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Development of a Model for Successful Implementation of Supply Chain Management Information System in Indian Automotive Industry

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Abstract

Supply chain management information system (SCMIS) has gained a lot of importance because of its ability to reduce costs and increase responsiveness in the supply chain. The implementation of SCMIS is a complicated process with significant risk since disparate systems spanning across companies are being integrated. A review of literature has revealed that the success in implementing SCMIS is not very encouraging. Against this backdrop, this paper identified 18 critical success factors and proposes a model for successful implementation of the system that can give the organization an edge over their competitors. The proposed model confirms that following factors play a significant role during implementation of SCMIS—top management support, user involvement, pre-implementation analysis, user training, change management, data accuracy and communication. The process model and critical success factors will provide a useful guide for industry practitioners who are planning to implement SCMIS in their organization. The study can help them gain an understanding of the complexities intrinsic in implementing these systems, improve decision-making for successful implementation of the system right from inception and subsequent realization of the enormous benefits, such as, reduction of inventories, minimization of bullwhip effect and cost reduction, that will accrue with right implementation.

Key Words

Supply Chain Management Information System, Inter-organizational System, ERP II, Critical Success Factors, Implementation

Introduction

Supply chain management (SCM) has become a very important and critical issue for an organization due to globalization (Gunasekaran, 2004; Marwah, Thakur & Gupta, 2012) and ever-increasing competition. It has been recognized by many organizations as a strategy to attain business goals (Altekar, 2005; Chan & Lee, 2005). SCM aims at movement of goods and services from one end of the chain to the other through different stages so as to improve the efficiency, effectiveness, productivity and profitability of the entire process. Thus, enhancing supply chain performance (SCP) is a critical approach for achieving competitive advantages for companies (Cai, Liu, Xiao & Liu, 2009). Apart from the movement of goods and services, information is another major flow in SCM. It serves as a lubricant that allows other supply chain drivers to work together with the goal of creating an integrated and coordinated supply chain. The flow of information has gained importance due to the advancement in information technology (IT) (Billington et al., 2004), which facilitates its movement between internal and external customers, suppliers, distributors and other partners in a supply chain. Studies show increase in the operational efficiency when information is readily available to the trading partners (Gaur, Giloni & Seshadri, 2005).

At present, focus is on integration of upstream and downstream partners through supply chain management information system (SCMIS). SCMIS involves managing and coordinating all activities associated with goods and

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information flows from raw material sourcing to product delivery and finally to the end customers (Wei & 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 & Miendl, 2005), gain competitive advantage (Dezdar & Ainin, 2011) and achieve better coordination. Thus, the basic idea of SCM integration lies in 'information integration'. Hence, the role of IT in SCM (Gunasekaran & Ngai, 2004) is similar to nervous system in a human body. It provides timely, accurate and reliable information, which greatly improves SCP (Li, Yang, Sun & Sohal, 2009). Manufacturing companies, including automobile companies, have already realized the importance of these systems as it needs to keep control over costs at every stage to remain competitive. Original equipment manufacturer (OEM) after integrating the functional areas through enterprise resource planning (ERP) within the organization shifted the focus on integration of business processes with trading partners. This resulted in the integration of customer relationship management (CRM) and supplier relationship management (SRM) systems in supply chain. 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, Akbulut, Mohamed & Greene, 2008). There is a strong evidence in the literature that implementation of SCMIS projects was either not completed on time or did not bring about the planned effects (Holland, Light & Gibson, 1999) and even exceeded their estimated costs (Davenport, 1998). This is substantiated by the research done by Panorama Consulting Solutions that summarizes the experiences of 192 ERP customers with regard to enterprise software, vendors, consultants and overall implementation as shown in Table 1.

Table 1 shows the average cost of implementation for last five years to be $6.4 million and average duration for implementation to be 16.6 months. Further, for 2013, 54 per cent of the projects have exceeded their planned budgets, 72 per cent have exceeded their planned durations and about 66 per cent of respondent organizations have received less than 50 per cent 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 & Seddon, 2009; Singh, Singh & Pereira, 2010; Syed Iftikhar & Hassan, 2008).

The reason often cited are the technical issues involved in implementing these systems. However, during the course of our detailed research and analysis, it is observed that the technical problems, howsoever large it may be, are not the main reason for unsuccessful implementation of SCMIS projects. In addition, there are *organizational, human and inter-organizational issues* also that need to be addressed for the successful implementation of SCMIS projects. Therefore, conducting research is crucial in order to have a successful implementation of these SCMIS projects. Further, the management should not expect the rewards for granted that may accrue from implementation of SCMIS projects but should also consider the risks involved and the ways to tackle organizational, human and inter-organizational issues.

Review of Literature

Critical Success Factors for SCMIS Implementation

Huge cost and risk are involved in the implementation of SCMIS; therefore, critical success factors (CSFs) should be identified, which would lead to the successful implementation of the system. The CSFs are identified from two groups of studies, namely, CSFs for ERP implementation, such as, top management support, business process re-engineering (BPR), change management, training, user involvement and communication, since SCMIS is an extension module of ERP. Second, CSFs for implementation of inter-organizational systems (IOS) such as, trust, partnership, long-term relationship, technical compatibility and pressure from the partners as supply chain, are a network of organizations that are connected, through

Table 1. Experience of ERP Users with Regard to Enterprise Software

Year	Cost ($ million)	Percentage of Cost Overruns (%)	Duration (month)	Percentage of Duration Overruns	Percentage Receiving 50 Per Cent or Less Benefits
2013	2.8	54	16.3	72	66
2012	7.1	53	17.8	61	60
2011	10.5	56	16	54	48
2010	5.5	74	14.3	61	48
2009	6.2	51	18.4	36	67

Source: Panorama consulting solutions.

upstream and downstream links, in the different processes and activities that produce value in the form of products and services that are delivered to consumer. Each of these CSFs are categorized and discussed below.

