Modeling the Critical Success Factors for Business Intelligence Implementation:
An ISM Approach

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ABSTRACT

Business intelligence (BI) helps organizations to make better and quicker decisions. The primary requirement, as per previous studies, for any successful BI implementation in an organization and its stakeholders, is to understand and pay heed to the vital issues and factors governing it. The objective of this study is, thus, to analyze the various critical success factors (CSFs) for business intelligence implementation in context to the Indian sub-continent. In this qualitative study, the CSFs for BI implementation are classified through the review of the literature, and to identify the relationship among the CSFs, interpretive structural modeling (ISM) is applied along with MICMAC classification method. The ISM approach's outcome shows that management support and business goal alignment are the most significant driving factors for implementing BI. These findings may help recognize the crucial facts that affect the firms adopting BI in India and give some insights for other countries.

KEYWORDS

Business Intelligence Implementation, Critical Success Factors, India, ISM, MICMAC

INTRODUCTION

The swift upsurge in the volume of data in all the organizations and its significance for management decision making has made it apparent that determining the most relevant factors concerning BI adoption has a profound influence on the choice to engage them. (Hou, 2013, 2014). To survive in today's unpredictable circumstances, companies are gradually endeavouring to create, gather, and change their data into information (Delen & Demirkan, 2013). Business intelligence systems have been progressively accepted in organizations while comprehending the characteristics of impacting factors on such adoption decisions requires getting ample academic attention. Business Intelligence and Analytics have developed as an essential area of study for both practitioners and researchers, showing the degree of influence of data-related problems on modern business organizations(Chen et al.,2012).

Business Intelligence (BI) term refers to a combination of architecture, databases, data warehouses, analytical tools, and applications (Sharda et al., 2017). It has been noted by some researchers that business intelligence (BI) is designed to give various corporates specific solutions suiting their needs

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(Martins, Oliveira, & Popovič, 2014; Petrini & Pozzebon, 2009). Vukšić, Bach & Popovič (2013) alleged that BI is used to analyse the accessible information and turned them into valuable knowledge to abate informational needs. Previous studies have ultimately shown the importance of using BI and are among the main concerns of most CIO's, i.e., chief information officers in organizations (Howson, 2007; Jones, et.al 2012).

BI implementation for any corporate is a considerably long process and continues for an extended period. To deal with problems arising in the process, holistic knowledge and various organizational factors play a vital role(Melody et al., 2010). However, a strong, dedicated, and adaptive leadership style can implement BI regardless of any obstacles (Melody et al., 2010). The present study is related to these organizational factors responsible for the successful implementation of Business Intelligence systems. This research focuses on studying interactions among these factors, using Interpretive Structural Modelling (ISM). The ISM approach has been used to generate cognizance, and provide an improved understanding of the critical success factors and added to the existing literature on Business Intelligence. Research studies have been steered earlier in India, detailing different factors and variables impacting different sectors. However, there is no known research on success factors related to Business intelligence done through ISM methodology.

ISM (Interpretive Structural Modelling) is an extensively used methodology in several fields and other complex systems because it converts complex problems into precise structural models (Luthra et al., 2014). ISM methodology can propose understanding the complex interactive relationships among an intricate system's factors and, therefore, overcome the restrictions and complications of traditional approaches, such as weighted score (Shen et al., 2016) and structural equation modeling (Tarka, 2018). Studies on complicated systems have applied ISM methodology as it offers better comprehension of interrelationships among variables (Luthra et al., 2014), grow understandings (Shen et al., 2016), recognize focus areas (Kumar et al., 2018), and supports policy analysis (Attri et al., 2013). Therefore, ISM delivers an efficient and suitable technique (Luthra et al., 2014; Gan et al., 2018) to develop a structural model for a multifaceted system and improve system behaviour understanding. In this study, the authors have identified the BI success factors and have utilized the ISM methodology to build and understand interrelationships between them, followed by MICMAC analysis. The objectives of the study undertaken, thus, are as follows:

- To identify the success factors of business intelligence implementation in organizations.
- To unearth the interrelationships among the success factors using ISM methodology.
- To identify the driving power of various success factors of BI implementation using MICMAC analysis.

LITERATURE REVIEW

A thorough literature review on the critical success factors of Business Intelligence implementation was done to realize the study's objective. Various organizational, technical factors were shortlisted based on research across the globe related to BI implementation. The literature review and analyses resulted in identifying a list of success factors for BI implementation, which was further shared with the panel of experts to understand their relevance in the Indian scenario.

Business Intelligence Implementation

One innovation that can significantly contribute to the firm's goals by improving decision making is Business Intelligence Systems (BIS) (Popovič et al., 2012). BIS was developed as an IS innovation for offering data integration and analytical capabilities to provide valuable decision-making information for stakeholders at different organizational levels (Turban et al., 2010; Yeoh & Popovič, 2016).

