International Journal of Productivity and Performance Management

Emerald Article: Modeling enablers of TQM to improve airline performance.

ALOK KUMAR SINGH, (Dr) Sushil

Article Title Page

Modeling enablers of TQM to improve Airline performance.

Author Details *(please list these in the order they should appear in the published article)*

Author 1 Name:	Alok Kumar Singh
Department:	Department of Management Studies
University/Institution:	Uttarakhand Technical University
Town/City:	Dehradun
State (US only):	Uttarakhand
Country: India	

Author 2 Name:	Prof. Sushil
Department:	Department of Management Studies
University/Institution:	Indian Institute of Technology, Delhi (IIT-D)
Town/City:	New Delhi
State (US only):	Delhi
Country: India	

Corresponding author: Alok Kumar Singh
Corresponding Author's Email: alokkumar.ia@gmail.com

☐ *Please check this box if you do not wish your email address to be published*

Acknowledgments (if applicable):

Biographical Details:

Alok Kumar Singh holds B.Tech in Mechanical Engineering from IIT-Roorkee, MBA in Operations Management from MDI-Gurgaon and is currently pursuing PhD from Uttarakhand Technical University, Dehradun. He has eleven years of experience in airline industry in the field of airline operations and maintenance. His current areas of research interest includes Operations management, Supply chain management, Total Quality Management, Service management, Multi Criteria Decision making, Statistics and Structural Equation Modelling.

Sushil is a professor of Strategic, Flexible Systems and Technology Management at the Department of Management Studies, Indian Institute of Technology, Delhi (IIT-D). He has twenty books to his credit in the areas of Flexibility, Systems Thinking and Technology Management. He has over 200 papers in various refereed journals and conferences. He is *Editor-in-chief* of '*Global Journal of Flexible Systems Management'*. He has pioneered the area of 'Flexible Systems Management' and made original contributions to the field of knowledge in the form of SAP-LAP models and linkages. He has evolved the concept and framework of 'Flowing Stream Strategy' as Strategic flexibility to manage continuity and change. He has also provided mantras for continuous organisational vitalization and model for execution excellence. He has acted as consultant to both government and private organizations; a few representatives ones being LG electronics, Rockwell International, TCS, Tata Infotech Ltd., CMC Ltd., James Martin and Co., GAIL, and Sona Koya Steering Systems. He is the founder president of Global Institute of Flexible Systems Management.

Structured Abstract:

Purpose: The purpose of this paper is to identify and analyze the interactions among different enablers of Total Quality Management (TQM) and its outcome variables in service sector specific to Indian domestic airline industry. No study has been done regarding the implementation of TQM in Indian domestic aviation sector. To fill this gap Interpretive Structural Modeling (ISM) and Total Interpretive Structural Modeling (TISM) based Quality framework model has been developed to understand the mutual interactions among the variables and to identify the driving and dependence power of these variables.

Design/methodology/approach: ISM and TISM based approach have been used to study and analyze the interactions between identified variables.

Findings: In this research work, total of 14 variables have been identified based on extensive literature review, brainstorming and experts opining from the Indian airline industry and academia. The result showed that top management commitment, training, continuous improvement, benchmarking, employee involvement and commitment have strong driving power and weak dependence power and are at the lowest level in hierarchy in the ISM and TISM model, while the outcome variables of TQM have low driving power but have high dependence power.

Practical Implications: Top management must stress on variables having strong driving power for efficient implementation of TQM. By implementation of TISM model in the Indian airline industry, organizations would become more productive, competitive and would eventually become more profitable.

Originality/value: In this research work, ISM and TISM based Quality framework structural model have been proposed for Indian domestic aviation industry which is a new effort in the area of TQM implementation in this sector.

Keywords: Interpretive Structural Modeling (ISM), Total Interpretive Structural Modeling (TISM), Total Quality Management (TQM).

Article Classification: Research paper.

For internal production use only

Introduction

With the liberalization of the Indian aviation sector, the aviation industry in India has undergone a rapid transformation. Previously, the Indian aviation sector was dominated by a national carrier, now with the opening of Indian skies, many players have forayed into the Indian aviation market. From being primarily a government-owned industry, the Indian aviation industry is now dominated by privately-owned full-service airlines and low-cost carriers. Private airlines accounted for a 81.8% share of the domestic aviation market in June 2012 (Times of India, 2012). India recorded a demand growth of 19.7% in August 2011, and was described as the top performer among domestic markets, as per figures released by the International Air Transport Association (IATA) (Times of India, 2011).

With intense competition in the market, organizations in the aviation sector need to improve their service quality in order to achieve competitive advantage and to remain competitive in the market. This will not only improve customer satisfaction levels but also help in increasing load factor and market share. These can be achieved by implementing several quality-related approaches such as Total Quality Management (TQM), Six sigma, Quality function deployment (QFD), Statistical process control (SPC), and Taguchi quality engineering. To improve competitiveness, to increase productivity and lower cost, organizations are looking for higher levels of effectiveness and efficiency in all their business processes and across all functions, and thus are choosing TQM as a competitive strategy in order to stay in the business (Baidoun, 2003). TQM philosophy was earlier used mainly in manufacturing industry, but now there is a strong demand for adopting TQM as a competitive strategy in the service industry also (Faisal et al., 2011). TQM helps organizations to improve productivity, efficiency, effectiveness, flexibility and competitiveness of a business as a whole, thus removing waste, by involving everyone in the organization in improving the ways things are done (Mosadegh Rad, 2005). The ultimate goal of TQM is to enhance customer satisfaction, thereby increasing market share, profits and revenue, by coordinated efforts of all employees in the organization through continuous quality improvement (CQI) programmes (Haleem *et al*., 2012; Mosadegh Rad, 2005; Faisal *et al*., 2011). Implementation of TQM has given positive results in terms of enhanced organisational performance and customer satisfaction (Faisal *et al.,* 2011; Hasan and Kerr, 2003).

TQM is not just a management philosophy but a culture of an organization committed to total customer satisfaction through continuous quality improvement programmes (Mosadegh Rad, 2005; Faisal *et al*., 2011; Vouzas *et al*., 2007). Earlier research works have shown that TQM is positively associated with performance outcomes, such as financial performance and profitability, as well as human outcomes, such as customer satisfaction, employee satisfaction and all stakeholders' satisfaction as a whole (Mosadegh Rad, 2005). However, in practice a TQM program is not easy to implement and its benefits are not easy to achieve (Mosadegh Rad, 2005; Faisal *et al*., 2011). TQM implementation is often unsuccessful due to the different focus of organizations on key variables of TQM without knowing their driving and dependence power and their inter-relationship between these variables. Quality is too important to be delegated; lack of requisite top management commitment is the main reason for 80 percent of TQM failures (Thiagarajan and Zairi, 1997). There are many critical success factors (CSF) or enablers of TQM, which need to be understood in terms of their interdependence and their driving and dependence power. The present work is aimed to fill these gaps in service organisations specific to the aviation industry in India.

The main *objectives* of this research are:

- to identify and rank enablers and outcome variables of TQM specific to airline industry in Indian context.
- to find out the interaction among identified variables using ISM and TISM approach.
- to analyze and discuss the managerial implication of this research.

This research proposes a model based on Interpretive Structural Modeling (ISM) and its upgraded version Total Interpretive Structural Modeling (TISM) (Sushil, 2012) for enablers and outcome variables of TQM implementation in airline industry. This model would help airline management to successfully implement TQM and to lay stress on those factors which directly or indirectly help to improve organization performance, productivity and competitiveness. To apply TISM to this Indian airline context is a novel contribution.

The remainder of this paper is organized as follows: The next section deal with the review of literature along with the identification of enablers of TQM implementation and their outcome variables. This is followed with ISM methodology and development of ISM based structural model followed with *Matrice d'Impacts Croises – Multiplication Applicqnce a un Classement* (MICMAC) analysis. The ISM model is then upgraded to TISM, by discussing various steps of TISM model and its uniqueness in completely interpreting the structural model. Finally the results are discussed in the discussion section along with their managerial implications. This is then followed with the limitations, scope for future research work and conclusion.

Literature review

TQM is considered as an important quality improvement and performance improvement tool (Kumar *et al., 2009;* Bhat and Rajashekhar, 2009). TQM has been studied and implemented throughout the world in different industries and sectors, such as manufacturing and production sector and the latest being the service sector (Faisal *et al.,* 2011; Bhat and Rajashekhar, 2009). Researchers have identified several critical success factors for TQM implementation in various industries. Bhat and Rajashekhar (2009) identified 21 items, representing barriers for successful implementation in Indian industries. From these barriers, five factors were extracted namely: lack of customer orientation, lack of planning for quality, lack of total involvement, lack of management commitment, and lack of resources. Faisal *et al.* (2011) identified twelve TQM barriers in service organisations and found that lack of top management commitment and lack of coordination between departments requires maximum attention. Baidoun (2003) identified nine major CSF for successful implementation in Palestinian organisations and the most critical of them was the top management commitment.
Thiagarajan and Zairi (1997) in his study discussed quality factors related to leadership, internal stakeholders' management, policy and strategy. Benito *et al,* (1999) analyzed the application of both TQM and Business process re-engineering (BPR) simultaneously and argued that if both are used simultaneously, can yield more improvements than if only one of them is used on its own. Vouzas and Psychogios (2007) identified nine key soft aspects of TQM for service industry. Three factors were extracted from their study namely: continuous improvement and training, total employee empowerment and involvement and finally quality driven culture.