Pre-implementation Dimension

The entire attention is paid on gauging the success of implementation of the system, and the pre-implementation stage is often not given much importance, whereas this stage, which is the planning phase, forms the foundation to the successful implementation of the SCMIS. Only few studies (Abdinnour, Lengnick-Hall & Lengnick-Hall, 2003; Van, Klievink & Janssen, 2009; Verville, Palanisamy, Bernadas & Halingten, 2007) have reviewed preimplementation stage. In the pre-implementation phase, the organization *prepares a business case*, which is a business plan that outlines proposed strategic and tangible benefits, resources, costs, risks and timeline (Wee, 2000). It thus establishes the *need for the system* and provides justification for the investment (Tarafdar & Roy, 2003; Xu, Nord, Brown & Nord, 2002). Another strategic factor for IOS in this phase is the *business vision* (Al Turki, 2011; Ngai, Law & Wat, 2008), which explains the context of implementing the system. The vision may be reduction of cost, more flexibility and quality improvement or to have better relation with the trading partners. Thus, the *system should link clearly to business objectives* (Adam & O'doherty, 2000; Aladwani, 2002; Duplaga & Astani, 2003; Fui-Hoon Nah, Zuckweiler & Lee-Shang Lau, 2003; Parr & Shanks, 2000; Soroor, Tarokh & Keshtgary, 2009; Sumner, 2000; Umble, Haft & Umble, 2003). Davenport (2000) gave a rational approach for implementing the system and divided into two parts: first, preparing the people and second, preparing the technical system. In preparing the people at pre-implementation stage, studies have considered *change management* (Ngai et al., 2008) as a factor for the successful implementation of the system. One key task is to build user acceptance of the project and a positive employee attitude (Abdinnour-Helm et al., 2003; Holland, Light & Gibson, 1999; Kumar, Maheshawri & Kumar, 2003; Parr & Shanks, 2000; Ross & Vitale, 2000). A climate for change is to be created for which the reasons for users' resistance is to be understood. The benefits of the system should be properly communicated (Bingi, Sharma & Godla, 1999; Holland et al., 1999). Further, effective agents of change (informal leaders) should be developed for making the change easier. As part of the change management efforts, users should be involved in design and implementation of business processes also. To prepare the technical system, Davenport (2000) describes the following processes: configuration, interface development, data standardization and conversion, testing and performance management.

Organizational Dimension

Stefanou (1999) had divided critical factors for successful implementation of systems into two main categories (technological and organizational factors) and concluded that the organizational factors were more important than the technological ones as far as the successful implementation of systems under SCM is concerned. The study by Ibrahim, Sharp and Syntetos (2008) also had classified CSFs into three major grouping in which one was organizational.

The main organizational factor considered by the researchers Al Turki (2011), Ngai et al. (2008), Beheshti (2006), Ngai, Cheng and Ho (2004), Soliman and Janz (2004), Craighead, Patterson, Roth and Segars (2006), Yao, Palmer and Dresner (2007), Aladwani (2002), Bradford and Florin (2003), Duplaga and Astani (2003), Fui-hoon Nah et al. (2003), Parr and Shanks (2000), Sarker and Lee (2003) and Umble et al. (2003) is the *support from the top management* as they ensure smooth change management and system rollout. Organizations where top management is committed for IOS and relationship are bound to be more successful as they will allocate more financial and human resources. 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. Intervention of the top management is necessary for the resourcing of the project, to take fast and effective decisions, to resolve conflict, to promote company-wide acceptance of the project and to build cooperation among the diverse groups within the organization. The involvement of top management is also vital to the effective re-engineering of the supply chain and logistics processes (Gunasekaran & Ngai, 2004). Other important organizational factor considered by Ngai et al. (2008), Fui-Hoon Nah et al. (2003) and Sarker and Lee (2003) is *communication*. It is one of the most challenging and difficult tasks in the project. Proper communication in regard to the rationale to the implementation and details of the business process management change with the employees (Mandal & Gunasekaran, 2003) is very important. It is imperative that we have the complete cooperation of employees at all levels; technologies alone will not improve the organizational competitiveness. Thus, all personnel should understand the benefits of implementing supply chain system and should be allowed to participate in the development of the system (Ngai et al., 2004). Therefore, the open communication with the employees, suppliers and customers is an important factor for the successful implementation of SCMIS (Mabert, Soni & Venkataramanan, 2003). *Organizational culture* is another important factor that needs to be considered for the success of the information system. The studies by Leidner and Kayworth (2006) have shown that the success rate of the system that is being implemented increases if the system is aligned with the organizational culture. According to Nah, Lau and Kuang (2001), a culture with shared values and common aims is conducive to success.