Table 1. Critical success factors identified from the review of literature

S.no	Critical success factor	Authors
1	Management Support	Batra (2017),Chenoweth, et al. (2006), Hawking &Sellitto (2010),Knaster & Leffingwell(2017), McLeod & Mac- Donell (2011), Morien et al. (2013), Motwani et al. (2005), Olszak (2016), Mukherjee & D'Souza (2003), Koronios & Yeoh (2010), Sammon & Finnegan (2000), Stackowiak et al. (2007), Watson &Wixom (2007), Yeoh et al.(2008), Thamir & Poulis, (2015),Yeoh & Popoviˇc (2016)
2	Business Goal Alignment	Stackowiak et al. (2007),Yeoh & Koronio (2010), Mungree, Rudra, & Morien (2013), Farrokhi & Pokoradi (2012), Olszak (2016),Watson &Wixom (2007)
3	Team Skills	Wixom & Watson (2001), Yeoh et al. (2008), Yeoh & Koronios (2010), Yeoh & Popoviˇc (2016)
4	Project Resources	Motwani et al. (2005), Olszak (2016), Sangar & Iahad (2013), Yeoh et al.(2008)
5	User Participation	Hawking & Sellitto (2010), Olszak & Ziemba (2007)
6	System Quality	Mungree et al. (2013), Olszak (2016), Seah et al. (2010), Watson & Wixom (2007), Sangar & Iahad (2013), Thamir & Poulis (2015), Yeoh et al. (2008), Yeoh & Koronios (2010), Yeoh & Popoviˇc (2016)
7	Data Quality	Chan et al. (2013), Cidrin & Adamala (2011), Hawking & Sellitto (2010), Lin, et al. (2009), Olszak & Ziemba (2012),Olszak(2016),Pham et al.(2016), Ramakrishnan et.al (2012),Sangar & Iahad (2013), Yeoh & Koronios (2010), Yeoh & Popoviˇc (2016)

Although there are similarities among different types of information systems(IS), prior business intelligence system (BIS) research reveals vital differences between BIS and other types of IS (Popovič et al., 2012). These divergences are one of the main reasons for examining BIS adoption separately from traditional IS adoption and better understanding the determinants and their effects on the BIS adoption process. To do so, firms must consider an integrative view of the adoption process that builds on prior IS adoption studies and develop them to address BIS's specifics.

In this section, the different factors of Business Intelligence implementation are identified from the literature review. The twelve factors initially identified and classified from the review of literature were: management support, fast implementation, business-driven approach, business goal alignment, change management, champion, project resources, team skills, metadata management, system quality, user participation and data quality. A brainstorming session was held with 15 eminent industry experts with more than ten years of experience in data warehousing, Data mining, Analytics, and other BI application implementation aspects. The experts were professionals working as BI consultants, data analytics team lead, data architects, and analysts in the banking, telecom and retail industry sectors. The success factors identified from the literature were shared with the expert panel to study the relevance of these factors. Seven factors were finalized out of the above twelve, based on expert opinion, that directly or indirectly affects the Business Intelligence implementation in Indian companies. Table 1 shows the list of the seven factors in the Indian scenario, discussed in detail later.

Management Support: Management support, in general, refers to extensive sponsorship for a project from the senior management team. The whole BI system implementation process is an expensive, challenging, resource-intensive venture and therefore involves robust management support. Watson & Wixom (2007) stress that BI should get importance from the management, which will help provide the vital resources and bring in a culture of information-based decision-making. An organization must participate in the BI implementation from both the sides, technical and business (Thamir & Poulis,2015). Senior management support has been discussed as a vital factor in BI system implementation by several kinds of research (Koronios & Yeoh, 2010; Morien et al. 2013, Stackowiak et al., 2007). The leading management team of a BI system implementation project should comprise of CIO's and functional managers at various levels. The senior managers and the managers at different levels can give planned direction to the BI project and bring about BI-business alignment (Yeoh & Popoviˇc, 2016).In domains related to project scope, selection of BI components, solving resistance, and conflict resolution, top management support has always been critical for BI implementation.

Business Goals Alignment: This refers to the orientation of business strategies and BI implementation strategy to align with each other, which helps organizations generate a strong BI vision. It is unanimously accepted that to boost the BI project's acceptance; there has to be proper linking of organizational goals to BI goals. Hence, there has to be an adequate comprehension of the business problem and need/requirement for BI systems in the organization. An excellent and enduring BI implementation plan, which is appropriately associated with the organization's strategic vision, is essential for effective implementation(Yeoh &Koronios, 2010). To create a precise map for BI implementation and subsequently make BI evolve into a significant enabler of the organizational decision-making process, the alignment between BI and business strategies is necessary (Watson & Wixom, 2007). Thus, creating understanding and need for a BI system in an organization through the business' strategic vision increases the probability of an effective BI system implementation (Yeoh & Popoviˇc, 2016).

Project Resources: For a successful BI system implementation, it is essential to cautiously consider the vital factors of project resources of time, money and appropriate human resources. Researches generally study cost, schedule, quality, and user satisfaction as crucial project accomplishment parameters (Heck & Zaidman, 2018; McLeod et al., 2012; Siau et al., 2010). However, project success parameters also comprise of budget, schedule, quality, customer needs, and decision-making. In implementing a BI system, the skills, knowledge, experience, and aptitude of the development team are also perceived to influence the project's outcome significantly.

