by Wang and Chen (2006) proves that more than 90 per cent of ERP implementations have been delayed, and required additional budget amounts. Further the research done by Panorama consulting solutions which summarizes the experiences of 192 ERP customers with regards to enterprise software, vendors, consultants and overall implementation shows the average cost of implementation for last five years to be \$6.4 million dollars and average duration for implementation to be 16.6 months. Further for 2013, 54% of the projects have exceeded their planned budgets, 72% have exceeded their planned durations and about 66% of respondent organizations have received less than 50% of the benefits that was expected from the system. The overall failures and implementation difficulties in implementing these systems have attracted lot of research (Liu and Seddon, 2009; Singh, 2010; Syed Iftikhar, 2008). Therefore the question that arises is "What are the critical success factors (CSFs) that would lead to the successful implementation of these systems?" and since these projects are expensive and time consuming therefore it becomes imperative for the management to evaluate whether the system implemented is successful. The review of literature illustrates that studies have been undertaken which focus on analyzing the CSFs that would lead to the successful implementation of the system. Various researchers have divided CSFs broadly into four categories namely technical, Organizational, Human and Inter Organizational. With this background in mind the present study was conducted to identify and analyze critical dimensions under organizational factor that needs to be considered to ensure successful implementation of the information system for the automobile industry. The organizational factor has

been considered to be very vital for the successful implementation of the system by various studies (Zhang et al., 2005; Dezdar and Sulaiman, 2009). The paper develops a model to analyze the relationships between factors and success indicators. Finally, the paper provides recommendations for the success of these systems based on the analysis of critical factors. The contributions of the paper would be useful for industry practitioners, researchers and policy makers. The process model and critical success factors would provide a useful guide for industry practitioners who are planning to implement SCMIS in their organizations. Further the study would help them to improve decision making for successful implementation of SCMIS right from inception and subsequent realization of the enormous benefits that will accrue with the right implementation.

2. REVIEW OF LITERATURE

The review of literature is divided into two parts namely identifying factors influencing successful implementation of the system and implementation success. The CSFs are categorized into Organizational, human and technological groups based on the study by Garcia and Perez (2007). Since the study focuses only on the organizational factors therefore these are discussed below.

2.1 Organizational factors:

According to the study by Garcia and Perez (2007) variables like top management support, Clear Business Plan and Vision, external support, change management and Business process reengineering (BPR) are included in the organizational dimension. These variables are explained below:

2.1.1 Top Management Support

Top management support describes the extent to which executive managers of the adopting firm provide the attention, resources, and authority required for ERP implementation (Wang and Chen, 2006). Top management has the responsibility to align the new ERP system with the current business practices and prepare the employees for the change brought by the new technology (Madininos, 2011). With top management support, user resistance can be partially

mitigated by having top executives encourage, or even mandate, user engagement in the implementation. (Wang and Chen, 2006). The involvement of top management is also vital for the effective re-engineering of the supply chain and logistics processes (Gunasekaran et al., 2004) leading to successful Inter organizational systems and relationship. It is the top management commitment and willingness to take up risk involved in the adoption of IOS to gain competitive advantage that will lead to successful implementation of the systems. Thus intervention of the top management is necessary for the allocation of financial and human resources, to take fast and effective decisions, resolve conflict, to promote company wide acceptance of the project and to build cooperation among the diverse groups within the organization. The study by Ahmad (2013) which had reviewed over 50 papers relevant to the identification of CSFs for the implementation of ERP systems had observed that management support had an occurrence percentage of 100.

2.1.2 Clear Business Plan and Vision

The system implementation requires that the key personnel within the organization should have a clear goals and vision about how to satisfy customers, facilitate suppliers and empower the employees (Umble, 2003) thus leading to the successful implementation of the system. The organization also needs to define the purpose of implementing the system so as to justify the investment. The vision should provide a clear link between business goals and IS strategy (Finney, 2007). Wee (2000) stated that the business plan should outline proposed strategic and tangible benefits, resources, costs, risks, and the timeline.

2.1.3 Change Management

The implementation of SCMIS requires changes in the way an individual employee performs his job. Employees are often comfortable the way they are performing their work and do not feel the need for a new system. Therefore change management is very important which enables the employees to adapt to the change. If people are not properly prepared for the imminent changes, then denial, resistance, and chaos will be predictable consequences of the changes created by the implementation (Umble, 2003).