Inter-organizational Dimension

SCMIS integrates companies both upstream and downstream; therefore, inter-organizational factors become important and critical. Successful implementation of IOS requires the *cooperation and commitment of trading partners* (Premkumar & Ramamurthy, 1995); thus, developing cordial relationships and *partnerships* (Gunasekaran, Lai & Edwin Cheng, 2008; Ketikidis, Koh, Dimitriadis, Gunasekaran & Kehajova, 2008) forms the basis of successful IOS. Yu, Yan and Cheg (2001) in their study emphasized on the benefits of supply chain partnerships based on information sharing. Premkumar and Ramamurthy (1995) in their study attempted to provide an integrated perspective of SCM and IOS and analyzed management issues, such as, commonality of objectives, desirability of establishing a long-term relationship from a business perspective, partners' willingness to participate, technical compatibility and Technical expertise of the partners. Study by Lu, Huang and Heng (2006) reveals seven CSFs for the IOS, namely, intensive stimulation, shared vision, cross-organizational implementation team, high integration with internal information systems, inter-organizational BPR, advanced legacy information system and infrastructure and shared industry standard. Another issue widely studied is inter-organizational information sharing quality (Li & Lin, 2006); Hsu, Chiu, Chen & Liu (2009) focused their study on *information transparency and visibility*. Soliman and Janz (2004) studied the degree of comfort about sharing sensitive information with the trading partners.

The literature has also researched *trust* between trading partners and has confirmed the trusting relationship as a critical factor for the success of IOS. Mutual trust refers to the fact that the channel members have confidence in their partners' reliability and honesty; namely, the channel members do business with one another on a foundation of mutual trust so the long-term and extra benefits are achieved. Soliman and Janz (2004) in the study have emphasized the importance of having trusting relationship in implementation of inter-organizational information systems. Study by Bagchi, Ha, Skjoett-Larsen and Soerensen (2005) emphasizes that most companies are quite cautious when it comes to sharing sensitive data. The studies by Mihok and Frank (2007), Ratnasingam (2005) and Hart and Saunders (1997) have also considered trust as one of the important success factor in implementing IOS.

Human Dimension

These factors are among the most important (critical) as the system being implemented is for the employees; therefore, the *user involvement and participation* should start much before the implementation takes place as has been emphasized by various studies (Bingi et al., 1999; Holland et al., 1999). Studies by Duplaga and Astani (2003), Hong and Kim (2002) and Rajagopal (2002) show r*esistance to change* as one of the important critical factor for SCMIS implementation. The studies revealed that the resistance is due to job changes and uncertainty of the systems. Studies by Ketikidis et al. (2008) and Soroor et al. (2009) show organizational resistance as a common cause of implementation failure. Another factor considered by the researchers for successful implementation under this head is *training and education* (Bradley, 2008; Ngai et al., 2004). This factor assumes importance because if proper training and education is not provided to the employees, there will be high resistance for change. With proper training and education, all personnel will understand the benefits of IOS. The study by Soroor et al. (2009) considers inadequate training for the team members and lack of user participation in the project as one of the SCMIS development failure factors. The main goal of the training should be the effective understanding of the various business processes and should address all aspects of the system. Researchers have suggested that training should include the development of IT skills for the users (Stratman & Roth, 2002; Tarafdar & Roy, 2003). It is very important to have *post-training analysis* so as to ensure that the users have received the appropriate training. Thus, for the successful implementation of these systems, human or personnel plays a crucial role (Aladwani, 2002; Duplaga & Astani, 2003; Markus, Axline, Petrie & Tanis, 2000; Rajagopal, 2002; Robey, Ross & Boudreau, 2002; Sumner, 2000).

Technical Dimension

Complexity of the software has been studied extensively by various researchers (Adam & O'doherty, 2000; Bradford & Florin, 2003; Francalanci, 2001; Parr & Shanks, 2000; Robey et al., 2002; Ribbers & Schoo, 2002; Sumner, 2000), and they have concluded that there exists a negative relationship between complexity of the software and successful implementation of these systems. According to the studies (Petter, DeLone & McLean, 2008), the information systems for SCM should be accessible, compatible, user-friendly, stable and reliable, requiring minimal training and offering strong after-sales service. The system quality features included in the studies were ease of use, ease of learning, system accuracy, flexibility, sophistication, integration capability and customization. They further included information quality features, such as, usability, understandability, relevance and conciseness.

The data flowing through the system are extremely valuable, and therefore, studies by Ngai et al. (2004), Warren and Hutchinson (2000), Premkumar (2000) and Bouchbout and Alimazighi (2008) included *data security* as one of the important technical factor for successful implementation of web-based SCM systems.

Hardware and software reliability is another factor to be considered for success of the system. Ngai et al. (2004) in the study considered reliability to consist of the accuracy of the data, adequate maintenance of the system and the capability of the hardware. The study by Craighead et al. (2006) related the reliability of the Electronic Data

Interchange (EDI) system with the frequency of downtime that may lead to a lack of faith in the system. Therefore for success, the system should be free from unplanned downtime. Another technical parameter somewhat related to reliability that is considered by Craighead et al. (2006) is *in-house ability to maintain* and to *change/update hardware and software*. The technical factors that are critical to organizations in their adoption decision of Internet-based inter-organizational information systems (IBIS) was also studied by Soliman and Janz (2004) and Bouchbout and Alimazighi (2008) and suggested establishing costs, network reliability, data security, scalability and complexity as main factors that significantly affect the adoption decision of IBIS.

Relatively inexpensive, simple for the customers and suppliers to adopt and ease to expand to other customers and suppliers are another technical dimension studied by Craighead et al. (2006).

Implementation of IT in SCM requires a *project management approach* with the right team for the planning and implementation of these projects and to provide financial and technical support. Studies by Aladwani (2002), Fui-Hoon Nah et al. (2003), Parr and Shanks (2000), Sarker and Lee (2003) and Umble et al. (2003) show the importance of the *implementing team*, which should include IT experts, business experts and consultants who should posses a balance of business and IT skills (Kalling, 2003). Studies have been conducted on the need of having a project leader (Bradley, 2008; Ngai et al., 2008), who should possess strong leadership skills (Mandal & Gunasekaran, 2003) as well as business, technical and personal managerial competencies (Kraemmergaard & Rose, 2002). Further study by Gefen and Riding (2002) shows the positive relationship between the responsiveness of the implementing team towards the user of the systems.

