Study of EFQM Business Excellence Model in Industry 4.0 Era

THESIS

Submitted in partial fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

by

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ABSTRACT

Business excellence is about developing and strengthening the management systems and processes of an organization to improve performance and create value for stakeholders. Adoption of business excellence models can help an organization to focus thoughts and actions in a systematic and structured way leading to the better performance. The emergence of quality as a critical success factor in the early 1980s saw the emergence of many quality management models or business excellence models in late 1980s, which created a competitive spirit in the world of quality and business excellence. Deming Prize is the first globally known business excellence model. Malcolm Baldrige National Quality Award (MBNQA) framework and European Foundation for Quality Management (EFQM) model for business excellence are the other two widely used business excellence models. During the last three decades, the national bodies developed/adopted suitable business excellence models for promoting quality and excellence awards based on the regional requirements and business environment.

The EFQM excellence model is a non-prescriptive framework consisting of enablers and results criteria. The criteria are further divided into sub-criteria and guidance points to provide better understanding of the model. The model could be adopted regardless of sector, size, structure, or maturity of the organization. The model motivates organizations to formulate strategies for the continual improvement of organizational processes leading to excellence. Formally, the EFQM model was introduced in 1991. The model has gradually matured over the three decades based on the inputs from the key stakeholders. The latest model is EFQM 2020 version. In 1994, Confederation of Indian Industry (CII) adopted the EFQM model for assessing the Indian Industries, and in association with Export Import Bank of India

instituted ‘CII-EXIM Bank Business Excellence Award’. The EFQM model contributes 45% of the worldwide quality awards, followed by the MBNQA (17%) and the Unique National Models (16%). It shows that EFQM is the popular choice of organizations to embrace the business excellence journey in their organizations. Several countries have created their national business excellence models based on EFQM, including India.

The EFQM theoretical construct serves as a base for the implementation of business excellence in the organization. However, the prioritization of actions for achieving excellence is a challenge. The leaders in organizations focus on attaining better business excellence scores, however during independent assessments, they face difficulties in correlating the business results to the effective deployment of the model. This is because the interrelationship among criteria at sub-criteria level are not available. This thesis provides the interrelationships between enablers and results, among enablers, and among results at the sub-criteria level so that decision makers in the organizations can prioritize their actions for better performance with minimum efforts. The data for the research is taken from the actual scores received by the organizations in their assessment for awards, which removes bias from the data. The category of awards received by the organization determines the measure of the maturity of the organization in the business excellence journey. A maturity model is a tool or framework to help organizations assess the strengths and weaknesses of their business processes and practices. This thesis also examines how the organization with high maturity and low maturity differ in the EFQM business excellence adoption and explores the path of attaining the high maturity of business excellence and performance of award-winning organizations. This helps the managers particularly in low maturity organizations to prioritize the EFQM improvements to move towards the high maturity of business excellence.

Recently, Fonseca et al. (2021) highlighted the EFQM 2020 model's novelties and its relationships with the Industry 4.0 paradigm. The EFQM has completed 30 years of journey as a forum, the look and feel of the branding did change but the basic motive did not change until 2019. The model continues to focus on excellence as a basis. Whereas, in the latest 2020 version, the excellence word itself is removed from the model. Evolution of the new EFQM model needs to be studied and its relationship with Industry 4.0 to be explored. Therefore, it is important to identify the critical success factors of Industry 4.0 and map these to EFQM to comprehend the relationship for the successful business outcomes. The linkages at the abstract or criteria level are important to understand the underpinning logics and take strategic decisions, but the actual success is measured by the KPIs at the operational level, which are important when implementing Industry 4.0. This research identifies the common KPIs by mapping KPIs to EFQM 2020 model and Industry 4.0 at the common platform. This will motivate the industry and practitioners to compare the EFQM and industry 4.0 for their business excellence journey. This comparison is expected to provide synergy to both EFQM model and Industry 4.0. The study of EFQM 2020 and Industry 4.0 would serve the researcher and academician to develop further on the concepts proposed in this thesis.

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LIST OF ABBREVIATIONS

Symbol / Abbreviation	Description
AFI	Area for Improvements
AGFI	Adjusted Goodness of Fit Index
AGQA	Arizona Governor's quality award
AHP	Analytic Hierarchy Process
ANOVA	Analysis of variance
ASQ	American Society for Quality
BCG	Boston Consulting Group
BE	Business Excellence
BEM	Business Excellence models
BHEL	Bharat Heavy Electricals Limited
BIC	Bayesian Information Criterion
BR	Business Result
BSC	Balance Score Card
CFA	Confirmatory factor analysis
CFI)	Comparative Fit Index
CiC	Cross Influence of criteria
CII	Confederation of Indian Industry
CMM	Capability Maturity Model Integrated
CMMi	Capability Maturity Model
COE	Centre of Excellence
CR	Customer Result
CSF	Critical Success Factors
CSR	Corporate Social Responsibility
df	degree of freedom
DOE	Design of Experiments
DP	Deming Prize
DQA	Dubai Quality Award
EFA	Exploratory Factor Analysis
EFQM	European Foundation for Quality Management
EQ	European Quality
EQA	European Quality Award
ERP	Enterprise Resource Planning
EXIM	Export Import Bank of India
FSS	Federal Specifications and Standards
GFI	Goodness of Fit Index
GP	Guidance Point
HM	High Maturity
i4	Industry 4.0
IMR	Impacting Magnitude on result
INQA	Iran National Quality Award
IoR	Impact on results
IQR	Inter-Quartile Range

Symbol / Abbreviation	Description
ISO	International Standards Organisation
JUSE	Japanese Union of Science and Engineering
KM	Knowledge Management
KMO	Kaiser-Meyer-Olkin
KPI	Key Performance Indicators
LM	Low Maturity
MB	Malcolm Baldrige
MBNQA	Malcolm Baldrige National Quality Award
NFI	Normed Fit Index
NIST	National Institute of Standards and Technology
NPS	Net Promoter Score
NQA	National Quality Award
OMG	Object Management Group
PCA	Principal Component Analysis
PCMM	People Capability Maturity Model
PDCA	Plan-Do-Check-Act
PLS	Partial Least Square
PLSR	Partial Least Squares Regression
PLS-SEM	Partial Least Squares Structural Equation Modelling
PR	People Result
QMS	Quality Management System
QS	Quality Standard
RADAR	Results, Approaches, Deploy, Assess and Refrain
RMSEA	Root Mean Square Error of Approximation
SA	Significant Achievement
SCE	Strong Commitment to Excel
SD	Standard Deviation
SEM	Structural Equation Modelling
SME	Small Medium Enterprises
SR	Society Result
SWOT	Strength-Weakness-Opportunity-Threat
TEI	Total Employee Involvement
TMMi	Test Maturity Model Integrated
TNQA	Taiwan National Quality Award
TPM	Total Preventative Maintenance
TQM	Total Quality Management
UAE	United Arab Emirates
UN	United Nations
US	United States
VIF	Variance Inflation Factor

CHAPTER-1

INTRODUCTION

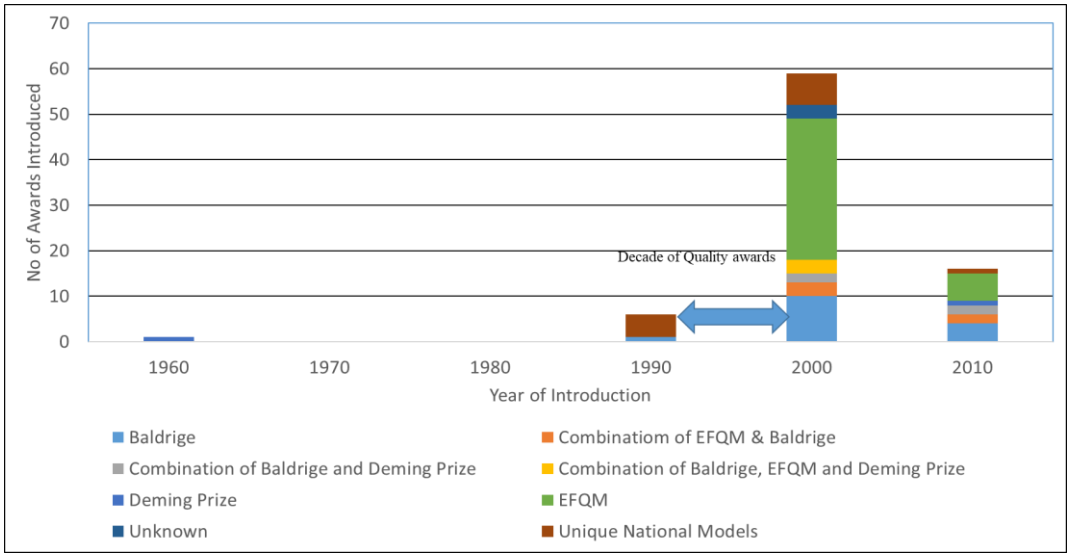
1.1 BUSINESS EXCELLENCE

Business excellence is about developing and strengthening the management systems and processes of an organization to improve performance and create value for stakeholders (Mann *et al.* 2004). Adoption of business excellence models can help an organization to focus thoughts and actions in a systematic and structured way leading to the better performance.

According to Feigenbaum and Feigenbaum (1999), the quality revolution is one of the twentieth century's most powerful creators of sales and revenue growth, better jobs, and sustainable business expansions. The issue of quality in products and services has interested researchers and practitioners for centuries (Juran, 1995). However, the contribution and influence of quality gurus like Dr. Walter Shewhart, Dr. W. Edwards Deming, Dr. Joseph M. Juran and to name a few made quality a high-priority area for academicians and practitioners in the twentieth century. Quality management has changed from being reactive to preventive while moving from inspection to statistical quality control, to quality assurance, to total quality management, to business excellence (Talwar 2011).

In 1951, Japan industrial forum realized the importance of Dr Deming's contribution to the quality and quality movement in Japan. The Japanese Union of Science and Engineering (JUSE) decided to recognize the contribution of Dr. Deming and institutionalised the **"Deming Prize",** the first globally known business excellence

model. The emergence of quality as a critical success factor in the early 1980s saw the emergence of many quality management models or business excellence models in late 1980s. Figure 1-1 depicts the chronology of quality awards in various countries which shows that a major focus on recognition of quality or performance excellence happened during the 1990s which created a competitive spirit in the world of quality and excellence. This decade is famous for quality awards and is generally referred as "**Decade of the global movement for business excellence**". The quality awards transformed from being a recognition tool to a practical management tool for driving excellence. While organisations competed to win quality awards, the main objective of the quality awards was to encourage companies to adopt and move towards structured quality management principles. Benchmarking against leading organisations helped numerous organizations to measure their status, identify gaps, and develop plans for future improvements in their journey of excellence.



Source: Adapted from Mohammad and Mann (2010)

Figure 1-1: Introduction of quality awards in various countries over the years

During the last three decades, the national bodies developed/adopted suitable business excellence models for promoting quality and excellence awards based on the regional requirements and business environment. The International Organization for

standardization (ISO), a specialized international agency for standardization composed of the national standards bodies of more than 160 countries, first published ISO 9000 standards in 1987 for quality systems standardization to improve the quality management practices in organizations. This standard has become a platform for quality improvement across the globe. In 1987, the US government realized the necessity of raising the awareness of quality and excellence among the US industries and introduced the Malcolm Baldrige National Quality Award (MBNQA) framework. It is the highest presidential award for excellence for industry performance in the US region (ASQ.org). In 1988, European industry leaders and practitioners came together to create a platform for learning and sharing to improve organizational performance. This forum was called the European Foundation for Quality Management (EFQM) and it introduced EFQM model for business excellence in 1991.

1.2 THE EFQM MODEL

Though, officially, EFQM forum was formed in 1989, Jacques Delors, the president of the European Commission took note of the TQM movement in Japan and the introduction of MBNQA in the US, triggering a thought of institutionalizing the recognition program of organizational quality and excellence in Europe. The leaders of the EFQM forum felt the need to build competitiveness in the European region. Jacques Delors joined hands with the leaders of 14 leading European companies in this journey. These leaders agreed to establish the European response to the global movement of quality and excellence. In 1988, the EFQM signed an agreement and tabled the formation of EFQM as a formal organizational entity with these 14 companies. Few more key industries joined this movement later. The formal launch of the EFQM forum and proposal for the model construct took place in 1989 at the first meeting of the EFQM in Montreux. The EFQM

excellence model is a non-prescriptive framework. Figure 1-2 shows the construct of the model based on the 2012 version of the EFQM model and provides a high-level description of each criterion. The model could be adopted regardless of sector, size, structure, or maturity of the organization. The model motivates organizations to formulate strategies for the continual improvement of organizational processes leading to excellence. According to EFQM 2012 booklet, it enables organisations to:

- Provides a common vocabulary and direction towards the path of excellence.
- Provides a basic structure for the organisation's management system.
- Assesses where is the organization on the path of excellence.
- Identifies the key strengths and potential gaps concerning the stated vision and mission.
- Integrates existing and planned initiatives and creates an integrated management tool as an overarching and holistic framework for sustainable excellence.
- Integrates different methods that fit together and complement each other

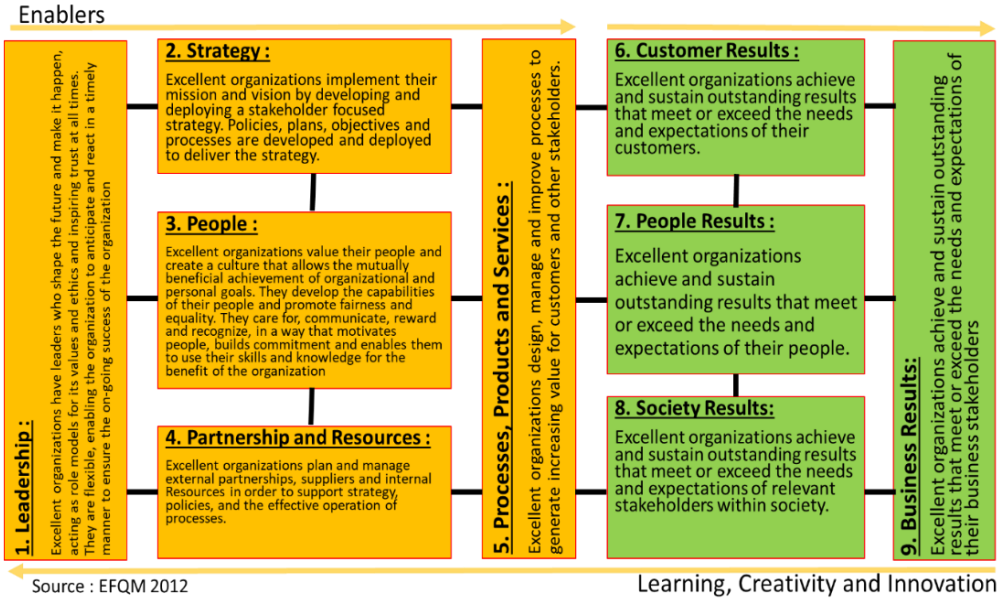


Figure 1-2: EFQM model construct showing criteria and criteria description.

In 1994, Confederation of Indian Industry (CII) adopted the EFQM model for assessing the Indian Industries, and in association with Export Import Bank of India instituted 'CII-EXIM Bank Business Excellence Award'.

1.2.1 Three Cornerstones of the EFQM Model

The philosophy of the EFQM framework is based on the three cornerstones as shown in Figure 1-3.

1.2.2 The Fundamental Concepts of Excellence

The 'Fundamental Concepts of Excellence' forms the fulcrum of the model. This provides the path for achieving sustainable excellence in any organization and it is a basis to describe the attributes of an excellent organization. This also serves as a common language for the top management. The fundamental concepts were driven from the European convention of human rights (1953) and updated subsequently. These were "part of the fabric" of the model and the assessors use these concepts during the assessment process. The first version of the fundamental concepts, introduced in 1999, was a set of eight titles with supporting high-level descriptions of the concepts.

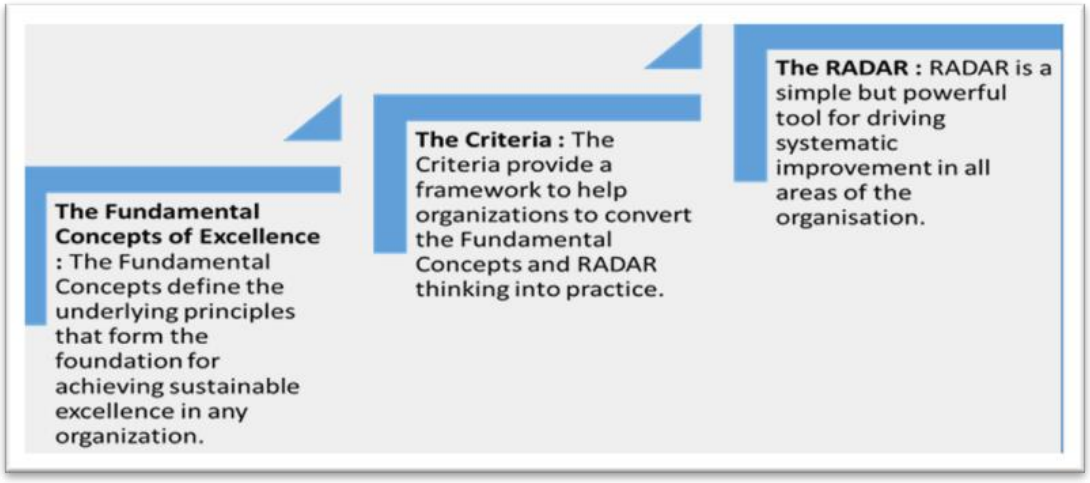


Figure 1-3: Three integrated components of the EFQM model

1.2.3 The Criteria, Sub-criteria and Guidance Points

The EFQM excellence model is a non-prescriptive framework based on nine criteria (five enablers and four results). The enablers or enabler criteria are leadership; strategy; people, partnership & resources; and products, processes, & services. The result criteria – customer, people, society, and business results – cover what an organization achieves by adopting enablers. To achieve sustained success, an organization needs strong leadership and a clear strategic direction. The enablers and results have two-way communication. 'Results' are caused by 'Enablers' and 'Enablers' are improved using feedback from the 'Results'. The arrows emphasize the dynamic nature of the model; showing learning, creativity and innovation helping to improve the capabilities that in turn leads to improved results. Each of the nine criteria has a definition (see Figure 1-2) that explains the high-level meaning of each criterion. Each criterion of the model is supported by sub-criteria to develop the meanings of criteria. Each sub-criterion is a statement that describes what an excellent organisation needs to demonstrate to achieve excellence. To describe further, each sub-criterion has a set of guidance points. There are 32 sub-criteria (24 for enablers and eight for results) in the model as given in Table 1-1

Each sub-criterion is provided with guidance points and is directly linked to the fundamental concepts. The guidance points are intended to aid the interpretation of the criteria and are not mandatory during implementation or assessment. The EFQM model version released in 2012 has a total of 119 guidance points. These points are used while assessing the organisation. The guidance points are presented in Appendix A-1.

Table 1-1: The EFQM model sub-criteria

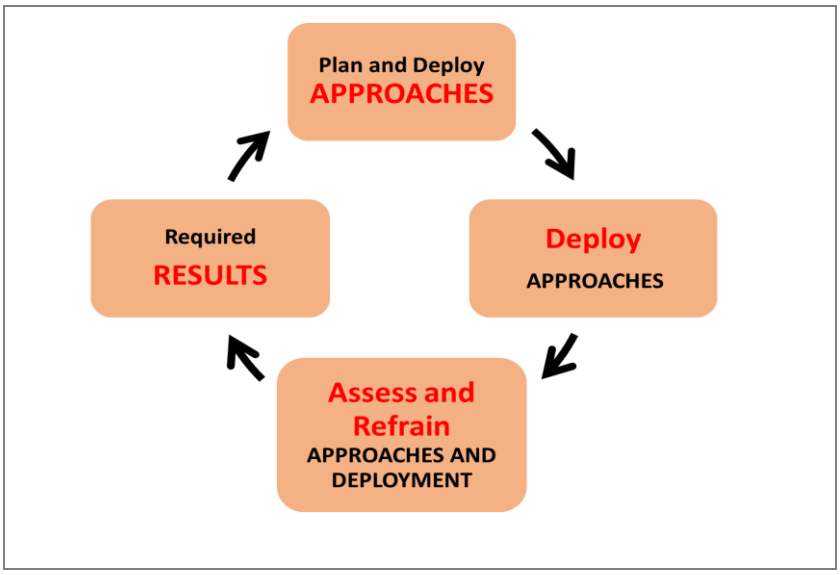
Criteria No.	Criteria Name	Sub-criteria	Sub-criteria description
1	Leadership	1.a	Leaders develop the Mission, Vision, Values and ethics and act as role models.
		1.b	Leaders define, monitor, review and drive the improvement of the organisation's management system and performance.
		1.c	Leaders engage with external stakeholders.
		1.d	Leaders reinforce a culture of excellence with the organisation's people.
		1.e	Leaders ensure that the organisation is flexible and manages change effectively.
2	Strategy	2.a	Strategy is based on understanding the needs and expectations of both stakeholders and the external environment.
		2.b	Strategy is based on understanding internal performance and capabilities.
		2.c	Strategy and supporting policies are developed, reviewed and updated.
		2.d	Strategy and supporting policies are communicated, implemented and monitored.
3	People	3.a	People plans support the organization's strategy
		3.b	People's knowledge and capabilities are developed.
		3.c	People are aligned, involved, and empowered.
		3.d	People communicate effectively throughout the organisation
		3.e	People are rewarded, recognized and cared for.
4	Partnerships & Resources	4.a	Partners and suppliers are managed for sustainable benefit.
		4.b	Finances are managed to secure sustained success.
		4.c	Buildings, equipment, materials and natural resources are managed in a sustainable way.
		4.d	Technology is managed to support the delivery of strategy.
		4.e	Information and knowledge are managed to support effective decision making and to build the organizational capability.
5	Processes, Products and Services	5.a	Processes are designed and managed to optimize stakeholder value.
		5.b	Products and Services are developed to create optimum value for customers.
		5.c	Products and Services are effectively promoted and marketed.
		5.d	Products and Services are produced delivered and managed.
		5.e	Customer relationships are managed and enhanced.
6	Customer Results	6.a	Customer perceptions
		6.b	Customer performance indicators
7	People Results	7.a	People perceptions
		7.b	People performance indicators
8	Society Results	8.a	Society perceptions
		8.b	Society performance indicators
9	Business Results	9.a	Business outcomes
		9.b	Business performance indicators

Source: EFQM 2012

1.2.4 The RADAR

The RADAR logic refers to Results, Approaches, Deploy, Assess, and Refrain as shown in Figure 1-4. The radar logic is built on the tenets of Deming's PDCA cycle. In simple words, it means that change in an organisation cannot be made simply through noble intentions, exhortations and frequent monitoring. The RADAR logic is a dynamic assessment framework and powerful management tool that provides a structured approach to evaluate the performance of an organization. At the highest stage, RADAR logic states that an organization should:

- Determine the results it is aiming to achieve as part of its strategy.
- Plan and develop an integrated set of sound approaches to deliver the required results, both now and in the future.
- Deploy the approaches systematically to ensure implementation.
- Assess and refine the deployed approaches based on monitoring and analysis of the results achieved and the ongoing learning activities.