Kumar *et al.* (2009) developed a four-stage conceptual model for TQM implementation in Indian industries. The first stage describes about preparation and awareness of TQM in organisations involving both management and employees. The second stage describes about focus on customer satisfaction. The third stage deals with planning and implementation of TQM and finally the fourth stage deals with development and backup which also include rewards and recognitions. The research work of Hasan and Kerr (2003) in Australian service organisations showed that organisational performance is affected by various quality dimensions. They identified nine quality dimensions and four dimensions of organisational performance and found that the role of top management and customer satisfaction are among the most important in terms of their effect on the organisational performance.

Gupta *et al.* (2005) developed a conceptual Total Quality Service (TQS) model for understanding the interaction between customer satisfaction and three major constructs of TQM namely: leadership, organisational culture and employee commitment by incorporating Deming's model and SERVQUAL. Lakhe and Mohanty (1995) analyzed various aspects of TQM in service systems and differentiated it from manufacturing systems in terms of implementation because of service intangibility, the heterogeneous nature of the service process, lack of predictability and repeatability of the service product, diversified customer requirements and finally developed a conceptual model for the measurement of the various dimensions of effectiveness of TQM in service systems. Ahmed *et al.* (2006) identified best practices and CSF of TQM implementation within the airline industry using SWOT analysis through a case study on Air China. Laszlo (1999) examined a case study on Southwest airlines and analyzed that their success is due to the application of quality management principles and the foundation blocks for quality in customer service organisations are management commitment, customer focus and employee involvement.

The literature review suggests that no study has been done to investigate the interactions among enablers and outcome variables of TQM specific to airline industry in Indian context. Therefore there is a need to develop a generally applicable model which establishes relationships.

Identification of variables

The aim of the literature review is to identify variables needed for successful implementation of TQM in service industry specific to aviation industry in Indian context and their outcome variables. An initial meeting was conducted with the airline management. In this meeting four experts from aviation industry were identified. These four experts had more than ten years of experience in the aviation quality management area. Literature related to CSF of TQM and its implementation had been circulated among experts. After fifteen days, a brainstorming session was organized along with two experts from academia to identify variables. During the brainstorming session, a total of 24 variables were identified. The number was reduced to 14 as some variables were of the same nature and could be covered under a common variable. The literature related to these 14 variables was circulated to experts. After ten days, a session was organized to establish mutual relationships among variables. A contextual relationship of the type "leads to" was chosen (Does one variable lead to another variable?). Experts were asked to answer this in terms of "yes" or "no". If the answer was "yes" it was to be further interpreted (how) in a single line. After seven days, the list of variables and inter-relationship diagram were circulated for any further modification.

Out of 14 variables identified, 11 variables are identified as enablers of TQM for successful implementation in domestic airline industry and the remaining three are the outcome variables. All these variables were identified keeping in mind the context of study. Table 1 shows different variables (enablers and outcome variables) and their references cited in different literatures.

Top Management Commitment

Top management commitment is one of the most crucial factors for TQM program implementation cited in literature. Top management commitment, efficient and visionary leadership sets the foundation for the implementation of TQM in an organization (Thiagarajan and Zairi, 1997). Top management has to take charge, lead the process, provide direction and facilities and further to implement guidelines for benchmarking and also to exercise forceful leadership while dealing with those who block improvement (Vouzas *et. al.*, 2007). Top management needs to define the quality objectives of the organization in their vision.

Communication

Effective communication is like cement that holds the bricks of TQM together (Baidoun, 2003). Effective communication between all levels of employees from top to bottom of the hierarchy is a major enabler of TQM implementation (Faisal *et al.*, 2011; Baidoun, 2003; Mosadegh Rad, 2005). Effective communication of quality awareness between all internal and external stakeholders is must for successful implementation of TQM program.

Benchmarking

Benchmarking is a continuous systematic approach to measuring key business process against the industry best practices. It is a CSF for implementation of any TQM program. Organization cannot achieve global standards without benchmarking their key critical business processes (Faisal *et al.*, 2011; Motwani, 2001). Benchmarking acts as a catalyst for business process re-engineering, improved operational performance and general change in organizational thinking and action (Baidoun, 2003). It is recognized as a powerful performance improvement effort for processes, business units and for the entire organization (Baidoun, 2003).

Employee involvement

Employee participation at all levels is the key to successful implementation of TQM as it will help to increase flow of information and knowledge and will contribute towards resolving problems (Vouzas *et. al.*, 2007). Vouzas has used the term *Total* Employee involvement as it implies that every employee contribute towards quality improvement process. Direct active employee involvement to the vision, values and quality goals are necessary for success of TQM program (Baidoun, 2003; Motwani, 2001). The critical importance of employee involvement comes from the fact that best process innovation ideas comes from the employees actually doing the job (Thiagarajan and Zairi, 1997).

Training and education

Training and education of employees are considered to be investment vitally important for TQM success (Baidoun, 2003). Trained and educated employees are an asset to the organization. For TQM to succeed the entire workforce must acquire specific knowledge, skills and abilities and thus prepare employees for greater involvement in the organization quality process (Thiagarajan and Zairi, 1997). Training and education based on total quality must be planned and provided, if TQM implementation is to be made successful (Thiagarajan and Zairi, 1997). *Quality begins and ends with training* (Thiagarajan and Zairi, 1997).

Empowerment of employee

Empowerment of employee is a CSF to the implementation of a TQM programme. Empowerment of employees provides authority and autonomy to employees working at various levels in the organization which gives them a sense of pride of workmanship, self improvement, self inspection and innovative ideas (Thiagarajan and Zairi, 1997). Empowered employees are also required as self-managing teams, self-directing teams or by autonomous groups in different organizations (Thiagarajan and Zairi, 1997). Empowerment will give employees a sense of belonging towards the organization and will work in more zealous and innovative ways.

Coordination and teamwork

Energy and efforts of all employees must be in the same direction towards one common goal called the vision of the organization and this can only be achieved if employees work as "*one team*" to achieve the same ultimate objective of "*customer satisfaction*". Coordination and Teamwork is a CSF for TQM implementation (Mosadegh Rad, 2005; Baidoun, 2003; Faisal *et al*., 2011; Vouzas *et al.*, 2007; David and Bishnu, 2009; Thiagarajan and Zairi, 1997; Bhat *et al.*, 2009; Motwani, 2001; Vouzas *et al.*, 2007).

Continuous improvement and continuous quality culture

Continuous improvement (CI) culture and commitment to quality culture in an organization are synonyms to each other. CI culture has become the lifeline for a TQM organization (Faisal et al., 2011). CI culture helps in monitoring the process at each level which virtually leads to zero defects. Continuous improvement culture leads to continuous evaluation of the process and provides feedback which is a CSF for a TQM program (Mosadegh Rad, 2005). CI is a culture of sustained improvement targeting the elimination of waste at all levels of the process of an organization (Bhuiyan and Baghel, 2005).

Customer involvement

Customers are an economic asset (Baidoun, 2003). The ultimate aim of a TQM program is customer satisfaction, hence customers play a crucial role in the implementation of TQM program (Baidoun, 2003). This requires that the voice of customers be implemented in the service design characteristics so that customer's voice or feedback is heard and implemented in the process. Various researchers have highlighted the importance of customer involvement (Baidoun, 2003; Faisal *et al.*, 2011; David and Bishnu, 2009; Bhuiyan and Baghel, 2005; Mosadegh Rad, 2005; Bhat *et al.*, 2009; Motwani, 2001).

Process Improvement

This involves adding value by increasing the quality across all levels (Motwani, 2001). For effective TQM implementation, processes are studied, analyzed and executed effectively to provide customers with quality services at lower costs (Mosadegh Rad, 2005). The main aim of service process improvement is to decrease the variability in the process to minimum levels so as to achieve maximum customer satisfaction and eliminate waste at lower costs. For an effective TQM program every process is brought under statistical control by studying the process and by identifying root cause of the problem by various statistical process control tools (David and Bishnu, 2009).

<Table 1. Variables identified and their references in literature>

Improved service quality

Service quality plays an important role not only in service organization but in any organization as increased service quality provides service differentiation leading to competitive edge over the competitors. It acts as order winners across organizations. Successful implementation of TQM results in improved service quality leading to increased customer satisfaction (Mosadegh Rad, 2005).

Outcome variables resulting from TQM implementation

On time performance

On time performance (OTP) or Punctuality is one of the key performance indicators (KPI) in airline industry and an important service differentiator for their valued customers (Niehues *et al.*, 2001). Research have indicated that airlines having high on time performance are more profitable than those with lower than average on time performance (Niehues *et al.*, 2001). Effective TQM implementation leads to efficient operations which support high OTP thus minimizing cost of delay which in turn drives profitability and customer satisfaction.

Increased load factor

Effective TQM implementation leads to satisfied customers thus leading to increased load factor in terms of passenger, cargo freight and mails. Effective TQM implementation increases market share by increasing the load factor of the organization in airline industry.

Customer satisfaction

The ultimate goal of effective TQM implementation is customer satisfaction. Customer satisfaction means meeting customer needs and wants at the right time and in the right quantity, at affordable price and the performance they want (Prasad, 1998). Satisfied customer becomes the repeat customer and brings in more customers by referrals or by word of mouth thus increasing revenues, profitability and shareholder's value.

Methodology

Interpretive Structural Modeling (ISM) and development of structural model

ISM is an interactive learning process in which a set of different and directly related elements or variables of interest are structured into a systematic hierarchical model known as a structural model (Warfield, 1974; Sage, 1977). Mental model are generally vague when we have a large number of variables and it becomes difficult to interpret the interactions and inter-relationships among variables; ISM gives a clear understanding of all the variables and their relationship with other variables. The model formed depicts the structure of a complex process or problem, a system or a field of study in a carefully designed pattern implying graphics as well as words (Ramesh *et al.*, 2010; Ravi and Shankar, 2005; Faisal *et al.*, 2006). ISM methodology helps to impose order and direction of complexity of relationships among system (Agarwal *et al.*, 2007; Ramesh *et al.*, 2010). The ISM methodology is interpretive in the sense that judgement of the group decides whether the variables are related or not and the direction of their contextual relationship. It is structural in the sense that an overall structure is extracted from the complex set of variables on the basis of relationships (Haleem *et al.*, 2012; Ramesh *et al.*, 2010; Agarwal *et al.*, 2007).