Team Skills: The project team has to transact on varied platforms, on several interfaces, linking legacy systems, a range of tools, and several other platforms. All these jobs require persons with diverse skills and capabilities. So an appropriate mix of technical and business knowledge is together referred to as team skills and is vital for BI project success. Wixom & Watson (2001) concluded from their research, which was primarily focussing on data warehouse success variables, that the implementation team's skills hold an integral place in bringing about successful outcomes. As per their study, both technical and personal capabilities together build the right team skills. A group or team that can involve users using strong interpersonal skills can effectively complete the job. The research of Wixom & Watson (2001) discussed data warehousing and not BI directly; however, the significance of team skills were acknowledged by several other studies that dealt with BI system implementation (Hawking & Sellitto, 2010; Morien et al.,2013).

User Participation: User's participation involves the roles and tasks performed by the end-user during BI project implementation. Substantial numbers of researchers deliberate that user participation can help meet the organization's requirements and needs more suitably. Enhanced user participation in the implementation process can lead to effective communication of their demands, which can help guarantee the system's successful start. Users know what they require more than an architect or developer who does not directly get involved in the product. Previous researches (Delone & McLean, 2003; Ziglio & Adler,1996) shows that end-users' participation directly influences the acceptance of information technology in an organization. The data dimensions, business rules, metadata, and data context needed by business users should be incorporated into the system (Watson & Haley,1998). User support should continuously evolve in response to growing business requirements, and users should help firms implement the required BI applications (Fuchs, 2006). It can be thus be concluded that the BI system will have more suitability for users' business needs when implemented with adequate user participation.

System Quality: Effective hardware systems, software, methods, and programs must build a sound quality system for BI. BI system quality is also reflected by its flexibility to adjust to new demands or conditions and to be able to integrate with a variety of sources systems within the organization. A strategic and scalable system has often been recognized as a significant variable in IT projects. Koronios & Yeoh (2010) and Yeoh & Popoviˇc (2016) emphasized scalable, flexible and business-driven infrastructures as the base for successful BI implementation. Morien et al. (2013) discussed the need for reliable systems and extensible technical facilities. Researchers believe that a BI project's technical system should ideally accommodate scalability and flexibility requirements in line with changing business needs. Using a proper business-oriented strategy to choose tools and technology can significantly raise the success rate of BI implementation.

Data Quality: Data quality refers to the quality of data that is provided by the BI system. Data quality is measured through the accuracy, consistency and comprehensiveness of the BI systems' data. Jones et al. (2012) pointed out that data reliability and quality are vital for a BI project to succeed or vice-versa. To realize more significant paybacks from BI, accumulating and cleaning, reliable, good quality, and integrated data could form a crucial foundation. Koronios & Yeoh (2010) stressed that the BI systems are necessarily required for in-depth data analysis, which serves the purpose of decision-making at various organizational levels; hence data quality and data accuracy are mandatory. The source system's data quality will impact management reports' quality, affecting the decision results (Friedman, 2005). The company's' data can only be wholly unified and utilized for better business worth once its quality and integrity are secured.

Interpretive Structural Modelling (ISM)

A multi-stage hybrid ISM (Interpretive structural modeling) research method (Gan et al.,2018) is adopted to study the interrelationship between the critical success factors for BI implementation. ISM is an excellent method that aids in recognizing and distinguishing the associations between the precise variables or objects (Warfield,1974; Sage, 1977). ISM is acknowledged as a group judgment-based practice. It is used as an interactive learning method to recognize how factors of a complex system are interconnected (Attri et al., 2013).

There are two elementary notions in ISM: transitivity and reachability (Farris & Sage, 1975; Sharma et al., 1995). It is an effective method to identify numerous sub-systems within a complex system, which aids in producing a multi-layered structural model (Bhadani et al., 2016). This study applies the ISM approach (Attri et al., 2013), which identifies relationships among specified objects. Researchers and academicians have progressively used this method to characterize and study the inter-relationships among diverse variables.

In recent studies, ISM has been used to regulate the interactive relationships among factors for a complex system and prioritize these factors to develop conforming policies (Gan et al., 2018). ISM has been applied in diverse fields and sectors like, in the field of the rural socioeconomic system, e.g., modeling barriers of telecom service adoption in rural India (Bhadani et al., 2016); sustainable development, e.g., determining hierarchical structure among sustainable development goals (Kumar & Sharma, 2018); policy interventions in community development, e.g., analysis of barriers and their interactions to development of landfill communities (Chandramowli et al., 2011). A summarised view of the recent literature on ISM is presented in Table 2.