Source: EFQM 2012

Figure 1-4 : The RADAR (Results, Approaches, Deploy, Assess and Refrain) logic

RADAR assesses an organisation's maturity of enabler criteria at seven levels – sound, integrated, implemented, structured, measurement, learning & creativity, and improvement & innovation. The result category RADAR attributes are scope & relevance, integrity, segmentation, trends, targets, and comparisons & confidence.

1.2.5 Integrations of the Fundamental Concepts and Criteria

The fundamental concepts and criteria are the cornerstones of the EFQM model. The construct of the model provides a clear linkage of the EFQM fundamental concepts with criteria. Table 1-2 shows the interlinkages of this relationship. For example, the functional concept, "Adding value for customers" has linkage to sub-criteria 5.b, 5.c, 5.d, and 5.e.

Table 1-2: Integration of functional concepts and criteria

Criterion	1. Leadership					2. Strategy				3. People					4. Partners & Resources					5. Processes, Products & Services				
Fundamental Concept	a	b	c	d	e	a	b	c	d	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Adding value for customers																								
Creating a sustainable future																								
Developing organisational capability																								
Harnessing creativity & innovation																								
Leading with vision, inspiration & integrity																								
Managing with agility																								
Succeeding through the talent of people																								
Sustaining outstanding results																								

Source: EFQM 2012

1.2.6 EFQM Model Implementation

Figure 1-5 shows how the organisations embrace the business excellence journey starting from initiation till their assessment. The organisation leadership decides on embracing the business excellence in the organisation. As a part of this exercise, the management/leadership would decide on the category of business excellence to apply.

The organisation would work on meeting the criteria of the model. If the organisation decides to participate in the award process, the organisation will put together an application document (position report) and apply to the awarding agency. After receipt of the application, the awarding agency carry out the initial screening of the application and forms an assessment team.

The assessment team consists of 3-6 members as assessors. The assessors from different organisations are trained and certified for EFQM business excellence assessment. The application document (position report) is furnished to the assessment team. The assessment team members are expected to perform an independent assessment of the organisation as per the guidelines of the EFQM model and as per the instruction of the lead assessor. Each team will be led by a lead assessor. The lead assessor will schedule a consensus meeting and invite all the assessment team members. This team will meet before site visit to arrive at a consensus score, identify the key strengths and areas of improvements for each sub-criterion. The entire consensus meeting is moderated by the lead assessor to guide the assessment process. At the end of the consensus assessment, the team would agree upon the consensus score, site visit schedule, and points to be verified during the site visit.

Based on the criteria established by the award committee, the organisations will be subjected to second phase assessment in terms of site visit. This is the next step of the assessment. Typically, organizations scoring 400 and above points are subjected to this second phase assessment i.e., site visit assessment. The assessment team will visit the site as per the schedule and carry out the site verifications needed for pre-identified points. The team will interact with a cross-section of people in the organisation to get the necessary evidence or confirmation of practices in the organisation. Based on this, the team will meet again and finalise the assessment score of the organisation. The team is

also responsible for the executive report of the assessment and the detailed report of the assessment. Finally, the assessment team completes the process of the assessment and submits the assessment report, score, etc. to the award committee. In India, CII administers the EFQM assessments, award program, business excellence training, and assessor certification programs.

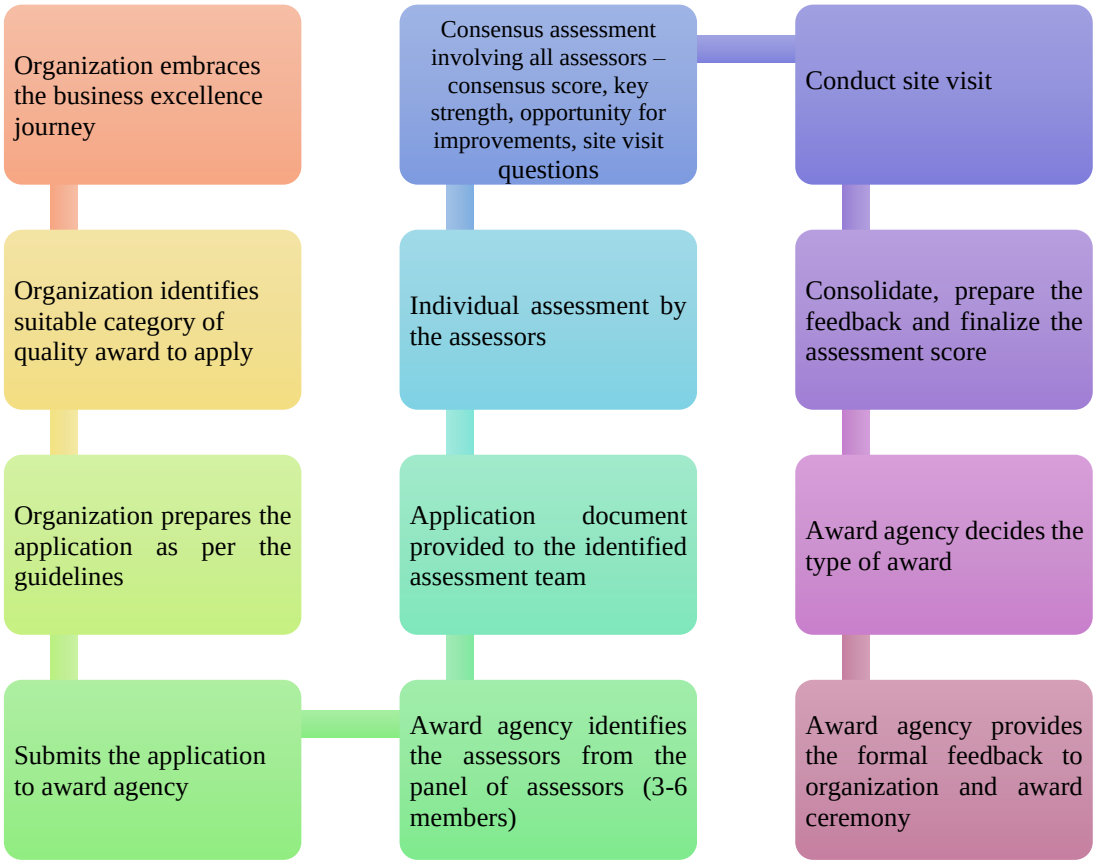


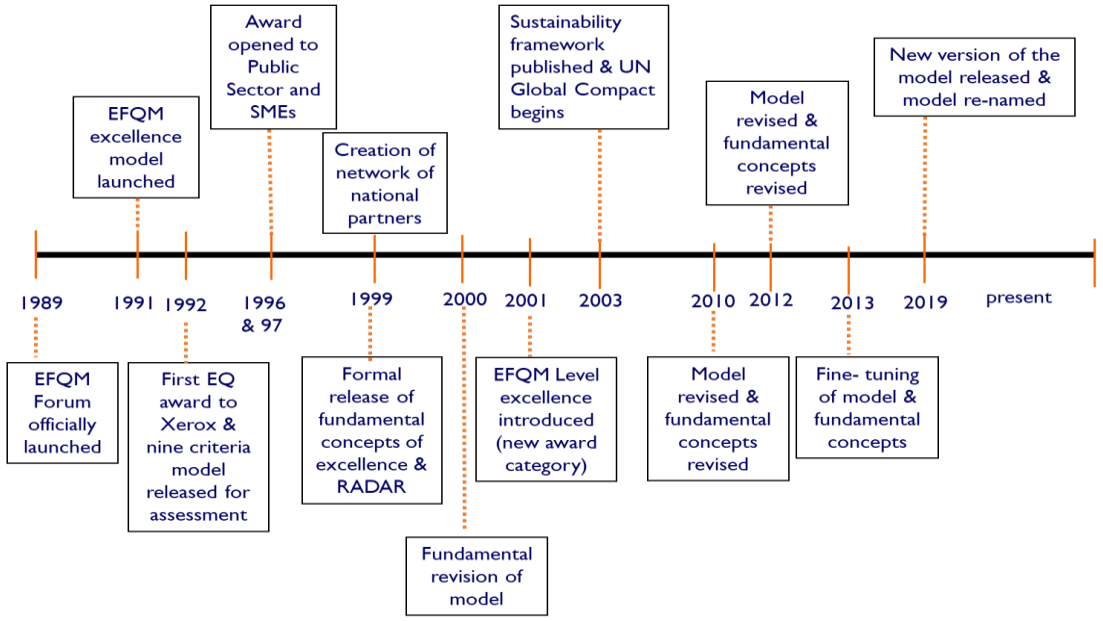
Figure 1-5: Flow diagram of the EFQM award process

The CII would determine the category of award to be given to the organisation based on the score of the organisation. In the case of a high maturity organisation, the next level of scrutiny will be done by a jury committee which is headed by top corporate leaders of the country. The jury committee would deliberate on the high maturity organisations based on the assessment score and decide the prize /award category. On the need basis, the jury committee would invite the lead assessor to present the assessment findings to the jury

committee. The assessment report, scores and jury committee discussions are confidential and strictly restricted to the award committee only. However, before getting into this award process, organisations need to examine their readiness through self-assessment. The four categories of recognition are SCE (Strong Commitment to Excel), SA (Significant Achievement), AW (Award Winner), and PW (Prize Winner). SCE is the lowest category of award and PW is the highest recognition.

1.2.7 Evolution of the EFQM Model

Even though the EFQM has completed 30 years of journey as a forum, the basic motive did not change until 2019. The model continued to focus on excellence as a base. The forum used the inputs from practitioners, academicians and industry to improvise the model. Each enhancement or change requests from the academician, practitioners and partners served as a seed for thought. The model has gradually matured over the three decades based on the inputs from all the key stakeholders. The milestones of the model depicted in Figure 1-6 provide a bird's eye view of the model and its evolution from its inception. The fundamental revisions of the model came in 2000, 2012 and 2020. Fundamental concepts of excellence and RADAR were released in 1999. The major shift in the model came in 2020 when the forum dropped the excellence from the title and made the perspective of application broader.

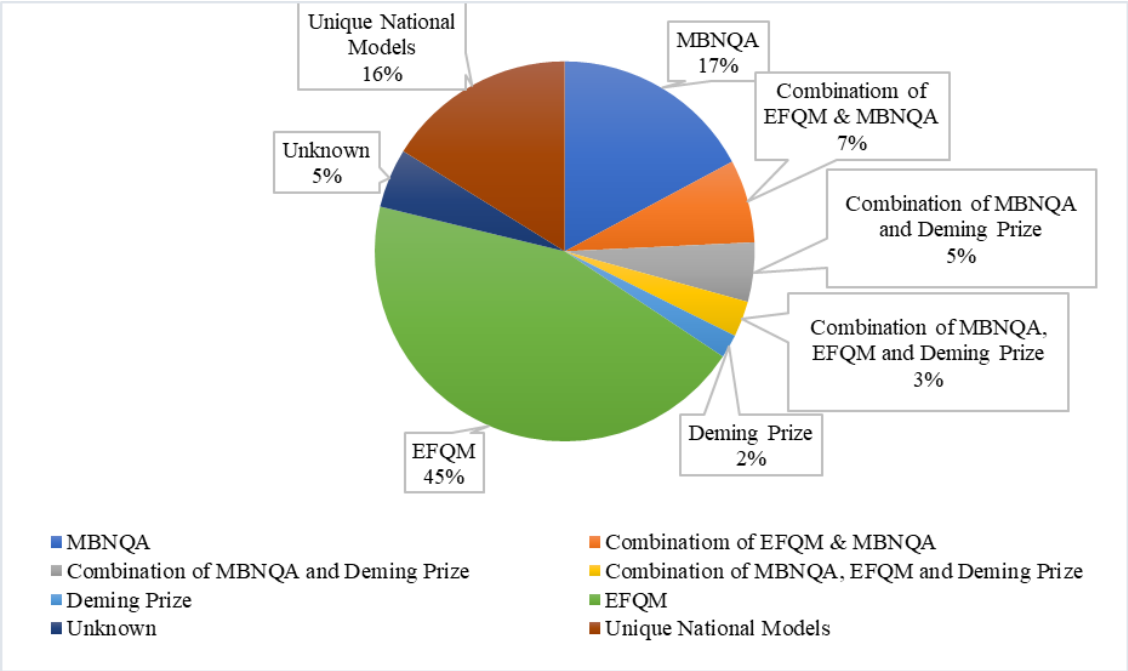


Source: Adapted from www.efqm.com and Simon (1996)

Figure 1-6 : Evolution of the EFQM model from its inception till date

1.3 RESEARCH MOTIVATION

Figure 1-7 depicts the quality and business excellence models adopted across the globe. The EFQM model contributes 45% of the worldwide quality awards, followed by the MBNQA (17%) and the Unique National Models (16%). It shows that EFQM is the popular choice of organizations to embrace the business excellence journey in their organizations. Several countries have created their national business excellence models based on EFQM, including India. The EFQM has established a theoretical construct of the model, and this serves as a base for the implementation of business excellence in the organization. It has been observed by the author, a senior implementor and assessor of the EFQM model, that the prioritization of actions for achieving excellence is a challenge. The leaders in the organizations focus on attaining better business excellence scores, however during independent assessments, they face difficulties in correlating the business results to the effective deployment of the model. This is because the interrelationship among criteria at sub-criteria level are not available. This is the primary motivation for this research.



Source: Adapted from Mohammad and Mann (2010)

Figure 1-7 : Quality awards adopted by various countries

1.4 OBJECTIVES OF THE RESEARCH

The objectives of the research are as follows:

- Establish the inter-relationship of the EFQM model at the sub-criteria level
- Establish the characteristics of high and low maturity organisations on the path of business excellence journey
- Identify the path of the excellence journey for the award-winning organisations
- Study the evolution of the EFQM model over the last 30 years.
- Establish the linkage between the EFQM 2020 model and Industry 4.0.

1.5 METHODOLOGY

To accomplish the above-mentioned objectives of the research, the following tasks were performed as shown in Figure 1-8.

- Conducted a literature review to trace the evolution of business excellence and the EFQM model.
- Developed the interrelationships among the EFQM sub-criteria by using DOE factorial analysis on the actual assessment score received by 58 Indian organizations during their assessment for EFQM award.
- Developed a quadrant matrix to classify the enablers based on their role in the EFQM model. The role of sub-criteria has been identified based on the influence of the sub-criteria on each other and their impacts on results.
- Identified the interrelationships among results at sub-criteria level.
- Validated the interrelationships among enabler sub-criteria, results sub-criteria, and influence of enabler sub-criteria among themselves and impacts on results through factor analysis and structural equation modelling.
- Assessed the characteristic of high maturity and low maturity organisations using the box plots, signal-to-noise ratio, and logistic regression.
- Studied the evolution of the EFQM model since its inception and a deep-dive analysis conducted to compare the EFQM 2012 and EFQM 2020 models.
- Carried out the descriptive analysis to identify the interrelationship between EFQM 2020 and Industry 4.0.
- Proposed the critical success factors (CSFs) for Industry 4.0.
- Proposed KPIs for assessing the digital factory and EFQM 2020 on a common base.

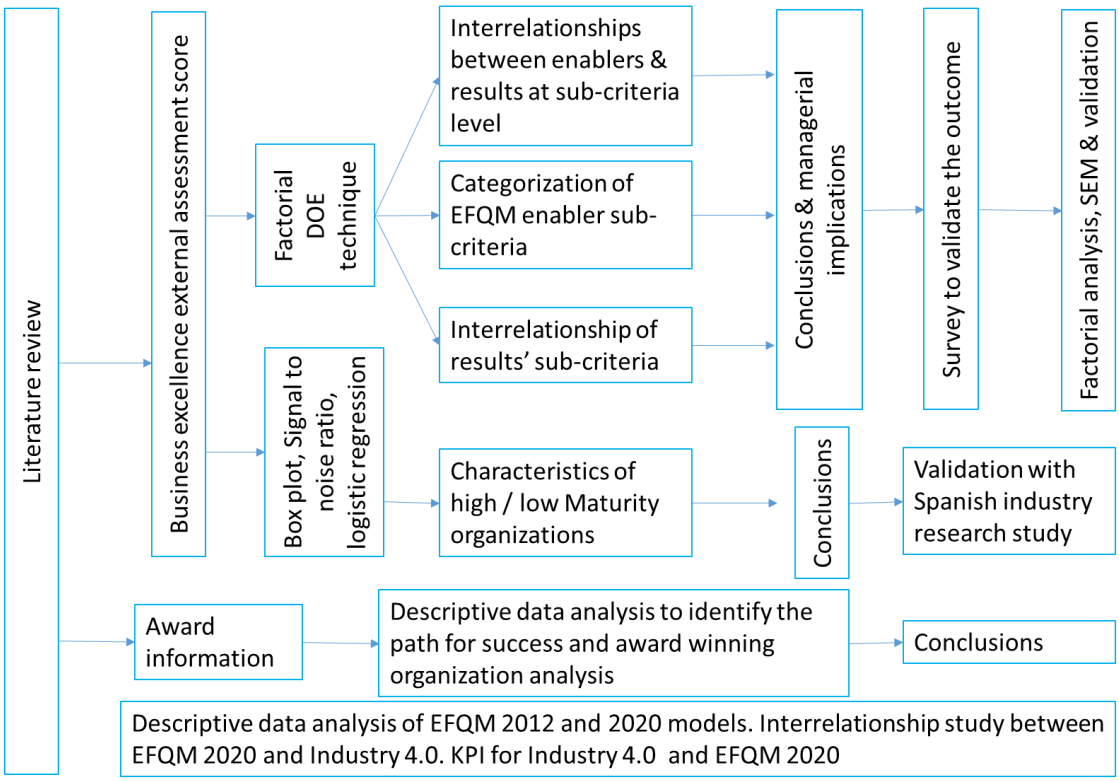


Figure 1-8 : Methodology and work plan

1.6 SIGNIFICANCE OF THE STUDY

The thesis contributes to the existing body of knowledge on the EFQM model and its usefulness in the industry 4.0 era. The study identifies and analyses the interrelationships of enablers and results of the EFQM model at the sub-criteria level. These analyses are based on the external assessment data and conclusions are related to the real practice scenarios of the organizations. This can serve as a managerial guide for the prioritization of the enabler deployment in the organizations at the sub-criteria level. The study has used the factorial DOE analysis for establishing the interrelationships by overcoming the multicollinearity issues. The study further deals with the identification of the characteristics of the high maturity organizations. The findings would help the low maturity organizations to focus on the appropriate practices and sub-criteria to improve their maturity on the path of business excellence. The study has presented evolution of the EFQM model over 30 years and deliberated on changes in the various dimensions of

the model, which is expected to be a launching pad for the future researchers in this area. The award information available at the CII website has been converted into meaningful data for the low maturity organizations to progress from one level to higher level of award. The work done in this thesis will help the managers and practitioners to adopt the EFQM in a much more effective way. This may support the managers to prioritize the EFQM improvements based on the desired maturity of the organization and to utilize the resources effectively. The identification of the critical success factors and KPIs relevant to the EFQM 2020 model and Industry 4.0 on a common platform will motivate the industry and practitioners to compare the EFQM and industry 4.0 for their business excellence journey. This comparison is expected to provide synergy to both EFQM model and Industry 4.0.