ISM is a powerful tool to develop relational (contextual relationship) structural model. Literature review highlights that ISM has been applied in various fields and some application areas along with contributors are shown in table 2.

<Table 2. Application areas of ISM>

ISM follows a methodological series of steps which are as follows:

Step 1. Identification of variables affecting the system or the process of interest. This could be done with the help of a literature review, brainstorming and opinion of the experts from industry and academia.

Step 2. Define the contextual relationship between variables of interest. The contextual relationship is dependent of the type of structure we are dealing with such as intent, priority, attribute enhancement, process of mathematical dependence and this gives the nature of relationships between the variables (Sushil, 2012). In case of intent structure, the contextual relationship can be that of 'leads to' type i.e. A leads to B.

Step 3. Developing a structural Self Interaction Matrix (SSIM) for variables. SSIM indicates pairwise relationships among variables of the system under consideration. This pairwise contextual relationship is expressed in the form of V, A, X and O which is explained in the next section.

Step 4. Developing a reachability matrix from the SSIM by converting the information in each cell of the matrix from step 3 into binary numbers "0" and "1".

Step 5. Reachability matrix obtained from step 4 is then checked for transitivity. Transitivity is the basic assumption in ISM which states that if a variable "i" is related to "j" and "j" is related to "k" then "i" is necessarily related to "k".

Step 6. The final reachability matrix obtained from step 5 is then partitioned into different levels on the basis of reachability and antecedents sets for each variable through a series of iterations called as level partitioning.

Step 7. On the basis of final reachability matrix obtained from step 5 and level partitions obtained from step 6, a conical matrix or lower triangular matrix is constructed. From this conical matrix a directed graph (DIAGRAPH) is constructed and all the transitive links (indirect links) are removed.

Step 8.The resultant diagraph is converted into ISM by replacing the variables nodes with statements.

Step 9.Finally, ISM model developed is checked for conceptual inconsistency and make necessary modifications, if any.

Structural Self Interaction Matrix (SSIM)

After identification of a total 14 variables (11 enablers of TQM and 3 outcome variables) through extensive literature review, brain storming and expert opinion from the aviation industry and academia, analysis was then carried out. For carrying out this research work four experts from the aviation industry and two from academia were consulted. These experts from industry and academia were very well conversant with issues of TQM implementation. A contextual relationship of "leads to” type was chosen, this means variable “i” leads to variable “j”. Keeping in mind the contextual relationship for each variable, the existence of a relationship between any two variables and the associated direction of relation was questioned. There were in all ${}^{n}C_2$ i.e. {n (n-1)/2} paired comparisons. Four symbols were used to denote the direction of relationship between any paired variables (i and j) which are as follows:

- V = variable i will leads to j.
- A = variable j will leads to i.
- X = variable i and j will leads to each other i.e. relation in both directions.
- O = variable i and j are not related i.e. no relationship exists between the two variables.

Based on the contextual relationship between the variables and responses from the experts, SSIM is developed, shown in table 3.

<Table 3. Structural Self Interaction Matrix>

Reachability matrix

The SSIM is transformed into initial reachability matrix by substituting each cell into binary digits 0 and 1. The substitution rule into binary digits is done as follows:

- If the (i, j) entry in SSIM is V, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0.
- If the (i, j) entry in SSIM is A, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1.
- If the (i, j) entry in SSIM is X, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 1.
- If the (i, j) entry in SSIM is O, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 0.

<Table 4. Final Reachability Matrix>

Following these rules, the initial reachability matrix for the variables is prepared. The final reachability matrix is obtained after incorporating the transitivity as explained in step 5 of ISM methodology. The final reachability matrix is shown in table 4 along with driving power and dependence power. The driving power of a variable is the total number of variables including itself which it may help to achieve. The dependence power is the total number of variables including itself which it may help in achieving it. The rank of each variable along with the driving and dependence power is also shown.

Level partitions

As suggested by Warfield (1974), the reachability and antecedents sets for each variable is found out from the final reachability matrix. The reachability set (R) consists of the element itself and other elements, which it may help to achieve, whereas the antecedent set (A) consists of the element itself and other elements, which may help achieving it. Then the intersection set is derived for each variable. The variables for which the intersection set and the reachability set are the same is given the top level variable in the ISM hierarchy. These top level variables in the ISM hierarchy will not help to achieve any other variable above their own level. Once the top level variables are identified, these are then removed from the rest of the variables and the process is repeated till all variables are assigned their levels. From table 5, it is seen that variable 13 (increased load factor) is at the top level of the ISM hierarchy. After removing variable 13, the same process is repeated again to find next level for variables. These levels help in building the diagraph and the final model. All the variables along with reachability set, antecedent sets, intersection sets and variable levels are shown in table 6.The process has been completed in ten iterations giving ten levels in the ISM hierarchy. From the iterations it is clear that variable 13 (increased load factor) is at the top level of the ISM hierarchy and variable 1 (Top management commitment) is at the bottom of the hierarchy while all other variables are at various intermediate levels.

<Table 5. Partitioning the final Reachability Matrix into different levels (Iteration 1).>

<Table 6. Partitioning the final Reachability Matrix into different levels (Iteration 2 - 10).>

Developing conical matrix

The final reachability matrix is converted into a conical matrix, also called a lower triangular matrix, by arranging the elements according to their levels as shown in table 7.

<Table 7. Conical Matrix>

Building final structural model (ISM)

From the conical matrix, obtained from the final reachability matrix, the initial diagraph is obtained including the transitive links. The final structural model (ISM) is obtained by removing the indirect links or the transitive links as shown in figure 1.

From the final ISM model shown in figure 1, it is observed that Increased load factor (variable 13) has appeared at the top of the hierarchy (level I) while top management commitment (variable 1) has appeared at the bottom of the hierarchy (level X). Top management commitment is very crucial and significant in the TQM implementation in the aviation industry in Indian context as it appears at the bottom of the model while all the outcome variables have appeared at the top of the hierarchy. Effective implementation of TQM program as depicted from the model will lead to increased on time performance which will lead to enhanced customer satisfaction and which eventually will lead to increased load factor.

It is clear from figure 1 that, Top management commitment (variable 1) will lead to training and education to employees (variable 5), continuous improvement and commitment to quality culture in organizations (variable 8) and empowerment of employees (variable 6). Training and education to employees (variable 5), continuous improvement and commitment to quality culture in organizations (variable 8) and empowerment of employees (variable 6) all these three variables are interrelated to each other and hence these appear at the same level of the hierarchy in the ISM model. All the three variables 5, 8 and 6 will lead to benchmarking (variable 3) and employee commitment (variable 4). Training imparts necessary skill for continuous improvement and benchmarking. Benchmarking and employee commitment are interrelated as one leads to another. Without employee commitment benchmarking cannot be done in the same way benchmarking further increases employee commitment. Benchmarking and employee commitment will lead to communication and information sharing (variable 2) and Coordination and teamwork (variable 7). In order to be order winners and to meet global standards, organizations need to benchmark their critical business process with industry best practices. This will lead to communication and information sharing (variable 2) and Coordination and teamwork (variable 7). Information sharing (variable 2) and Coordination and teamwork (variable 7) are interrelated as one leads to the other. Communication leads to better information visibility across the boundaries and thus will lead to effective coordination and teamwork.

Communication (variable 2) and Coordination and teamwork (variable 7) will lead to customer involvement (variable 9) that will lead to process improvement (variable 11) leading to improved service design as it will incorporate voice of customer. This will in a way give boost to innovations in terms of service design characteristics. Process improvement will in turn lead to improved service quality (variable 10) which leads to better on time performance (variable 12) i.e. flight will depart on time and thus airlines will stick to their schedule leading to less cancellations and delays so in a way this will minimize the cost of delay and cost of cancellations, thus increasing revenues for the organization. Improved on time performance (variable 12) will lead to enhanced customer satisfaction (variable 14), which eventually will lead to increased load factor (variable 13) thus increasing market share.

<Figure 1. ISM based Quality framework (TQM) model for domestic airline industry in Indian context.>

MICMAC analysis (*Matrice d'Impacts Croises – Multiplication Applicqnce a un Classement*)

MICMAC analysis helps in analysing and categorization of variables of interest in terms of driving and dependence power (Mandal and Deshmukh, 1994). In this, variables are classified into four different clusters based on their driving and dependence power. Figure 2 shows the dependence and the driving power of variables. As an illustration, it is observed that variable 5, 6, 8 have dependence power of 4 and driving power of 13. Also, from final reachability matrix (table 4), these variables are ranked IXth in terms of dependence power and IInd in terms of driving power. These identified variables are grouped together in terms of driving and dependence power gets clustered into four categories. The first cluster is a group of "Autonomous variables" that have weak driving and weak dependence power. These variables are relatively disconnected from the system. The second cluster is a group of "Dependent variables" (variables 9, 10, 11, 12, 13, 14) that have weak driving and strong dependence power. The third cluster is a group of "linkage variables" (variables 2, 7) that have strong driving and strong dependence power. These variables are relatively unstable and any action on these variables have an effect on others and also a feedback on themselves, therefore managers must take special care in handling these variables. The fourth cluster is a group of "Independent (driver) variables" (variables 1, 3, 4, 5, 6, 8) that have strong driving and weak dependence power.