RESEARCH METHODOLOGY

The critical success factors were identified from a comprehensive review of the literature. The review helped identify twelve success factors, which were further shown to a panel of 15 experts. Based on the experts' opinion, seven BI success factors were shortlisted, which had relevance in the Indian

Table 2. Literature review of ISM studies

S.no.	Description	Year	Type of factors (Factors/ Barriers/Antecedent/ Determinants, Enablers)	Author(s)
1	Study on the critical failure factors (CFFs) that help in the systematic decision-making and strategic management of stakeholders.	2020	Critical Failure factors	Pilar, et al.
2	Study on barriers for CSR (Corporate Social Responsibility) implementation in manufacturing industry	2020	Barriers factors	Bux, et al.
3	Study on the various factors impacting additive manufacturing (AM) implementation.	2020	Success Factors	Sonar, et al.
4	Study on Determinants of rural livelihood interventions using the ISM-MICMAC approach.	2019	Determinants/ factors	Kumar, et al.
5	Research on Green Purchase Determinants Based On Interpretive Structural Modelling. A Case Of Iran's Green Marketing.	2019	Antecedent factors	Nayeri & Moradi
6	Study on evaluating critical constructs for measurement of sustainable supply chain practices in lean-agile firms of Indian origin: A hybrid ISM-ANP approach	2019	Success Factors/criteria	Digalwar et al.
7	Research on Structural relationships among critical failure factors of microbusinesses	2019	Critical Failure Factors	Del Pilar, et al.
8	Studying the Interrelationship amongst the Success Factors for Implementation of ERP Software amongst Educational SMEs in Developing Countries	2019	Success Factors	Jha, et al.
9	Research on analysis of factors influencing AM application in the food sector using ISM	2019	Success Factors	Palaniappan et al.
10	An overview and study on ISM Methodology in Modelling the Supply Chains.	2012	Barriers /Success Factors	Shahabadkar, et al.
11	Research related to the analysis of the operational risk factors in public hospitals in an Indian state.	2019	Risk factors	Vishnu et al.
12	A study in the Indian scenario on modeling the barriers to online banking using an ISM approach.	2018	Barriers Factors	Katiyar & Badola
13	Analyzed the interactions among the barriers of Indian automotive industries by using ISM and fuzzy MICMAC approach	2018	Barrier factors	Katiyar et al.
14	Modeling the barriers of Indian telecom services using ISM and MICMAC approach	2017	Barrier Factors	Talib & Rahman
15	Attempted to address barriers in green lean six sigma product development from an extensive literature review	2016	Barrier Factors	Kumar et al.
16	Modeling the measures of supply chain performance in the Indian automotive industry	2015	Measures of performance	Katiyar et al.
17	Focuses upon technology management enablers and categorized by applying an integrated interpretive structure modeling (ISM) and fuzzy MICMAC methodology	2013	Enablers	Khan & Haleem

scenario. The seven shortlisted success factors were: management support, business goal alignment, project resources, team skills, system quality and data quality. To determine the inter-relationship between these seven variables, ISM methodology was applied. The panel of 35 experts was further consulted, some being the same, as were approached earlier. The experts were professionals working in the BI domain as BI consultants, data analytics team lead, data architects, BI project managers, business analysts and data analysts in the banking, telecom and retail industry sectors. The responses were taken through interviews conducted individually to avoid any overlapping of opinions. Each interview lasted from 45 minutes to one hour fifteen minutes. All the responses were studied and were used for structuring the matrices in interpretive structural modeling. In this section, the research process followed for ISM modelling has been put in steps mentioned below. The steps followed in the ISM methodology are also broadly illustrated in Figure 1.

Based on the recent ISM studies, the following necessary steps are adopted to develop the ISM model (Gan et al., 2018; Kumar & Sharma, 2018):

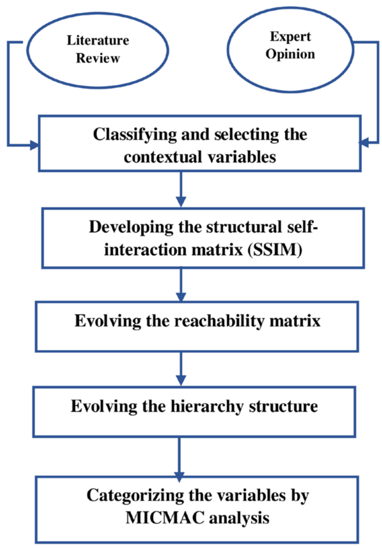
Step 1: Identify and categorize the success factors which affect business intelligence implementation through the literature review and expert opinion.
Step 2: Construct SSIM (Structural Self-Interaction Matrix) to demonstrate the contextual relationship among variables leading to Business Intelligence implementation. SSIM encompasses the plotting of the pairwise relationship among variables. (Attri et al., 2013).
Step 3: Construct the reachability matrix, which illustrates the direct and indirect relationships among variables impacting Business Intelligence implementation. The reachability matrix is made in two phases. In the first step, an initial reachability matrix is developed from the SSI matrix by replacing all the direct contextual relationships with 1 or 0. The initial reachability matrix portrays only direct relationships among variables (Shen et al., 2016). In the second step, reliability in the judgments is verified, and transitivity is brought in to develop the final reachability matrix (Luthra et al., 2014). Transitivity means if there are interconnected relationships from variable 1 to variable 2, and from variable 2 to variable 3, then there should be a relationship from variable 1 to variable 3.
Step 4: Construct partitions among variables to categorize impact levels and rank the factors.
Step 5: Finally, the ISM based hierarchy model is presented, depicting the various relationship between factors.
Step 6: Using the reachability matrix developed in step 3, driving power and dependence power is estimated for each variable. Based on this, MICMAC analysis is steered to categorize the factors into four clusters, namely driving, dependent, linkage and autonomous factors.