The study of EFQM 2020 and Industry 4.0 would serve the researcher and academician to develop further on the concepts proposed in this thesis.

1.7 ORGANIZATION OF THE THESIS

The thesis is organized into nine chapters as shown in Figure 1-9. CHAPTER-1 covers the introduction of the thesis. CHAPTER-2 focuses on the literature review to identify the research gaps for the thesis work. CHAPTER-3 establishes the interrelationships of enablers and results at the sub-criteria level. CHAPTER-4 presents the proposed quadrant model to categorise the EFQM enabler sub-criteria for their cross influence and impacts on results. CHAPTER-5 depicts the interrelationship of results criteria. The validations of the identified influences and impacts of enablers are presented in CHAPTER-6. CHAPTER-7 demonstrates the characteristics of high and low maturity organisations. CHAPTER-8 showcases the interrelationship of EFQM 2020 with Industry 4.0, and also presents the critical success factors and KPIs for EFQM 2020 and Industry 4.0 on a

common platform. Finally, Chapter-9 presents the conclusions and future scope of the work.

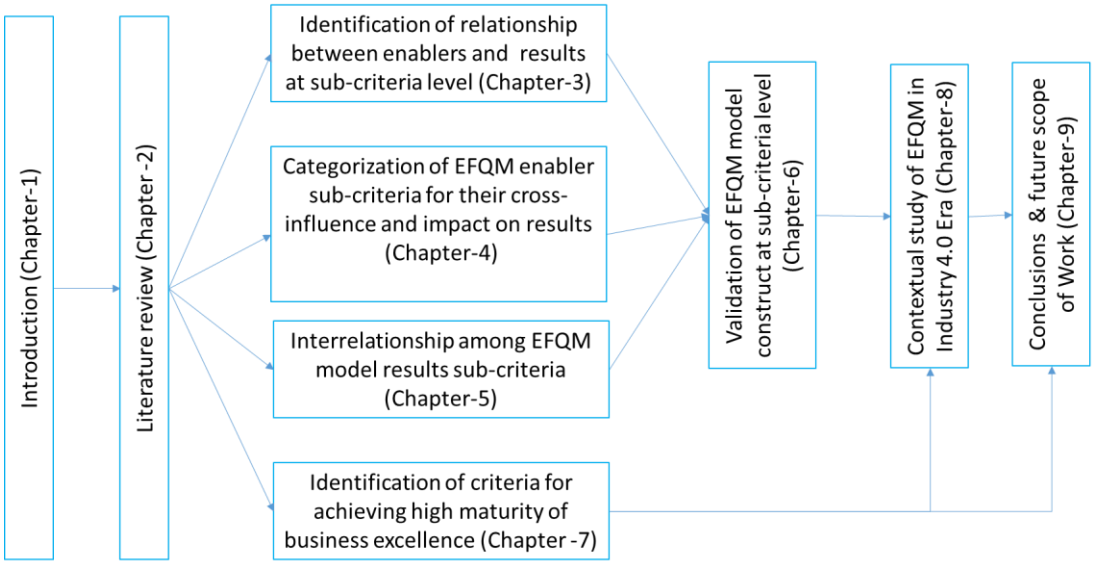


Figure 1-9 : Organization of the thesis

CHAPTER-2

LITERATURE REVIEW

This chapter presents a review of the literature to find the research gaps for charting the course of action for the research. The literature on various aspects of business excellence and EFQM model has been reviewed.

2.1 INTRODUCTION

Over the years, organizations across the globe have faced severe business and technology challenges. The newer technologies have made a significant impact on the assumed relationship between organizational behavior, business model, and business results. This has forced the leadership and organizations to reinvent their strategies and business approaches. Charles Darwin's theory of animal and species, "Survival of the fittest" holds well for the current business environments with a slight modification as "Organizations that are responsive to change will survive". Organizations that have adapted to the new business environment, demonstrated adaptation of cutting-edge technologies related to products and services, strong leadership, culture, and continually evolving organizations have survived. Given the dynamics of the business environment, it is crucial for all the professionals and leaders to come forward and analyze the situation to identify the changes required in the management approaches. Realizing these dynamics in the marketplace, industry leaders, industry forums and national bodies have realized the need for business excellence practices. Over the years, the national bodies, governments, and non-profit organizations have introduced several awards in the field of quality to recognize excellence in organizations for their performance. These awards are generally

instituted for assessing the quality systems. These awards or recognitions are broadly termed as quality awards.

In 1988, European industry leaders and practitioners came together to create a platform for learning and sharing to improve organizational performance. This led to the benchmarking of European organizations for achieving sustainable economic growth and improving the organizational maturity. This forum was called the European Foundation for Quality Management (EFQM) and this forum introduced an excellence award called EFQM Award (www.efqm.org). In the initial days it was termed as EQA (European Quality Award) and later it was termed as EFQM Business Excellence award.

2.2 RESEARCH METHODOLOGY FOR LITERATURE REVIEW

A literature search was done for the business excellence and EFQM model papers using Elsevier, Emerald, Taylor & Francis, and Inderscience databases. The "Business Excellence" keyword carries 635 research articles and the keyword "EFQM" (including Extended form) carries 671 articles. These papers had four literature review papers: Kim *et al.* (2010) providing a review of 114 papers; Suárez *et al. (*2017) providing a review of 53 papers published during 1991–2015; Ghafoor *et al.* (2020) covering 382 papers published during 1990 – 2020; and Unnikrishnan *et al.* (2019) providing a review of 371 papers selected from 1985 to 2018. Since the span, depth and breadth of the papers were significant and the papers were also latest, therefore a snowballing (forward and backward) approach was used to identify the papers for the literature review. This provided a sizeable number of papers (918 in number) for the study. After discarding the repeat papers, 753 unique papers were left for the review. These papers were divided after reading the title, abstract and conclusions into 15 categories as presented in Table 2-1. This gave an idea of how to make the review manageable under various categories. Next,

the search was narrowed down to the papers on EFQM model to make the deep-dive review within manageable limits. This resulted in 154 papers. All these 154 papers are reviewed in the next section.

Table 2-1: Broad classification of the research papers on BE (753 papers)

SL No	Areas of research	Scope of the paper	%age literature
1	Case studies and applications	Intensive systematic investigation of an organization or region or country for BE adoption	14.2%
2	Empirical assessment/ validity of BE models/ frameworks	Empirical studies using statistical analysis, exclusively derived from concrete, verifiable evidence. The studies are carried out to verify/validate BE practices using data.	12.6%
3	Comparison of BE with ISO, TQM and quality management practices	The papers related to the comparison of BE with TQM, ISO, balance scorecard, knowledge management etc.,	12.1%
4	Impact of BE and BE models/ frameworks on organizational outcomes	These papers focus on measuring BE, impact of BE models on organization, region or country	10.5%
5	Components of BE	Analysis of components of BE and studies concerning new areas like information technology, knowledge management, intellectual capital, human capital, etc.	8.9%
6	Interrelationship of BE model/ framework criteria	Assessment of the interrelationship of BE model criteria based on the empirical or literature-based study	7.4%
7	Guides on implementing and using BE	These papers present implementation challenges, the approach of implementation, usage of BE and guidance of implementation	6.8%
8	Application of BE in new industrial segments	Application of BE models apart from the manufacturing, like, education, construction, hotel, R&D, hospital, services, airport, golf course management, call center, etc.	6.8%
9	Development of future BE models	The papers focus on how BE models have been developed and look from the future perspective.	4.9%
10	Self-assessment	These papers focus on how an organization uses self-assessment for process improvements, and comparison of self-assessments of BEMs.	4.2%

SL No	Areas of research	Scope of the paper	%age literature
11	Award-winning organization's path to success	These papers focus on how award-winning organizations succeed in award-winning, the practices they have adopted and how they sustain the practices.	4.2%
12	History and evolution of BE from TQM	Papers cover the evolution of BE	4.1%
13	Literature Review	Literature reviews paper	1.1%
14	Implementation, Implementation challenges and success factors	Implementation, implementation challenges and success factors of BE are studied	0.4%
15	Miscellaneous	Not fitted to above listed topics	1.7%

2.3 REVIEW OF LITERATURE

Finally, 154 papers were found within the ambit of this research which were focused for performing the deep dive. The literature is divided into three segments: National business excellence / quality awards, business excellence models, and EFQM model.

2.3.1 National Business Excellence Awards

In this section, the literature review of the national business excellence awards is presented with the evolution of the quality awards in various countries. A comparison of the key business excellence awards is also presented.

Bohoris (1995) conducted a study focused on the comparative assessment of three TQM models namely; Deming Prize, MBNQA and EFQM. The study highlights that these three awards have unique systems, set of examination criteria, purpose, and overall approach. All the three models demonstrate the underlying TQM practices. The study highlights that the DP focuses on company-wide quality control practices, MBNQA is

driven by customer focus and satisfaction, and EFQM focus on community, customer and employee satisfaction.

Tan and Khoo (2003) highlighted similarities and differences within award criteria and scoring systems of 27 national awards. Miguel (2005) studied quality and business excellence awards adopted by 76 countries. This paper presents the main characteristics of the quality and business excellence models which include mission, core values, levels of eligibility, recognition, categories, and scoring methods.

Talwar (2011) presented 100 BEMs / NQA being used in the world. The study highlights the adoption of the business excellence awards based on EFQM, MBNQA, DP, or unique models. It is found that over the years, DP is losing its popularity in Japan but gaining popularity in some emerging economies.

Mohammad and Mann (2010) identified 96 national quality/business excellence awards adopted by 83 countries around the globe. This paper deliberates on BEMs, how these are adopted for the overarching framework to manage the multiple improvement initiatives in the countries. The authors proposed a new model for enabling the criteria of BEM to serve as a roadmap for BE implementation.

Ghicajanu *et al.* (2015) presented a comparison among DP, MBNQA and EFQM models. The paper highlights the excellent practices in managing the organization and achieving the results based on a set of concepts and values. The three models focus on business innovation, customer satisfaction, human resource, vision and strategy, leadership, business ethics, sustainability in business, and financial results.

Adebanjo and Mann (2005) presented a business excellence framework and compared EFQM and MBNQA models. The paper highlights the benefits realized by some of the award-winning organizations and the study also highlights that 86 countries have adopted

the business excellence or quality awards. The paper depicts that organizations adopt business excellence to improve and seek recognition through excellence awards, but a majority of the organizations adopt business excellence to improve organizational performance and to enhance competitive positioning in the marketplace.

2.3.2 Business Excellence Models

This section presents a comparison of the BEMs, case studies, empirical studies, and key success factors for BE.

2.3.2.1 Comparative study of business excellence models and other management practices

Pannirselvam *et al.* (1998) adopted the Arizona Governor's quality award (AGQA) assessment data to validate the MBNQA model criteria. The authors found that AGQA criteria like MBNQA and very comprehensive. The study reveals that the AGQA model provides a comprehensive quality management system for embarking on the quality improvement path of the organization.

Vokurka *et al.* (2000) compared the constructs of five quality awards: MBNQA, EFQM, Deming prize, Canadian quality award, and Australian quality award. The study highlights the quality objectives, criteria and scoring systems.

Boys *et al.* (2004) presented the opinions from Canadian quality standardization experts that were used to explore the needs of the business against what is offered by ISO 9004 and to assist in the comparison of ISO 9004 with common business excellence models.

Vaxevanidis *et al.* (2006) highlighted the relationship between generic ISO 9000:2000, automotive sector-specific QS9000, ISO /TS16949, MBNQA, and EFQM. The study highlights the that MBNQA and EFQM models have the similar objectives. The paper also highlights the efficacy of ISO 9000 standard as a base for developing the other quality models.

Heras-Saizarbitoria (2006) analyzed the influence of the adoption of quality models (ISO 9000 and EFQM) on organizational results based on the qualitative survey approach using the Delphi Method. Based on the feedback from 27 QM professionals and experts, the study confirms that the implementation of QM models impacts the organizational performance.

Sharma and Talwar (2007) presented a universal business excellence model based on the Vedic practices of India. The Vedic philosophy devices infinite creativity, actions and power from the universal laws of nature. The paper compares the EFQM, DP, MBNQA practices to Vedic practices.

Jayamaha *et al.* (2009) presented an empirical validity of three key business excellence models; namely the Australian business excellence model, New Zealand business excellence model and Singapore quality award based on the past assessment scores of the applicants in the region. Partial least square regression method was adopted to assess the relationship between enablers and results and found high levels of cross-loadings on results in all the three models. When all the key stakeholders were taken as a whole, all the enablers became equally influential in predicting the overall organizational results.

Vernekar and Sheykhoteslam (2015) compared MBNQA, DP, and EFQM models exclusively on process criterion. The study depicts the merits and demerits of the process criterion and its impact. Sreeja and Hemalatha (2016) also compared the DP, MBNQA, EFQM, and Australian business excellence models.

Pakhale (2017) covered the literature review of the leading quality awards in various countries and deliberated on MBNQA and EFQM models. Shrouty and Tiwari (2017) focused on the literature of business models, their certification bodies, and various quality model criteria. The study focuses on the DP, MBNQA, Tata business excellence model,

and Golden peacock national award. The paper proposed a model to understand the differences among business excellence, operation excellence and performance excellence.

2.3.2.2 **Model deployment / implementation challenges**

Zamani and Valmohamammad (2014) revealed the effect of the Iran National Quality Award (INQA) model implementation in Iran through an empirical study. The study shows that the performance, environment and society results as well as 'leadership and management', 'processes improvement', and 'organizational resources' criteria have shown significant improvements in Iran.

Pozega *et al.* (2014) presented the level of business excellence knowledge in Sibenik-Knin County covering the knowledge of the top management concerning business excellence and quality principles. The paper shows that the organizations in Sibenik-Knin County lack the initiatives and the systematic approach for the implementation of business excellence models and the organizations believe that the ISO certification is sufficient for strengthening competitive advantage and organization success.

Leonard and McAdam (2002) deliberated on the management thought process about how the business excellence model is used in the organizations. The paper suggests how managers should be involved in organizational change models like business excellence.

Vartiak (2016) presented internal and external factors affecting business excellence. The paper presents six (structure, strategy people, technology, systems, and results) internal and five (social forces, economic forces, cultural forces, customer focus, and partner forces) external factors affecting the business excellence. The study also highlights that while organizations adopt business excellence model, the organizations need to identify the critical success factors for effective deployment of the business excellence.

Ghinea *et al.* (2017) presented the application of the business excellence model in higher education in the context of the Bologna process. Adopting the excellence model provides more flexibility to the institute for understanding the stakeholder expectations to develop the institutional strategies. Authors proposed a model named as ENCLOSURE (Excellence model for sustainable higher education) for fostering cultural-economic diversity and enabling authentic excellence.

2.3.2.3 **High maturity and award-winning organizations**

Gupta (2013) deliberated on how to achieve the world-class status of an organization. The study establishes a conceptual framework for achieving the world class status. The study is based on the survey data of the 75 companies.

Doulatabadi and Yusof (2014) studied the factors contributing to sustaining quality management practices in UAE using Dubai quality award winners. The survey identified the eight influencing factors, from award-winning organizations, affecting the implementation of quality management practices: leadership commitment, strategy, empowerment and involvement, education and training, teamwork and cooperation, recognition and reward, communication and relationship and work culture and climate.

Bandyopadhyay and Nair (2015) reviewed the award-winning firms and highlighted that the differences in the key management practices compared to the non-award-winning organizations.

Lasrado and Uzbeck (2017) study highlighted the adoption of the business excellence model in the UAE and its impact on 21 award-winning organizations in the region. It was found that the adoption of business excellence models helped the organization to enhance quality; and award-winning organizations have exhibited unique programs to embrace the business excellence practices.

Lasrado (2017) presented six perceived benefits of the excellence model adoption – independent quality assessment; fostered continuous improvement; promoting the culture of business excellence; fostered teamwork and organization learning; opportunity to share, learn and benchmark; and brand recognition and pride – from the analysis of 13 UAE award-winning organizations.

2.3.2.4 **Business excellence model interrelationships**

Wilson and Collier (2000) focused on the causal performance linkages within the MBNQA model through a survey involving 101 questions and feedback from 38 respondents. The study highlights that leadership significantly influences the system performance and results. The leadership does not have a direct influence on the financial results, however it influences overall performance through the system approach. Information and analysis are the next most significant factors. Process management influences customer satisfaction and financial results.

Pannirselvam and Ferguson (2001) presented the underlying relationships of MBNQA criteria with quality management and organizational performance. The study used the Arizona Governor's quality award assessment data to compare the construct of MBNQA. The study shows that leadership has a significant influence on the system construct.

Meyer and Collier (2001) empirically tested the causal relationship of MBNQA model for healthcare sector using 220 US hospital data. The study developed an SEM model of 28 dimensions of the MBNQA that were found reliable and valid for healthcare.

Flynn and Saladin (2001) focused on the validation of the three versions of MBNQA from 1992 to 1997. The study highlights that managers should focus on the three critical drivers of quality performance: leadership, process management, and information and analysis.

Tan and Khoo (2003) highlighted 10 important criteria for achieving the business excellence; namely leadership, strategies, policies and plans, customer focus and satisfaction results, people focus and results, information, processes, resources, supplier and partner results, society and environment, and other results.

Badri *et al.* (2006) presented an empirical test of the MBNQA criteria for education performance excellence. The author used the survey data of 220 respondents from 15 UAE universities and colleges to verify the construct of the model. The result shows that leadership is a driver for all components in the Baldrige system. The construct shows that enablers influence the organizational performance results; and student, stakeholder and market focus.

Jayamaha *et al.* (2008) assessed the validity of Baldrige criteria for performance excellence of New Zealand organizations using self-assessment scores of 91 New Zealand organizations and the PLS method. The study found 11 statistically significant interrelationships to endorse the salient features of quality management: reliance on measurement, analysis, and knowledge management; the involvement of people; and the role of leadership in setting direction.

Saunders *et al.* (2009) examined the relationship between strategy deployment and quality management and showed that the two fields are effective for achieving business excellence. From the empirical study, it was evidenced that quality management and strategy deployment are connected.

Su *et al.* (2003) examined interrelationships of the Taiwan national quality award (TNQA) model through a survey of the Taiwanese industry. SEM and path coefficients were used to validate the internal relationship of the model. The study shows leadership has a strong influence on information management and information management is the

key driver of the TNQA system. Leadership and innovation, and strategic management directly influence the business results.

Jayamaha *et al.* (2011) presented the empirical results of 118 MBNQA and Australasian business excellence award applicants. The empirical study shows a low level of measurement validity under both models. It indicates that model level is designed at the high level of integration.

Zhen *et al.* (2011) developed a measurement model by using exploratory and confirmatory factor analyses to validate the theoretical construct of the Baldrige framework based on evidence from China. The study finds that process management is the most important construct in the Baldrige framework from Chinese point of view followed by leadership.

Lobo *et al.* (2012) assessed the quality management capabilities of manufacturing industries in Australia using the conceptual quality management assessment framework. The analysis provides valuable guidelines for the managers and organizations for benchmarking their practices to identify the gaps in their current practices.

Gupta (2013) studied 75 best performing Indian listed companies to establish the relationship of business results based on the leadership styles and types of organizations. Leadership, strategy, and customer focus were found to be the key determinants of business excellence from the Indian context. The findings of Indian companies are quite diverse, and the companies have focused on human resource development, customer satisfaction, product quality, focus on a wide variety of process practices, TQM, and cost competitiveness.

Karimi *et al.* (2014) carried out an in-depth analysis of the Baldrige model to facilitate the prominent role in the TQM implementation. The authors used the assessment scores

of the organizations to assess the interrelations of the model and found that leadership has a strong role in the implementation of TQM practices in the organizations.

Mai (2017) evaluated the causal relationships implied in Baldrige criteria for performance excellence. The author used the assessment score and PLS path modelling to validate the hypothesized causal relations across different industry sectors. Path analysis demonstrated strong support for performance excellence across the organizations. Measurement, information and analysis criteria have less predictive power in the context of service industries. Human resource criteria have played a larger role in determining quality in the service sector. The study also highlights that in the service industry, strategy to the customer has significant influence. Leadership has a vital role in performance excellence in an organization.

Jeyaprabha (2018) explored and validated some of the quality management beliefs which are connected to the Baldrige criteria linkage using the visual PLS software. The paper established key external results and internal performance metrics of the model.

Kassem *et al.* (2019) studied the organizational culture dimensions (mission culture, adaptability culture, involvement culture, and consistency culture) on business excellence results by using the data from 448 managers. It was found that the organizational culture is related to business excellence wherein information and communication technology acts as a moderator between organizational culture and business excellence results.

Kothandaraman and Kamalanabhan (2018), using feedback of 521 participants from the technology service industry, confirmed that people excellence variables positively influence organizational maturity and in turn improves the business outcome across staff, firm and customer dimensions.

Chipwatanga and Kaira (2019) created an innovative strategic operational excellence framework to improve and sustain organizational performance. The authors developed a theoretical construct of the model involving the organizational diagnostic model and factors influencing the performance of the organization. The study highlights the close relationship between operational excellence and innovation.

2.3.2.5 **Relation of business excellence models with other management practices**

Curkovic *et al.* (2000) assessed the TQM dimensions influencing the MBNQA organizations. The survey data of 526 automotive industry plant managers confirms that TQM practices influence the MBNQA program.