However if the change management initiatives are properly undertaken people would be well prepared to embrace the opportunities that would be provided by the system. Due to its collaborative nature, managing people, organizational inertia and change management are even more critical to ERP II implementation (Koh et al., 2008; Møller, 2005; Weston, 2003).

2.1.4 External Support

The implementation process requires external support in the form of vendors' and consultants'. Vendor support represents an important factor with any packaged software including extended technical assistance, emergency maintenance, updates, and special user training (Sawah, 2008). Consultants support is required to facilitate the implementation process by providing suitable solutions to the problems being faced. Further internal implementation team depends on the consultant for their technical expertise.

2.1.5 BPR and Minimal Customisation

BPR plays an important role in implementing SCMIS. It is very imperative that the organization should be willing to change the way businesses are conducted as to have minimum customization of the software. It is the enterprise that should fit into the system so lead to a successful implementation

2.2 Implementation success measures

The review of literature focuses on different measures that act as a surrogate to the IS implementation success. Measuring information system (IS) implementation success is a complicated issue and has been a major topic of research in the area of information systems. One of the most important measure of IS success is user satisfaction. Ives et al., (1983) defines user satisfaction as "a perceptual or subjective measure of IS success" and considered information product, EDP staff and services, and user knowledge and involvement as three construct to user information satisfaction which was confirmed in the study by Baroudi and Orlikowski (1988). Further research in this area was done by Doll et al., 1995; Doll and Torkzadeh, 1988; Doll, et al., 1994; Doll and Weidong, 1997; Torkzadeh and Doll, 1991. Doll and Torkzadeh (1988) in their study proposed a second-order factor model of end-user computing

satisfaction. The first-order factors measured by 12 items include content, format, accuracy, ease of use, and timeliness. The second-order factor is interpreted as end-user computing satisfaction. Doll, et al., (1994) conducted a confirmatory factor analysis on the Doll and Torkzadeh model (1988) to confirm the five factor second order model.

Further DeLone and Mclean (D&M) model (1992) is one of the most cited model for information system success (Gable, Sedera & Chan, 2003; Myers, Kappelman & Prybutok, 1997; Heo & Han, 2003), D&M conducted an extensive review of literature and classified dimensions of IS success measures into six categories:

- (1) System quality: The desired characteristics of an IS itself.
- (2) Information quality: The desired characteristics of the product of an IS.
- (3) Use: The receipt consumption of the product of an IS.
- (4) User satisfaction: The interaction between the user and the system.
- (5) Individual impact: The effect of information on the behavior of a receipt.
- (6) Organizational impact: The effect of information on organizational performance

According to them these six dimensions of success are not independent but they are interrelated. Figure 1 shows D&M IS success model. System quality and information quality both would affect use and user satisfaction which are themselves related. Use and user satisfaction in turn will have an impact on the individual performance and this impact finally affects the organizational performance. Thus the first two variables of system quality and information quality are quality measures; next two variables of use and satisfaction are attitudinal outcomes and last two variables of individual and organizational impacts are basically performance related outcomes.

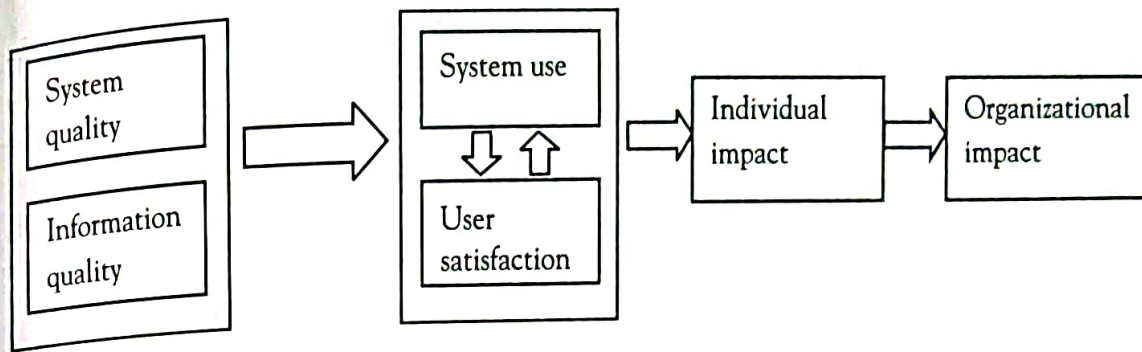


Figure 1: D&M IS success model

Thus D&M developed a model of “temporal and causal” interdependencies between six categories of IS success.