ANALYSIS

In this section, the ISM hierarchy model is developed, following the research methodology's steps, using the seven variables impacting Business Intelligence implementation. The model's hierarchical structure will aid in improved understanding of the interrelationships among the variables. Moreover, the MICMAC method is used to categorize the variables based on their impact and dependence.

Developing the Structural Self-Interaction Matrix (SSIM). Firstly, the structural self-interaction matrix is developed, which depicts the pairwise relationship between the variables. Based on the opinion of academicians and industrial experts, the contextual relationship between the variables was identified. The criteria of A leads to B; was chosen to indicate the relationship. This implies that experts were asked if factor 'a' will influence factor 'b' and vice versa. All the possible combinations of implementation factors were presented, and experts were asked to specify the relation between the variables (a and b) using four symbols. Four symbols (i.e., V, A, X, O) are used to establish the contextual relationship between the success factors.

Figure 1. ISM methodology/ research process



V = Where success factor a helps in attaining success factor b.
A = Where success factor b helps in attaining success factor a.
X = When success factor a and b help in attaining one another.
O = When success factor a and b show no relation with each other.

Following the above research process (Gan et al.,2018), the interactive relationships among eight contextual variables (seven independent and one dependent) are built in an SSIM, as shown in Table 3. The table shows the direct-effect relationship among all the eight variables from S1 to S8.

Developing the Initial and Final Reachability Matrix. The initial reachability matrix and final reachability matrix are calculated by transforming the SSIM into binary digits (i.e.1s or 0s), using the following rules to substitute V, A, X, O of SSIM into the reachability matrix.

- If the (a, b) entry in the SSIM is V, then (a, b) entry in the reachability matrix will be 1, and (b, a) entry will be 0.
- If the (a, b) entry in the SSIM is A, then (b, a) entry in the reachability matrix will be 0 and (b, a) entry will be 1.
- The presence of X in SSIM indicates using 1 in both (a, b) and (b, a) entries in the reachability matrix.
- The presence of O in SSIM indicates to use 0 in both (a, b) and (b, a) entries in the reachability matrix.

The initial reachability matrix with binary values 0 and 1 is obtained from the Structural self-interaction matrix, shown in table 4. This is followed by applying transitivity rules (Gan et al., 2018). To retain consistency by incorporating transitivity, 1* is substituted at important places. The final

Table 3. Structural self-interaction matrix (SSIM)

Success factor no.	Success factor description	S8	S7	S6	S5	S4	S3	S2	S1
S1	Management Support	V	O	V	O	O	V	X	
S2	Business Goal Alignment	V	O	V	V	O	V		
S3	Project Resources	V	V	V	O	X			
S4	Team Skills	V	V	V	V				
S5	User Participation	V	A	A					
S6	System Quality	V	X						
S7	Data Quality	V							
S8	Business Intelligence Implementation								

reachability matrix is depicted in Table 5, obtained by adding all transitivity in the initial reachability matrix. The dependence power and driving power of each variable are also provided in table 5. The driving power depicts the number of factors that a given factor may help to attain. The dependence power specifies the number of factors that may help to attain the given factor. The driving and dependence power will contribute to executing MICMAC analysis.

Level Partitions. The reachability set and antecedent set are derived for each factor from the reachability matrix. The antecedent set portrays the factor (including itself) that may help to get a particular factor. In contrast, the reachability set for a particular factor shows the factor (including itself) that it may help attain. The intersection set for a specific factor consists of common factors in both the antecedent and reachability sets. After that, the parameter for which the intersection set and reachability set are alike is shown as level one in the ISM ranking. The top-level variables are omitted in the consecutive iterations, and this process is continued until the final iteration leads to bottom level variables. The five iteration process and the reachability set, antecedent set, and intersection set are shown in Tables 6 to 10.

Structuring the ISM Model: The output obtained from the final reachability matrix and partition table are used to develop the structural model. The factors extracted in the initial iteration level are placed on the top of the diagram. The following factors are placed down, conforming to the level of iteration in the partition procedure. The subsequently created illustration is known as a digraph, shown in figure 2. Finally, the digraph is transformed into ISM, as illustrated in Figure 3.It can be inferred from the model that different factors are likely to have a different level of influence on Business Intelligence implementation. The lower level indicates that these variables are at the top of the hierarchy and more likely to be influenced by higher-level variables. It is clear from the table that level 1 consists of one variable, Business Intelligence implementation (S8); level 2 also consists of one variable, User Participation (S5); level 3 includes two variables, System Quality (S6) and Data Quality (S7); and level 4 contains two variables, Project Resources(S3) and Team skills(S4) and level 5 contains two variables again, Management Support (S1) and Business Goal Alignment (S2). A higher level in the structural model recommends that these factors are positioned at the bottom of the hierarchy. Based on the results, the ISM hierarchy model is completed using level partitioning shown in Figure 2 and Figure 3, which depicts the chain of influence of contextual variables in BI implementation.