Research Objectives and Methodology

The main objectives of this paper are:

1. To identify various critical dimensions and their factors for the implementation of SCMIS.
2. To propose a conceptual model for the successful implementation of SCMIS.
3. To design a model for the successful implementation of SCMIS.

To achieve the research objectives, the methodology adopted was:

Questionnaire Development

The dimensions for the development of the model 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 adopted from the previous research while others were formed specifically for this study. Table 2 shows the various variables and the study from which the various items of variables are being adopted.

The questionnaire covering these dimensions 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 of the questionnaire. Validity

Table 2. Construct Development

S. No.	Variable	Abbreviated Name	No. of Items	Author
1	Top Management Support	TM	5	Ngai et al. (2004)
2	Communication	Co	4	Ngai et al. (2004)
3	Organizational culture	CT	4	Stefanou (1999)
4	Training and education	Tr	4	Ngai (2004)
5	User support and involvement	US	2	Zhang (2005)
6	Change management	CM	4	Kumar V et al. (2003)
7	External support	ES	3	Zhang et al. (2005)
8	Cooperation and commitment of trading partners	CC	5	Premkumar and Ramamurthy (1995)
9	Trust	Trust	5	Neeley (2006)
10	Pre-implementation analysis	PRE	4	Abdinnour-Helm. et al. (2003)
11	Data security	DS	4	Ngai et al. (2004)
12	BPR	BPR	3	Zhang (2003)
13	Effective project management	PM	5	Zhang (2003)
14	Clear business plan and vision	VB	5	Dezdar et al. (2009)
15	Project team composition	TC	5	Nah et al. (2001)
16	Project champion	PC	3	Nah et al. (2001)
17	Technical infrastructure/suitability of hardware and software	TI	3	Ngai et al. (2004) and Zhang (2003)
18	Data accuracy	DA	4	Umble et al. (2003)

Source: Authors' own.

Table 3. Response of the Users of SCMIS

S. No.	Company	Population	Sample	Actual Response	Percentage Response Rate
1	Maruti Suzuki India Ltd	260	160	48	30
	1st Tier Suppliers	10	10	10	100
	Dealers in NCR	10	10	06	60
2	Honda Cars India Ltd	310	160	49	30.62
	1st Tier Suppliers	08	08	08	100
	Dealers in NCR	08	08	06	75

Source: Authors' own.

of the instrument was done to see if the questionnaire is measuring what it intended to measure and is the questionnaire comprehensive enough to collect all the information needed to address the purpose. Thirty practitioners and scholars 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 implementers. The discussion with the experts led to certain changes in the wording of some survey items that was incorporated into the draft of the questionnaire.

Sample of the Study

The pretested questionnaire was administered to 175 executives of 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 (Appendix 1). The questionnaires were administered through e-mail and personal meetings with the respondents. Table 3 shows the actual response and percentage response rate of the users of SCMIS. A total of 127 respondents or 36 per cent has responded to the questionnaires. The respondents expressed their opinions concerning the importance of subsequent factors for the implementation success.

The data were analyzed in Statistical Package for the Social Sciences (SPSS) and the reliability was checked. Exploratory factor analysis was carried on the data for reduction in the variables. Stepwise regression in SPSS was carried on to develop the model and test the significance of the hypotheses established.

Quantitative Analysis and Results

Profile of the Respondents

Table 4 shows the demographic profile of the respondents. The survey was conducted among 127 respondents of whom 77.95 per cent were males. While 41.73 per cent of total respondents had working experience of 5–10 years, 31.50 per cent respondents had working experience of more than 10 years. Out of the total respondents surveyed, 45.67 per cent worked in SCM and another 14.96 per cent worked in the IT department. Around 10 per cent each of the total respondents worked in production, marketing and purchase departments.

Table 4. Demographics Profile of Respondents

	Number of Respondents	Percentage of Respondents
Gender		
Male	99	77.95
Female	28	22.05
Total Work Experience		
Less than 5 years	34	26.77
5–10 years	53	41.73
More than 10 years	40	31.50
Department		
Production	14	11.02
Purchasing	12	09.45
Supply chain management	58	45.67
IT	19	14.96
Finance	02	01.57
Marketing	14	11.03
Others	08	06.30

Source: Authors' own.

Extracting Success Variables

Factor analysis is an ideal method for creating an easy understanding of the framework by identifying groups of related variables. The study applied factor analysis using SPSS software to explore the latent factors of the critical success variables (CSVs) for implementation of SCMIS. Eighteen CSVs were subjected to factor analysis using principal component analysis and varimax rotation. Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant (χ^2 (153) = 1154.595, $p < 0.001$), indicating it was appropriate to use the factor analytic model on the set of data. The examination of the Kaiser–Meyer–Olkin measure of sampling adequacy indicated the strength of the relationship among the variables was high (KMO = 0.897), thus it was acceptable to proceed for the analysis. Four factors were extracted based on eigenvalue greater than 1 and scree plot. The first factor had an eigenvalue of 7.335, and it accounted for 23.98 per cent of the variance in the data. Factor two had an eigenvalue of 2.014 and accounted