Thus review of literature defines five surrogates of IS implementation success:

1. Oliver White’s ABCD Classification Scheme which was considered by various researchers (Burns and Turnipseed, 1991; Wilson et al., 1994). They created an ABCD checklist and proposed successful implementation measures along two dimensions namely improved performance and user satisfaction.
2. Completion of system implementation on time
3. Completion of system implementation within budget
4. Intended business performance improvements has been used as by various researchers (Al-Mashari et al., 2003; Hong and Kim, 2002; Mandal and Gunasekaran, 2002; Markus et al., 2000; White et al., 1982; Yusuf et al., 2004)
5. System acceptance and usage

Based on the review of literature, the following hypotheses were defined:

- H1: Top management support has a positive impact on SCMIS implementation success.
- H2: Change Management initiatives have a positive impact on SCMIS implementation success.
- H3: BPR has a positive impact on SCMIS implementation success.
- H4: External support has a positive impact on SCMIS implementation success.
- H5: Clear Business Plan and vision has a positive impact on SCMIS implementation success.

3. RESEARCH METHODOLOGY

3.1 Questionnaire Development

The dimensions are based on the previous studies reported in the literature and discussions with the researchers, experts and practitioners in this field. The questionnaire was developed using review of literature with some measures being adapted from the previous research while others were formed specifically for this study. Items for the Top Management Support variable were adapted from the study by Ngai et al., (2004), change management items from Ahmed et al., (2006), items for variable BPR from Zhang (2003), External support variable items were adapted from Jafari et al., (2006) and items for Clear Business Plan And Vision variable from Dezdar et al., (2009).

Thus the final questionnaire was divided into three sections. In section I the respondents were required to fill their demographic profile such as gender, total work experience and to specify the department they were working in. In section II the respondents were asked to give their perception on the factors that influence SCMIS implementation success in their Organization. In section III the respondents were asked to indicate the success of the system implemented in their organization based on user satisfaction and organizational impact.

The questionnaire covering these variables were framed on five-point Likert scale ranging from 1 (highly disagree) to 5 (highly agree) to measure the attitude of respondents for every question. A pilot test was conducted for measuring the validity and reliability of the questionnaire. Thirty practitioners and scholars were administered the questionnaire and were asked to comment on its readability and comprehensiveness. Thus the validity was established

using a panel of experts from the area of SCM and discussions with academicians and practitioners. The discussion with the experts led to certain changes in the wording of some survey items which was incorporated into the draft of the questionnaire. The reliability of the data was tested using the SPSS software. The value of Cronbach alpha, for all items, were 0.88 which is above 0.7, hence, the questionnaire was considered to be reliable as suggested by Hair et al., (2006).

3.2 Sample of the study

A sample of 145 executives from two main companies namely – Maruti Suzuki India Ltd. and Honda Cars India Ltd including their suppliers and dealers located in National capital region (NCR) of India was selected. The pretested questionnaires were administered through e-mail and personal meetings with the respondents. Total of 113 questionnaires were returned and after reviewing 13 questionnaires were omitted, as they were incomplete. Therefore only 100 questionnaires were used for analysis.

3.3 Proposed conceptual model

Based on the variables under the organizational factor a conceptual model has been proposed for the successful implementation of the SCMIS. The model shows that if variables like top Management Support, change management, BPR, External support and Clear Business Plan and Vision are considered, it would lead to successful implementation of the information system. The framework of the proposed conceptual model is given below (Figure 2)