Prabhu *et al.* (2000) studied the performance of 700 ISO and non-ISO companies in the UK. The study confirms that 74 percent of the TQM companies and 28 percent of the ISO companies have achieved the status of the potential winner or world-class.

Mccarthy and Greatbanks (2006) studied the leadership practices and perceptions among German and UK organizations. Bassioni *et al.* (2008) developed the criteria and sub-criteria of the construction industry excellence model based on the TQM framework and excellence models by using the survey data and factorial analysis.

Martensen *et al.* (2007) examined approaches to measure and diagnose innovation excellence based on the data from Danish organizations. The paper presented a conceptual model for innovation excellence and measurement system which has been validated by SEM and PLS techniques.

Talib *et al.* (2010) carried out a study establishing the relationship between TQM implementation and the company performance among Indian service companies. Farhad *et al.* (2011) presented critical success factors of the quality management systems for SMEs in the manufacturing sector.

Mann (2011a) presented the business excellence adoption in India, Japan, China, Singapore, and Thailand by analyzing the data from 74 companies, 21 discussion groups meetings and interviews of 12 award winners. The key findings are: business excellence has a major impact on competitiveness and performance, business excellence model is relevant from a long-term competitive perspective, the assessment exercise helps organizations to benchmark and learn from others, and award-winning is important but not a major motivator for the majority of the companies participating in the survey.

Corbett and Angell (2011) examined the approach, performance and progress of New Zealand organizations using the assessment score data from 1993 to 2008. The study highlights that organizations show slightly higher scores during the initial phase of the business excellence model adoption, but later this gets neutralized due to changes and impacts on the results.

Dawei *et al.* (2011) presented a diamond model having the four dimensions of operational excellence, strategic fit, capability to adopt, and unique voice and connecting to the classical school, strategic school, dynamic school, and individual school of business excellence. The author highlights the interlink and mutual reliance among the four dimensions as the key for business excellence.

Pregeljc (2012) used the machine learning technique to assess the connection between the quality of an organization and the business results of the organization. The study using 72 data sets of quality performance and business results confirms the existence of dependency relationship between quality and business results.

Gupta (2012) studied leadership strategies and actions from a sample of 75 top-performing Indian companies listed in stock exchanges. It was found that leadership

practices influenced results directly or indirectly through business practices like operations, structure, resources, operation strategies, etc.,

Rocha-Lona (2015) explored the integration of BEMs with corporate sustainability by measuring performance in terms of economic, social, and environmental bottom lines.

Androniceanu (2017) articulated the quality management in connection with technical, social and economic dimensions, having inter-conditioning relationships. The results based on the data from 280 managers of 56 companies reveals the vulnerabilities and weaknesses of the system for the three-dimension approach of TQM to achieve business excellence in Romanian firms.

Alomairy (2016) studied the impact of organizational innovation and dynamics capabilities on business excellence involving 24 organizations. The study confirms the positive correlation of innovation and performance excellence concerning Baldrige implementation.

Amponsah and Ahmed (2017) mapped the history of business excellence evolution and tried to connect to the social perception of the practices and the role of ethics in business. The findings reflect the conflicting roles of business excellence models in the business performance. The study suggests the use of business models as a strategic tool rather than the tactical role of the business excellence models.

De-Vijith and Quadros (2019) identified the factors in management systems that contribute to business excellence in an organization. The study conducted at Veoneer Sweden AB through benchmarking three organizations that have achieved business excellence by conducting interviews with 14 people found that the management systems contribute to business excellence through a mix of systemic and cultural factors.

Sony (2019) proposed an integrated model for sustainable operational excellence considering the social, economic and environmental aspects of operational excellence.

Jankalová and Radoslav (2020) explored the business excellence dimensions related to sustainability by evaluating the cross-cultural values of national quality awards and excellence models. The paper mapped the business excellence dimensions to sustainability using secondary data from business excellence adoption.

2.3.2.6 **Self-assessment**

Saunders and Mann (2005) critically examined the self-assessment practices followed at the New Zealand benchmarking club. The empirical study identified 57 relationships between performance excellence criteria, and a strong correlation was found between customer-focused results with financial and market results.

Williams *et al.* (2006) examined the relevancy of self-assessment using the excellence models by academic validity and practical validity of the models and their procedures. The study confirms the academic validity of these business excellence models and practical validity are questionable.

Doulatabadi and Yusof (2018) detailed the self-assessment practices used for assessing the quality management practices based on National quality awards in terms of necessity, benefits and adoption. The paper depicts the self-assessment practices adopted for four leading business excellence models: DP, MBNQA, EFQM, and Australian business excellence model.

2.3.2.7 **System dynamic of business excellence**

Mavroeidis *et al*. (2009) presented the system dynamic model for the criteria versus the results. The paper provides a dynamic view for the organization using a computer program that simulates the situations.

Seyed-Hosseini *et al.* (2009) presents the system dynamic model using total quality management practices and by applying the Vensim PLE version to simulate the decision making for improving the Total Quality Management Index (TQMI). This simulation helps the organizations to decide on improvement prioritization while embracing the excellence journey.

2.3.3 EFQM Literature

This section presents the papers on EFQM model. These papers are grouped and presented based on the broad level categorization.

2.3.3.1 Application of EFQM in different industry segments

Naylor (1999) examined the appropriateness of the EFQM business excellence model for hospital management and showed the improvements in organizational performance by aligning the strategic actions to the EFQM based approach. Nabitz (2000) examined the EFQM application in Dutch health care industry. Nabitz *et al.* (2006) also demonstrated the good results across all nine criteria of the model by evaluating the evidence-based deaddiction treatment process redesign programme implemented as a part of total quality management in a Dutch addiction treatment center. Gorji and Siami (2011) studied the effect of enablers on hospital results through EFQM adoption. The data from 203 employees was correlated with the self-assessment scores of the model and it was found that the hospital performance is influenced by process criteria, partnerships, leadership, people, and policies and strategies. Mesgari *et al.* (2017) found the causal structure among the EFQM criteria in the healthcare sector. The theoretical framework suitable for health care sector is developed and tested based on the results of self-evaluations performed in Iran public hospitals using the Structural Equation Modelling.

Hides *et al.* (2004) demonstrated the application of EFQM in UK higher education sector to create a customer-oriented culture using the self-assessment scores. The author

extended the self-assessment learning to public sectors. Davies (2004) also examined the implementation of EFQM in UK academic universities. Jamal (2015) presented the application of the EFQM excellence model in Palestinian Universities in the Gaza strip. The study highlights enabler criteria as the key indigents for the success of the university outcomes.

Sadeh and Arumugam (2010) evaluated the EFQM application in small and medium-sized enterprises in Iran. DEMATEL technique was applied to assess the integrations using MATLAB software. The study highlights leadership criterion as the most significant influencer of excellence in SMEs followed by people criterion. The study also highlights the positive impact of EFQM enablers on the key performance results.

Mohamadesmaeil *et al.* (2011) applied the EFQM model in central libraries of the government medical science universities of Iran. The survey and explanatory interview conducted with 22 managers and officials highlight enhancement and improvement of the processes and the development of the analytical and scientific quality culture after the adoption of the EFQM model.

Savić *et al.* (2014) demonstrated that the leadership has a dominant influence, and employee satisfaction and employee loyalty showed positive impact by adopting the EFQM in the Serbian banking sector. However, the corporate social responsibility of the banks was not evidenced by their employees.

Vukomanovic *et al.* (2014) explored the suitability of EFQM model application in the construction industry using assessment scores from 34 construction companies in the South-Eastern Europe region. The study highlights that the EFQM model requires modifications for the construction industry.

Seňová and Antosova (2015) presented the EFQM model as a base for measuring the business performance assessment for the expansion of the organizational knowledge base with modern management practices in the mining industry.

Hemsworth (2017) presented the EFQM model application in the purchasing department of an organization and found, based on the survey data of 306 purchase agents, that quality management practices help in the improvement of internal customer satisfaction and business performance.

Pop and Pelau (2017) identified, through the application of EFQM model in Romanian clothing companies, the three strategic directions influencing the business results – external environment of the company, internal environment of company, and leadership.

Escrig *et al.* (2019) analyzed the drivers of internalization of the EFQM model adoption, appraisal and compensation system in Spanish organizations by using an empirical study. The study highlights that internal motives of participative style and appraisal system oriented towards the development of employees are the main drivers of internalization.

Grønholdt and Martensen (2019) established a link between the employee-customer-business results chain through an empirical study by creating a model of hotel chain using data from four Denmark hotels.

Turisová *et al.* (2021) examines the EFQM model adoption in e-maintenance application using the survey data of 70 industrial organizations. Dahlgaard *et al.* (2013) reviewed how a world-class company, Boeing Aerospace support, adopts a business excellence framework to enhance the business excellence practices.

Jonathan (2014) investigated the EFQM application in UK FE colleges. The authors used quantitative evidence of feedback from 42 senior managers, quality managers and others.

They also used the case studies of six EFQM award-winning colleges. The study shows a positive correlation between EFQM adoption in institutional achievements.

Zdrilic and Dulcic (2016) presented the influence of business excellence models on company performance in 106 Croatian large enterprises with more than 250 employees. The study shows a positive correlation between business excellence adoption and organizational financial results.

Gómez-López *et al.* (2019) studied the impact of EFQM model in Spanish firms using factorial analysis and cluster analysis. This study shows that the implementation of EFQM leads to an improvement in the external image of the company and increase in efficiency of internal processes. The firms can be categorized into three groups according to their results: highly results-oriented, moderately results-oriented and minimally results-oriented.

Madan (2010) highlighted the nine-year total quality management implementation in a big public sector unit in India – Bharat Heavy Electrical Limited (BHEL). The paper presents the journey of BHEL from the adoption of TQM practices to the winning of the business excellence award.

2.3.3.2 **EFQM and other management practices**

Oger and Platt (2002) opined that the EFQM model places more emphasis on tactical issues in relation to the diffusion and implementation of strategy whereas MBNQA focuses on the development of strategy, and reporting and analysis of business results.

Nenadál (2020) presented the critical analysis of EFQM 2020 and its previous version in terms of the advantages and weaknesses of the latest version of the EFQM model based on the input from 18 quality professionals from Czech production organizations. The

study highlights that model 2020 has changed significantly and some of the guidance points provided in the new model are superficial and confusing.

Fonseca (2021) presented the difference between the EFQM 2020 model and EFQM 2013 version, supported by literature review and content analysis. Fonseca *et al.* (2021) also presented the relationship among EFQM 2020 model, Industry 4.0 and Quality 4.0. The study highlights the several linkages between the EFQM 2020 model and Industry 4.0 at the criteria level and guidance points to support successful digital transformation.

Santos-Vijande and Alvarez-Gonzalez (2007) established the relationship between total quality management practices and organizational performance using structural equation modelling using the data collected from Spanish manufacturing and services firms. The study highlights that EFQM enablers help the organizations to excel.

Shulver and Lawrie (2007) compared the EFQM model with the balanced scorecard model. The study highlights that even though the two models are management models, designed and deployed for different purposes yet there is a strategic performance connection between both the management models. The balanced scorecard is a management instrument for measuring the effectiveness of the actual strategy and associated implementation activities whereas the EFQM model is more of a management tool for benchmarking.

Ruiz-Carrillo and Ortiz (2005) identified the most representative resources and capabilities of the enterprise to create a competitive advantage using EFQM. The study confirms the merits of the EFQM model as an effective tool to measure the competitive advantages of an organization by considering internal and external perspectives.

Bou-Llusar *et al.* (2009) analyzed the EFQM excellence model linkages to TQM practices in a company based on responses received from 446 Spanish companies. The

study reveals that the social and technical dimensions are embedded in the model and are correlated.

Suárez *et al.* (2014) established the TQM linkages to the EFQM model by using assessment data from 116 firms. The paper highlights the synergies between the critical factors of the management system consisting of leadership, strategy and process management. The process management mediates the influence of strategy, partnership and resource management and influences the overall results.

Ismail (2016) integrated the EFQM model with measurement, analysis and knowledge management of students, stakeholders and market factors of MBNQA.

Gómez-López *et al.* (2017) identified the TQM implementation barriers through EFQM implementation by using data from 68 firms. The results show that lack of time, lack of physical and financial resources as the key barriers and the barriers can be divided into three groups: behavioral and cultural barriers, organizational barriers, and resource barriers.

Miroslav *et al.* (2018) deliberated managing quality, characteristics, history, description, and self-assessment of the EFQM model for improvement. The paper concludes that a comprehensive quality management framework would bring profound change in the culture of an organization.

Mavroeidis and Mylonakis (2013) present the EU-25 business excellence models adopted by the European countries. These business models are classified into three categories: EFQM Model, modified EFQM model, own business excellence models. The authors have provided integrated current practices and business excellence models to support the European union competitive advantage.

2.3.3.3 **Evaluation of EFQM model**

Dodangeh *et al.* (2011) developed a fuzzy multi comprehensive method for evaluating, assessing and determining the areas of improvement in the EFQM model to help the organizations to prioritize their improvement concerning cost, duration of implementation, impact on the business excellence results, etc.

Dodangeh and Yusuff (2012) proposed a model for prioritization of areas for improvement (AFI) identified during the assessment. The AFI needs to be prioritized based on the budget, effort, time for implementation, and resources. The authors proposed a model using the TOPSIS model to prioritize the AFI. The results showed that the developed model is more acceptable for selecting the areas for improvement in EFQM.

Askari *et al.* (2013) used the AHP model to propose a new scoring system for the assessment of weightage in the EFQM model to consider the effect of the interaction of EFQM criteria.

Saryazdi and Mehrjerdi (2014) presented a dynamic model to simulate the effect of enablers on the results criteria of the EFQM model to show that the efficiency of the EFQM model could be improved by the dynamic models.

Hosseini *et al.* (2015) presented a new integrated approach of using fuzzy logic/analytical hierarchy process and operations research for improving organizational excellence using EFQM model. AHP is used to prioritize the sub-criteria which need to be improved for prioritizing the improvement projects in an organization.

2.3.3.4 **EFQM and high maturity organizations**

Escrig and Menezes (2015) depicted the characteristics of the leading companies which adopted the business excellence models. The study highlights the EFQM enablers for predicting high performance and concludes that the people criterion dimensions lead to the high performance of business excellence.

Yadav and Waalb (2020) compared the performance of Indian organizations to Asian organizations in the region using the high-performance organizational framework.

Hasan and Hannifah (2013) presented the study of business excellence award winners in Sydney and Singapore, which shows that that the quality practices in award-winning organizations are similar and only difference is in the management decisions and deployment of the systems.

2.3.3.5 **Systematic literature reviews on EFQM**

Kim *et al.* (2008) presented a review of 91 papers on EFQM research and divided the papers based on whether these are conceptual, case studies, empirical, analytical, or simulation based.

Kim *et al.* (2010) stressed on the nature of the research topics and methodologies used in EFQM model research studies. The study indicates that the majority of the paper focused on performance measurement and a limited focus on the case studies.

Suárez *et al.* (2017) carried out quantitative research on the EFQM model by adopting a systematic literature review for the period 1991-2015 The review of 53 papers to finds the purpose, nature and instruments of data collection, types of quantitative analysis adopted, and the sectors of study.

Yousaf and Bris (2020) examined 108 papers linked to EFQM from 1991 to 2019 and the 30% of these papers are from Spanish organizations from mainly two sectors (education and health).

Ghafoor *et al.* (2020) presented a bibliometric and thematic review of journal papers related to BE frameworks from the Elsevier database covering 415 papers during the period between 1990 to 2020.

Unnikrishnan *et al.* (2019) provided a comprehensive literature review of 371 papers related to business excellence models. The paper highlights the significant improvement in business excellence practices in developing countries.

2.3.3.6 **Interrelationships among EFQM criteria**

Dijkstra (1997) analyzed the association between enablers and business results from a survey of Netherland firms. Eskildsen and Dahlgaard (2000) conducted a study focusing on people criteria and people results in the EFQM model. The study reveals that enablers of EFQM have a strong influence on people results

Eskildsen *et al.* (2001) examined the weight structure of the EFQM model through a survey of 756 chief executive officers of Danish companies. The survey data has been analyzed using CFA and Bootstrapping. The study shows that perceived criteria weights are varying compared to the current allocation in the EFQM Model. The Danish companies perceive all the enablers are equally important except result criteria.

Eskildsen *et al.* (2000) highlighted the causal structure of the EFQM model using the survey data of 750 Danish companies. From the study, it is clear that the official model and theoretical construct of the model matches but it suggests that leadership and strategy criteria can be integrated and people criteria can be combined with people result. Moreover, people, process and partnership could be termed as systems. The customer results, society results and key performance results could be termed as business excellence index.

Bou-Llusar *et al.* (2005) assessed the interrelationship between enabler and results criteria in the EFQM model through a survey of 446 respondents. The study shows that the set of enabler criteria strongly influences result criteria except policy and strategy criteria. The balanced focus on all enablers helps to enhance the results scores and contributes to the improvement of results.

Calvo-Mora *et al.* (2006) analyzed the implicit relationship of EFQM model adoption in higher education institutions. The data from 111 Spanish public centers were collected and the Partial Least Square technique was used to test the hypothesis. The study confirms the suitability of the EFQM model for higher education institutions. The top management leads the excellent development of key processes in the university through appropriate leadership, strategy formulation, partnerships establishment, resource allocation, and human resource management.

Caliskan and Deliorman (2007) studied the relationship between people criteria to people results based on EFQM model in Turkish public institutions. The study confirms people results are influenced by criteria that deal with motivation, satisfaction, and performance indicators. The study highlights that the public institutions lack in the areas of creating pride in employees, performance evaluation, social activities and reward and recognitions.

Nabitz *et al.* (2001) identified the elements to design a structure for the improved EFQM model. The authors have proposed 11 criteria for the improved EFQM model and the proposed two criteria are: strong focus on customer orientation and new measuring system.

Schmidt *et al.* (2012) studied the EFQM model and focused on soft and hard critical factors of TQM which would influence the EFQM practices in the organizations. Factorial analysis was carried out on the data collected from 116 firms to identify the soft factors, strategic management of partnerships, and resources and people management practices. Regression study reveals the hard factors like strategic management of partnerships and resources, and processes impact the key business results. The study also highlights that soft factors influence the hard factors and hard factors influence the business results.

Zade *et al.* (2011) presented the relationship between enabler and result criteria and showed that the enablers are strongly related to results. A balanced approach in the development of enabler criteria would impact the improvement of the results in an organization. The authors highlighted that leadership and process enabler criteria, key performance results, and customer results have the high impact on the model.

Yaghoubi *et al.* (2011) carried out studies to ascertain the effect of the implementation of the EFQM model using the survey inputs of 103 employees. The results show that the adoption of EFQM has improved the leadership, policy and strategy, human resource, resources and processes in the organization. The results also show the customer results, employee results, leadership, and performance results improvement after the adoption of EFQM.

Gómez *et al.* (2011) presented the relationship within the EFQM model 2003 version using self-assessment scores of 68 organizations. The study also analyses the implementation differences between public and private organizations. The results reflect that policy and strategy, people, and partnership and resources do not have statistically significant effects on the process as indicated in official EFQM model.

Heras-Saizarbitoria *et al.* (2012) established the relationship between enabler and result criteria in the EFQM model based on 242 independent scores of EFQM assessment. From the study, it is evident that leadership enables the pursuit of the policy and strategy in the organization, it also strongly influences people criteria and partnerships and resources in the organization. It is also evidenced that policy criteria and partnership criteria influence the process criteria in the model. However, people criteria do not have an impact on process criteria in the model. Process criteria impact the customer results and customer results influence the key performance results in the model. The assessment data shows

the left side of the EFQM is considerably better supported compared to the right side of the model (result criteria).

Safari *et al.* (2012) carried out correlation studies between people criteria and people results. The study shows that all people sub-criteria contribute to the improvement of people results. Sub-criteria of 'aligning, involving and empowering people', and 'supporting the organization's strategy by people plans' have the high impact on people results.

Calvo-Mora *et al.* (2013) found that the leadership commitment to quality improvement drives the management philosophy; and setting goals and objectives helps in creating an appropriate organizational system. The strategy based on the needs of current and future expectations helps in realizing the vision. Human resource management is a basic pillar for successful quality management practices. It is also important to engage the entire workforce in the improvement activities of the organization for excellence.

Uygur and Sumerli (2013) developed the relationship of leadership, partnership and resources, and processes on the basic performance of a company operating in the manufacturing industry.

Gómez *et al.* (2015) established the underlying logic in the EFQM model which was not presented in the official model. From the study, it is evident that people results and customer results have no significant relationship with process criterion. The partnership influences the strategy and people criteria in the organization. The study also highlights that society results and customer results have a direct effect on key results of the model. The new relationship between people results and society results is evidenced in the paper. It also highlights the absence of significant relationship between society results and customer results.

Espin *et al.* (2016) analyzed the cultural influence on the EFQM model using empirical study. The paper uses the SEM model to establish the relationship of culture, organizational learning and quality. The study shows that organizational culture positively contributes to improving results and develops explorations and exploitation competencies.

Rio-Rama *et al.* (2017) presented the quality management practices in rural accommodation establishments influencing the society results. The study shows the weak relationship between the critical factors of quality and society results in rural accommodation. The study shows a direct relationship of process management concerning society results.