MICMAC (Matrice d’ Impacts Croises - Multipication Applique a classement) Analysis

MICMAC technique is based on matrices multiplication property, used to identify variables through interactions of various sub-systems in a complex arrangement (Kumar & Sharma, 2018). MICMAC analysis is conducted by examining the dependence power and driving power of each variable. The MICMAC analysis is performed to categorize all the success factors into four clusters

Table 4. Initial reachability matrix

Success factor	Success factor description	S1	S2	S3	S4	S5	S6	S7	S8
S1	Management Support	1	1	1	0	0	1	0	1
S2	Business Goal Alignment	1	1	1	0	1	1	0	1
S3	Project Resources	0	0	1	1	0	1	1	1
S4	Team Skills	0	0	1	1	1	1	1	1
S5	User Participation	0	0	0	0	1	0	0	1
S6	System Quality	0	0	0	0	1	1	1	1
S7	Data Quality	0	0	0	0	1	1	1	1
S8	Business Intelligence Implementation	0	0	0	0	0	0	0	1

to check consistency in associations (Kumar & Sharma, 2018). MICMAC analysis's four outcome variables are independent, dependent, autonomous, and linkage variables. The variables/factors are plotted on the two-dimension chart, shown in figure 4, by applying the data from the final reachability matrix, given in table 5. The dependence power of each factor is plotted on the x-axis and the driving factor on the y-axis. The eight variables are classified into the following four clusters:

Driving factors: These are the factors with high driving power and low dependence power. The four variables which fall in this category are Management Support (S1), Business Goal Alignment (S2), Project Skills (S3) and Team Skills (S4).

Dependent factors: These are the factors that depict low driving power and high dependence power. The four variables which fall in this category are User Participation (S5) and Business Intelligence Implementation (S8), System Quality (S6) and Data Quality (S7).

Linkage factors: These factors reflect high driving power and high dependence power. There are, as such, no variables in this cluster. However, the two variables, System Quality (S6) and Data Quality (S7), have considerably higher driving power and are close to the linkage success factor quadrant.

Table 5. Final reachability matrix

Success Factor	Success factor description	S1	S2	S3	S4	S5	S6	S7	S8	Driving power
S1	Management Support	1	1	1	1*	1*	1	1*	1	8
S2	Business Goal Alignment	1	1	1	1*	1	1	1*	1	8
S3	Project Resources	0	0	1	1	1*	1	1	1	6
S4	Team Skills	0	0	1	1	1	1	1	1	6
S5	User Participation	0	0	0	0	1	0	0	1	2
S6	System Quality	0	0	0	0	1	1	1	1	4
S7	Data Quality	0	0	0	0	1	1	1	1	4
S8	Business Intelligence Implementation	0	0	0	0	0	0	0	1	1
Dependence power		2	2	4	4	7	6	6	8	

*Shows transitivity

Table 6. Iteration(i) for the partitioning of levels of success factors of business intelligence

Success factor	Reachability set (RS)	Antecedent set (AS)	Intersection set (RS ∩ AS)	Level
S1	1,2,3,4,5,6,7,8	1,2	1,2	
S2	1,2,3,4,5,6,7,8	1,2	1,2	
S3	3,4,5,6,7,8	1,2,3,4	3,4	
S4	3,4,5,6,7,8	1,2,3,4	3,4	
S5	5,8	1,2,3,4,5,6,7	5	
S6	5,6,7,8	1,2,3,4,6,7	6,7	
S7	5,6,7,8	1,2,3,4,6,7	6,7	
S8	8	1,2,3,4,5,6,7,8	8	I

Table 7. Iteration (ii)

Success factor	Reachability set (RS)	Antecedent set (AS)	Intersection set (RS ∩ AS)	Level
S1	1,2,3,4,5,6,7	1,2	1,2	
S2	1,2,3,4,5,6,7	1,2	1,2	
S3	3,4,5,6,7	1,2,3,4	3,4	
S4	3,4,5,6,7	1,2,3,4	3,4	
S5	5	1,2,3,4,5,6,7	5	II
S6	5,6,7	1,2,3,4,6,7	6,7	
S7	5,6,7	1,2,3,4,6,7	6,7	

Table 8. Iteration (iii)

Success factor	Reachability set (RS)	Antecedent set (AS)	Intersection set (RS ∩ AS)	Level
S1	1,2,3,4,6,7	1,2	1,2	
S2	1,2,3,4,6,7	1,2	1,2	
S3	3,4,6,7	1,2,3,4	3,4	
S4	3,4,6,7	1,2,3,4	3,4	
S6	6,7	1,2,3,4,6,7	6,7	III
S7	6,7	1,2,3,4,6,7	6,7	III

Table 9. Iteration (iv)

Success factor	Reachability set (RS)	Antecedent set (AS)	Intersection set (RS ∩ AS)	Level
S1	**1,2,3,4**	**1,2**	**1,2**	
S2	1,2,3,4	1,2	1,2	
S3	3,4	1,2,3,4	3,4	IV
S4	3,4	1,2,3,4	3,4	IV

Table 10. Iteration (v)

Success factor	Reachability set (RS)	Antecedent set (AS)	Intersection set (RS ∩ AS)	Level
S1	1,2	1,2	1,2	V
S2	1,2	1,2	1,2	V