Table 5. Final Exploratory Factor Solution—Varimax Rotation

	Loadings			
Items	I	II	III	IV
CT	.754	–.169	–.053	.023
BPR	.753	.101	.229	.098
TM	.742	.161	.105	.333
CM	.736	.155	.165	.108
US	.725	.182	.192	.262
VB	.666	.315	.197	.299
Co	.635	.146	.257	.270
PRE	.518	.254	.347	.312
TI	–.041	.838	–.070	.174
PM	.230	.775	.226	.108
DA	.255	.775	.110	.110
ES	.061	.629	.389	.164
DS	.118	.125	.831	–.051
Trust	.266	.141	.771	.262
CC	.234	.115	.698	.278
PC	.219	.117	.151	.787
TC	.176	.185	.062	.756
Tr	.327	.168	.201	.719
Alpha	0.89	0.80	0.77	0.78
KMO sampling adequacy				0.897
Bartlett's Test of Sphericity		Chi square		1,136.414
		Degree of freedom		153
		Significance		0.000

Source: Authors' own.

for further 15.17 per cent of the variance. The eigenvalues for factors three and four were 1.360 and 1.150, respectively, together accounting for a further 26.73 per cent of the total variance. The matrix in Table 5 revealed factor one consists of eight CSVs, and this factor was labelled organizational dimension. The second factor consisted of four CSVs and was named technical dimension. Factors three and four with three CSVs each were named inter-organizational and human dimensions, respectively.

Proposed Conceptual Model

Based on these factors, a conceptual model has been proposed for the successful implementation of the SCMIS. The model shows that if such dimensions, such as, organizational, technical, inter-organizational study and human aspects, with their respective factors, are considered, it would lead to successful implementation of the information system. The framework of the proposed conceptual model is given in Figure 1.

The following hypotheses were formulated based on the above addressed issues:

H1a: Clear business plan and vision have a positive impact on SCMIS implementation success.
H1b: Pre-implementation analysis has a positive impact on SCMIS implementation success.
H1c: Top management support has a positive impact on SCMIS implementation success.
H1d: Change management initiatives have a positive impact on SCMIS implementation success.
H1e: Involving user has a positive impact on SCMIS implementation success.
H1f: Organizational culture has a positive impact on SCMIS implementation success.
H1g: BPR has a positive impact on SCMIS implementation success.
H1h: Effective communication has a positive impact on SCMIS implementation success.
H2a: Technical infrastructure has a positive impact on SCMIS implementation success.
H2b: Effective project management has a positive impact on SCMIS implementation success.
H2c: Data accuracy during conversion has a positive impact on SCMIS implementation success.
H2d: External support has a positive impact on SCMIS implementation success.
H3a: Data security has a positive impact on SCMIS implementation success.
H3b: Trust among trading members has a positive impact on SCMIS implementation success.
H3c: Cooperation and commitment of trading partners have a positive impact on SCMIS implementation success.
H4a: Project team composition has a positive impact on SCMIS implementation success.
H4b: Training and education has a positive impact on SCMIS implementation success.
H4c: Project champion has a positive impact on SCMIS implementation success.

Regression Model

Multiple regressions used in this study are an extension of simple regression. The goal of multiple regression is to assess the relationship between a dependent (predicted) variable and several independent (predictor) variables. The end result of multiple regression is the development of a regression equation (line of best fit) between the dependent variable and several independent variables. The model in the study has one independent variable and multiple predictors for success of system implementation as dependent variables.

The multiple variable, multiple regression model is written as:

$$y = b_0 + b_1X_1 + b_2X_2 + ... + b_KX_K + ... + b_nX_n ...$$

where b_0 is the y intercept and b_1, b_2 … b_n are the coefficients/slope of the predictors X_1, X_2, … X_n

Further, a common problem with multiple regression is that there may be large set of predictor variables. The ultimate objective is to choose a small subset from the larger set so that the resulting regression model is simple yet have a good predictive ability. Stepwise