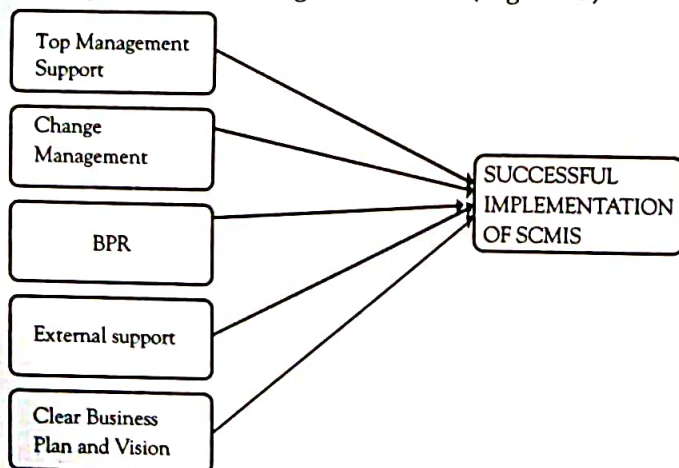


FIGURE 2: CONCEPTUAL MODEL

4. DATA ANALYSIS AND FINDINGS

4.1 Profile of the respondents

Table 1 shows the demographic profile of the respondents. The study was conducted among 100 respondents of whom 79% were Males, 44% of total respondents had working experience of 5 -10 years while 31% respondents had working experience of more than 10 years. The table further reveals that 47% of the total respondents were from SCM department while 13% of them were from the IT Department and production department.

Table 1: Demographics Profile of Respondents

	Number of respondents	Percent	Cumulative percent
Gender			
Male	79	79.00	79
Female	21	21.00	100
Total work experience			
Less than 5 years	25	25.00	25
5-10 years	44	44.00	69
More than 10 years	31	31.00	100
Department			
Production	13	13.00	13
Purchasing	10	10.00	23
Supply chain Management	47	47.00	70
IT	13	13.00	83
Finance	02	02.00	85
Marketing	11	11.00	96
Others	04	04.00	100

4.2 Measurement model

To assess the measurement model evaluation of convergent and discriminant validity of each of the measurement scales is done. For assessing convergent validity three measures are used namely factor loading, composite construct reliability (CR), and average variance extracted (AVE). For discriminant validity

measures used are Maximum Shared Variance (MSV) and Average Shared Variance (ASV).

According to Hair et al., (2006) the recommended threshold values for these measures are:

For Reliability

CR > 0.7

For Convergent Validity

CR > AVE

AVE > 0.5

Discriminant Validity

MSV < AVE

ASV < AVE

These measures are shown in table 2.

Table 2: Convergent and Discriminant validity

Construct	Items	Factor loading	Composite reliability (CR)	Average variance extracted (AVE)	Maximum Shared Variance (MSV)	Average Shared Variance (ASV)
Top Management support (TM)	TM1	0.72	0.823	0.537	0.264	0.144
	TM2	0.78				
	TM3	0.70				
	TM4	0.73				
Business Process Re-engineering (BPR)	BPR1	0.75	0.815	0.595	0.112	0.064
	BPR2	0.79				
	BPR3	0.78				
External Support (ES)	ES1	0.75	0.769	0.526	0.185	0.081
	ES2	0.71				
	ES3	0.72				
Change Management (CM)	CM1	0.73	0.793	0.562	0.187	0.106
	CM2	0.77				
	CM3	0.76				
Clear Business Plan and Vision	BPV1	0.80	0.886	0.609	0.260	0.115
	BPV2	0.80				
	BPV3	0.80				
	BPV4	0.72				
	BPV5	0.71				
User satisfaction and organizational impact	SM1	0.65	0.896	0.588	0.264	0.191
	SM2	0.70				
	SM3	0.68				
	SM4	0.75				
	SM5	0.77				
	SM6	0.59				

Therefore, analyzing table 2 all constructs had adequate convergent and discriminant validity as recommended by Hair et al., (2006).

4.3 Structural Model

The second stage of SEM process involves testing the structural model. The proposed structural model was examined using a software AMOS. The maximum likelihood method was employed to estimate all parameters and fit indices. To evaluate the fit of CFA various goodness of fit (GOF) indices are

employed. Various GOF indicators included in the study to assess the model's goodness of fit are the ratio of χ^2 to degrees-of-freedom (DF), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), incremental fit index (IFI), root mean square error of approximation (RMSEA) and root mean square residual (RMR).

