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ANALYZING THE SUCCESS FACTORS FOR BUSINESS ANALYTICS OUTSOURCING AN INTERPRETIVE STRUCTURAL MODELING (ISM) APPROACH

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ABSTRACT

Analytics and R&D services are set to drive the next wave of outsourcing from India. India offers skills, infrastructure and business environment to support the offshoring of higher margin services like Business Analytics. With traditional services like voice and non-voice business processes, as well as software development maturing, offshoring of Business Analytics services can provide the necessary impetus to the Indian economy in general and the IT-enabled services (ITeS) industry, in particular. The availability of statisticians, data scientists and research scholars contribute to the overall attractiveness of India as an outsourcing destination for analytics consulting and related services. There is also a vast pool of experienced IT professionals, which are looking to up skill themselves to enter this domain. Analyst firms are of an opinion that over the course of time, talent abundance will effectively keep the wage inflation in check for analytics services and India will continue to maintain its cost arbitrage globally.

The paper intends to evaluate the factors critical to the success of Business Analytics services providers in an outsourcing engagement. A range of critical success factors have been identified from the literature review. With the help of ISM methodology, the paper intends to identify the complex relationships between the success factors of Business Analytics Outsourcing organization. MICMAC analysis provided a basis to assess the driving power and dependence of each of these success factors and eventually assist in developing a driver-dependence diagram. The driver dependence diagram provides valuable insights about the relative importance and the interdependencies among the key factors responsible for the success of Business Analytics outsourcing. This can assist the Business Analytics service providers in prioritizing the factors which are more critical to the success of their outsourcing engagements and proactively address them first.

Keywords— Interpretive Structural Modeling, Business Analytics Outsourcing, Data Analytics, Success Factors, Knowledge Process Outsourcing, Analytics Consulting, Performance metrics

INTRODUCTION

The world is moving to data-driven decision making. Enterprises want to utilize the vast expanse of customer and operational data available to them, to build a solid understanding about the requirements of their customers and to improve their operational efficiency. Analytics service providers can assist enterprises in achieving this and more. However, with the analytics market getting flooded with new players and the competition getting stiffer by the day, it is getting difficult for service providers to differentiate themselves from the competition and be successful in the marketplace. Literature reviews an assist in identifying factors which are critical to the success of an analytics outsourcing engagements. However, it does not help in identifying the complex interactions and dependencies between these factors. It also does not help in prioritizing the most important factors from the least important ones.

ISM (Interpretive Structural Modeling) technique can help in this regard. It can assist an enterprise in the following ways:

1. Identifying the complex interdependencies of factors
2. Prioritizing the factors in their relative order of importance for an analytics service provider
3. Identifying the factors which are Autonomous, Dependent, or Independent variables

The method was first proposed by John N. Warfield in his paper, *'On arranging elements of a hierarchy in graphic form'* [1]. ISM can be used in small working groups to identify the interdependencies of success factors or barriers of a business process. Various researchers have offered different definitions to the ISM methodology:

- ISM is a systematic and comprehensive method for integrating group judgments in the development of 'first-cut' structural models. [2]
- ISM is a process that transforms unclear and poorly articulated mental models of systems into visible, well-defined models useful for many purposes. [3]
- ISM is an interactive learning process. In this technique, a set of different directly and indirectly related elements are structured into a comprehensive systematic model. [4]

ISM has been deployed in a variety of academic studies aimed at identifying complex relationship between factors or barriers. Some of these studies conducted in the last two years have been listed in the Table I below.

TABLE I. SAMPLE ISM PAPERS IN 2016-17

S. No.	Field	Author (Year)
1	Enablers of u-commerce proliferation in a developing economy	Faisal, Mohd. Nishat Khan, Habibullah (2016)
2	Key barriers to lean implementation in the construction industry	Khaba, Sorokhaibam; Bhar, Chandan (2017)
3	Key barriers for environmental management system (EMS) adoption	Yang, Fan; Zhang, Xiongfei (2017)
4	Major enablers of reconfigurability within a supply chain	Biswas, Pallab (2017)
5	Factors of the Fair Value Measurement Audit Process.	Doliya, Prince; Singh, Jatinder P (2016)

IDENTIFICATION OF VARIABLES

The first step in creating a ISM model is to identify the list of variables. For this study, the researcher undertook an extensive literature review which is detailed in the Literature review. The

following factors have been identified from the literature review, which are expected to contribute to the success of an analytics service provider.