<Figure 2. Driving Power and Dependence Diagram >

Total Interpretive Structural Modeling (TISM)

ISM was a major breakthrough in terms of interpreting the vague, inter-twined and ill-defined mental model. ISM consists of various interconnected nodes and links. ISM interprets the nodes in terms of the definitions of variables for each nodes and defines the links in terms of direction and contextual relationships between the variables only, so that a clear picture of the structural model is portrayed in term of defining the inter-relationships between the elements, however ISM remains quiet on interpreting the links, when it comes to the question "HOW" (Sushil, 2012). The interpretation of the link is limited to only the direction and contextual relationship between the variables, therefore there is a need to interpret links in term of clarifying the way in which the directed relationship is conceptualized or defined by the experts (Sushil, 2012). TISM is indeed, a stepping stone in enhancing the interpretiveness in the structural modeling thereby making the logic of the model much more transparent, rather than leaving it open to multiple interpretations by different users (Sushil, 2012). TISM has been applied in education sector (Prasad and Suri, 2011) and in e-governance (Saboohi, 2011).

Hence, in order to interpret the structural model completely, and to restrict multiple interpretations by different users, TISM is further applied in this research work by upgrading the ISM model formed. The main theme of ISM i.e. Reachability matrix and level partitions is adopted as it is in the process of TISM (Sushil, 2012). TISM follows several methodological series of steps which are as follows:

<Figure 3. Flow chart for TISM preparation>

Step 1. Identification of variables affecting the system or the process of interest. This could be done with the help of literature review and experts opinion from industry and academia.

Step 2. Define the contextual relationship between variables of interest.

Step 3. Interpretation of pair-wise comparison. Keeping in mind the contextual relationship for each variable, the existence of a relationship between any two variables and the associated direction of relation is questioned in terms of "yes" and "no". There will be in all ${}^{n}C_2$ i.e. {n (n-1)/2} paired comparisons. And further, in order to upgrade it to TISM, the expert needs to explain the interpretive logic for dominance of one element over the other for each paired comparisons (Sushil, 2012). Each i-j link in the entry could be "yes" or "no" and if it is "yes" it is to be further interpreted. This will unearth the interpretive logic of the paired relationships in the form of "Interpretive logic - Knowledge base" (Sushil, 2012).

Step 4. Developing a structural Self Interaction Matrix (SSIM) for variables. SSIM indicates pairwise relationships among variables of the system under consideration. This pairwise contextual relationship is expressed in the form of V, A, X and O which is already explained.

Step 5. Developing initial and final reachability matrix from the SSIM by converting the information in each cell of the matrix from step 3 into binary numbers "0" and "1" and incorporating transitivity.

Step 6. The final reachability matrix obtained from step 5 is then partitioned into different levels on the basis of reachability and antecedents sets for each variable through a series of iterations called as level partitioning.

Step 7. On the basis of final reachability matrix obtained from step 5 and level partitions obtained from step 6, conical matrix or lower triangular matrix is constructed. From this conical matrix a directed graph (DIAGRAPH) is constructed and only those transitive links (indirect links) are retained whose interpretation is crucial (Sushil, 2012).

Step 8. The final diagraph is translated into a binary interaction matrix (table 8) form depicting all interactions by 1 entry. The cells with 1 entries are interpreted by picking the relevant interpretation from the knowledge base in the form of interpretive matrix (Sushil, 2012) as shown in table 9.

Step 9. Finally, TISM model is developed in which, links are also interpreted and the interpretation is written along the side of the respective links. TISM is finally checked for conceptual inconsistency and the necessary modifications made, if any. The final TISM model is developed by replacing the variables nodes with statements (Sushil, 2012). The flowchart for preparing TISM is shown in figure 3.

<Table 8. Interaction Matrix (Binary)>

<Table 9. Interpretive Matrix.>

Figure 4, shows TISM based Quality framework (TQM) model for the airline industry in the Indian context. This is an upgraded version of the earlier ISM based model where only nodes, direction of relationship and contextual relationship were interpreted. The upgraded version, TISM not only interprets the nodes, direction of relationship and contextual relationship but also interprets "in what way" or "how" one variable leads to another. TISM model in itself is self explanatory and the structural model is fully interpretive. It also contributes to creating a knowledge base of the interpretive logic of all the relations. For example in figure 4, training and education to employees (variable 5) leads to benchmarking (variable 3), continuous improvement and commitment to quality (variable 8) and process improvement (variable 11) by *skills improvement and better understanding of the processes*. TISM interprets all links and nodes in the structural model, thus making the model more transparent rather than leaving it open for multiple interpretations by various users. The statement written across the links in figure 4, gives the interpretation of the link between the two variables.

<Figure 4. TISM based Quality framework (TQM) model for domestic airline industry in Indian context.>

Discussion

The main objective of this research work is to identify and rank enablers and outcome variables and further to analyze the interactions among enablers and outcome variables of TQM which help in the successful implementation of TQM in the airline industry in the Indian context. To achieve these objectives, ISM based model and its upgraded version TISM model have been developed in order to understand the interactions among different variables completely so that management may lay stress on those variables which are more effective for TQM implementation. This will help to improve organization performance and productivity in the airline industry and thus will help in improving customer satisfaction and thereby increasing load factor and market share.

The driver-dependence matrix diagram helps classify and collect together variables in terms of driving power and dependence power. This along with TISM gives valuable managerial insight and implications about the relative importance and the interdependence between the variables of interest. It is seen from figure 2, that there are no autonomous variables, which indicates that all variables which are identified as enablers, play a significant role in the implementation of TQM program in the airline industry and outcome variables are the result of TQM implementation. Therefore management should pay attention to all identified enablers of TQM in order to achieve outcome variables as results.

Variables such as top management commitment (variable 1), training and education to employees (variable 5), continuous improvement and commitment to quality (variable 8), empowerment of employees (variable 6), benchmarking (variable 3) and employee commitment (variable 4) are clubbed together into the IVth quadrant of the driver-dependence matrix diagram. All these variables have strong driving power and weak dependent power and are called driver variables. These variables lie at the lower portion of the ISM and TISM hierarchy. Hence in order to implement TQM successfully and to increase productivity and competitiveness of service organization in the airline industry, management must lay stress on these variables. Since, top management commitment (variable 1) lie at the bottom of ISM and TISM hierarchy and has the strongest driving power (figure 2), it is the most important enabler for successful implementation of TQM. Variables such as communication and information sharing (variable 2) and coordination and teamwork (variable 7) lie in the IIIrd quadrant very near to the centre part of the diagram, hence these variables have medium driving power and medium dependence power. These variables are relatively unstable and needs consistent attention of the management because any effect on these two variable will effect others and on themselves also.

Variables such as customer involvement (variable 9), process improvement (variable 11), and improved service quality (variable 10) have weak driving power and strong dependence power. Hence, these variables lie above the middle portion of ISM and TISM hierarchy. Variables such as: on time performance (variable 12), customer satisfaction (variable 14) and increased load factor (variable 13) have the strongest dependence power and weakest driving power and hence come into the category of the outcome variables. These variables are seen at the top of the ISM and TISM hierarchy and these are clubbed together into IInd quadrant of the driver-dependence matrix diagram. These outcome variables are dependent on mid-level and bottom level variables. Hence in order to achieve the desired result in the form of outcome variables, management must focus on variables having high driving power and should formulate TQM implementation strategies based on these results and findings.

Limitations and scope for future research work

In the present research work only eleven enablers of TQM and three outcome variables are identified, while more variables can be identified to develop ISM and TISM models. The ISM and TISM model developed in this research work is based on opinions of a few experts and therefore some amount of bias in the work cannot be discounted. In this research work theoretical structural model have been developed using ISM and its upgraded version TISM but these models have not been statistically validated. These models can be statistically validated with the help of a technique called Structural Equation Modeling (SEM), which requires that the model must be backed by strong theoretical justifications. Since, ISM and TISM models have strong theoretical justification they therefore are strong contenders for testing (ISM and TISM models) statistically with SEM technique, which can be the scope for future research work.

Conclusion

In this present research work ISM based model has been developed for successful implementation of TQM program in the airline industry in Indian context for improving productivity, customer satisfaction and increasing market share. This ISM based model has been upgraded to TISM based model so that the structural model can be interpreted and analyzed completely by interpreting the links thereby making the logic more transparent rather than leaving to multiple interpretations by different users. In this research work an attempt has been made to identify enablers of TQM implementation and its outcome variables. Although a large amount of literature is available on TQM enablers, no study has been done to understand the interactions among these enablers and outcome variables. The major contribution of this research work is the development of contextual relationships among identified variables through a systematic framework. The present research work provides a ISM and TISM based model to understand the relationships among identified variables. Hence, this research assumes importance in this context.

A major finding of this research work is that the “top management commitment”, “training and education to employees”, “continuous improvement and commitment to quality”, “empowerment of employees”, “benchmarking” and “employee commitment” are significant enablers of TQM implementation in airline industry. These variables have the strongest driving power and the weakest dependence power and lie at the bottom of the ISM and TISM hierarchy. This can help the top management in deciding on the priority and focus on those variables which leads to the desired results in the form of outcome variables. The findings are very crucial for the airline management, policy makers and consultants for TQM implementation. Thus, the proposed TISM model provides a more realistic approach to the problems during the course of TQM implementation.

Finally, this research adds to the body of knowledge by providing empirical insights into the relationships between enablers of TQM implementation and their outcome variables. TISM based model developed in this paper acts as a tool for the top management to understand the variables of TQM implementation in the airline industry. The TISM approach leads us to the variables where fruitful results in terms of improvement in outcome variables such as increased load factor, increased customer satisfaction, and improved on time performance can be achieved. The result of the research leads us to the variables on which the top management has to lay stress in order to implement TQM program effectively and efficiently, which will help to improve organization performance in the domestic airline industry in the Indian context.