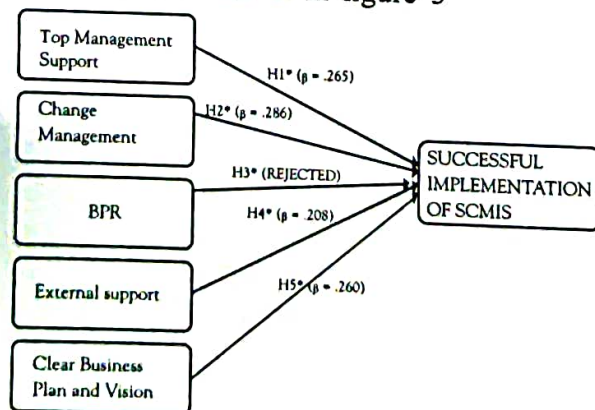
Table 3: Goodness of fit measurement of the SEM framework

EVALUATION INDEX	GOF	THRESHOLD	VALUES
Absolute fit index	Pearson chi-square (χ^2)	The least	260.568
	Degrees of freedom		236
	CMIN/DF	<3 good <5 sometimes permissible	1.104
	P value	> 0.05	.130
	RMR value	>0.05	.027
	RMSEA value	>0.05	.032
	GFI value	>0.9	.836
	AGFI	>0.8	.800
Relative fit index	IFI value	>0.9	.977
	CFI value	>0.9	.976

Thus based on the results of the SEM fit indices, the proposed model provided an acceptable fit for the data.

5. DISCUSSIONS

SEM path results, standardized path coefficients and significance values of all relationships hypothesized in the model are shown in figure 3



* $p < 0.05$

FIGURE 3: Path analysis results for SCMIS implementation success model

Hypothesis H1 proposed that top management support has a positive impact on SCMIS implementation success. The results of SEM analysis support this hypothesis ($\beta = .265$; $p < 0.05$)

Next H2 proposed that change Management initiatives have a positive impact on SCMIS implementation success. The results of SEM analysis support this hypothesis ($\beta = .286$; $p < 0.05$) Further Hypothesis H3 which proposed that BPR has a positive impact on SCMIS implementation success was not found to be significant ($p > 0.1$) therefore it was rejected. Furthermore, hypothesis H4 recommended that external support has a positive impact on SCMIS implementation success. The coefficient for this path is also significant ($\beta = .208$; $p < 0.05$) which support H4. Finally H5 recommended that the clear business plan and vision has a positive impact on SCMIS implementation success. The coefficient for this path is also significant ($\beta = .260$; $p < 0.05$) which support H5.

The highest beta value is for change management initiatives which have a significant impact on the successful implementation of the system. The finding is consistent with the results of the research done by Aladwani (2002); Motwani et al., (2005); Finney (2007). Therefore the organizations should implement the strategies for minimizing this risk and should be competent enough to facilitate a smooth implementation of the system. The most frequently used strategies to overcome resistance to change are communication, user participation, user involvement and training.

Communication

As the organizations move towards integration with the outside world proper communication is imperative between the users, top management, project management team and leader. Communication is required in every phase before, during and after the implementation. Proper communication should ensure that the users understand the need and the benefits associated with the adoption of the inter-organizational system. Communication should be two way as well as open where employees are free to express themselves and give their feedback. Communication will reduce the uncertainty with the adoption of the information system and would diminish the concern about the threat of job, power or status.

User participation and involvement

According to Briolat and Pogman (2000), "user participation is advocated in order to discover

Users' needs and point of view validate specifications, and hence build better IS for the Organization". The users who participate in the planning and implementing stage of the system are less likely to resist the change. Users' participation can improve system quality by knowing exactly the information requirements, not adding any superfluous feature that adds cost of implementation but does not add any value to the user. The users should be asked to give their suggestions and feedback in the process of implementation which will improve user understanding of the system. Thus it is very important to keep

the users and other stakeholders motivated and actively involved.