TABLE II. SUCCESS FACTORS FOR BUSINESS ANALYTICS OUTSOURCING

Factors	Bibliography
Outsourcing Regulations	Dara O'Rourke (2003), Amar Gupta and Deth Sao (2009), Stephan Manning, Silvia Massini and Arie Lewin (2009), Hedley Lawson (2008), Shannon Klinger and M. Lynn Sykes (2004), Lin Bai (2007)
Shared Vision	Isabelle Sender (1998), Amar Gupta (2009), Jim Lanigan (2004), L. Gary Boomer (2004), William J Krochalis (2004), Andie Burjek (2016), Jim Miller (2013), Glenn Baker (2013)
Customer focus	Rich Lee, Chen Ing-Yi (2014), Jesse Harriott (2013), Craig Seebach (2013), Piyush Sharma (2011), Stefan Wuyts, Aric Rindfleisch and Alka Citrin (2015), Irina I. Salanta, Dan C. Lungescu and Veronica M. Pampa (2011)
Analytical Skills	Gary Cokins (2014), Alan Brandyberry (2016), Steven D. Jones (2015), Angela D'Auria Stanton and Wilbur W. Stanton (2016), Kevin Daniel Andre Carillo (2017), Joe Skorupa (2016), Mary K Pratt (2015), Hugh J Watson (2007, 2012), Shari Rogalski (2007), David Weldon (2014), Stephen Lowe (2016)
Analytical Tools	Steven D. Jones (2015), Venkat Viswanathan (2016), Steve Prentice (2010), Paul Hofmann (2016), Shari Rogalski (2007), Hugh J. Watson (2015), Steve Prentice (2010)
Data Security Controls	Dennis Broeders et al (2017), Michel Wedel et al (2016), Alessandro Mantelero (2016), Nancy J. King et al ((2016), Handanhal Ravinder Misra et al (2015), Connie L. McNeely (2014), Rashmi Krishnamurthy et al (2014), Sarah Pearce (2017)

ISM MODEL DEVELOPMENT

ISM is based on relational mathematics, which can help transform ill-structured mental models into a clear interrelated structured set of system elements [5]. It is a well-established methodology for identifying relationships among specific items, which define a problem or an issue [6]. This methodology has at least two desirable properties when compared to the similar approaches namely simplicity in the sense of not requiring from the user i.e. viewpoint of advance mathematical knowledge and efficiency in terms of economizing in computer time [4].

ISM methodology can be categorized as:

- An interpretive methodology as the judgement of the group helps in identifying the relationship of variables.
- A structural methodology as the relationships identified help in forming an overall framework of variables.

The steps involved in the ISM technique [1, 7] are shown in Figure 1.

Step 1. Identify the list of variables or factors critical to the success of business analytics service providers using literature review.

Step 2. Developing contextual relationship between factors identified through literature review.

Step 3. Developing a Structural Self-Interaction Matrix (SSIM) for the factors, indicating the mutual relationship between individual factors.

Step 4. Developing a reachability matrix from SSIM and checking the matrix for transitivity. A test for transitivity assumes that if variable X is related to Y and Y is related to Z, then X is necessarily related to Z.

Step 5. Partitioning the reachability matrix into different levels.

Step 6. Developing a directed graph to prioritize the factors and arranging these by their order of relationship.

Step 7. Converting the graphs into ISM by replacing variable nodes with statements.