References

Agarwal, A., Shankar, R. and Tiwari, M.K. (2007) "Modeling agility of supply chain", *Industrial Marketing Management*, Vol. 36 No. 4, pp. 443-457.

Ahmed, A.M., Zairi, M. And Almarri, K.S. (2006), "SWOT analysis for Air China performance and its experience with quality", *Benchmarking: An international*, Vol. 13 No. 1, pp. 160-173.

Baidoun, S. (2003), "An empirical study of critical factors of TQM in Palestinian organizations", *Logistics Information Management*, Vol. 16 No. 2, pp.156-171.

Benito, J.G., Lorente, A.R.M. and Dale, B.G. (1999), "Business process re-engineering to total quality management: An examination of the issues", *Business Process management Journal*, Vol. 5 No. 4, pp. 345-358.

Bhat, K.S. and Rajashekhar, J. (2009), "An empirical study of barriers to TQM implementation in Indian Industries", *The TQM Magazine*, Vol. 21 No. 3, pp. 261-272.

Bhuiyan, N and Baghel, A. (2005), "An overview of continuous improvement: from the past to the present", *Management Decision*, Vol. 43 No. 5, pp. 761-771.

David, G and Bishnu, S. (2009), "An investigation of hard and soft quality management factors of Australian SMEs and their association with firm performance", *International Journal of Quality and reliability Management*, Vol. 26 No. 9, pp. 865-880.

Enrique, C., Tari, J.J. and Molina, J.F. (2002), "Areas of improvement in certified firms advancing towards TQM", *International Journal of Quality and Reliability Management*, Vol. 19 No. 8/9, pp. 1014-1036.

Faisal, M.N. (2010),"Sustainable supply chains: a study of interaction among the enablers", *Business Process Management Journal*, Vol. 10 No. 3, pp. 508-529.

Faisal, M.N., Banwet, D.K. and Shankar, R. (2006) "Supply chain risk mitigation: modeling the enablers", *Business Process Management Journal*, Vol. 12 No.4, pp.535-552.

Faisal, T., Rahman, Z., Qureshi, M.N. (2011), "Analysis of interaction among the barriers to total quality management implementation using interpretive structural modeling approach", *Benchmarking: An international*, Vol. 18 No. 4, pp. 563-587.

Gunasekaran, A. (1998), “An integrated product development – quality management system for manufacturing”, *The TQM Magazine*, Vol. 10 No. 2, pp. 115-123.

Gupta, A., McDaniel, J.C. and Herath, S.K. (2005), “Quality management in service firms: sustaining structures of total quality service”, *Managing Service Quality”*, Vol. 15 No. 4, pp. 389-402.

Haleem, A., Sushil., Qadri, M.A. and Kumar, S. (2012), “Analysis of critical success factors of world class manufacturing practices: an application of interpretive structural modelling and interpretative ranking process”, *Production planning and control: The Management of Operations*, Forthcoming.

Hasan, M. And Kerr, R.M. (2003), “The relationship between total quality management practices and organisational performance in service organisations”, *The TQM Magazine*, Vol. 15 No. 4, pp. 286-291.

Ilyas R. M., Shankar, R. and Banwet, D.K. (2008) "Creating flex-lean-agile value chain by outsourcing: An ISM-based interventional roadmap", *Business Process Management Journal*, Vol. 14 No. 3, pp.338-389.

James, S. and Robertson, H.W. (2000), “A scorecard approach to benchmarking for total quality construction”, *International Journal of Quality and Reliability Management*, Vol. 17, No. 4/5, pp. 453-466.

Jyoti., Banwet. D.K. and Deshmukh, S.G. (2010), “Modelling the success factors for national R&D organizations: a case of India”, *Journal of Modelling in Management*, Vol. 5 No. 2, pp.158-175.

Kumar, R., Garg, D. and Garg, T.K. (2009), “Total quality management in Indian industries: relevance, analysis and directions”, *The TQM Journal*, Vol. 21 No. 6, pp. 607-622.

Lakhe, R.R. and Mohanty, R.P. (1995), “Understanding TQM in service systems”, *International Journal of Quality and Reliability Management,* Vol. 12 No. 9, pp. 139-153.

Laszlo, G.P. (1999), “Southwest Airlines – living total quality in service organization”, *Managing Servive Quality,* Vol. 9 No. 2, pp. 90-95.

Mandal, A. and Deshmukh, S.G. (1994), “Vendor selection using interpretive structural modelling (ISM)”, *International Journal of Operations and Production Management*, Vol. 14 No. 6, pp. 52-59.

Mashari, M.A., Zairi, M. and Ginn, D. (2005), “Key enablers for the effective implementation of QFD: a critical analysis”, *Industrial Management and Data systems*, Vol. 105, No. 9, pp. 1245-1260.

Mosadegh Rad, A.M. (2005), “A survey of total quality management in Iran: Barriers to successful implementation in health care organizations”, *Leadership in Health Services*, Vol. 18, No. 3, pp. 12-34.

Motwani, J. (2001), “Critical factors and performance measures of TQM”, *The TQM Magazine*, Vol. 13, No. 4, pp. 292-300.

Najmi, M. and Dennis, F.K. (2000), “An integrated framework for post-ISO 9000 quality development”, *International Journal of Quality and Reliability Management*, Vol. 17, No. 3, pp. 226-258.

Niehues, A., Belin, S., Hansson, T., Hauser, R., Mostajo, M. And Richter, J. (2001), "Punctuality: How airlines can improve On-Time Performance", *Booz.Allen & Hamilton Airline and Aerospace*. (viewpoint).

Oakland, J.S. and Tanner, S.J. (2007), "A new framework for managing change", *The TQM Magazine*, Vol. 19, No. 6, pp. 572-589.

Parikshit, C., Shankar, R. and Baisya, R.K. (2008), "Analysis of interactions among the variables of supply chain performance measurement system implementation", *Business Process Management Journal*, Vol. 14 No. 4, pp.512-529.

Prasad, B. (1998), "A measure for measuring total value towards designing goods and services", *The TQM Magazine*, Vol. 10, No. 4, pp. 258-275.

Prasad, U.C. and Suri, R.K. (2011), "Modeling of continuity and change forces in private higher technical education using Total interpretive Structural Modeling (TISM)", *Global Journal of Flexible Systems Management*, Vol. 12, No. 3&4, pp. 31-40.

Pravin, K., Shankar, R. and Yadav, S.S. (2008), "Flexibility in global supply chain: modeling the enablers", *Journal of Modelling in Management*, Vol. 3 No. 3, pp.277-297.

Qureshi, M.N., Kumar, D. and Kumar, P. (2007), "Modeling the logistics outsourcing relationship variables to enhance shippers' productivity and competitiveness in logistical supply chain", *International Journal of Productivity and Performance Management*, Vol. 56, No. 8, pp. 689-714.

Qureshi, M.N., Kumar, D. and Kumar, P. (2008), "An integrated model to identify and classify the key criteria and their role in the assessment of 3PL services providers", *Asia Pacific Journal of Marketing and Logistics*, Vol. 20, No. 2, pp. 227-249.

Ramesh, A., Banwet. D.K. and Shankar, R. (2010), "Modeling the barriers of supply chain collaboration", *Journal of Modelling in Management*, Vol. 5 No. 2, pp.176-193.

Ravi, V. and Shankar, R. (2005), "Analysis of interactions among the barriers of reverse logistics", *Technological Forecasting and Social Change,* Vol. 72, No. 8, pp. 1011-1029.

Saboohi, N. (2011), "Total Interpretive Structural Modeling of continuity and change forces in e-government", *Journal of Enterprise Transformation,* Vol. 1, No. 2, pp. 147-168.

Sage, A.P. (1977), *Interpretive Structural Modeling: Methodology for Large Scale Systems*, McGraw-Hill, New York, NY.

Sahney, S., Banwet. D.K. and Karunes, S. (2010), "Quality framework in education through the application of Interpretive structural modeling: an administrative staff perspective in the Indian context", *The TQM Journal*, Vol. 22 No. 1, pp. 56-71.

Samuel, K.M.H. and Christopher, K.H.F., (1994), "Developing a TQM excellence model", *The TQM Magazine*, Vol. 6, No. 6, pp. 24-30.

Sanjay, J. and Shankar, R. (2004), "IT enablement of supply chains: modeling the enablers", *International Journal of Productivity and Performance Management*, Vol. 53 No. 8, pp. 700-712.

Singh, R.K. (2011). “Developing the framework for coordination in supply chain of SMEs”, *Business Process Management Journal*, Vol. 17 No. 4, pp.619-638.

Soti, A., Shankar, R. and Kaushal, O.P. (2010) "Modeling the enablers of Six Sigma using interpreting structural modeling", *Journal of Modelling in Management*, Vol. 5 No. 2, pp.124-141.

Sushil. (2012), “Interpreting the Interpretive Structural Model”, *Global Journal of Flexible Systems Management*, Forthcoming.

Thiagarajan, T. and Zairi, M. (1997), “A review of total quality management in practice: understanding the fundamentals through examples of best practice applications – Part-I”, *The TQM Magazine*, Vol. 9 No. 4, pp. 270-289.

Times of India (2011), “Air traffic rises 20% in India, slows globally”, 5 October, p.1.

Times of India (2012), “Indigo topples Jet group as No. 1 airline”, 18 August, p.25.

Vittal, S. A. (2007), “Linking KM effectiveness attributes to organizational performance”, *The journal of Information and Knowledge Management Systems*, Vol. 37 No. 2, pp. 133-149.

Vittal, S. A. and Kanungo, S. (2010), “Modelling enablers for successful KM implementation”, *Journal of Knowledge Management,* Vol. 14 No. 1, pp. 100-113.