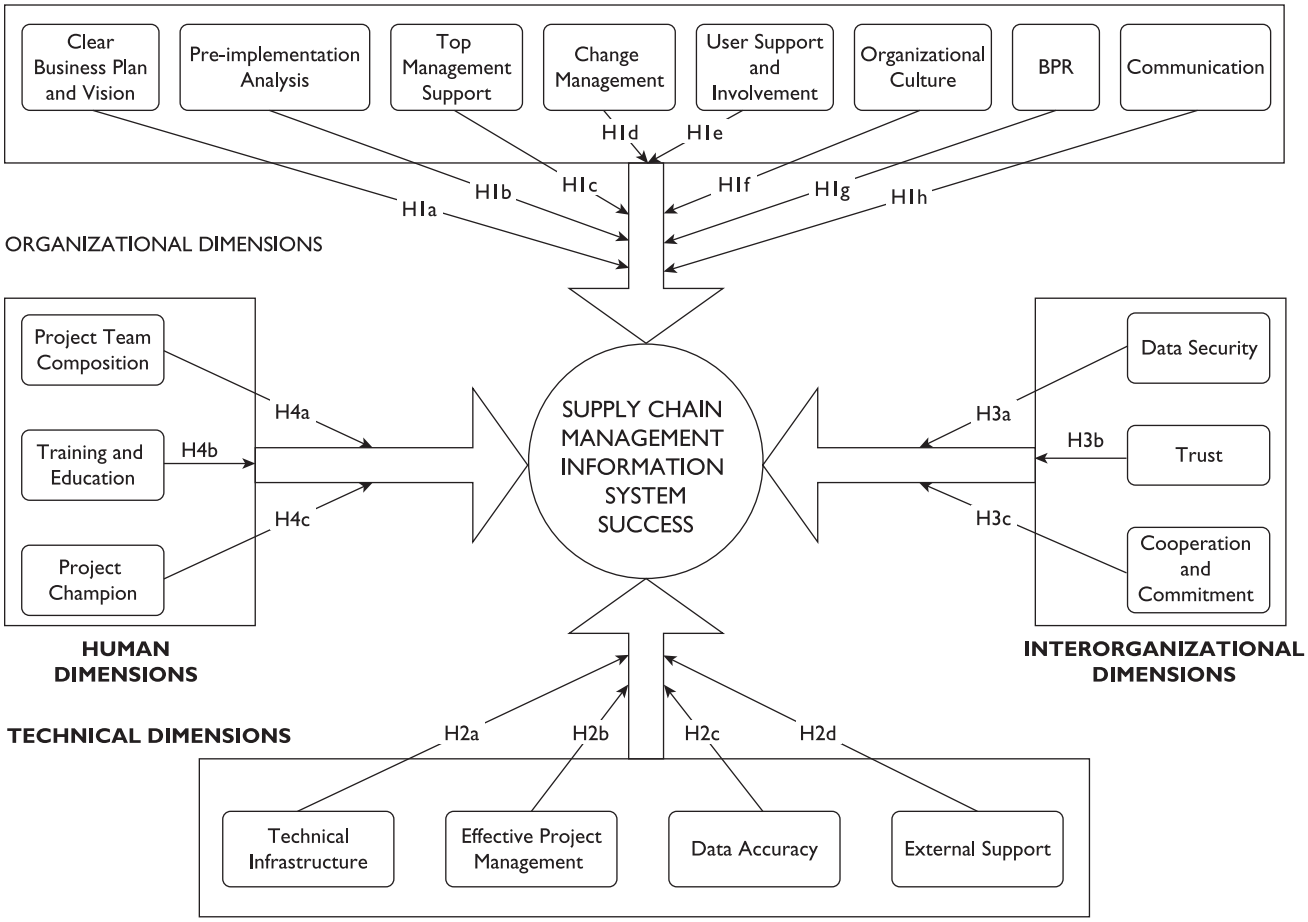

Figure 1. Conceptual Model for Successful Implementation of Supply Chain Management Information System

Source: Authors' own.

regression is used for the study, which enters and removes predictors, in a stepwise manner, until there is no justifiable reason to enter or remove more. According to Dash and Kumar (2013), following are the attributes of good multiple regression model:

- Correlation analysis: Correlation between dependent and independent variables must be high, which means they are highly correlated with each other and with acceptable value > 0.6.
- *R*-squared: It is a statistic that gives information about the goodness of fit of a model. It shows the percentage variance of dependent variable as explained by independent variables. High value of R^2 model is considered to be good.
- Adjusted *R*-squared: The adjusted R^2 is one of the several statistics that attempts to compensate for the artificial increase in accuracy of R^2. For good model fit, difference between R^2 and adjusted R^2 should not be greater than 0.5.
- *F* value: For good model fit, *F* value should be > 10.
- *p* values: For good model fit, *p* value should be < 0.05.
- *t* values: For good model fit, *t* value should be > 1.96.
- Variance inflation factor (VIF): Value < 3 indicated no problem of multi-collinearity.
- Durbin–Watson value: Value of 2 indicates no auto-correlation problem.

All the variables from the organizational, technical, inter-organizational and human dimensions were entered and stepwise regression was performed. Table 6 shows the model summary, and the predictors included in the model were TM, US, PRE, Tr, CM, DA and Co. The value of *R*, which is the square root of *R*-squared and is the correlation between the observed and predicted values of dependent variable, is 0.893, which is more than the acceptable value of 0.6. Further, Table 6 reveals the value

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.893	.798	.786	.263

Source: Authors' own.

of R^2, which is the coefficient of determination, as 0.798, which means that 79.8 per cent of the total variation in the dependent variable is explained by the above-mentioned independent predictor variables. The value of adjusted R-squared that penalizes the addition of extraneous predictors to the model is 0.786, and the difference between R^2 and adjusted R^2 is less than 0.5, which indicates good model fit. The value of standard error of the estimate, which is referred to as root mean square error, is 0.263.

Table 7 indicates analysis of variance in which the total variance with value 40.724 is partitioned into the variance with value 32.508, which can be explained by the independent variables (regression), and the variance that is not explained by the independent variables (residual) has the value of 8.217. The significance value refers to the test of the entire model (i.e. the entire collection of independent variables) as a whole. The general form of the hypothesis test is:

H_0: None of the independent variables are significant predictors of the dependent variable.

Thus, Table 7 shows F (7,119) = 67.258, $p < 0.001$ and therefore null hypothesis is rejected, and which proves the alternative hypothesis that at least one independent variable is a significant predictor of the dependent variable.

According to the regression analysis on the successful implementation of SCMIS, as shown in Table 8, factors that have significant impact at 5 per cent or higher level include top management support, user support and involvement, training and education, change management, pre-implementation analysis, communication and data accuracy. B values indicate the coefficients and constant for the regression equation that measures predicted value for implementation success of the system. While beta (β) values refer to the standardized regression coefficients that allow for an equal comparison of the coefficient weights, the t value refers to the value of B divided by the standard error of B. The significance indicates the probability that the t value could happen by chance, so it is considered significant at the $p < 0.05$ level if this index is less than 0.05.

Table 8 shows the results of regression coefficients. The first variable (constant) represents constant called as 'Y' intercept, which is the predicted value of a dependent variable when all other variables are 0. The t values of all the variables in the model are statistically significant as their significant values lie below 0.05; therefore, it can be safely concluded that the analysis predicts fitness of the model.