Step 8. Reviewing the graph to check for conceptual inconsistency

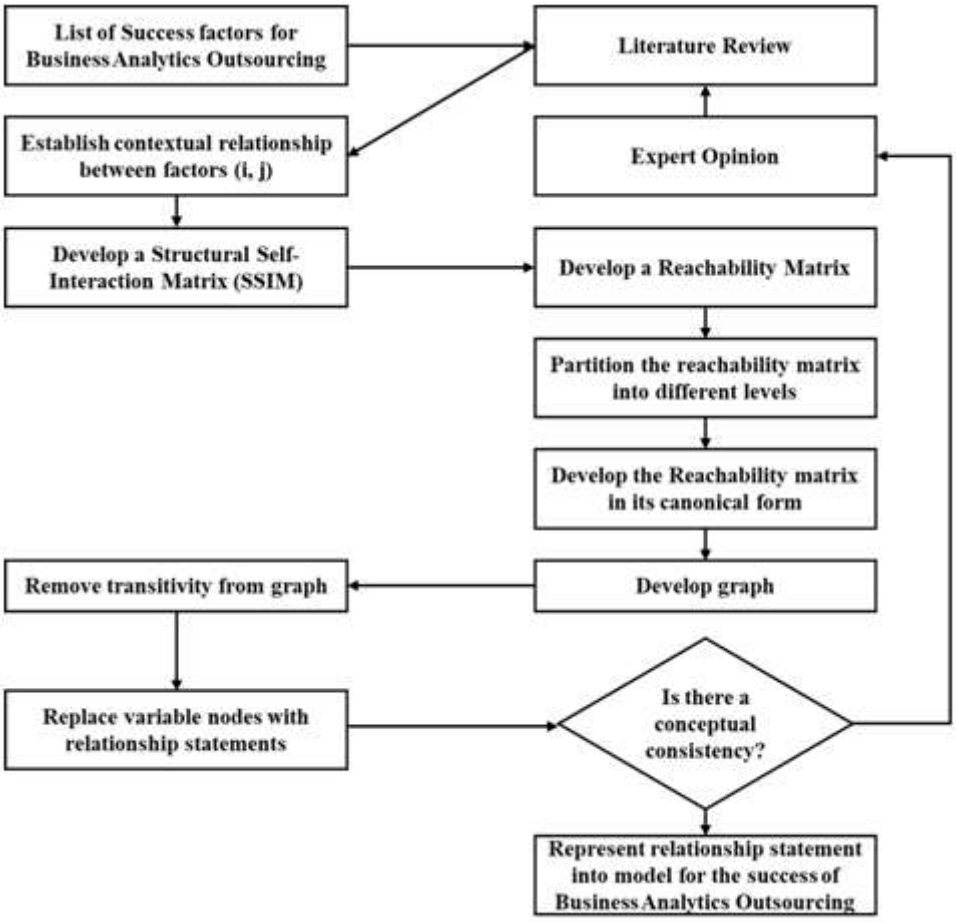


Fig. 1. **Steps of ISM modelling**

STRUCTURAL SELF-INTERACTION MATRIX

Developing a Self-Interaction Matrix is the next step once the success factors for business analytics outsourcing have been identified from the literature review. The development of the matrix requires inputs from experts in the field of business analytics outsourcing. Senior executive from the analytics industry were interviewed for identifying the contextual relationship between the success factors. The executives interviewed for the research have significant experience in delivering analytics engagement and are placed as team leads or above in their respective organizations.

Four symbols are typically used in Structural Self-Interaction Matrix to denote the contextual relationship between factors (i and j). They are listed as below:

V: Factor i will help achieve factor j;

A: Factor j will help achieve factor i;

X: Factor i and j will help achieve each other; and

O: Factor i and j are unrelated.

Table III shows the Structural Self-Interaction Matrix (SSIM) developed as per to this research

TABLE III. STRUCTURAL SELF-INTERACTION MATRIX (SSIM)

#	BAO Success Factors	7	6	5	4	3	2	1
1	Outsourcing Regulation	V	V	V	V	V	V	
2	Shared Vision	V	V	X	V	X		
3	Customer Focus	V	V	X	V			
4	Data Quality	A	V	V				
5	Analytical Skills	V	X					
6	Analytical Tools	V						
7	Data security controls							

The following would explain the use of the symbols V, A, X, and O in SSIM (Table 4.3).

- Outsourcing regulation will help achieve data security controls. Therefore, the relationship between factors 'Outsourcing Regulations' and 'Data security controls' has been identified as a 'V' in the SSIM.
- 'Data security controls' will help achieve 'Data Quality' but the reverse may not be true. Therefore, the relationship between 'Data Quality' and 'Data security controls' have been identified as a 'A' in the SSIM.
- 'Shared Vision' and 'Customer Focus' will help achieve each other. Thus, their relationship has been identified as a 'X' in the SSIM.
- No factors were identified to be unrelated to others. Therefore, none of the relationships have been marked as 'O' in the SSIM.