Vouzas, F. and Psychogios, A.G. (2007), “Assessing managers’ awareness of TQM”, *The TQM Magazine,* Vol. 19 No. 1, pp. 62-75.

Warfield, J.W. (1974), “Developing interconnected matrices in structural modeling”, *IEEE Transcripts on Systems Men and Cybernetics*, Vol. 4 No. 1, pp. 51-81.

Zairi, M., Letza, S.R. and Oakland, J.S. (1994), “Does TQM impact on bottom-line excellence”, *The TQM Magazine*, Vol. 6 No. 1, pp. 38-43.

Table 1. Variables identified and their references in literature

S.No. Variables	References
1. Top Management Commitment	Baidoun, 2003; Faisal *et al.*, 2011; Vouzas *et al.*, 2007; David and Bishnu, 2009; Bhuiyan and Baghel, 2005; Mosadegh Rad, 2005; Thiagarajan and Zairi, 1997; Bhat *et al*., 2009; Motwani, 2001; Oakland and tanner, 2007; Gunasekaran, 1998; Najmi and Dennis, 2000; Enrique *et al.*, 2002; Mashari *et al.*, 2005; Samuel *et al*., 1994; Zairi *et al*., 1994.
2. Communication	Oakland and tanner, 2007; Mosadegh Rad, 2005; David and Bishnu, 2009; Baidoun, 2003; Faisal *et al.*, 2011; James *et. al.*, 2000; Gunasekaran, 1998; Najmi and Dennis, 2000; Enrique *et al.*, 2002; Zairi *et al.*, 1994;Thiagarajan and Zairi, 1997; Zairi *et al.*, 1994.
3. Benchmarking	David and Bishnu, 2009; Motwani, 2001; Baidoun, 2003; Faisal *et al.*, 2011.
4. Employee involvement	Oakland and tanner, 2007; Thiagarajan and Zairi, 1997; Mosadegh Rad, 2005; David and Bishnu, 2009; Bhuiyan and Baghel, 2005; Motwani, 2001; Baidoun, 2003; Faisal *et al.*, 2011; James *et al.*, 2000; Gunasekaran, 1998; Enrique *et al*., 2002.
5. Training and Education	Thiagarajan and Zairi, 1997; Mosadegh Rad, 2005; Vouzas *et al*., 2007; Bhat *et al.*, 2009; Motwani, 2001; Baidoun, 2003; Faisal *et al.*, 2011; James *et al.*, 2000; Gunasekaran, 1998; Najmi and Dennis, 2000; Enrique *et al.*, 2002; Samuel *et al.*, 1994.
6. Employee empowerment	Thiagarajan and Zairi, 1997; Mosadegh Rad, 2005; David and Bishnu, 2009; Vouzas *et al.*, 2007; Bhat *et al.*, 2009; Motwani, 2001; Baidoun, 2003; Faisal *et al.*, 2011; Gunasekaran, 1998; Samuel *et al.*, 1994; Zairi *et al.*, 1994.
7. Teamwork	Thiagarajan and Zairi, 1997; Mosadegh Rad, 2005; Vouzas *et al.*, 2007; Bhat *et al.*, 2009; Baidoun, 2003; Faisal *et al.*, 2011; Najmi and Dennis, 2000; Samuel *et al.*, 1994; Zairi *et al.*, 1994.
8. Continuous improvement and continuous quality culture	Thiagarajan and Zairi, 1997; Mosadegh Rad, 2005; David and Bishnu, 2009; Bhuiyan and Baghel, 2005; Vouzas *et al.*, 2007; Bhat *et al.*, 2009; Baidoun, 2003; Faisal *et al.*, 2011; Gunasekaran, 1998; Najmi and Dennis, 2000; Enrique *et al.*, 2002; Mashari *et al.*, 2005; Samuel *et al.*, 1994; Zairi *et al.*, 1994.
9. Customer involvement	David and Bishnu, 2009; Motwani, 2001; Baidoun, 2003.
10. Improved Service quality	Mosadegh Rad, 2005; James *et al.*, 2000.
11. Process improvement	Oakland and tanner, 2007; Mosadegh Rad, 2005; David and Bishnu, 2009; Motwani, 2001; Baidoun, 2003; Faisal *et al.*, 2011; Gunasekaran, 1998; Najmi and Dennis, 2000; Enrique *et al.*, 2002; Mashari *et al.*, 2005.
12. On time performance	Developed by self, based on experts opinion and brainstorming.
13. Increased load factor	Developed by self, based on experts opinion and brainstorming.
14. Customer Satisfaction	Prasad, 1998; Mosadegh Rad, 2005; Vouzas *et al.*, 2007; Bhat *et al.*, 2009; Motwani, 2001; Baidoun, 2003; Faisal *et al.*, 2011; Najmi and Dennis, 2000; Enrique *et al.*, 2002; Mashari *et al.*, 2005; Samuel *et al.*, 1994.

Table 2. Application areas of ISM

S. No.	Areas of application	Contributors
1.	Vendor selection	Mandal and Deshmukh, 1994.
2.	Supply Chain	Ramesh *et al.*, 2010; Faisal *et al.*, 2006; Parikshit *et al.*, 2008; Faisal *et al.*, 2010; Pravin *et al.*, 2008; Singh *et al.*, 2011; Ilyas *et al.*, 2008; Qureshi *et al.*, 2008; Sanjay, *et al.*, 2004; Ravi and Shankar,2005; Qureshi *et al.*, 2007.
3.	Knowledge management	Vittal, 2007; Vittal *et al.*, 2010.
4.	Quality management	Sahney *et al.*,2010; Faisal *et al.*, 2011
5.	Six sigma	Soti *et al.*, 2010.
6.	Production Planning	Haleem *et al.*, 2012.
7.	R&D	Jyoti *et al.*, 2010.

Table 3. Structural Self Interaction Matrix (SSIM)

Variables	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1. Top Management Commitment	V	V	V	V	V	V	V	V	V	V	V	V	V	-
2. Communication	V	V	V	V	V	V	A	X	O	A	A	A	-	
3. Benchmarking	V	V	V	V	V	O	A	O	A	A	A	-		
4. Employee Commitment	V	V	V	V	V	O	A	V	A	A	-			
5. Training and Education	V	V	V	V	V	V	X	V	O	-				
6. Empowerment of employees	V	V	V	V	V	V	A	V	-					
7. Coordination and Teamwork	V	V	V	V	V	V	A	-						
8. Continuous Improvement Culture	V	V	V	V	V	V	-							
9. Customer Involvement	V	V	V	V	V	-								
10. Improved Service Quality	V	V	V	A	-									
11. Process Improvement	V	V	V	-										
12. On Time Performance	V	V	-											
13. Increased Load Factor	A	-												
14. Customer satisfaction	-													

Table 4. Final Reachability Matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Driving Power	Rank
1.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	I
2.	0	1	0	0	0	0	1	0	1	1	1	1	1	1	8	IV
3.	0	1	1	1	0	0	1	0	1	1	1	1	1	1	10	III
4.	0	1	1	1	0	0	1	0	1	1	1	1	1	1	10	III
5.	0	1	1	1	1	1	1	1	1	1	1	1	1	1	13	II
6.	0	1	1	1	1	1	1	1	1	1	1	1	1	1	13	II
7.	0	1	0	0	0	0	1	0	1	1	1	1	1	1	8	IV
8.	0	1	1	1	1	1	1	1	1	1	1	1	1	1	13	II
9.	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6	V
10.	0	0	0	0	0	0	0	0	0	1	1	1	1	1	4	VII
11.	0	0	0	0	0	0	0	0	0	1	1	1	1	1	5	VI
12.	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	VIII
13.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	X
14.	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	IX
Dependence Power	1	8	6	6	4	4	8	4	9	11	10	12	14	13		
Rank	X	VII	VIII	VIII	IX	IX	VII	IX	VI	IV	V	III	I	II		

Table 5. Partitioning the final Reachability Matrix into different levels (Iteration 1).

Var	Reachability Set (R)	Antecedent Set (A)	Intersection	Level
1	1,2,3,4,5,6,7,8,9,10,11,12,13,14	1	1	
2	2,7,9,10,11,12,13,14	1,2,3,4,5,6,7,8	2,7	
3	2,3,4,7,9,10,11,12,13,14	1,3,4,5,6,8	3,4	
4	2,3,4,7,9, 10,11,12,13,14	1,3,4,5,6,8	3,4	
5	2,3,4,5,6,7,8,9,10,11,12,13,14	1,5,6,8	5,6,8	
6	2,3,4,5,6,7,8,9,10,11,12,13,14	1,5,6,8	5,6,8	
7	2,7, 9,10,11,12,13,14	1,2,3,4,5,6,7,8	2,7	
8	2,3,4,5,6,7,8,9,10,11,12,13,14	1,5,6,8	5,6,8	
9	9,10,11,12,13,14	1,2,3,4,5,6,7,8,9	9	
10	10,12,13,14	1,2,3,4,5,6,7,8,9,10,11	10	
11	10,11,12,13,14	1,2,3,4,5,6,7,8,9,11	11	
12	12,13,14	1,2,3,4,5,6,7,8,9,10,11,12	12	
13	13	1,2,3,4,5,6,7,8,9,10,11,12,13,14	13	I
14	13,14	1,2,3,4,5,6,7,8,9,10,11,12,14	14	

Table 6. Partitioning the final Reachability Matrix into different levels (Iteration 2 - 10).