Thus, the following regression equation was derived based on the regression output:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$$

where Y = perceived successful implementation of the system (SI) (dependent variable) and X = CSVs (independent variable)

$$\mathrm{SI} = b_0 + b_1\mathrm{OTM} + b_2\mathrm{OUS} + b_3\mathrm{OPRE} + b_4\mathrm{HTr} + b_5\mathrm{OCM} + b_6\mathrm{TDA} + b_7\mathrm{OCo}$$

Therefore,

$$\mathrm{SI} = -2.403 + 0.190\mathrm{OTM} + 0.172\mathrm{OUS} + 0.152\mathrm{OPRE} + 0.183\mathrm{HTr} + 0.190\mathrm{OCM} + 0.165\mathrm{TDA} + 0.160\mathrm{OCo}$$

The equation shows the value of beta to be 0.190 for top management support and change management which is significant at $p < 0.05$. Further, beta values for user support and involvement is 0.172, for pre-implementation analysis is 0.152, for training and education is 0.183 and for communication is 0.160. The regression results are also shown in Figure 2. Thus, the above regression model

Table 7. Analysis of Variance

	Sum of Squares	Df	Mean Square	F	Significance
Regression	32.508	7	4.644	67.258	.000
Residual	8.217	119	.069		
Total	40.724	126			

Source: Authors' own.

Table 8. Regression Coefficients

		Unstandardized Coefficients		Standardized Coefficients		
Model	Variable	B	Std. Error	Beta	T	Sig
	(Constant)	–2.403	.323		–7.435	.000
	OTM	.301	.098	.190	3.083	.003
	OUS	.206	.072	.172	2.871	.005
	OPRE	.182	.067	.152	2.701	.008
	HTr	.231	.065	.183	3.562	.001
	OCM	.249	.075	.190	3.302	.001
	TDA	.238	.066	.165	3.628	.000
	OCo	.196	.072	.160	2.713	.008

Source: Authors' own.

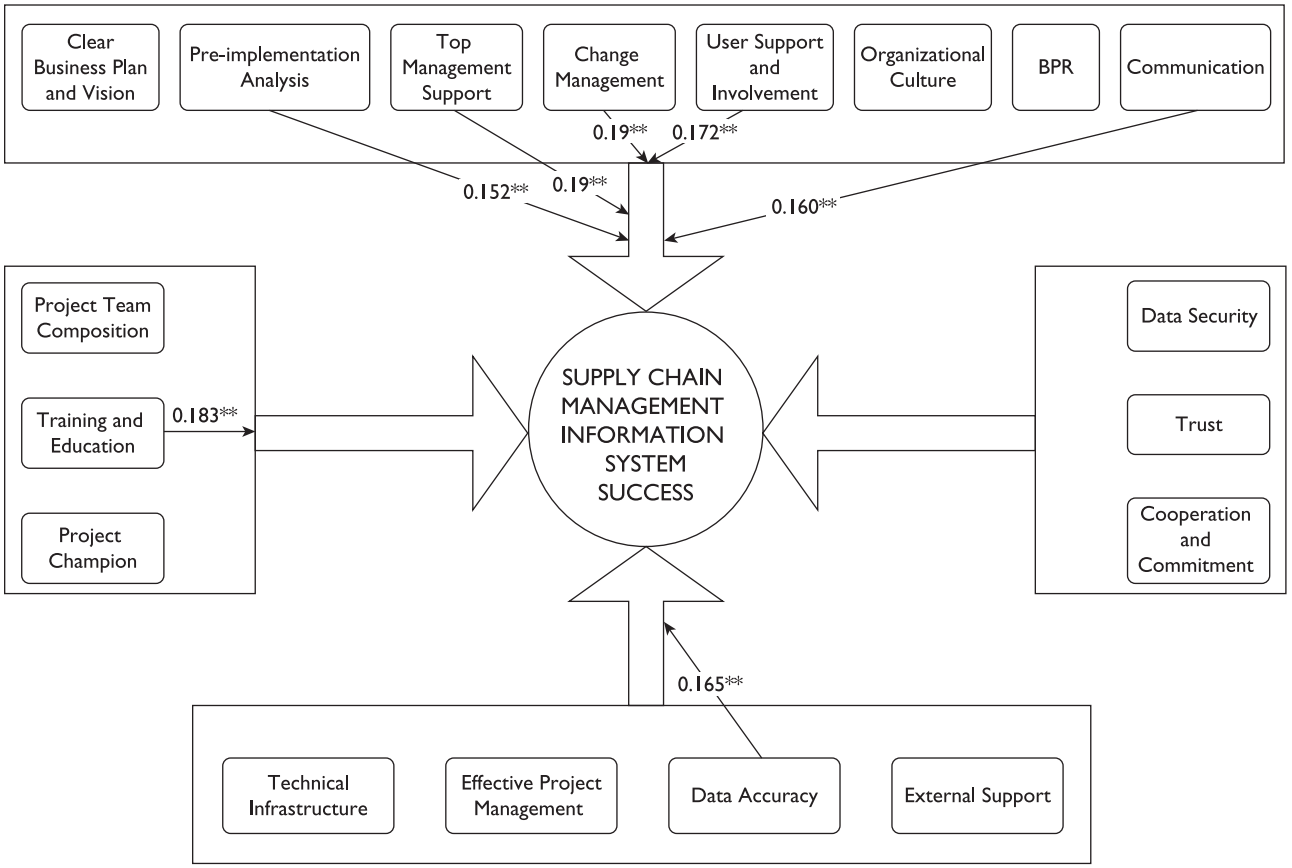

Figure 2. SCMIS Success Model with Result of Regression

Source: Authors' own.
Note: Numbers are the beta weight and $^{**}p < 0.05$.

confirms that these CSVs has a significant impact, and in order to have a successful implementation of SCMIS, top management support, user support and involvement, pre-implementation analysis, training, change management, data accuracy and communication are critical.