REACHABILITY MATRIX

Next step in the ISM methodology is to convert SSIM into the binary reachability matrix. For this purpose, all V, A, and X in the SSIM are replaced is replaced by a digit 1 and O by 0 (zero). The substitution of l s and 0s are done using the below rules:

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

Table IV illustrates the initial reachability matrix developed by replacing the SSIM relationship variables into binary digits.

TABLE IV. INITIAL REACHABILITY MATRIX

#	BAO Success Factors	1	2	3	4	5	6	7
1	Outsourcing Regulation	1	1	1	1	1	1	1
2	Shared Vision	0	1	1	1	1	1	1
3	Customer Focus	0	1	1	1	1	1	1
4	Data Quality	0	0	0	1	1	1	0
5	Analytical Skills	0	1	1	0	1	1	1
6	Analytical Tools	0	0	0	0	1	1	1
7	Data security controls	0	0	0	1	0	0	1

The final reachability matrix is obtained by incorporating the transitivity's as detailed in Step 4 of the ISM methodology. This is shown in Table V. The table also demonstrates the driving power and dependence of each of the factor. In this table, the driving power and dependence of each analytics success factor are also shown. The driving power of a particular factor is the total number of factors (including self) which it may help achieve. The dependence is the total number of factors which may help achieving it. These driving power and dependencies are of particular importance in developing the MICMAC analysis, where the factors will be classified into four groups of autonomous, linkage, dependent and independent factors. This is detailed further in section VI later in this chapter.

TABLE V. FINAL REACHABILITY MATRIX

#	Success Factors	1	2	3	4	5	6	7	Driving Power
1	Outsourcing Regulation	1	1	1	1	1	1	1	7
2	Shared Vision	0	1	1	1	1	1	1	6
3	Customer Focus	0	1	1	1	1	1	1	6

#	Success Factors	1	2	3	4	5	6	7	Driving Power
1	Outsourcing Regulation	1	1	1	1	1	1	1	7
4	Data Quality	0	0	0	1	1	1	1	3
5	Analytical Skills	0	1	1	0	1	1	1	5
6	Analytical Tools	0	0	0	0	1	1	1	3
7	Data security controls	0	0	0	1	0	0	1	2
	Dependence	1	4	4	5	6	6	6	

The various levels of this analysis involve the factors reachability set, antecedent set and intersection set. The reachability set consists of the factor itself and the other factors, which it may help achieve. The antecedent set consists of the factor itself and other factors, which may help achieving it. Thereafter, intersection of these two sets is derived for all factors. One by one the factors having the same reachability set and intersection set are eliminated in each iteration. The results of the iterations are reproduced in Tables VI.

TABLE VI. ITERATIONS FOR HIERARCHICAL MODEL

Iteration	Variable	Reachability Set	Antecedent Set	Intersection	Level
I	**1**	1,2,3,4,5,6,7	1	1	
	2	2,3,4,5,6,7	1,2,3,5	2,3,5	
	3	2,3,4,5,6,7	1,2,3,5	1,2,3,4,5	
	4	4,5,6	1,2,3,4,7	1,3,4,5,6,7	
	5	2,3,5,6,7	1,2,3,4,5,6	2,3,5,6	
	6	5,6,7	1,2,3,4,5,6	5,6	
	7	4,5	1,2,3,4,5,6,7	4,5	**I**
II	**1**	1,2,3,4,5,6	1	1	
	2	2,3,4,5,6	1,2,3,5	2,3,5	
	3	2,3,4,5,6	1,2,3,5	2,3,5	
	4	4,5,6	1,2,3,4	4	
	5	2,3,5,6	1,2,3,4,5,6	2,3,5,6	**II**
	6	5,6	1,2,3,4,5,6	5,6	**II**
III	**1**	1,2,3,4,	1	1	
	2	2,3,4	1,2,3	2,3	
	3	2,3,4	1,2,3	2,3	
	4	4	1,2,3,4	4	**III**
IV	**1**	1,2,3	1	1	
	2	2,3	1,2,3	2,3	**IV**
	3	2,3	1,2,3	2,3	**IV**
V	**1**	1,2,3	1	1	**V**