Var	Reachability Set (R)	Antecedent Set (A)	Intersection	Level
1	1	1	1	**X**
2	2,7	1,2,3,4,5,6,7,8	2,7	**VII**
3	3,4	1,3,4,5,6,8	3,4	**VIII**
4	3,4	1,3,4,5,6,8	3,4	**VIII**
5	5,6,8	1,5,6,8	5,6,8	**IX**
6	5,6,8	1,5,6,8	5,6,8	**IX**
7	2,7	1,2,3,4,5,6,7,8	2,7	**VII**
8	5,6,8	1,5,6,8	5,6,8	**IX**
9	9	1,2,3,4,5,6,7,8,9	9	**VI**
10	10	1,2,3,4,5,6,7,8,9,10,11	10	**IV**
11	11	1,2,3,4,5,6,7,8,9,11	11	**V**
12	12	1,2,3,4,5,6,7,8,9,10,11,12	12	**III**
14	14	1,2,3,4,5,6,7,8,9,10,11,12,14	14	**II**

Table 7. Conical Matrix

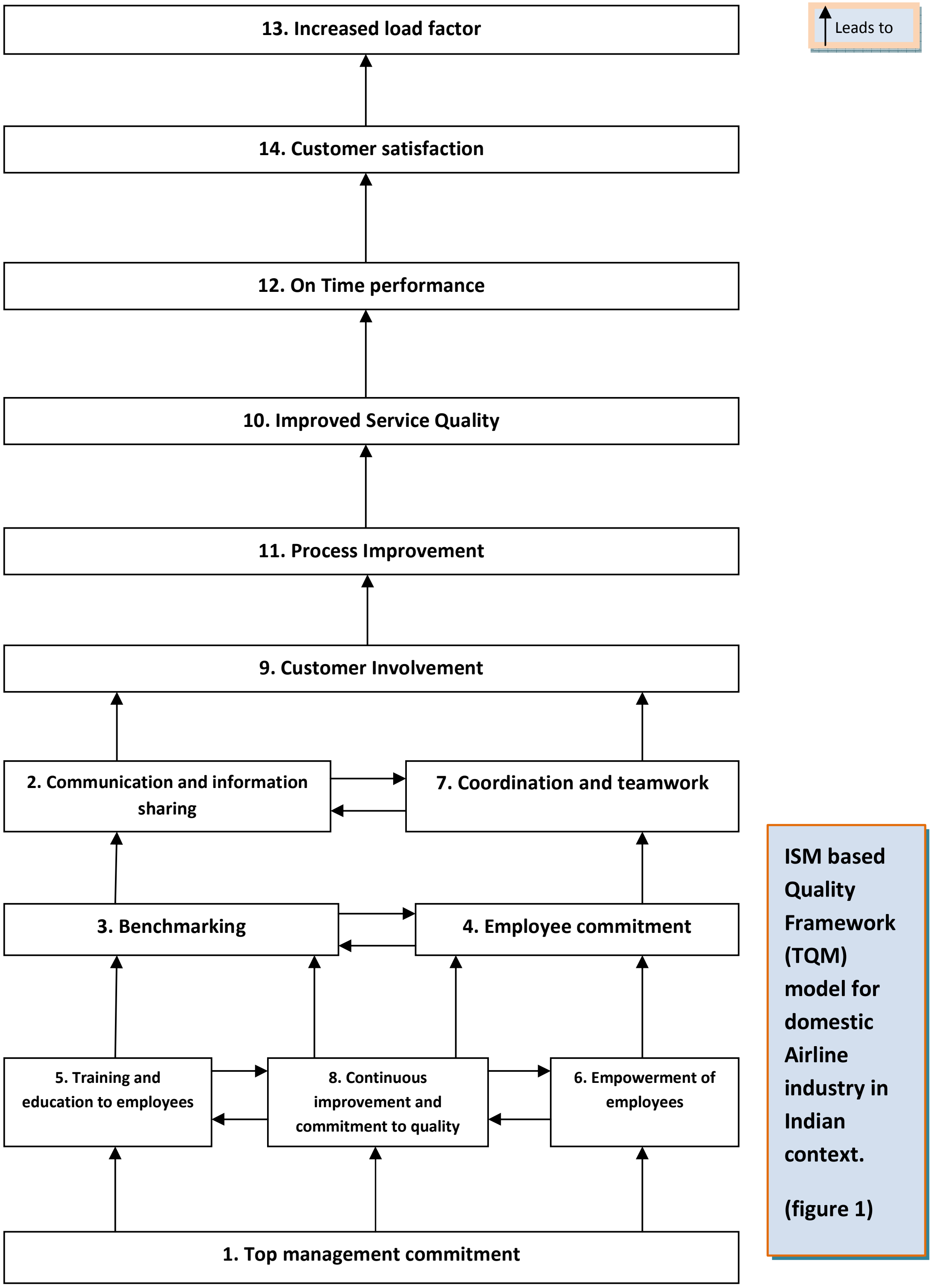
Variables	13	14	12	10	11	9	2	7	3	4	5	6	8	1
13. Increased Load Factor	1	0	0	0	0	0	0	0	0	0	0	0	0	0
14. Customer satisfaction	1	1	0	0	0	0	0	0	0	0	0	0	0	0
12. On Time Performance	1	1	1	0	0	0	0	0	0	0	0	0	0	0
10. Improved Service Quality	1	1	1	1	0	0	0	0	0	0	0	0	0	0
11. Process Improvement	1	1	1	1	1	0	0	0	0	0	0	0	0	0
9. Customer Involvement	1	1	1	1	1	1	0	0	0	0	0	0	0	0
2. Communication	1	1	1	1	1	1	1	1	0	0	0	0	0	0
7. Coordination and Teamwork	1	1	1	1	1	1	1	1	0	0	0	0	0	0
3. Benchmarking	1	1	1	1	1	1	1	1	1	1	0	0	0	0
4. Employee Commitment	1	1	1	1	1	1	1	1	1	1	0	0	0	0
5. Training and Education	1	1	1	1	1	1	1	1	1	1	1	1	1	0
6. Empowerment of employees	1	1	1	1	1	1	1	1	1	1	1	1	1	0
8. Continuous Improvement Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1. Top Management Commitment	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 8. Interaction Matrix (Binary)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Top Management Commitment	0	0	1	1	1	1	0	1	0	0	1	1	0	0
2. Communication	0	0	0	0	0	0	1	0	1	0	0	0	0	0
3. Benchmarking	0	1	0	1	0	0	0	0	0	0	1	0	0	0
4. Employee Commitment	0	0	1	0	0	0	1	0	0	0	0	0	0	0
5. Training and Education	0	0	1	0	0	0	0	1	0	0	1	0	0	0
6. Empowerment of employees	0	0	0	1	0	0	0	1	0	0	0	0	0	0
7. Coordination and Teamwork	0	1	0	0	0	0	0	0	1	0	0	0	0	0
8. Continuous Improvement Culture	0	0	1	1	1	1	0	0	0	1	0	0	0	0
9. Customer Involvement	0	0	0	0	0	0	0	0	0	1	1	0	0	1
10. Improved Service Quality	0	0	0	0	0	0	0	0	0	0	0	1	0	1
11. Process Improvement	0	0	0	0	0	0	0	0	0	1	0	0	0	0
12. On Time Performance	0	0	0	0	0	0	0	0	0	0	0	0	0	1
13. Increased Load Factor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14. Customer satisfaction	0	0	0	0	0	0	0	0	0	0	0	0	1	0

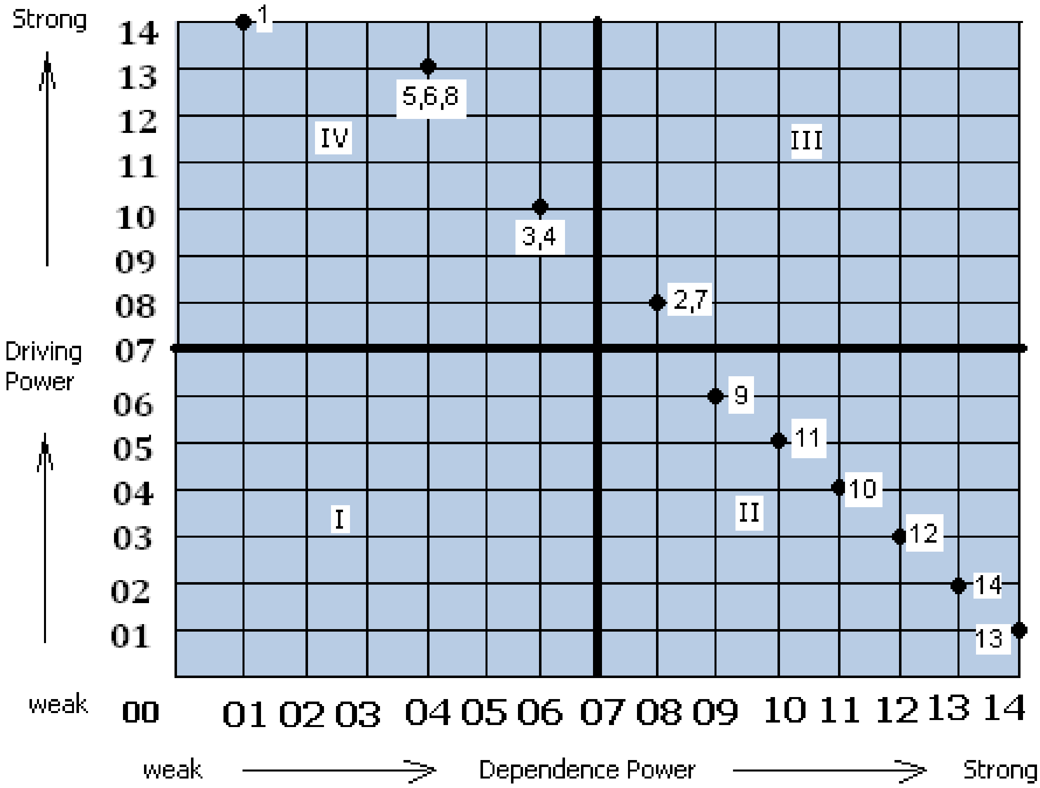
Table 9. Interpretive Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	-	-	*Implement benchmark Standards to follow*	*Rewards & Recognitions*	*Provides facilities for efficient and Effective*	*Delegation of Authority*	-	*Quality Assurance*	-	-	*Adopting strict policy implementation guidelines*	*Timely decision making*	-	-
	-	-	-	-	-	-	*Better information visibility*	-	*Organization will know customer*	-	-	-	-	-
	-	*Effectiveness in process improvement*	-	*Employee Satisfaction*	-	-	-	-	-	-	*Implement world class business*	-	-	-
	-	-	*Involvement of employees*	-	-	-	*Improve working environment and culture*	-	-	-	-	-	-	-
5	-	-	*Skills improvement & better understanding of the process*	-	-	-	-	*Skills improvement*	-	-	*Skills improvement*	-	-	-
6	-	-	-	*Sense of belongingness & responsibility*	-	-	-	*Build confidence measures*	-	-	-	-	-	-
7	-	*Better information visibility*	-	-	-	-	-	-	*Encourage customer involvement in the process*	-	-	-	-	-
8	-	-	*Service design Improvements& implementation*	*Rewards & Recognitions*	*Lay more stress on training & quality*	*Build confidence measures*	-	-	-	*Continuous Quality checks at Various levels*	-	-	-	-
9	-	-	-	-	-	-	-	-	-	*Voice of customers in service design*	*Implement Voice of Customers*	-	-	*Voice of customers in service design*
10	-	-	-	-	-	-	-	-	-	-	-	*Better service standards*	-	*Better service standards*
11	-	-	-	-	-	-	-	-	-	*More customers centric*	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	*Fulfill customer's needs and wants*
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	*More no. of repeat and new customers*	-