Table 8 shows that top management support and change management were the most significant and critical for the successful implementation of SCMIS.

Implications of the Study

The contributions of the article are important for industry practitioners, researchers and policy makers. The implementation requires huge investment and intensive research. Industry practitioners have not fully recognized the importance of such research due to a lack of understanding of technologies and their benefits. The process model and CSFs 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, such as, reduction of inventories, minimization of bullwhip effect, cost saving, quality improvement, better coordination with the suppliers, more visibility of the information across the supply chain and greater competitive advantage that will accrue with right implementation. Managers could gain an understanding of the complexities intrinsic in implementing these systems and increase the likelihood of achieving desired results by streamlining their business processes and carefully managing the change. 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.

Discussion and Conclusions

The objective of this study was to identify CSVs and propose a model for the successful implementation of

SCMIS in the automotive industry in India. This article identified 18 CSVs from literature review and experts' opinions, and proposes a model for the successful implementation, which can give the organization an edge over their competitors. Exploratory factor analysis was used to analyze the data collected through the questionnaire from the executives of two automotive companies, their suppliers and distributors in the NCR of India. The hypotheses established were tested for significance using regression analysis. The findings of this study support the proposed hypothesis that top management support has a positive impact on SCMIS implementation success (H1c), so an increase in support of top management will lead to more successful implementation. The primary responsibility of the top management is to provide sufficient financial support for setting of a successful system. The support from the top management also plays an important role in reducing resistance to change. Formal and honest communication from the top management leads to reduction in the resistance to change. The management can facilitate team spirit by empowering the employees and also create a conducive environment for the employees to accept change.

Next, the study supported the proposed hypothesis that user involvement and support has a positive impact on SCMIS implementation success (H1e), so an increase in user involvement will lead to more successful implementation. The users who participate in the planning and implementing stage of the system are less likely to resist the change. Users' participation can improve information quality by knowing exactly the information requirements. The users should be asked to give their suggestions and feedback in the process of implementation that will improve user understanding of the system. Thus, it is very important to keep the users and other stakeholders motivated and actively involved.

Further, the study support the proposed hypothesis that pre-implementation analysis has a positive impact on SCMIS implementation success (H1b); it increases the likelihood of achieving desired results by streamlining their business processes prior to implementation of the system. It is imperative to study the organizational readiness for the system in pre-implementation stage.

The findings also support the proposed hypothesis that training and knowledge transfer has a positive impact on SCMIS implementation success (H4b), so organization should arrange effective training for the end users of SCMIS for smooth implementation of the system. Education and training should be provided to the user so that he becomes comfortable with the system. There must be development of a formal training programme to meet the requirements of the users and proper allocation of resources for the training should be done. Training is one of the most costly components of an ERP implementation project, so the proper monitoring and evaluation should be done to ensure that the employees have received the appropriate training.

The proposed hypothesis that change management initiatives have a positive impact on SCMIS implementation success (H1d) has also been accepted. This indicates that the organization should manage the change at every level, highlighting that all successful change initiatives start from the top. For most of the change initiatives, it is pertinent to engage and motivate employees in the process towards change. Further, it should be implemented in a phased manner with enough time for the process of change to set in.

The proposed hypothesis that data accuracy during conversion has a positive impact on SCMIS implementation success (H2c) has also been supported by findings. It is very important to realize that executives do not underestimate the importance of accurate data. Data accuracy is required for the system to function properly. It is vital to have accurate data during conversion period; otherwise, the employees will continue to run parallel system that is not good for the implementation.

Lastly, the findings of this study support the proposed hypothesis that communication has a positive impact on SCMIS implementation success (H1h), so as organizations move towards integration with the outside world, proper communication is imperative between the users, top management, project management team and leader. 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.

The study concludes that apart from the technical factors, there are other dimensions, such as, organizational issues, inter-organizational system, human dimension and their factors, that need to be considered for the successful implementation of SCMIS. Thus, these systems should not be viewed as an IT implementation but instead as an organizational revolution that would transform the organization processes into more efficient and effective one.

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, their suppliers and dealers of NCR of India. Thus, first, 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. Second, the study does not include the views, opinions and perceptions of software experts that are involved in the development of SCMIS from organizations, such as, IBM, Oracle and SAP. Another

major limitation of the study is that it uses perceptual data provided by the executives of two companies in the NCR of India.

Appendix 1

Suppliers of Honda Cars India Ltd

1. Munjal Showa Limited
2. Motherson Sumi Systems
3. Denso India Limited
4. Lumax Industries Limited

Suppliers of Maruti Suzuki India Ltd

1. Motherson Sumi Systems
2. Subros Limited
3. Sona Koyo Steering Systems Ltd
4. Gabriel India Limited
5. Minda Industries Ltd

Dealers of Honda Cars India Ltd

1. Pearl Honda
2. Ace Honda
3. Prime Honda
4. Ring Road Honda

Dealers of Maruti Suzuki India Ltd

1. Rohan Motors Limited
2. Vipul Motors Limited
3. Competent Automobiles Co. Ltd
4. Bagga Link Motors Limited
5. Apra Auto India Pvt. Ltd

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