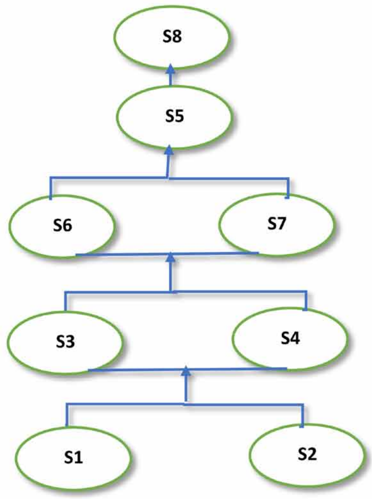
Table 11. Partitioning of levels of success factors of business intelligence - iteration (i) to (v)

Success factor	Reachability set (RS)	Antecedent set (AS)	Intersection set (RS ∩ AS)	Level
S1	1,2,3,4,5,6,7,8	1,2	1,2	V
S2	1,2,3,4,5,6,7,8	1,2	1,2	V
S3	3,4,5,6,7,8	1,2,3,4	3,4	IV
S4	3,4,5,6,7,8	1,2,3,4	3,4	IV
S5	5,8	1,2,3,4,5,6,7	5	II
S6	5,6,7,8	1,2,3,4,6,7	6,7	III
S7	5,6,7,8	1,2,3,4,6,7	6,7	III
S8	8	1,2,3,4,5,6,7,8	8	I

Autonomous factors: The factors in this cluster reflect a weak driving and dependence power. Hence, they do not have much impact on the system. It can be realized from figure 4 that there are no autonomous factors in this research, showing that all the factors of the study are significant.

MICMAC analysis outcomes complement the ISM hierarchy model in categorizing and judging the degree of impact of variables. It can be seen from the ISM model that Management Support (S1) and Business Goal Alignment (S2) are the most influencing factors in the hierarchy model as well as has the highest driving power as per MICMAC analysis. Project Resources (S3) and Team Skills (S4) come at the second most significant level of the hierarchy in the ISM model and have the second-highest driving powers. Therefore, due importance should be given to getting management support and having proper alignment of business and BI goals, followed by acquiring proper project resources and adequate team skills, for smooth BI implementation in organizations.

Figure 2. Digraph showing levels of business intelligence success factor based on the partitioning of various levels

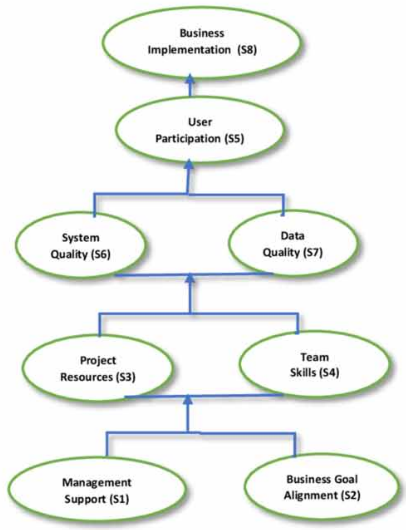


FINDINGS AND DISCUSSIONS

This study aids in understanding the success factors that are crucial and pose challenges during the implementation process. Organizations need to pay more attention to driving factors for better implementation of Business Intelligence systems. The MICMAC analysis graph (Figure 4) shows that Management Support and Business Goal Alignment are the factors with the most driving power for BI implementation. As also shown in Figure 3 (ISM hierarchy model), Management support (S1) and Business Goal Alignment (S2) are at level 5,which suggests that they are the most critical factors for the success of Business Intelligence Implementation. The literature too supports the theory that a robust, dedicated and adaptive leadership style can implement BI irrespective of any challenges (Melody et al., 2010). Many studies on BI success also emphasize on the alignment between BI and business objectives (McMurchy,2008). Research recommends that an absence of appropriate linking between an organization's BI implementation plan and business goals is one primary reason for the lack of BI success (Eckerson,2003; Watson et al.,2006). It can also be seen from the reachability matrix (Table 5) that Management support (S1) and Business Goal Alignment (S2) can influence all eight variables, including themselves.

Similarly, another observation from the reachability matrix is that Project resources (S3) and Team skills (S4) can exert influence on all the other variables except S1 (Management support) and Business Alignment (S2). This indicates the importance of addressing these four variables' impact by strengthening and applying processes for better accountability, transparency, and relevance. This can be accomplished by adequate support from top management to the functional teams throughout the implementation process. It can be noted that the next two variables are shown in Figure 3 (ISM hierarchy Model) at level 4 are Project Resources (S3) and Team skills (S4). They largely illustrate the organization's capabilities to build a BI system. Team skills (S4) are an important asset within any organization or company, whereas Project Resources (S3) efficiently bring organizations' capabilities and outcomes together to deliver on intended objectives. One of the key reasons why project resources

Figure 3. ISM-based model for success factors for business intelligence implementation