Martín-Gaitero and Escrig-Tena (2018) analyzed the level of corporate social responsibility linkage to the EFQM model. The research is based on multiple case studies from the Spanish industry and an in-depth analysis of four organizations using EFQM. The study reveals that high commitment of CSR is evident in organizations using EFQM.

Calvo-Mora *et al.* (2018) established the influence of TQM social factors (leadership and human resource) and TQM technical and strategic factors (strategy-resource management and process management) with social results using data from 116 Spanish companies having TQM and EFQM experience. The study reveals that the EFQM excellence model is a reliable and valid framework to measure and improve the organizational impact. Strategy and resource management criteria influence the social results of an organization and also helps in determining the efficiency of how an organization manages its key processes.

Para-González *et al.* (2018) explored and confirmed the positive effect of the strategy, leadership and personnel on organizational performance, and also clarified the role of

strategic management of human resources as a mediator between the personnel management and the results of a company. The study is based on 200 Spanish firms.

Periañez-Cristobal *et al.* (2020) focused on establishing the relationship between key factors identified from the assessment results of the EFQM model. The authors used cluster analysis, chi-square test and other statistical analysis to establish the relationship. The results show that the organizational profile of top-scoring companies stand out for their strategic vision and focus on stakeholder expectations, human resource development, and policies.

Calvo-Mora *et al.* (2020) studied the relationships between soft and strategic-hard EFQM factors and the organizational results (customers, people, society, and key results) through the data obtained from 225 Spanish companies and using partial least squares structural equation modelling (PLS-SEM). The results confirm that soft and strategic-hard EFQM factors constitute a socio-technical system in which there are multiple direct and indirect relationships between these factors and the results.

Table 2-2 shows the existence of relations among various criteria in EFQM model. Some inharmonious observations viz-a-viz the general perception of EFQM criteria co-relationships have been captured from the literature review. One, the number of studies examining the relationship of strategy with people, and partnerships & resources are low. Two, the number of studies examining the relationship of people with partnerships & resources, and process are also low. Three, and the most important observation is that there are few studies which show the existence of the negative relationship of strategy with processes (Martinez-Lorente, *et al.* 2009), people with processes (Suárez *et al*. 2014 and Heras-Saizarbitoria *et al.* 2012). No doubt, the studies showing negative relations are few but it shows that further studies are required to find the relationships among the various EFQM criteria. Similarly, the review of existing literature provides interesting

results contradicting the general perception of the EFQM model that the relationship between criteria and results is through the process criteria (see Table 2-2). Table 2-3 shows that the existence of negative results of process criteria on people and society results. Also, many of the relations between criteria and results; and between results and results have not been investigated in the literature. This shows the need to study the correlations among criteria, results, and relationships between criteria and results. Specifically, they are more on information derived from external assessments made by independent professionals using a very rigorous protocol based on the scores applied to the categories and subcategories of the EFQM model.

Table 2-4 show the summary of the deep-dive analysis of the literature study. It captures the author's name, country, organization or industry in which the study was conducted, the data source used in the study, type of study, the statistical model used, software used, and mapping to keywords.

Table 2-2: Literature review on EFQM interrelationships among criteria

Interconnections of Criteria	Leadership relationship with strategy (E1)	Leadership relationship with people (E2)	Leadership relationship with partnerships and resources (E3)	Leadership relationship with processes, products & services (E4)	Strategy relationship with people(E5)	Strategy relationship with partnership and resources (E6)	Strategy relationship with processes, products & services (E7)	People relationship with partnership and resources(E8)	People relationship with processes, product & services(E9)	Partnership and resource relationship with processes, product & services (E10)
Eskildsen *et al.* (2000)	P	P	P		P	P	P		P	P
Eskildsen and Dahlgaard (2000)			P	P						
Wilson and Collier (2000)										P
Eskildsen *et al.* (2001)			P							
Meyer & Collier (2001)	P									
Su *et al.* (2003)										P
Tejedor (2004)							P			P
Calvo-Mora *et al.* (2006)	P	P	P		P	P	P			
Calvo-Mora *et al.* (2005)	P	P	P		P	P	P		P	P
Badri *et al.* (2006)	P	P		P			P			
Martensen *et al.* (2007)			P							
Martinez-Lorente *et al.* (2009)	P	P	P		P	P	N		P	P
Sadeh and Arumugam (2010)	P	P	P				P		P	P
Gómez *et al.* (2011)	P		P							
Zhen *et al.* (2011)			P	P						
Heras-Saizarbitoria *et al.* (2012)	P	P	P			P	P		N	P
Savić *et al.* (2014)	P	P		P						
Suárez *et al.* (2014)	P	P	P		P	P	P		N	P
Río-Rama *et al.* (2017)	P	P			P		P		P	P
Total of P	12	10	12	4	6	6	9	0	5	10
Total of N	0	0	0	0	0	0	1	0	2	0
Total Researcher	12	10	12	4	6	6	10	0	8	10
% of Positive Relationships	100%	100%	100%	100%	100%	100%	90%	0%	71%	100%

Note : P denotes study connected with criteria to criteria is positive and N denotes the negative correlation.

Table 2-3: Review of EFQM interrelationships between criteria and results

Author Reference	Processes relationship with the customer results	Processes relationship with the people results	Processes relationship with the society results	Processes relationship with the business results	Partnership with the society results	Partnership with the business results	People Management to customer result	People management relationship with people results	People management relationship with society results	People results relationship with the business results	Strategy relationship to customer result	Strategy relationship to society result	Strategy with business result	Customer results relationship with the people Results	Customer results relationship with society Results	Customer results relationship with the business Results	People results relationship with business results	Society results relationship with the key performance results
1	P	P	P	P														
2				P										P	P	P	P	
3	P	P	P		P			P						P	P	P	P	
4	P		P															
5																		P
6				P									P					
7								P										
8														P	P	P		P
9	P	N	N	P	P	P	P	P	P		P	P		P	P	P	P	P
10	P	N	N													P	P	P
11	P		P															P
12	P	N	N							P				P	P	P		N
13																P	P	
14								P										
15				P						P							P	
16				P														
17			P															
	8	2	5	6	2	1	1	4	1	2	1	1	1	6	5	6	6	4
	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	8	6	9	6	2	1	1	4	1	2	1	1	1	6	5	6	6	5
	100%	33%	56%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%

Note:

a). Process in the table refers to Processes, Product & Services criteria, b). Partnership in the table refers to Partnership and Resources criteria, c). P denotes study connected with criteria and results is positive and N denotes the negative correlation.

Author references: 1). Eskildsen (1998), 2). Prabhu *et al.* (2000), 3). Eskildsen *et al.* (2000), 4). Eskildsen *et al.* (2001), 5). Westlund (2001), 6). Badri *et al.* (2006), 7). Caliskan and Deliorman (2007) 8). Gonzalez *et al.* (2009), 9). Martinez-Lorente *et al.* (2009), 10). Sadeh and Arumugam (2010), 11). Gómez *et al.* (2011), 12). Heras-Saizarbitoria *et al*. (2012) 13). Gorji *et al.* (2012), 14). Hossein *et al.* (2012), 15). Savić *et al.* (2014), 16). Suárez *et al*. (2014), 17). Río-Rama *et al*. (2017).

Table 2-4: Literature review summary

			Data Source					Type of Study								Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
1	Miguel (2005)	Brazil				x						x	Qualitative analysis		x		
2	Bohoris (1995)	UK				x						x	Qualitative analysis		x	x	x
3	Tan and Khoo (2003)	Singapore				x						x	Qualitative analysis		x	x	
4	Ghicajanu *et al.* (2015)	Czech Republic				x						x	Qualitative analysis		x		
5	Vernekar and Sheykhoteslam (2015)	India				x						x	Qualitative analysis			x	x
6	Unnikrishnan *et al.* (2019)	India				x						x	Qualitative analysis		x	x	x
7	Vartiak (2016)	Slovakia				x						x	Qualitative analysis			x	
8	Yousaf and Bris (2020)	Czech Republic				x						x					x
9	Grønholdt and Martensen (2019)	Denmark	Hotel				x	x									x
10	Adebanjo and Mann (2005)	New Zealand				x						x	Qualitative analysis			x	x
11	Doulatabadi and Yusof (2018)	Indonesia				x						x	Qualitative analysis			x	

				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
12	De-Vijith and Quadros (2019)	Sweden	Manufacturing	x				x								x	
13	Sharma and Talwar (2007)	India		x				x					EFA	SPSS		x	
14	Mavroeidis and Myloanakis (2013)	Greece				x		x					AHP				x
15	Sony (2019)	Namibia				x						x				x	
16	Doaa Jamal (2015)	Gaza	Education	x				x						SPSS			x
17	Chipwatanga and Kaira (2019)	Zambia	Banking	x				x	x				ANOVA			x	
18	Gómez *et al.*(2019)	Spain	Manufacturing				x	x					EFA, Cluster analysis				x
19	Talwar (2011)	India										x			x	x	
20	Nenadál (2020)	Czech Republic		x								x					x
21	Santos-Vijande and Alvarez-Gonzalez (2007)	Spain	Manufacturing	x				x					CFA	SPSS & EQS6.0			x
22	Periañez-Cristobal *et al.* (2020)	Spain	Manufacturing		x			x					Cluster analysis				x
23	Jayamaha *et al.* (2009)	New Zealand	Manufacturing and Service		x			x					PLSR	LISREL		x	

				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
24	Bassioni *et al*. (2008)	Egypt	Construction industry	x				x					CFA	SPSS		x	
25	Jankalová and Radoslav (2020)	Slovakia				x						x				x	
26	Rio-Rama *et al.* (2017)	Spain	Rural Accommodation	x				x					SEM	SPSS			x
27	Shulver and Lawire (2007)	Canada										x					x
28	Calvo-Mora *et al.* (2020)	Spain	Manufacturing				x	x					SEM-PLS				x
29	Dodangeh *et al.* (2011)	Malaysia			x			x					AHP	FMCDM			x
30	Caliskan and Deliorman(2007)	Turkey	Education	x	x			x					EFA	SPSS			x
31	Fonseca (2021)	Portugal				x						x					x
32	Gupta (2013)	India	Manufacturing and Service			x		x								x	
33	Ruiz-Carrillo and Ortiz (2005)	Spain				x						x					x
34	Martensen *et al.* (2007)	Denmark	Manufacturing	x				x					SEM, PLS			x	
35	Farhad *et al.* (2011)	Malaysia	Manufacturing and Service									x	Qualitative analysis			x	

				Data Source				Type of Study								Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
36	Kim *et al.* (2008)	Canada										x					x
37	Saryazdi and Mehrijerdi. (2014)	Iran	Electricity Corporation				x		x	x			AHP				x
38	Bou-Llusar *et al.* (2009)	Spain	Manufacturing	x				x					SEM				x
39	Mavroeidis *et al* (2009)	Greece								x			AHP			x	
40	Jayamaha *et al.* (2008)	New Zealand	Manufacturing		x			x					PLS	LISREL		x	
41	Hosseini *et al.* (2015)	Iran			x					x			AHP			x	
42	Dahlgaard-Park (2008)	Sweden				x						x				x	
43	Seňová and Antosova (2015)	Slovakia	Mining Industry				x	x	x				Descriptive data analysis				x
44	Saunders *et al.* (2009)	New Zealand				x						x				x	
45	Escrig and Menezes (2015)	Spain	Manufacturing		x			x					ANOVA, Logistic regression	SPSS			x
46	Khoo and Tan (2002)	Singapore				x			x							x	
47	Bandyopadhyay and Nair (2015)	India				x						x				x	

				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
48	Escrig *et al.* (2019)	Spain	Manufacturing	x				x					SEM, Cluster Analysis and ANOVA				x
49	Oger and Platt (2002)	France				x						x					x
50	Leonard and McAdam (2002)	USA				x						x				x	
51	Hemsworth (2017)	Canada		x				x					CFA				x
52	Seyed-Hosseini *et al.* (2015)	Iran	Electricity Corporation		x			x	x	x			AHP				x
53	Rocha-Lona *et al.* (2015)	UAE										x				x	
54	Salehzadeh *et al.* (2017)	Iran	Restaurant Industry	x				x					EFA, CFA, SEM	SPSS		x	
55	Jaeger and Matyas (2016)	Australia	Machinery and metalware		x					x						x	
56	Jayamaha *et al.* (2011)	New Zealand			x			x					PLSR	PLS Graph3.0		x	
57	Lasrado and Uzbeck (2017)	UAE			x			x						Nvivo 10.0		x	
58	Pannirselvam and Ferguson. (2001)	USA			x			x					Descriptive data analysis, CFA	LISREL 8		x	
59	Zdrilic and Dulcic (2016)	Croatian	Manufacturing	x			x	x					Descriptive data analysis and T-test				x

				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
60	Badri *et al.* (2006)	UAE	Education	x				x					SEM, Hypothesis			x	
61	Pop and Pelau (2017)	Bucharest	Clothing	x				x					EFA	SPSS			x
62	Meyer and Collier (2001)	USA	Healthcare	x				x					SEM			x	
63	Llusar *et al.* (2005)	Spain	Manufacturing	x				x					Correlation analysis				x
64	Pannirselvam *et al.* (1998)	USA			x			x								x	
65	Sreeja and Hemalatha (2016)	India				x						x				x	
66	Flynn and Saladin (2001)	USA	Manufacturing	x				x					Path analysis			x	
67	Jeyaprabha (2018)	India	Manufacturing	x				x					PLS	PLS		x	
68	Saunders and Mann (2005)	New Zealand	Manufacturing	x				x					Descriptive data analysis and correlations			x	
69	Naylor (1999)	UK	Healthcare						x								x
70	Talib *et al.* (2010)	India	Service Industry				x						SEM, Hypothesis	LISREL		x	
71	Androniceanu (2017)	Romania	Manufacturing	x				x					Reliability analysis	SPSS		x	

				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
72	Heras-Saizarbitoria (2006)	Spain				x										x	
73	Alomairy (2016)	USA					x			x			ANOVA, Regression model			x	
74	Paranitharan *et al.* (2017)	India	Manufacturing	x				x					SEM	SPSS		x	
75	Dijkstra (1997)	Netherlands	Manufacturing	x				x									x
76	Miroslav *et al.* (2018)	Slovakia				x						x					x
77	Enescu and Enescu (2018)	Romania				x						x				x	
78	Zamani and Valmohamammadi (2014)	Iran	Manufacturing	x				x					CFA, SEM			x	
79	Eskildsen *et al.* (2001)	Denmark	Manufacturing	x				x					CFA and Bootstrapping				x
80	Nabitz *et al.* (2000)	Netherlands	Healthcare			x						x					x
81	Vokurka *et al.* (2000)	USA				x						x				x	
82	Suárez *et al.* (2017)	Spain				x						x					x
83	Heras-Saizarbitoria *et al.* (2012)	Spain			x			x					Bootstrapping				x

				Data Source				Type of Study								Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
84	Vaxevanidis *et al.* (2006)	Greece				x										x	
85	Calvo-Mora *et al.* (2006)	Spain	Education				x	x					SEM				x
86	Williams *et al.* (2006)	Netherlands				x						x				x	
87	Kassem *et al.* (2019)	UAE		x				x					EFA, SEM	SPSS		x	
88	Lasrado (2017)	UAE					x	x								x	
89	Gómez *et al.* (2015)	Spain		x				x					SEM				x
90	Ismail (2016)	Malaysia	Education	x				x					SEM, Hypothesis				x
91	Espin *et al.* (2016)	Spain	Manufacturing	x				x					Hypothesis, SEM				x
92	Curkovic *et al.* (2000)	USA	Automotive industry	x				x					CFA, SEM			x	
93	Kothandaraman and Kamalanabha (2018)	India	Technology service industry	x				x					CFA, SEM			x	
94	Pakhale (2017)	India				x										x	
95	Calvo-Mora *et al.* (2005)	Spain	Education	x				x					PLS				x

				Data Source				Type of Study								Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
96	Nabitz *et al.* (2006)	Netherlands	Healthcare		x			x									x
97	Prabhu *et al.* (2000)	UK	Manufacturing	x				x					ANOVA, Chi-square			x	
98	Calvo-Mora *et al.* (2018)	Spain	Manufacturing	x				x					PLS-SEM				x
99	Shrouty and Tiwari (2017)	India				x						x				x	
100	Eskildsen *et al.* (2001a)	Denmark	Manufacturing	x				x					SEM	LISREL 8			x
101	Mccarthy and Greatbanks(2006)	New Zealand		x				x								x	
102	Wilson and Collier (2000)	USA	Manufacturing	x				x					EFA, SEM			x	
103	González *et al.* (2018)	Spain	Manufacturing	x				x					SEM				x
104	Pregeljc (2012)	Slovenia	Manufacturing				x					x				x	
105	Nabitz *et al.* (2001)	Netherland				x				x			Qualitative analysis				x
106	Hasan & Hannifah (2013)	Australia					x					x				x	
107	Safari *et al.* (2012)	Iran	Manufacturing		x			x					Correlation analysis	SAS 9			x

				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
108	Eskildsen and Dahlgaard (2000)	Denmark		x				x					SEM				x
109	Ghinea *et al.* (2017)	Romania	Education				x	x					Multivariate analysis			x	
110	Lobo *et al.* (2012)	Australia	Manufacturing	x				x					Descriptive data analysis			x	
111	Zade *et al.* (2011)	Iran	Manufacturing				x	x	x				Descriptive data analysis				x
112	BOYS *et al.* (2004)	Canada				x						x				x	
113	Mai *et al.* (2017)	USA	Manufacturing		x			x					PLS	PLSPM Library		x	
114	Gupta (2012)	India	Manufacturing	x				x					EFA, Correlation test, path analysis	SPSS, AMOS		x	
115	Yaghoubi *et al.* (2011)	Iran	Manufacturing	x				x					T-test				x
116	Hides *et al.* (2004)	UK	Education			x						x					x
117	Martín-Gaitero and Escrig-Tena (2018)	Spain	Manufacturing				x	x					Qualitative analysis				x
118	Amponsah and Ahmed (2017)	UAE				x				x						x	
119	Pozega *et al.* (2014)	Croatia		x				x								x	
120	Kim *et al.* (2010)	Canada				x						x					x
121	Davies (2004)	UK	Education	x				x					Descriptive data analysis				x

				Data Source				Type of Study								Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
122	Sadeh and Arumugam (2010)	Iran	SME				x	x					DEMATEL	MATLAB			x
123	Rusov *et al.* (2017)	Serbia	Insurance company				x	x					Regression model			x	
124	Suárez *et al.* (2014)	Spain	Manufacturing		x			x					PLS, Hypothesis	PLS-Graph			x
125	Madan (2010)	Peru	Public sector				x		x							x	
126	Gorji and Siami (2011)	Iran	Health-care	x				x					Hypothesis				x
127	Schmidt *et al.* (2012)	Spain	Manufacturing		x			x					EFA and Regression analysis				x
128	Gómez-López et. (2017)	Spain	Manufacturing	x				x					EFA, Descriptive data analysis				x
129	Askari et al (2013)	Malaysia			x				x	x			AHP	AHP			x
130	Mann (2011a)	New Zealand		x												x	
131	Su *et al.* (2003)	Taiwan	Manufacturing	x				x					SEM and path analysis			x	
132	Mohammad Yahia Zare Zare (2014)	Iran					x			x			AHP	VENSIM PLE			x
133	Mohamadesmaeil *et al.* (2011)	Iran	Library	x				x					T-test	SPSS			x

				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
134	Mesgari *et al.* (2017)	Iran	Hospital	x				x	x				SEM				x
135	Štok *et al.* (2010)	Slovenia	Manufacturing	x				x					ANOVA			x	
136	Mann *et al.* (2011b)	New Zealand	Manufacturing	x							x		Descriptive data analysis			x	
137	Uygur and Sumerli (2013)	Turkey				x						x					x
138	Doulatabadi and Yusof (2014)	Malaysia		x				x					Reliability, descriptive stats	SPSS		x	
139	Corbett and Angell (2011)	New Zealand	Manufacturing	x		x		x					Descriptive data analysis			x	
140	Karimi *et al.* (2014)	Iran			x			x					Correlation analysis			x	
141	Savić *et al.* (2014)	Serbia	Banking	x				x					CFA, SEM, Hypothesis	LISREL & SPSS			x
142	Dawei *et al.* (2011)	USA				x						x				x	
143	Dahlgaard *et al.* (2013)	Sweden	Aerospace			x						x					x
144	Vukomanovic *et al.* (2014)	Croatia	Construction industry		x			x									x
145	Mohammad *and Mann* (2010)	New Zealand		x		x						x			x		
146	Gupta (2013)	India	Manufacturing	x		x					x		Descriptive data analysis			x	

Table 2-4 Contd.