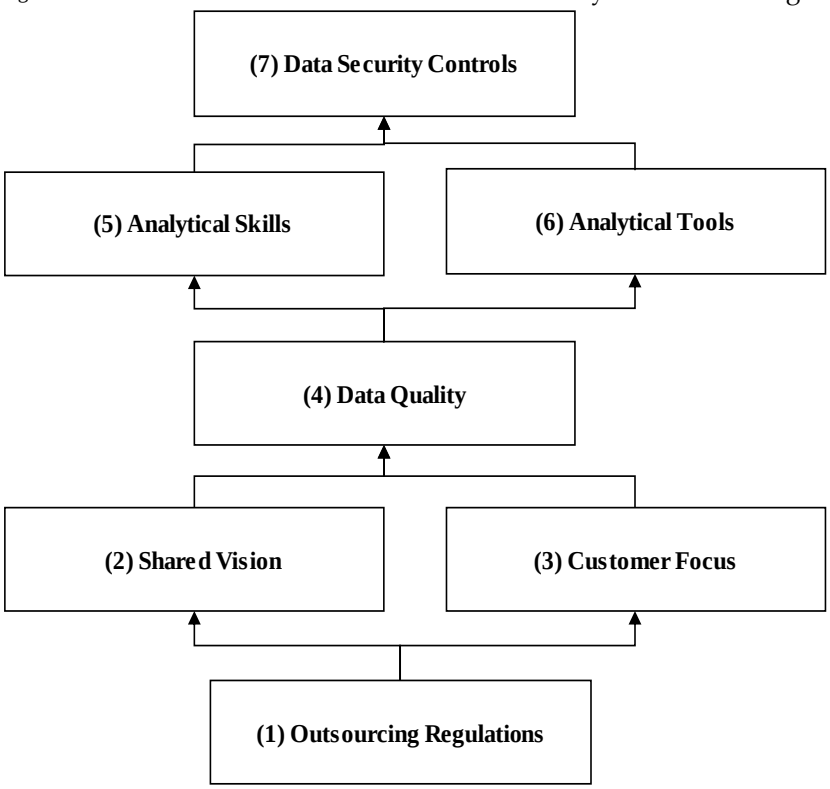
The levels of the factors are crucial for developing the ISM model. Level one factor indicates that it is of utmost importance of the success of a business analytics service provider. The second level factors indicate that they are next in priority for the success of an analytics service provider and so on.

The identification of priority levels of factors critical to the success of analytics service provider through an iterative process, helps establish a hierarchical relationship between the factors. The iterations and the factors identified as level one, two, three and so on, helps establish the designation of the factor in the hierarchical mode and the direction of its relationship with the help of an arrow. The digraph drawn thus is examined to eliminate transitivity of relationships. The final ISM

model for the success factors of analytics service provider is illustrated in Figure 2.

Figure 2 below illustrates the ISM based model which offers a hierarchical view of factors critical for the success of an analytics service provider.

Fig. 2. ISM-based model for success factors of Analytics Outsourcing



MICMAC ANALYSIS

MICMAC stands for Matrice d'Impacts Croisés Multiplication Appliquée á un Classement. The method was developed by Duperrin and Godet [8]. It is also known as the Cross-Impact Matrix Multiplication. The MICMAC analysis helps categorize the factors into four clusters and presents a graphical representation of the factors based on their driving power and dependence.

Both ISM and MICMAC have similar calculating processes [9]. Both the methods help identifying the relationship between factors. ISM methodology helps develop a hierarchical relation between factors and helps to arrange them by their priority level in contributing success to the business analytics organization. MICMAC analysis goes a step further and helps in developing a better understanding of the relationship between factors. It helps to classify the success factors for business analytics outsourcing into Autonomous, Dependent, Linkage and Independent variables. A combination of ISM and MICMAC analysis helps to understand the direct and indirect relation between the success factors. Various academic studies, as listed in Table II, have used a combination of these methods to build an understating of the relational complexities between factors. While ISM methodology provides insights about the direct relationships between variables, MICMAC analysis is used to map and understand the indirect and hidden relationships between variables.

MICMAC analysis is used to analyze the driver power and dependence of each variable [10].