ISM based Quality Framework (TQM) model for domestic Airline industry in Indian context.

(figure 1)



I = Autonomous variable, II = Dependent variable, III = Linkage variable,
IV = Independent (Driver) Variable

Figure 2. Driving Power and Dependence Diagram

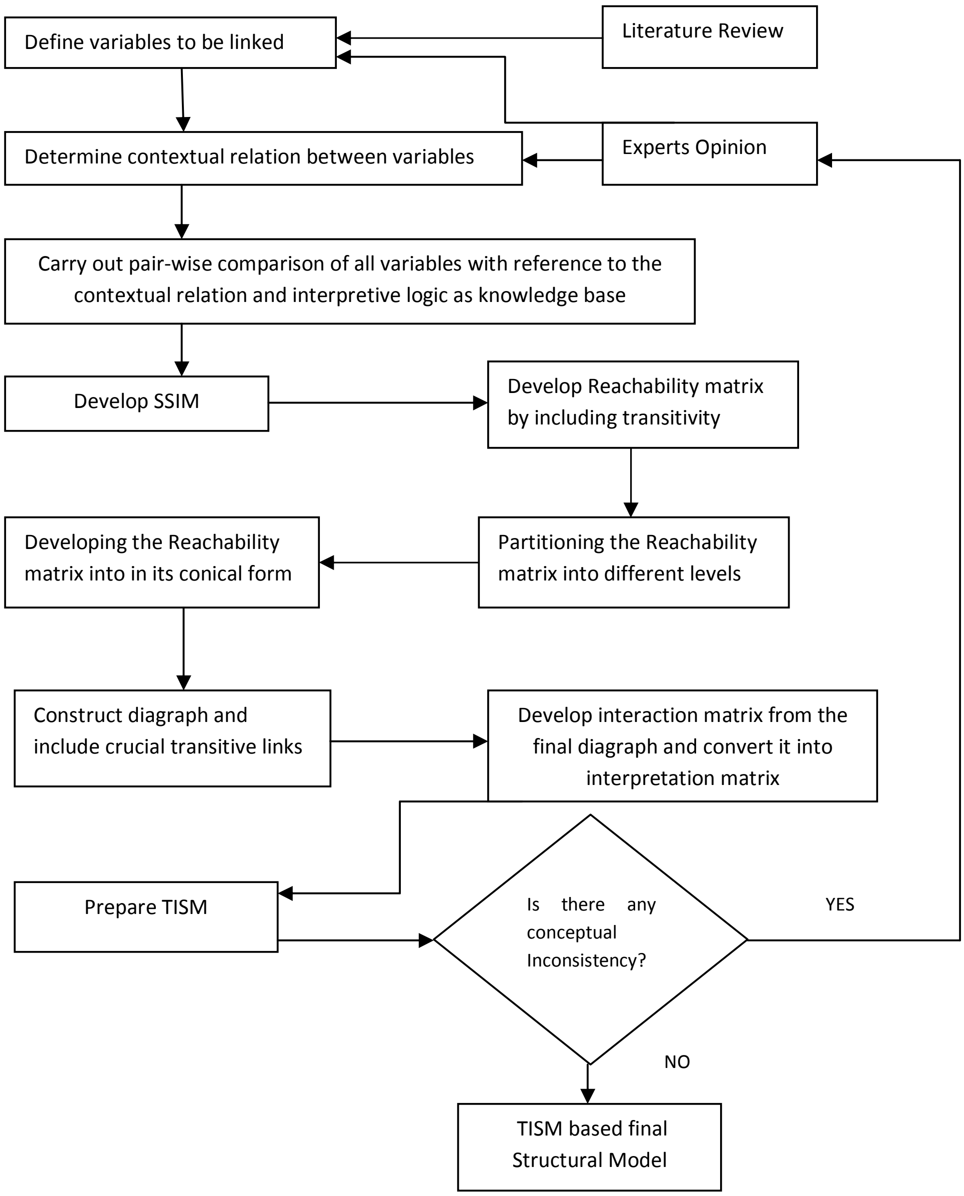
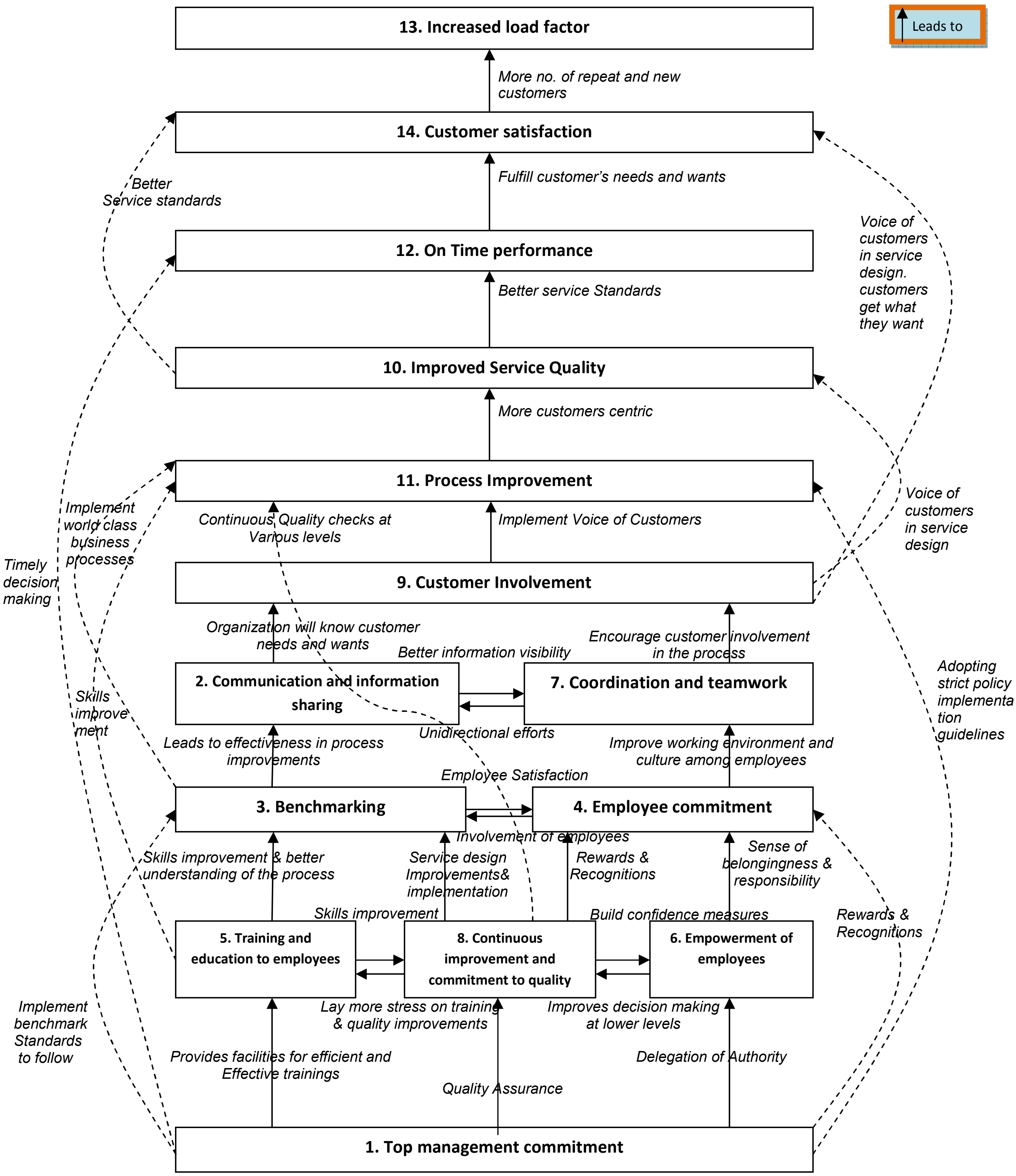


Figure 3. Flow chart for TISM preparation



TISM based Quality Framework (TQM) model for domestic Airline industry in Indian context (figure 4)