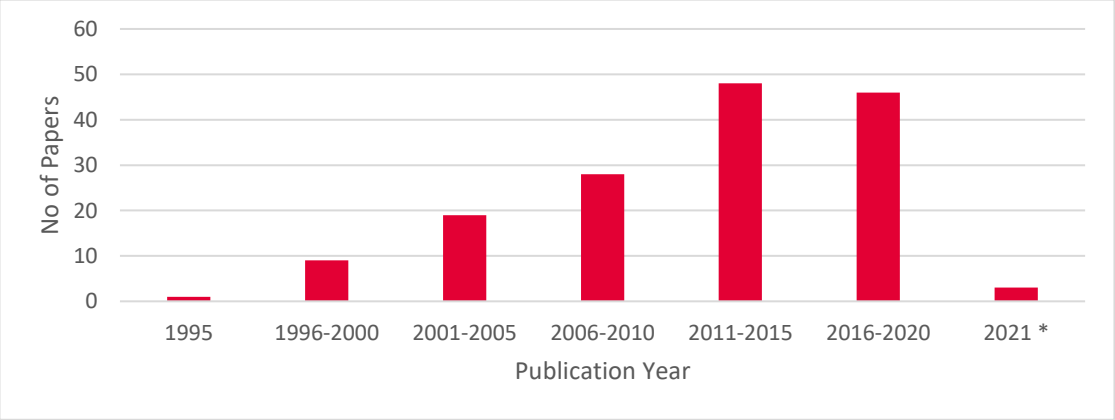
				Data Source				Type of Study							Mapping to literature review keywords		
Sl No	Author	Country	Organization/ Industry	Survey Data/ Interview data	Assessment Scores	Publicly available data	Organizational Performance	Empirical Study	Case Study	Concept & Dynamic	Exploratory study	Literature Review	Methodology / Technique	Software used	Quality Awards	Business Excellence	EFQM
147	Jonathan (2014)	UK	Education	x				x					Qualitative analysis	SPSS			x
148	Gómez *et al.* (2011)	Spain	Manufacturing		x			x					PLS				x
149	Zhen *et al.* (2011)	China	Manufacturing	x				x					EFA, CFA, Hypothesis			x	
150	Dodangeh *et al.* (2011)	Malaysia	Manufacturing		x			x					TOPSIS				x
151	Fonseca *et al.* (2021)	Portugal				x						x					x
152	Turisová *et al.* (2021)	Slovakia	Manufacturing	x				x					Descriptive data analysis				
153	Yadava and Waalb (2020)	India	Manufacturing	x				x					EFA			x	
154	Ghafoor *et al.* (2020)	New Zealand				x						x			x	x	x

2.4 DESCRIPTIVE ANALYSIS

A descriptive analysis provides the basic features of the collected data. A descriptive analysis is done to summarize the data from the identified154 articles in terms of distribution of papers, journal and conferences, timeline distribution, geography, authorship, statistical techniques used, and software used in the analysis. The descriptive analysis is useful for drawing data-based conclusions.

2.4.1 Timeline Distribution

Figure 2-1 shows the papers published over the years. The model has evolved over 30 years and papers from 1995 onwards have been considered for the review. It is also clear the 64% of the papers are post 2010. The number of papers is steadily increasing except the last phase (2016-2020). This decrease in papers may be attributed to the announcement of new model in 2019, and it takes some time for the researchers and practitioners to study and write. In Figure 2-1, 2021 data is partial (until March).



* data upto March 2021

Figure 2-1: Year-wise distribution of reviewed papers

2.4.2 Geographical Distribution

The geographical distribution of the reviewed literature is shown in Figure 2-2. The methodology used for this geographical distribution is the geographical location of the first author of the paper. Figure 2-2 shows 154 papers is from 35 countries. No doubt the

EFQM model is Europe based, but its applications are spread across the globe. It reveals that the highest number of papers are contributed by Spain (24 articles), followed by India (16 articles), Iran (14 articles), and New Zealand (12 articles).

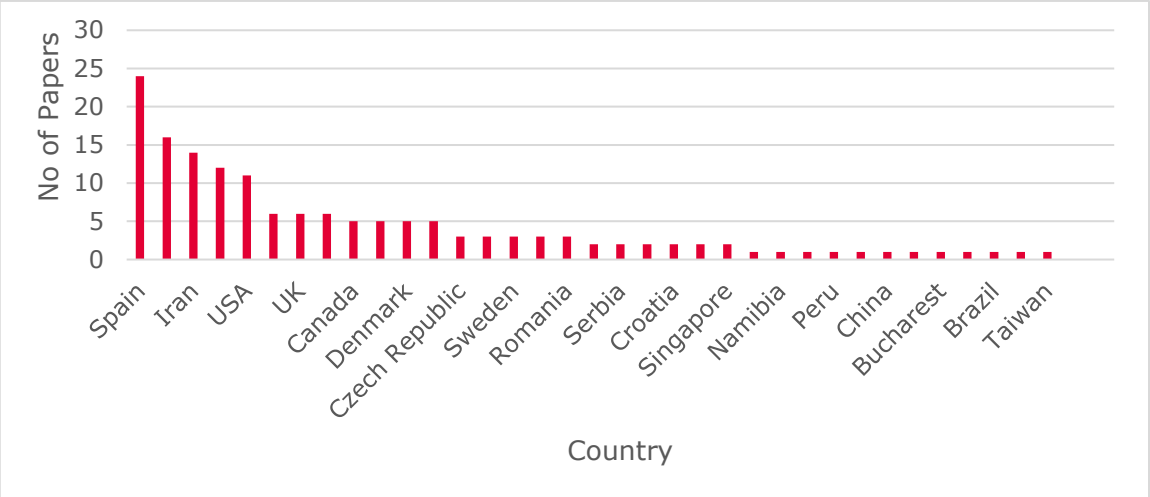


Figure 2-2: Geographical distribution of the papers

This shows that countries / region from where the data is used for the empirical studies, case studies and other organizational performance analysis in the research work. 89 papers were carrying the data for their research work: Spanish (20), Iranian (11), Indian (8) US and UK organizations (5 each) are the key contributors to the data resources.

2.4.3 **Data Sources**

Table 2-5 shows the data sources used for the research in the reviewed papers. 63 papers used survey / Interview data, 24 papers used assessment scores (self-assessment or external assessment scores), 46 papers used publicly available data (it could be internet-based, literature or through publicly published literature), and 19 papers used the organizational performance data (KPIs) for their research work. In some of the papers, the researchers have used more than one data source to conduct their research work.

Table 2-5: Data source used by researchers

	Survey data/ interview data	Assessment scores	Publicly available data (internet, literature)	Organizational performance data
Number of papers added	63	24	46	19

2.4.4 Nature of the Studies

Table 2-6 shows the types of research studies carried out by the peer researchers. 89 studies are empirical studies, 10 are case studies, 10 are concept & dynamic modelling studies, 2 are exploratory based studies, and 43 are literature reviews / studies.

Table 2-6: Types of research studies

	Empirical studies	Case studies	Concept & dynamic modelling studies	Exploratory studies	Literature reviews
No of Papers	89	10	10	2	43

2.4.5 Statistical Techniques

Table 2-7 shows the statistical techniques used in the reviewed papers. SEM (24), EFA/CFA (23), descriptive statistics / data analysis (18), ANOVA (17), qualitative analysis (13), and PLSR (10) are the key statistical techniques used by the researchers. These six techniques constitute 73% of the total techniques. In some papers, the authors have used more than one statistical technique to prove their research claims.

Table 2-7: Statistical techniques used in the literature study papers

Statistical techniques used	No. of instances	% of instances
SEM	24	16.7%
EFA/CFA	23	16.0%
Descriptive data analysis	18	12.5%
ANOVA / Hypothesis	17	11.8%
Qualitative analysis	13	9.0%

Statistical techniques used	No. of instances	% of instances
PLSR	10	6.9%
AHP	8	5.6%
Canonical correlation analysis	3	2.1%
Cluster analysis	3	2.1%
Path analysis	3	2.1%
Regression analysis	3	2.1%
T-test	3	2.1%
Boot strapping	2	1.4%
Chi-square	2	1.4%
Construct reliability	2	1.4%
Correlations	2	1.4%
Content validity	1	0.7%
DEMATEL	1	0.7%
Logistic regression	1	0.7%
Multi-attribute decision making model (TOPSIS)	1	0.7%
Multivariate analysis	1	0.7%
Pearson coefficient	1	0.7%
PLS-SEM	1	0.7%
Predictive validity	1	0.7%
Total	144	100.0%

2.4.6 **Software Used**

33 of the reviewed papers have explicitly mentioned the software tools used for the analysis (Table 2-8). SPSS and LISREL are the most widely used tools because of the statistical analyses used to validate the empirical studies.

Table 2-8: Software used by peer researcher in their research work

Software Used	No. of Instances
SPSS	16
LISREL	6
PLS-Graph	3
AMOS	1
EQS6.0	1
FMCDM	1

Software Used	No. of Instances
MATLAB	1
Nvivo 10.0	1
PLSPM Library	1
SAS 9	1
VENSIM PLE	1

2.4.7 Authorship

The authorship analysis gives an idea of whether the research is done individually or in collaboration with others. Table 2-9 shows that 82% of the papers have two or more authors. The 154 papers are contributed by 408 researchers. Business excellence, quality awards and EFQM are some of the important topics for research and many researchers are making contributions in this area.

Table 2-9: Authorship of the papers

No. of authors	No. of papers	% of papers
1	28	18.2%
2	47	30.5%
3	47	30.5%
4	20	13.0%
5	9	5.8%
6	2	1.3%
8	1	0.6%
Total	154	100.0%

2.4.8 Industry Segments

It is observed that non-manufacturing industries are also using EFQM for business excellence. Table 2-10 presents that there are 37 papers where the EFQM model is applied apart from the manufacturing sector. It shows that the EFQM is widely spreading to other industrial segments as a management framework for the implementation of new management concepts or simply to improve the business results.

Table 2-10: Adoption of BE in non-manufacturing / other industrial segments

Industry / Sector	No. of Papers
Education	8
Healthcare	7
Banking sector	2
Construction industry	2
Electricity corporation	2
Service industry	3
Aerospace	1
Clothing	1
Hotel industry	1
Insurance	1
Library	1
Machinery and metalware	1
Mining	1
Public institutions	1
Public sector	1
Restaurant	1
Rural accommodation	1
SME	1
Technology service industry	1

2.5 CRITICAL OBSERVATIONS FROM THE LITERATURE REVIEW

The critical observations from the review of 154 papers are summarized as:

- The review reflects the existence of research to ascertain the relationship of enablers and results, however, there is hardly any research at sub-criteria level studies based on the assessment score. Most of the empirical studies are based on the survey data or organizational performance data or self-assessment scores. This does not provide an unbiased view for the organization about the inter-relationships. Self-assessment and survey data have organizational influence and would carry some bias. In the case of the external assessment scores, the assessments are independents and provide an independent view.

- Most of the research conclusions are at the criteria level and model has got nine criteria and 32 sub-criteria. If the conclusions are at the criteria level, it is difficult for any organization to operationalize or deploy the model. The role of sub-criteria is important to drive organizations for achieving their results.
- The key methods include structural equation models, multi-factor variant analysis, correlations, PCA, hypothesis methods to prove the research objectives. These techniques have piggy-packed on each other's ideas. Most of the statistical techniques adopted by the peer authors do not address the multi-collinearity.
- The criteria and sub-criteria of the EFQM model persist with the multicollinearity issue. In most of the publications, the multi-collinearity issue is not addressed or addressed partially. This situation does not help the managers or organizations to prioritize and focus their energy to improve the performance of the organization. Multicollinearity can be a problem in a regression model as it becomes difficult to distinguish between the individual effects of the independent variables on the dependent variables.
- The review of literature provides interesting results contradicting the general perception of the EFQM model that the relationship between criteria and results is through the process criterion. Some of the papers show positive and others show negative relationships between the criteria interactions.
- The scan of the research studies reveals that only a few papers covered the complete evolution of the EFQM model and the reason for changes made during the evolution.
- The literature review on the adoption of EFQM shows that many studies have found that the factors to achieve business excellence. But what causes the organizations to score high to achieve higher levels of business excellence is lacking in the literature.

- The empirical studies from the Indian context do not deal with the inter-relationships in the EFQM model and there is no study in the Indian context based on the external assessment data.
- Interesting papers are coming which are analyzing the EFQM model in relation to the Industry 4.0.

2.6 RESEARCH GAPS

Following research gaps are identified based on the review of 154 articles:

- No doubt, EFQM model has been widely practiced by industry, but the existence of logics in this model has not been explored
- There is no universal acceptance of the unidimensionality of the relationships among the EFQM criteria. There is a need to find the correlation among EFQM criteria on one hand and between criteria and results on the other hand.
- Despite a substantial body of the literature, empirical validation of the causal relationships within the EFQM model is limited, and it is mostly based on studies that test isolated associations. There is a lack of research that deals with investigating: (1) the role played by each sub-criteria of the model; (2) the relationships that are produced between these sub-criteria on the EFQM results and (3) how sub-criteria would influence the managerial aspects in an organizational context.
- The EFQM has completed 30 years of journey as a forum, the look and feel of the branding has changed but the basic motive did not change until 2019. The model continues to focus on excellence as a basis. Whereas, in the latest 2020 version, the excellence word itself is removed from the model. Is it because of widespread prevalence of Industry 4.0 in Europe or something else. Evolution of the new

EFQM model needs to be studied and its relationship with Industry 4.0 is to be explored.

- The relationship between the EFQM 2020 model and Industry 4.0 needs to be explored at the different levels to support successful digital transformation in the industry. It requires the mapping of KPIs from EFQM model to Industry 4.0.

CHAPTER-3

IDENTIFICATION OF RELATIONSHIP BETWEEN ENABLERS AND RESULTS AT SUB-CRITERIA LEVEL

This chapter assesses the interrelations between the EFQM model enablers and results at the sub-criteria level. The chapter identifies the primary influencing factors at the sub-criteria level for the customer, people, society, and business results.

3.1 INTRODUCTION

Even though the business excellence models were introduced about three decades ago, yet this is one of the favourite research topics for academicians, researchers as well as practitioners in industrial engineering and management. The quality approach used by the award-winning organizations is similar, but the differences lie in the way decisions are deployed based on the organization's unique needs. Since the EFQM model is widespread and applied in multiple sectors, it is necessary to understand the underlying logics between the enabler criteria and results at the sub-criteria level so that decision making becomes more informed.

Most of the research, as shown in the literature review chapter, tried to validate the existence of positive relation of leadership on people, strategy, and partnership and resources or the positive effects of people, strategy, and partnership and resources on processes, products, and services or the effects of the enablers on results. Also, except for a few papers like Calvo-Mora *et al.* (2005), Gómez *et al.* (2011) and Heras-Saizarbitoria *et al.* (2012), others have obtained the data from company managers through surveys. These managers have certain notions and ideas about the general correlation of enablers

and results. Perhaps this makes the empirical research biased towards the known unidirectional correlations and the existence of natural correlations is not unfolded. This chapter is based on the actual scores provided by the external professional assessors to the criteria and sub-criteria based on the reliable company facts and figures during evaluation for EFQM excellence award; in contrast to the internal managers who merely provide personal judgements. Moreover, Williams *et al.* (2006) observed the lack of academic work that contrasts the relationships within the EFQM model, a basic issue for the legitimization of any management model (Heras-Saizarbitoria *et al.* 2012). What Williams observed in 2006 is still valid today. Even after the use of the EFQM model for more than three decades, there is hardly any research that contrasts the basic relationships of the model. Many other authors want more reliability studies to be conducted on the EFQM model (Bou-Llusar *et al.* 2005). As indicated by Bou-Llusar *et al.* (2008), despite a substantial body of the literature, it is still widely recognized that the empirical validation of the causal relationships within the EFQM excellence model is limited, and it is mostly based on studies that test isolated associations. The widely used methodology is the study of effects at the criteria and results level. There is a lack of research that deals with (1) the role played by each sub-criteria of the model; (2) the relationships that are produced between these sub-criteria on the EFQM results and (3) identifying how such sub-criteria would influence the managerial aspects of the model in an organizational context. This chapter tries to unfold the relations at sub-criteria levels to drive more meaningful managerial conclusions.

3.2 RESEARCH METHODOLOGY

Figure 3-1 depicts the overall flow of the research work. One of the key decisions to make during this research study was multicollinearity and an approach to overcome the

multicollinearity situation. Literature reviews also reveal that research carried out using structural equation models, multi-factor variant analysis, correlations, PCA (Principal Component Analysis), and hypotheses have piggy-backed on each other's ideas. The factorial methods of DOE have been selected to appropriately handling multicollinearity. The search was for a statistical inference method for identifying the key factors rather than conducting DOE for optimising the results. The statistical analysis is carried out at two stages. Stage-1 of factorial analysis at criteria level and stage-2 of factorial analysis is at the sub-criteria level. Figure 3-1 shows the multiple iterations carried out in each stage.

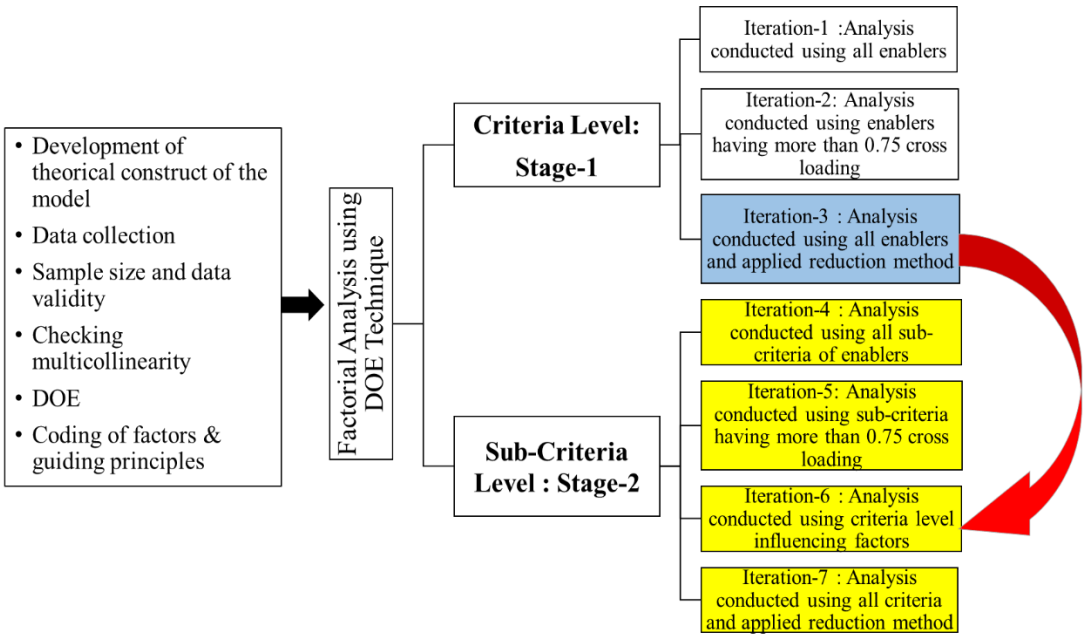


Figure 3-1: Flow diagram of the empirical research methodology

3.2.1 **Data Collection**

The data was collected from 58 organizations in the Indian region based on the CII-Exim bank business excellence model (based on EFQM) scores. These companies are assessed by a team of EFQM business excellence qualified assessors. Since the assessment team is independent of the assessing company, qualified, and have adequate industry experience to understand the mechanics of the industry, therefore this removes the bias

from the system. To ensure repeatability of the assessment, they have carried out the assessment using the RADAR framework. The collected data has been tabulated and a data sanity check was carried out. The data was collected at the sub-criteria level and criteria level. The criteria scores are an aggregation of the sub-criteria scores.

3.2.2 Sample Size & Data Validation

The list of organizations participating in CII EXIM award during 1996 - 2019 was collected from the CII website. This information is publicly available. Total 225 unique organizations or organizational units participated in the award process during this time. This list of the participating organizations is presented in APPENDIX A-2. From this, the assessment scores of 58 companies were gathered. This translates to 26% of the participating organizations data. Before proceeding with the analysis, it is important to check the reliability of the data. The reliability of the data is one of the key factors in data analysis. Cronbach's alpha measurement is a widely used technique to assess the internal consistency and degree to which items are homogeneous (Cooper and Emory, 1995; Saraph *et al.* 1989). The value of Cronbach alpha was calculated for all items and it was found to be 0.99, which is much above the recommended value of 0.6. Therefore, it is recommended for further analysis as reliability of the data is acceptable. The descriptive statistics of sub-criteria data is presented in Table 3-1 Cronbach's alpha and descriptive statistics are calculated using SPSS.

3.2.3 Checking Multicollinearity

Using Minitab, cross-loadings were found as correlations concerning the criteria as well as sub-criteria. The cross-loadings reveal that the data is valid as per Heras-Saizarbitoria *et al.* (2012). Criteria level cross-loadings and sub-criteria level cross-loading analyses are given in Table 3-2 and Table 3-3 respectively. The values are above the recommended value of 0.75.