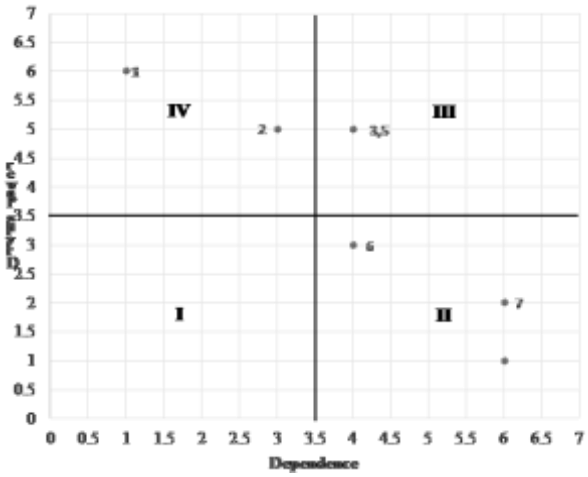
- **'Driver power'** refers to the degree of influence that one variable has over another
- **'Dependence'** is defined as the extent to which one variable is influenced by others [11].

The driver power and dependence of each variable can be obtained from the stable matrix by the summation of 1s in the corresponding rows and columns, respectively. The driving power and dependence of each success factor is then used to plot them on a two-dimensional graph, called a driver-dependence diagram. The horizontal axis representing the extent of dependence and the vertical axis representing the extent of driver power. The driver-dependence diagram helps categorize success factors into four clusters: Independent, Linkage, Dependent, and Autonomous

variables [12].

The objective of MICMAC analysis is to analyze the driver power and the dependence power of the variables. Subsequently, the driver power–dependence diagram is constructed using final reachability matrix (Table V) as shown in Figure 3. For example, Outsourcing Regulations has a driver power of 7 and a dependence of 1 as suggested in Table V. Accordingly, it is mapped in the right place in the MICMAC quadrants in the Figure 3.

Fig. 3. Driving power and dependence diagram from MICMAC analysis



MICMAC graphical representation places success factors for analytics outsourcing into four clusters (Figure 3).

- **Autonomous factors:** These factors have weak drive power and weak dependence power. They are relatively disconnected from the system, with which they have few links, which may be very strong.
- **Linkage factors:** These factors have strong drive power as well as strong dependence power. These factors are unstable in the fact that any action on these factors will have an effect on others and also a feedback effect on themselves.
- **Dependent factors:** These factors have weak drive power but strong dependence power.
- **Independent factors:** These factors have strong drive power but weak dependence power. A factor with a very strong drive power, called the 'key factor' falls into the category of independent or linkage factors.

Observations from the driver-dependence diagram are detailed below

Cluster I. **Autonomous Variables** – None of the factors have been identified as the Autonomous factors, which suggests that none of the factors are disconnected from the system and do not demonstrate weak drive power and weak dependence.

Cluster II. **Dependent Variables** – Data Quality, Analytical Tools and Data security controls have been identified as Dependent factors, suggesting that they are dependent on other factors for the success of an analytics service provider.

Cluster III. **Linkage Variables** – Shared Vision, Customer Focus, and Analytical Skills have been identified as Linkage factors, which suggest that these factors are unstable. Any action on these factors will have an effect on others and also a feedback effect on themselves.

Cluster IV. **Independent Variables** – Outsourcing Regulations has been identified as an Independent factor, which suggest that it is a 'key factor' with a very strong drive power for the success of an analytics service provider.

The driver-dependence diagram (Figure 3) suggests Outsourcing regulation is a key factor for the success of an analytics service provider. This can further be confirmed from the ISM model in Figure

2, which identifies Outsourcing regulation as having highest priority. This is followed by Shared vision and Customer focus, which are critical success factors. ISM model identifies Data security controls as a factor with least priority for the success of an analytics service provider.

CONCLUSION

With the help of ISM methodology, we could identify the complex relationships between the success factors of Business Analytics Outsourcing organization. The interactions among the key factors responsible for the success of Business analytics service providers can be identified using the ISM model. It also provides a roadmap for the implementation of these factors.

MICMAC analysis provided a basis to assess the driving power and dependence of each of these success factors and eventually assisted in developing a driver-dependence diagram. The driver dependence diagram developed as part of the MICMAC analysis also assisted in categorizing the parameters as Autonomous variables, Dependent variables, Linkage variables, and Excluded variables. The analysis provides valuable insights about the relative importance and the interdependencies among the key factors responsible for the success of Business Analytics outsourcing. This can assist the Business Analytics service providers in prioritizing the factors which are more critical to the success of their outsourcing engagements and proactively address them first.

The driving power-dependence diagram developed as part of the MICMAC analysis and the ISM matrix will assist potential Business analytics service providers in identifying and focusing on the key factors which are critical to the success of a business analytics outsourcing engagement.

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