Education and training

Education and training should be provided to the user so that he becomes comfortable with the system. Due to lack of training users are uncomfortable to input or retrieve data from the system (Peng & Nunes, 2007). The user will be reluctant to use the system or will not possess sufficient skill unless and until sufficient training is imparted to him. Low-skilled and ill-trained staff represents a crucial barrier to the use of ERP systems (Sherer & Alter, 2004; Wright & Donaldson, 2002). It is very important to give hands on training to the user so that he gets a feel of it. There must be development of a formal training program to meet the requirements of the system users. Proper allocation of resources for the training should also be done. The training could be organized in-house or at the training centre where consultants could transfer knowledge to the technical personnel and end users. Training is one of the most costly components of an ERP implementation project (Estevez et al., 2002) so the proper monitoring and evaluation should be done to ensure that the employees have received the appropriate training.

It is very necessary to reduce human impediments because user satisfaction has received widespread acceptance as a measure of information system success (Wu et al., 2002). As also noted by Holsapple et al., (2005) user satisfaction is one of the key factors affecting the management information systems' success.

The results of the study also showed that there is positive relationship between top management support and successful implementation. This result supports the findings of previous research

(Al-Mashari et al., 2006, Somers and Nelson, 2004; Ifinedo, 2008; Sedera and Dey, 2006; Sawah et al., 2008). For the successful implementation top management plays an important role. Formal and honest communication from the top management leads to reduction in the resistance to change. Employees and the Management acting in tandem as a team can alleviate the resistance. The Management can

facilitate team spirit by empowering the employees and also create an environment for the employees to accept change. They can also develop informal leaders who can become effective agents of change and also can practice soft coercion tactics to reduce resistance. Top management should assign sufficient resources to the change management and should act as a leader and not boss. Top management should establish reward system which would further reduce the resistance.

Further the study showed that external support by the vendors and consultants have a positive impact on the successful implementation of the system. This result is supported by the findings of the study by Ifinedo (2008); Wang and Chen (2006). The external expertise is a necessity for the successful implementation of the system. The vendors and consultants should provide the necessary training, knowledge, maintenance and other technical support to the organization implementing the system since at times the organizations do not have the expertise in implementing the system. Organizations want the vendors and consultants to be cooperative and trustworthy.

Lastly the study showed that clear business plan and vision have an impact in the successful implementation of the system and this result is supported by the findings of Ifinedo (2008); Stefanou (2001). It is imperative to have clarity about the adoption of the system vis-a-vis corporate mission and operational goals for the successful implementation. An organization that understands how SCMIS implementation can help it realize their objectives will gain from it and all those that do not understand such issues will face the failure of implementation. Thus it is very important for the organization to align the reasons for adopting these systems with their business intent for the successful implementation.

6. CONCLUSIONS

The study aimed to stress upon the organizational factors that are critical for the successful implementation of SCMIS. The study concluded that the most important organizational factor is the change management initiatives that will drive towards the successful implementation of the system.

Further top management support is an imperative organizational factor that will lead to the successful implementation of SCMIS. Study also concluded that having clear business plan and vision will further lead to the successful implementation. Lastly the effect of the external support, cooperation from the vendors and consultants will further steer towards the successful implementation of SCMIS.

The contributions of the paper are important for industry practitioners, researchers and policy makers. The process model and critical success factors will provide a useful guide for industry practitioners who are planning to implement SCMIS in their Organizations. The study can help them to improve decision making for successful implementation of SCMIS right from inception and subsequent realization of the enormous benefits that will accrue with right implementation.

For the academic researchers the study forms the basis of a more detailed examination of the subject related to the implementation of SCMIS. The proposed model can form the basis of deriving 'performance metrics' to give organizations a clearer picture of the benefits accruing from SCMIS. This study can encourage and enlighten policy makers to establish new training institutes and formulate policies in favour of SCMIS in the wider interest of the industries and improve the overall economy.

7. LIMITATIONS OF THE STUDY

The major limitation of this study is that the findings were limited to only two major players of the automotive sector of National capital region of India. Thus it is recommended that similar research studies should be conducted by taking a larger sample of organizations in automotive industry from other parts of India so as to include any other dimension whatsoever, that might have been left out while covering these two organizations only of the automotive industry. Secondly the study does not include the views, opinions and perceptions of software experts that are involved in the development of SCMIS from organizations like IBM, Oracle and SAP. Thirdly the present study focused only on organizational factors for the successful implementation of the system. Future researchers could examine other

factors like human dimension, technical and inter organizational.

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