Table 3-1: Descriptive analysis of sub-criteria

Sub-criterion reference	Minimum value	Maximum Value	Mean	Std. Deviation
1.a	30.00	71.00	50.36	9.65
1.b	30.00	67.00	49.04	9.87
1.c	30.00	67.00	47.90	9.49
1.d	25.00	66.00	48.05	9.87
1.e	30.00	67.00	47.69	9.83
2.a	28.00	75.00	47.89	10.67
2.b	30.00	67.00	47.87	9.57
2.c	25.00	72.00	47.58	9.45
2.d	26.00	71.00	47.63	9.52
3.a	25.00	64.39	48.75	8.86
3.b	20.00	66.00	48.27	9.76
3.c	25.00	71.00	48.09	9.57
3.d	25.00	70.00	48.04	9.20
3.e	25.00	75.00	50.25	9.01
4.a	30.00	65.00	49.49	8.31
4.b	30.00	74.00	51.61	9.14
4.c	30.00	67.00	49.42	8.41
4.d	32.50	72.00	49.88	8.78
4.e	25.00	63.17	46.49	8.96
5.a	25.00	66.00	49.38	9.15
5.b	33.00	64.81	49.00	8.10
5.c	30.00	61.33	48.85	7.46
5.d	35.00	71.00	51.26	7.85
5.e	30.00	73.00	48.84	8.91
6.a	25.00	69.00	46.94	10.75
6.b	19.38	72.00	45.68	10.72
7.a	20.00	70.00	46.31	11.62
7.b	20.00	63.13	44.65	10.35
8.a	15.00	65.03	44.63	13.10
8.b	20.00	67.12	46.07	11.85
9.a	20.00	72.00	50.17	9.83
9.b	30.00	65.00	48.42	9.27

The customer result has got five variables influencing the outcome. Similarly, people result is influenced by two variables, society result is influenced by four variables, and business results are influenced by six variables. In this research, the variable refers to the

criteria. Similar observations are made at the sub-criteria level (Table 3-3). From this exercise, it can be concluded that the model has multiple criteria (enablers) and sub-criteria influencing the same result, which means the data has multi-collinearity. This situation does not help the managers or organizations to prioritise and focus their energy to improve the performance of the organization.

Table 3-2: Cross loadings at the criteria level

	Strategy	people	Partnerships & Resources	Processes, Products & Services	Customer results	People results	Society results	Business results
Leadership	***0.952***	***0.849***	***0.924***	***0.957***	***0.892***	0.727	***0.771***	***0.808***
Strategy		***0.889***	***0.930***	***0.936***	***0.901***	***0.750***	0.735	***0.836***
People			***0.816***	***0.850***	***0.811***	***0.862***	***0.775***	***0.788***
Partnerships & Resources				***0.951***	***0.878***	0.690	0.749	***0.829***
Processes, Products & Services					***0.885***	0.712	***0.766***	***0.815***
Customer results						0.707	0.678	***0.851***
People results							0.727	0.747
Society results								0.673
Total occurrences	1	2	3	4	5	6	7	8
Total no of occurrences where cross loading is more than 0.75	1	2	3	4	5	3	3	6
%age of relations with more than 0.75 cross loading	100%	100%	100%	100%	100%	50%	43%	75%

Note: Bold Italic text presents the correlation of more than 0.75 between the factors

Table 3-3: Cross loadings at sub-criteria level

Sub-criteria	Leadership	Strategy	People	Partnerships & Resources	Processes, Products & Services	Customer results	People results	Society results	Business results
1.a	***0.954***	***0.927***	***0.866***	***0.885***	***0.907***	***0.884***	0.740	0.727	***0.831***
1.b	***0.964***	***0.911***	***0.776***	***0.890***	***0.919***	***0.891***	0.653	0.694	***0.759***
1.c	***0.958***	***0.904***	***0.799***	***0.923***	***0.942***	***0.846***	0.679	***0.783***	***0.782***
1.d	***0.953***	***0.887***	***0.852***	***0.849***	***0.911***	***0.836***	0.721	0.730	***0.781***
1.e	***0.946***	***0.898***	***0.765***	***0.878***	***0.890***	***0.832***	0.692	0.739	***0.793***
2.a	***0.941***	***0.970***	***0.864***	***0.895***	***0.913***	***0.874***	***0.755***	0.687	***0.814***
2.b	***0.931***	***0.956***	***0.830***	***0.909***	***0.919***	***0.894***	0.692	0.697	***0.843***
2.c	***0.901***	***0.959***	***0.857***	***0.888***	***0.894***	***0.861***	0.736	0.711	***0.808***
2.d	***0.917***	***0.964***	***0.889***	***0.911***	***0.897***	***0.859***	***0.753***	0.742	***0.827***
3.a	***0.860***	***0.865***	***0.956***	***0.816***	***0.852***	***0.792***	***0.832***	***0.770***	***0.763***
3.b	***0.760***	***0.803***	***0.951***	0.733	***0.774***	0.725	***0.810***	0.744	***0.751***
3.c	***0.841***	***0.867***	***0.959***	***0.819***	***0.836***	***0.817***	***0.810***	***0.750***	***0.781***
3.d	***0.824***	***0.866***	***0.952***	***0.782***	***0.816***	***0.810***	***0.818***	0.663	0.747
3.e	***0.774***	***0.810***	***0.926***	***0.757***	***0.777***	0.745	***0.849***	0.745	***0.810***
4.a	***0.837***	***0.835***	0.697	***0.915***	***0.863***	***0.802***	0.625	0.694	0.749
4.b	***0.861***	***0.842***	***0.763***	***0.924***	***0.871***	***0.807***	0.675	0.699	***0.843***
4.c	***0.894***	***0.877***	***0.803***	***0.945***	***0.911***	***0.817***	0.685	***0.767***	***0.803***
4.d	***0.834***	***0.860***	0.722	***0.926***	***0.870***	***0.830***	0.569	0.607	***0.751***
4.e	***0.857***	***0.867***	***0.791***	***0.916***	***0.885***	***0.811***	0.679	0.690	0.747
5.a	***0.865***	***0.836***	***0.757***	***0.865***	***0.904***	0.746	0.650	***0.763***	0.710
5.b	***0.853***	***0.847***	***0.758***	***0.870***	***0.873***	***0.771***	0.574	0.667	0.727
5.c	***0.837***	***0.790***	***0.783***	***0.793***	***0.880***	***0.755***	0.683	0.693	0.697
5.d	***0.884***	***0.860***	***0.769***	***0.876***	***0.911***	***0.828***	0.648	0.650	***0.824***
5.e	***0.892***	***0.873***	***0.784***	***0.883***	***0.920***	***0.894***	0.710	0.668	***0.805***
6.a	***0.882***	***0.888***	***0.801***	***0.860***	***0.872***	***0.993***	0.702	0.656	***0.847***
6.b	***0.871***	***0.877***	***0.792***	***0.877***	***0.868***	***0.962***	0.693	0.700	***0.833***
7.a	0.701	0.724	***0.837***	0.668	0.685	0.676	***0.993***	0.688	0.723
7.b	0.748	***0.762***	***0.863***	0.716	0.741	***0.769***	***0.905***	***0.786***	***0.808***
8.a	0.741	0.706	***0.758***	0.732	0.737	0.641	0.723	***0.964***	0.658
8.b	0.702	0.651	0.695	0.659	0.694	0.617	0.639	***0.948***	0.598
9.a	0.724	***0.757***	0.735	***0.764***	0.742	***0.785***	0.735	0.603	***0.963***
9.b	***0.820***	***0.828***	***0.764***	***0.826***	***0.822***	***0.840***	0.695	0.701	***0.966***
No of Interrelations having more than 0.75 Cross Loading	27	29	28	27	27	26	9	7	23

Note: Italic Bold text presents the correlation of more than 0.75 between the variables

3.2.4 **Design of Experiments (DoE)**

The NIST has explained the DOE in simple terms (https://www.itl.nist.gov/div898/handbook/). DOE is a systematic, rigorous approach to engineering problem-solving that applies principles and techniques at the data collection stage to ensure the generation of valid, defensible, and supportable engineering conclusions. In addition, this requires minimal expenditure of engineering runs, time, and

money. There are four general engineering problem areas in which DOE may be applied: comparative, screening/characterizing, modelling, and optimizing. An experiment is a series of tests conducted systematically to increase the understanding of an existing process or to explore a new product or process. DOE is a tool to develop an experimentation strategy that maximizes learning using minimum resources. DOE is widely used in many fields with broad applications across all the natural and social sciences. It is extensively used by engineers and scientists involved in the improvement of manufacturing processes to maximize yield and decrease variability. Often engineers also work on products or processes where no scientific theories or principles are directly applicable. Experimental design techniques become extremely important in such studies to develop new products and processes cost-effectively and confidently. "Illustrations of the Logic of Science" (1878) by Charles S. Peirce and "A Theory of Probable Inference" (1883) provide the basis for DOE.

Modern technological advances have made the management systems, products and processes exceedingly complicated. As the cost of experimentation rises rapidly, it is becoming increasingly difficult for the analyst, who is already constrained by resources and time, to investigate the numerous factors that affect these complex processes using trial and error methods. Instead, a technique is needed that identifies the "vital few" factors efficiently, and then directs the process to its best setting to meet the ever-increasing demand for improved quality and increased productivity. DOE techniques provide powerful and efficient methods to achieve these objectives. A full factorial analysis is adopted to identify the factors/enablers which are influencing the results or outcomes. The factorial analysis would help in overcoming the complexity and multicollinearity issues.

3.2.5 **Coding of Factors & Guiding Principles**

To conduct the factorial DOE analysis, the assessment scores of criteria and sub-criteria were codified. To conduct the factorial DOE runs, the raw data needs to be sub-grouped. The raw data ranges from values of 22 to 75 based on the assessment scores. Practically, it will be difficult to handle this raw data range and construct the factorial design. To simplify the factorial design, the data needs to be clustered. The raw data was clustered as per the scheme presented in Table 3-4. This classification is derived based on the maturity of the assessment and keeping the RADAR into account. The codified data of criteria level is presented in Table 3-5 and the sub-criteria level is depicted in Table 3-6.

Table 3-4: Codification of data for factorial analysis

Assigned code	Criteria score	Sub-criteria score
1	0-30	0-30
2	30.01-40	30.01-40
3	40.01-50	40.01-50
4	50.01-60	50.01-60
5	60.01-75	60.01-75

Table 3-5: Codified data of criteria level

Company	Leadership	Strategy	People	Partnerships and Resources	Processes, Product & Services
1	4	3	3	4	4
2	3	2	3	3	3
3	3	3	2	3	3
4	3	3	3	3	3
5	4	4	4	4	4
6	2	2	2	2	2
7	3	3	3	3	3
8	5	5	5	5	5
9	4	4	4	3	3
10	5	5	4	5	4
11	4	4	4	4	4
12	3	3	3	4	3
13	2	2	2	2	3
14	2	2	2	2	3
15	5	5	4	5	5
16	3	4	4	3	3
17	3	3	3	3	3

Company	Leadership	Strategy	People	Partnerships and Resources	Processes, Product & Services
18	3	3	3	3	3
19	3	3	3	3	3
20	2	2	3	3	3
21	3	3	3	3	3
22	5	5	5	4	4
23	4	4	4	4	4
24	2	2	1	3	2
25	2	2	3	2	2
26	2	2	1	2	2
27	3	3	4	3	3
28	2	3	3	3	3
29	3	3	3	3	3
30	4	3	3	4	4
31	2	2	2	2	2
32	4	4	4	4	3
33	3	4	4	4	4
34	3	3	2	4	4
35	4	3	3	4	4
36	5	5	4	4	4
37	2	2	2	3	3
38	3	3	3	3	3
39	3	3	3	3	3
40	3	3	4	3	3
41	4	4	4	4	4
42	4	4	4	4	4
43	4	4	4	4	4
44	4	4	4	4	4
45	5	5	5	5	5
46	4	4	4	4	4
47	5	5	5	5	5
48	3	3	3	3	3
49	4	4	4	4	4
50	5	4	4	4	4
51	5	5	4	5	5
52	3	3	3	3	3
53	3	3	3	3	3
54	4	4	4	4	3
55	2	3	3	3	3
56	3	4	4	3	4
57	4	4	4	4	4
58	4	4	4	4	4

Table 3-6: Codified data of sub-criteria level

Company	1.a	1.b	1.c	1.d	1.e	2.a	2.b	2.c	2.d	3.a	3.b	3.c	3.d	3.e	4.a	4.b	4.c	4.d	4.e	5.a	5.b	5.c	5.d	5.e
1	3	3	4	4	3	3	3	3	4	4	3	3	2	3	4	4	4	4	3	5	4	4	4	3
2	3	3	3	2	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
3	3	3	3	2	3	3	3	3	3	2	3	3	2	3	3	3	2	3	2	3	3	3	3	3
4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3
5	4	4	4	4	5	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
6	3	2	2	2	2	2	2	2	2	3	3	2	3	3	3	2	2	2	2	2	2	3	3	3
7	3	3	3	3	4	3	2	3	3	3	3	2	2	4	4	3	3	3	3	4	2	3	3	4
8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	4	4	5	5
9	4	4	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	3	3	3	3	4	4
10	5	5	4	5	5	5	5	5	4	4	4	4	4	5	5	5	5	5	4	5	4	5	5	5
11	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	3	4	4	3	5	4	4
12	3	2	3	3	3	3	3	2	3	3	3	3	3	3	4	4	3	4	4	3	3	3	3	3
13	2	2	2	3	2	1	2	1	2	2	1	2	2	3	2	3	2	2	2	2	2	3	4	2
14	2	3	2	2	2	2	2	3	1	2	2	2	2	3	2	3	3	3	1	3	2	3	3	2
15	5	5	5	5	5	5	5	5	5	4	4	4	4	4	5	5	5	5	4	5	5	4	5	4
16	4	3	3	3	3	4	3	4	4	4	4	4	4	4	3	3	4	3	3	3	4	3	4	3
17	4	4	3	4	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
18	4	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
19	3	3	2	2	3	3	3	3	2	3	2	3	2	3	3	2	3	3	2	2	3	2	3	2
20	2	2	2	2	2	2	2	2	2	3	3	4	3	3	2	3	3	3	3	3	3	3	3	3
21	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
22	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	5	4	5	4
23	5	5	4	5	4	4	5	4	4	4	5	5	4	5	5	5	4	5	4	4	4	4	5	5
24	2	2	2	1	3	2	2	3	2	2	1	1	1	1	3	3	3	3	3	2	3	2	3	2
25	2	2	2	3	2	2	2	2	2	3	4	4	3	4	2	2	2	2	2	1	2	3	3	2
26	2	3	3	2	2	2	2	2	2	1	1	2	2	2	3	3	2	3	1	1	2	3	2	3
27	3	2	3	3	3	2	3	3	3	4	4	4	3	5	3	4	4	2	2	2	3	3	3	2
28	3	3	2	2	2	2	3	3	3	3	4	2	3	4	2	3	3	4	3	3	3	3	3	3
29	4	3	3	4	3	4	4	3	3	4	3	3	4	3	4	4	3	3	3	3	4	3	3	4
30	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	4	4	4	3	4	4	3	4	4
31	3	2	3	2	3	2	3	2	2	2	2	3	3	3	3	2	2	2	2	3	2	3	3	3

Company	1.a	1.b	1.c	1.d	1.e	2.a	2.b	2.c	2.d	3.a	3.b	3.c	3.d	3.e	4.a	4.b	4.c	4.d	4.e	5.a	5.b	5.c	5.d	5.e
32	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	3	4	4	4	4	4	4	3
33	3	3	3	3	3	4	4	4	4	4	3	3	3	4	4	4	4	4	4	4	4	4	4	3
34	3	3	3	3	3	3	3	3	3	2	2	2	3	2	4	4	4	4	3	4	4	1	5	2
35	4	4	4	4	4	3	4	3	4	4	3	3	3	3	4	5	4	5	4	3	4	4	5	4
36	5	5	5	5	5	5	5	5	4	5	5	4	4	4	4	4	5	4	4	5	4	4	5	4
37	2	2	2	1	2	2	2	2	3	2	2	2	2	3	3	3	4	3	3	3	3	1	3	3
38	3	4	3	3	3	3	3	3	3	3	3	3	4	3	4	3	3	3	4	4	3	4	3	3
39	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	3	2	3	3	3	3	3
40	3	3	3	3	3	3	3	3	3	4	4	3	4	4	3	3	3	3	3	3	3	3	3	3
41	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
42	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
43	4	5	4	4	4	5	5	4	4	4	4	4	4	4	4	5	4	5	4	4	4	5	4	4
44	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4
45	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
46	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
47	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	4	4	5	5	4	5	5
48	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
49	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
50	5	5	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
51	5	5	5	4	5	5	4	5	4	4	4	4	4	4	5	5	5	4	4	4	5	5	5	4
52	3	3	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	4	3	3	4	3
53	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
54	4	4	4	3	4	4	3	4	4	4	4	3	4	4	4	4	4	3	3	3	3	4	3	3
55	3	2	2	2	2	3	3	3	4	3	3	3	3	3	4	4	4	4	3	3	3	2	3	3
56	4	4	3	3	3	3	4	4	4	4	4	4	4	4	4	3	4	3	3	4	3	4	4	4
57	4	4	4	4	4	4	3	3	4	4	4	4	4	4	4	5	4	4	3	4	4	4	4	4
58	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

The following points serve as guiding principles Ekstrom (2020) and Domann *et al.* (2012) for the analysis of the outputs.

- R-squared (R^2) and Adj. (R^2) values of more than 70% qualify as a good fit and the difference of -/+ 5% is acceptable and closer the better (Rule-1). R-squared is a statistical measure of how close the data is to the fitted regression line and the adjusted R-squared is a modified version of R-squared that has been adjusted for the number of predictors in the model.
- P-value is one of the key factors in DOE. Factors having P-value below 0.05, or closer to 0.05 value will provide 95% confidence (Rule-2) and the model will be a good fit. P-Value is the probability of observing the test statistics under the null hypothesis.
- Variance inflation factor (VIF) is a measure of the amount of multicollinearity in a set of multiple regression variables. Its acceptable value is between 1 and 5, "1" means no multicollinearity and "5" means moderate multicollinearity within factors. VIF values beyond 5 means strong multicollinearity exists between the factors. In this study, VIF less than 5 is acceptable (Rule-3).
- In the standardised effect of the Pareto-chart at alpha value of 0.05, the horizontal red line is the reference line and factors crossing this red line are termed as influencing factors.
- A higher F-value (minimum acceptable value is 4) shows that factor is significant in the model and influences the results.

3.2.6 Theoretical Construct of the EFQM Model

Pannirselvam and Ferguson (2001) have confirmed the theoretical reliability of the data obtained from external assessment processes. The theoretical construct of the EFQM model Figure 3-2 appears in the full criteria level interconnections unlike the original model which does not show all these interconnections. To implement the model for the practical or managerial application, it is necessary and important to establish interactions.

Researchers have made assumptions and assessments based on the base model to keep the model simple. A few researchers have gone beyond the base model interactions with

the result criteria. Based on the theoretical construct of the model, the results are likely to be influenced by enablers. Four result categories (**CR, PR, SR, and BR**) likely to get influenced by 15 combinations of enablers and cross-influence of six combinations from result criteria as shown in Figure 3-2. The first five relationships are direct (first-order) and the next ten are second-order indirect relationships. The red line shows the relationship to results and the green line shows the criteria interactions. Further analysis was done to validate the proposed construct.

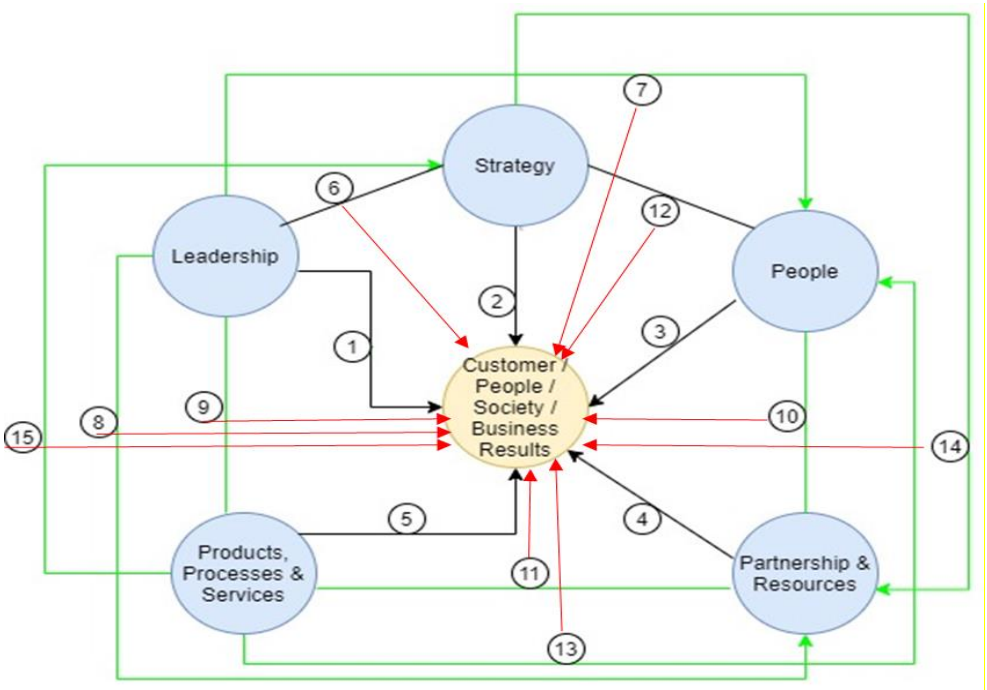


Figure 3-2: Proposed theoretical construct showing direct and indirect criteria interactions

3.3 RESULTS AND DISCUSSION

This section presents the results of stage-1 and stage-2 factorial analysis.

3.3.1 Factorial Analysis at the Criteria Level

The factorial analysis at the criteria level was carried out using *Minitab 19.0*. The results and the discussion of different iterations is presented next.