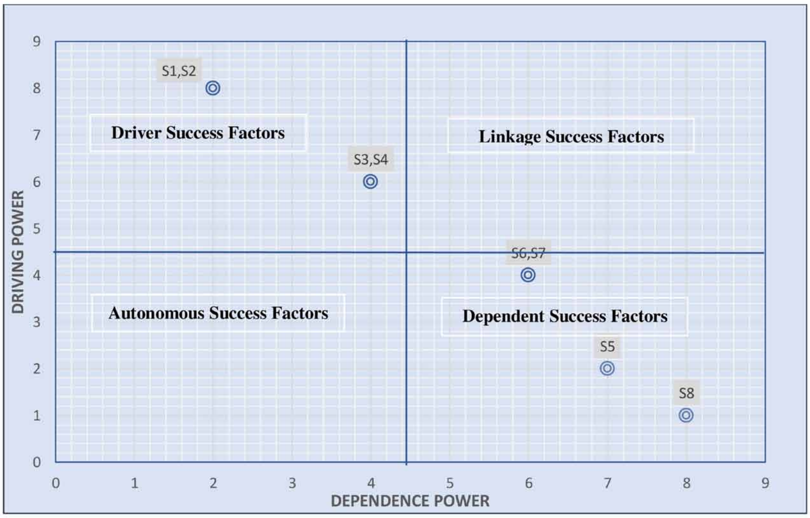


and team skills are considered dominant determinants is that these variables help bring synergy among organizational capabilities, practices, and overall preparedness of an organization towards the BI implementation. The significance of team skills has been recognized by quite a few researchers' in coherence with BI system implementation (Hawking & Sellitto, 2010; Morien et al., 2013).

The two variables that occupy the middle portion, exhibiting their mediating role in the hierarchy model are System Quality (S6) and Data Quality(S7). It is estimated that more than half of BI projects fail due to data quality problems. BI's technological ability to deliver accurate, consistent and timely information across its users can enable an organization to improve its business agility. There is a lot of debate on system and data quality in BI, precisely on data integration and its allied tools. The integration of both interrelated systems as well as separate data stores presents a substantial challenge in many sectors. Companies must discover ways to effectively manage integration within the BI systems as well as integration between BI and other information systems. Technological quality is vital because it often regulates the success of the BI initiative. Therefore, technological capability indicators, system and data quality act as mediating factors and perform a linking role in the hierarchy model for BI implementation success. Hence, it is evident that technology plays a vital role, but other factors, such as people, processes, management style and culture, are more significant. These factors frequently signify a considerable hurdle and can disrupt or avert attempts to implement effective BI solutions in organizations.

It can be understood from the model, that the variable User Participation(S5), is situated at almost the top of the hierarchy structure (Figure 3) and is mostly affected by other variables situated at lower levels. The extent of user participation depends on the BI implementation team's involvement with the BI system users. During the entire implementation process, interactive user participation can help meeting vital information needs and format requirements (Yeoh & Popoviˇc,2016). At the top of the ISM hierarchy is Business Intelligence Implementation (S8) factor. This shows that all the other factors play roles' in varying degrees in impacting this implementation process in all organizations.

Figure 4. Driving power and dependence diagram



The findings highlight the need for the various BI success factors during the implementation process and throw light on each of them with varying degrees of importance. However, this ISM model demonstrates the dominant effects of the two factors, management support and business goal alignment, in influencing the BI implementation process.

Organizations that have attained success with their BI implementations have ensured that their BI is steady with their corporate business objectives. It is essential to develop a favourable procedure that helps convert the organization's various structures and processes to implement BI tools efficiently.

CONCLUSION

This study contributes to the Business intelligence literature by classifying and categorizing the BI implementation project's dominant and facilitating factors. This study identified seven important factors influencing the implementation of Business Intelligence systems. With the ISM approach, these seven factors are organized in a hierarchical model and divided into five distinct influence levels. Using MICMAC analysis, these factors (one dependent and seven independent) are classified into four groups: four driving factors, four dependent factors, and no linkage or autonomous factors. The four independent factors, management support and business goal alignment, followed by project resources and team skills, primarily, are the most significant factors affecting Business Intelligence implementation. It will be more beneficial for organizations to develop conforming BI strategies to address these four independent factors. This research will help policymakers develop conforming processes, strategies, and instruments to address and prioritize various factors while implementing BI tools in organizations.

Limitations and Future Work

In this study, the existing list of factors conveys a general assessment of the critical success factors for BI implementation, which substantiates some of the researchers' works. However, several other authors have been working on this subject and who, based on their knowledge and understanding, have elaborated on different success factors for BI.

The other limitation of this study is that the hierarchical model is developed from the viewpoint of a specific set of companies, from where the responses were collected. Each BI implementation solution in a specific business format is unique. Hence, the pre-conditions for BI's acceptance and practice are varied, and probably, a particular set of success factors might not be applicable for every enterprise. It is essential to find important factors in every individual implementation, and it is also essential to quantify their impact. Therefore, future research can be directed towards discovering diverse structural, contextual relationships.

Further, the statistical validity of the model can be verified using structural equation modeling. In the end, it can be indisputably said that Business Intelligence is beneficial for businesses, and it has a positive influence on the information processing capabilities of various business-processes in any organization. Organizations should count on this technology for advanced decision-making skills and bring about its implementation more professionally and scientifically.

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