3.3.1.1 **Criteria level (Level-1) iteration-1 analysis**

In the first iteration (run), all enabler criteria were considered as variables against the result category to identify the key influencing factors. The codified data of criteria and scores of the results were taken as input. While running the factorial DOE, the codified data of criteria is considered as a variable and their effect on each result (customer, people, society, and business) is considered. While analysing the data, respective results are considered with two-way interactions of the factors. The outcome of the statistical analysis carried out using Minitab 19.0 software is presented in the subsequent section. The Minitab provides multiple analysis reports and key results are presented here. The main effect plot (Figure 3-3) shows the effect of various criteria on customer results. It is clear that the leadership has a strong influence on customer results. The interaction plot (Figure 3-4) shows how the enabler criteria are behaving with each other concerning customer results. Figure 3-5 shows the result of the factorial regression run results concerning customer results. Two factors are important here: p-value and VIF. Table 3-7 also shows the model summary in terms of R-Squared and Adjusted R-Squared value. The Pareto chart (Figure 3-5) shows the absolute values of the standardized effects from the largest effect to the smallest effect. The chart also plots a reference line to indicate which effects are statistically significant. The reference line for statistical significance depends on the significance level (denoted by α or alpha). The factors above the red line are influencing factors.

The residual plots are presented in Figure 3-6. The residual plot consists of four graphs. The normal probability plot of the residuals displays the residuals versus their expected values when the distribution is normal. The normal probability plot presents the residuals to verify the assumption that the residuals are normally distributed. The normal probability plot of the residuals should approximately follow a straight line. The next

plot, the residuals versus fits graph plots the residuals on the y-axis and the fitted values on the x-axis. The residuals versus fits plot is to verify the assumption that the residuals are randomly distributed and have constant variance. Ideally, the points should fall randomly on both sides of 0, with no recognizable patterns in the points. The third plot, the residuals versus order plot displays the residuals in the order that the data were collected. The residuals versus order plot is to verify the assumption that the residuals are independent of one another. Independent residuals show no trends or patterns when displayed in time order. Patterns in the points may indicate that residuals near each other may be correlated, and thus, not independent. Ideally, the residuals on the plot should fall randomly around the centre line. The fourth plot, the histogram of the residuals shows the distribution of the residuals for all observations. The histogram of the residuals is to determine whether the data are skewed or include outliers. Similarly, people results are presented in Figure 3-7, Figure 3-8, Figure 3-9, Figure 3-10 andTable 3-8. Society results are presented in Figure 3-11, Figure 3-12, Figure 3-13, Figure 3-14 and Table 3-9. Business results are presented in Figure 3-15, Figure 3-16, Figure 3-17, Figure 3-18 and Table 3-10

Figure 3-3: Factorial plots for customer results (criteria level)

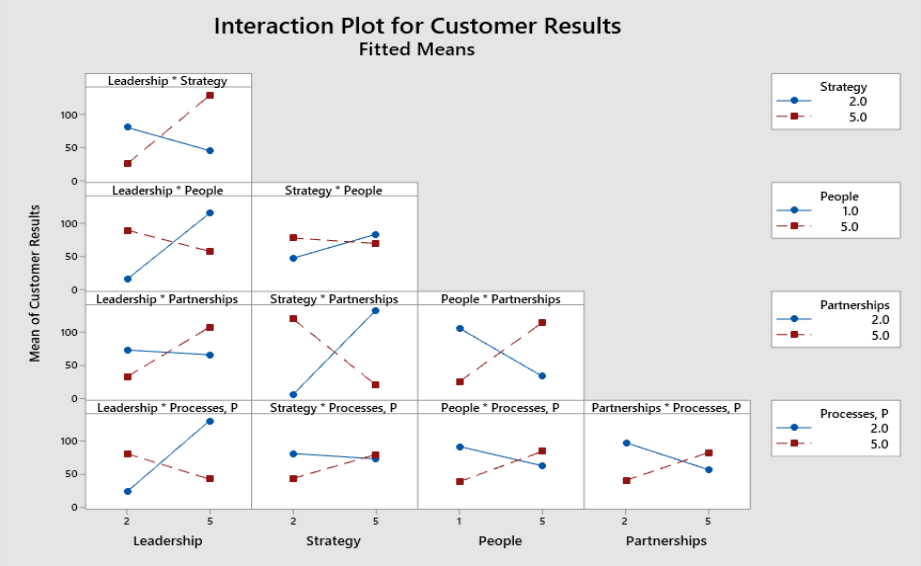


Figure 3-4: Interaction plots for customer results (criteria level)

Table 3-7: Analysis of Variance for customer result (criteria level)

Term	**P-Value**	**VIF**
Constant	0.000	
Leadership	0.011	16.11
Strategy	0.262	13.58
People	0.473	6.28
Partnerships and Resources	0.962	14.68
Processes, Product & Services	0.302	13.27
Leadership*Strategy	0.016	31.06
Leadership*People	0.148	50.69
Leadership*Partnerships and Resources	0.421	80.63
Leadership*Processes, Product & Services	0.250	109.78
Strategy*People	0.584	37.71
Strategy*Partnerships and Resources	0.097	153.57
Strategy*Processes, Product & Services	0.748	137.22
people*Partnerships and Resources	0.129	54.31
people*Processes, Product & Services	0.541	78.05
Partnerships and Resources*Processes, Product & Services	0.270	34.88

Model Summary

S	**R-sq**	**R-sq(adj)**	**R-sq(pred)**
7.86781	81.87%	75.40%	*

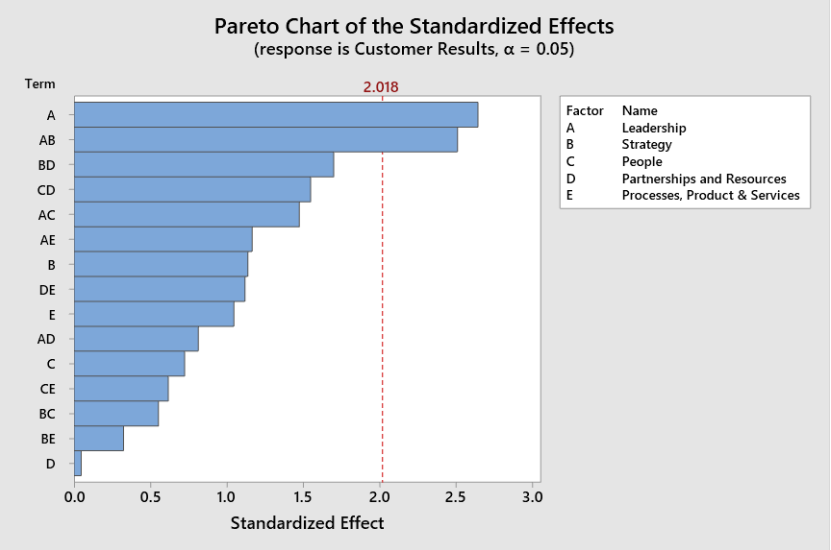


Figure 3-5: Pareto chart for customer results (criteria level)

Figure 3-6: Residual plots for customer results (a to d) – criteria level

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Figure 3-7: Factorial plots for people results (criteria level)

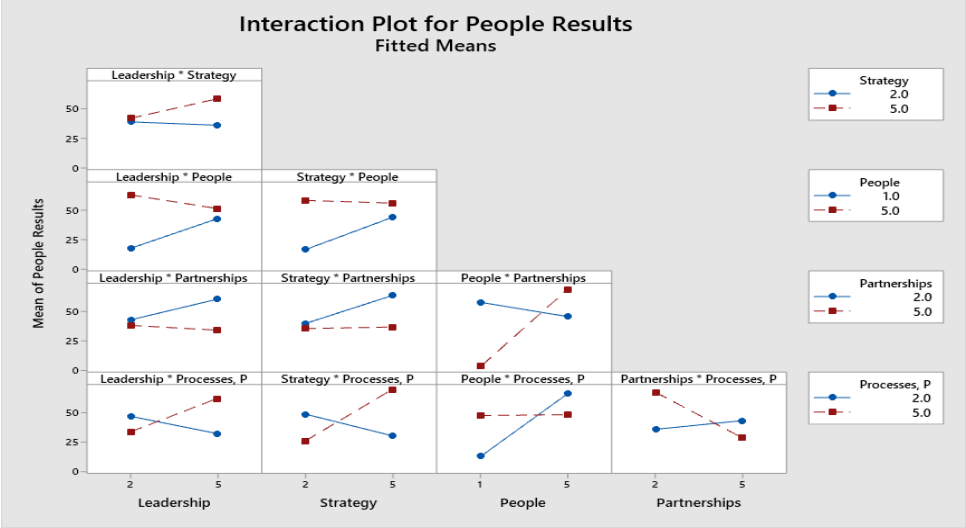

Figure 3-8: Interaction plots for people results (criteria level)

Table 3-8: Analysis of Variance for people results (criteria level)

Term	P-Value	VIF
Constant	0.000	
Leadership	0.504	16.11
Strategy	0.197	13.58
People	0.005	6.28
Partnerships and Resources	0.183	14.68
Processes, Product & Services	0.476	13.27
Leadership*Strategy	0.657	31.06
Leadership*People	0.604	50.69
Leadership*Partnerships and Resources	0.787	80.63
Leadership*Processes, Product & Services	0.663	109.78
Strategy*People	0.640	37.71
Strategy*Partnerships and Resources	0.832	153.57
Strategy*Processes, Product & Services	0.566	137.22
People*Partnerships and Resources	0.351	54.31
People*Processes, Product & Services	0.585	78.05
Partnerships and Resources*Processes, Product & Services	0.433	34.88

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
6.19532	76.35%	67.91%	*

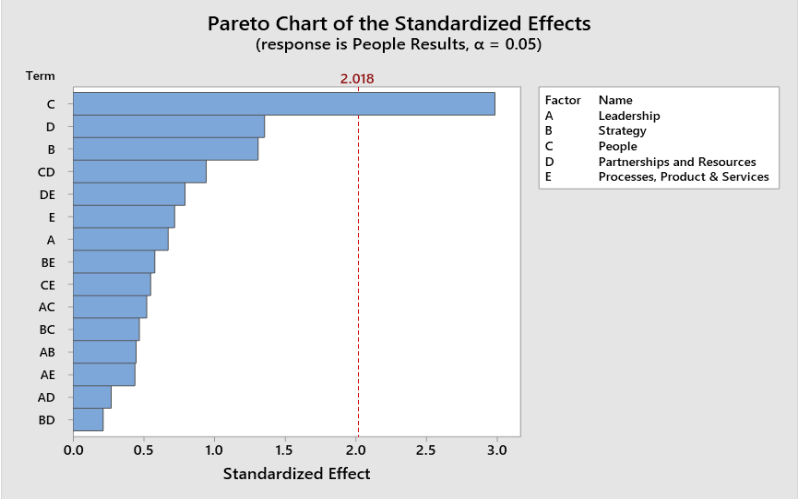

Figure 3-9: Pareto chart for people results (criteria level)

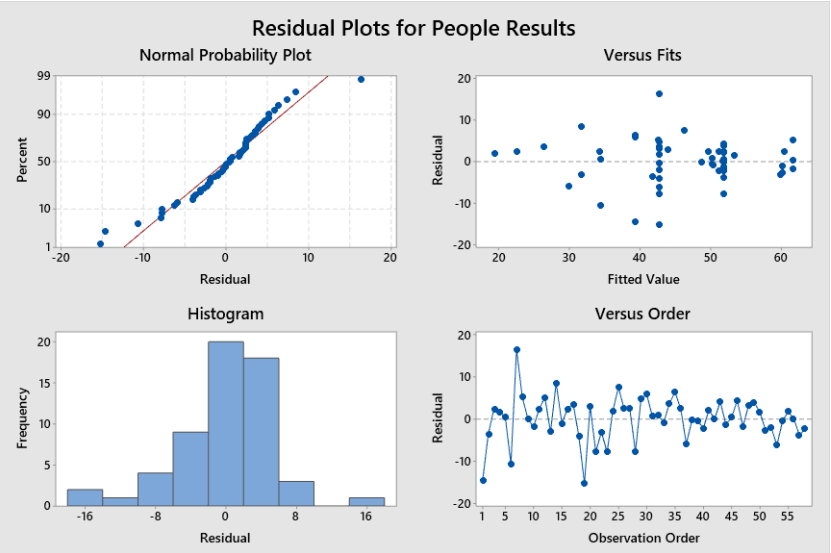

Figure 3-10: Residual plots for people results (a to d) – criteria level

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Figure 3-11: Factorial plots for society results (criteria level)

Figure 3-12: Interaction plots for society results (criteria level)

Table 3-9: Analysis of Variance for society results (criteria level)

Term	P-Value	VIF
Constant	0.000	
Leadership	0.010	16.11
Strategy	0.291	13.58
People	0.040	6.28
Partnerships and Resources	0.159	14.68
Processes, Product & Services	0.212	13.27
Leadership*Strategy	0.638	31.06
Leadership*People	0.083	50.69
Leadership*Partnerships and Resources	0.865	80.63
Leadership*Processes, Product & Services	0.318	109.78
Strategy*People	0.081	37.71
Strategy*Partnerships and Resources	0.828	153.57
Strategy*Processes, Product & Services	0.647	137.22
People*Partnerships and Resources	0.284	54.31
People*Processes, Product & Services	0.363	78.05
Partnerships and Resources*Processes, Product & Services	0.125	34.88

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
7.29319	73.13%	63.54%	*

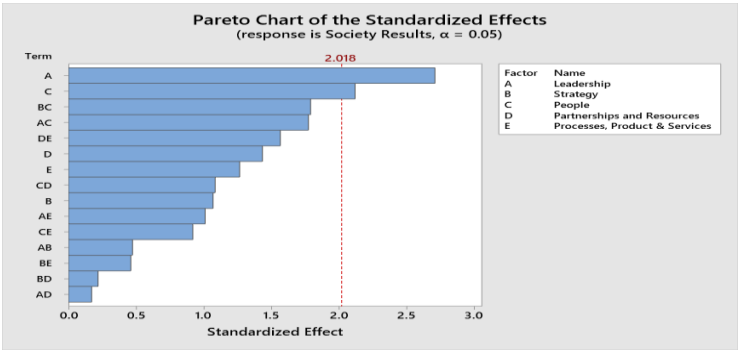

Figure 3-13: Pareto charts for society results (criteria level)

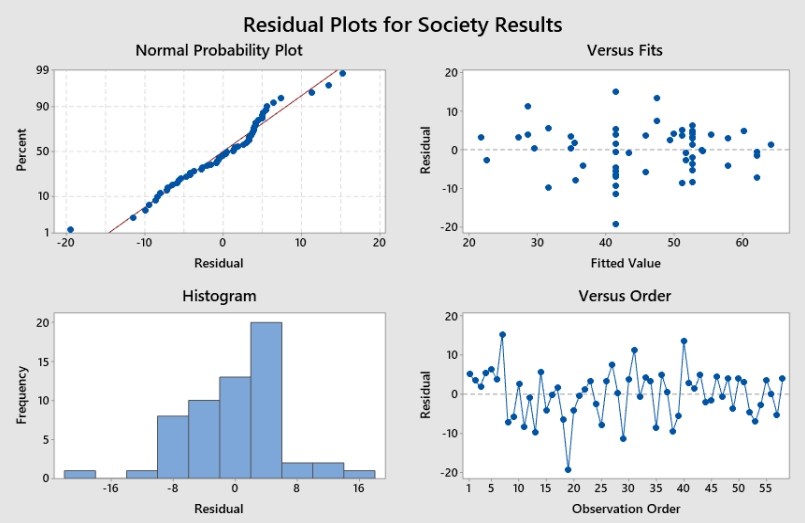

Figure 3-14: Residual plots for society results (a to d)-criteria level

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Figure 3-15: Factorial plots for business results (criteria level)

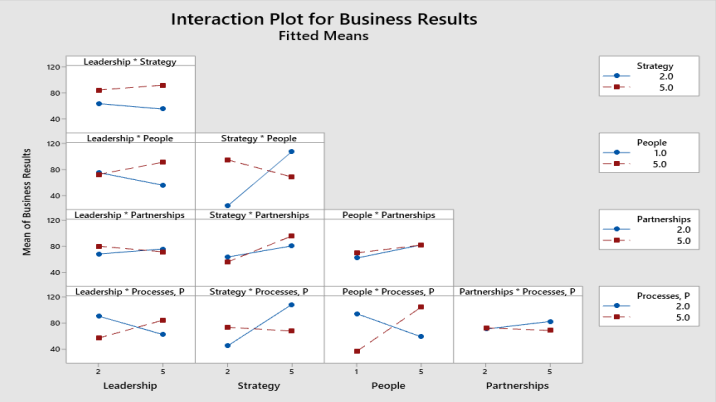


Figure 3-16: Interaction plots for business results (criteria level)

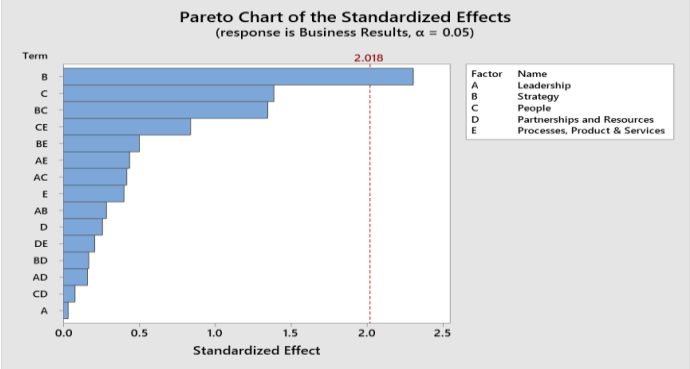


Figure 3-17: Pareto chart for business results (criteria level)

Table 3-10: Analysis of Variance for business result (criteria level)

Term	P-Value	VIF
Constant	0.000	
Leadership	0.974	16.11
Strategy	0.026	13.58
People	0.173	6.28
Partnerships and Resources	0.797	14.68
Processes, Product & Services	0.691	13.27
Leadership*Strategy	0.777	31.06
Leadership*People	0.678	50.69
Leadership*Partnerships and Resources	0.874	80.63
Leadership*Processes, Product & Services	0.665	109.78
Strategy*People	0.186	37.71
Strategy*Partnerships and Resources	0.867	153.57
Strategy*Processes, Product & Services	0.619	137.22
People*Partnerships and Resources	0.939	54.31
People*Processes, Product & Services	0.406	78.05
Partnerships and Resources*Processes, Product & Services	0.837	34.88

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
7.99016	74.90%	65.93%	*

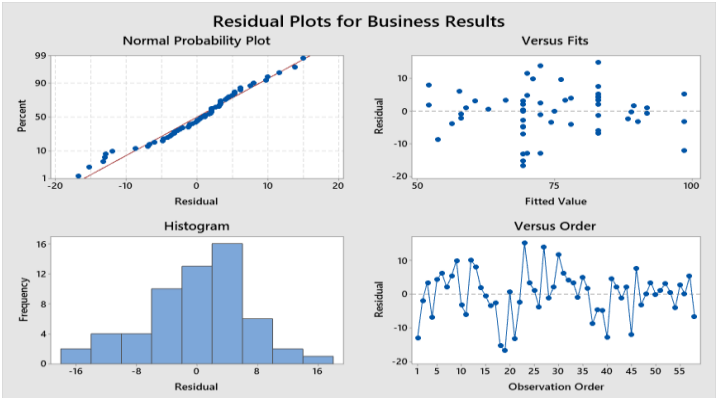


Figure 3-18: Residual plots for business results (criteria level)

The summary of analysis is tabulated in Table 3-11. The VIF value is more than 5 in each run against the result categories. Therefore, the identified criteria may not be the key influencers. Hence, this iteration was rejected and iteration 2 was carried out.

3.3.1.2 **Criteria level (Level-1) iteration-2**

In the second iteration, factors having above 0.75 correlations were considered against each result category as suggested by Heras-Saizarbitoria *et al.* (2012). Steps similar to iteration 1 were followed. The only major difference is the factors are considered as per Table 3-2, cross-loadings at criteria level. Under each result category, marked in bold italic colour factors are considered to run the DOE factorial. The Minitab generated a similar kind of report as per the previous section. The results are presented in APPENDIX A-3 from the better readability. Once again, the summary of results is tabulated in Table 3-11. In this iteration, the VIF value is more than five in only of the result categories. The identified factors may not be the key influencers. These results are partially acceptable in this case Heras-Saizarbitoria *et al.* (2012).

3.3.1.3 **Level-1 iteration-3**

Finally, in the third iteration, iteration-1 run output is used for the factorial reduction method to arrive at the key influence of the criteria. In the factorial reduction method, the factor with the highest VIF value and P-value more than 0.05 is eliminated first and it is continued till the model reaches a good fit and meets identified rules. The Minitab generated a similar kind of report as per the previous section. The final run results are presented in APPENDIX A-4 for the better readability. The results of these three iterations are presented in Table 3-11. Iteration-3 provides significant criteria influencing each result category. For example, PR is influenced by people and strategy* process interaction criterion. Similarly, CR category is also affected by leadership and strategy. The results show that leadership, strategy, people, and process criteria are the influencing

criteria. The EFQM model has five enabler criteria and four result criteria. If all taken together then there exists multicollinearity and it becomes difficult to take any decisions to prioritize the improvements. Hence, the outcome of the iteration is inconclusive. Therefore, it is necessary to look at the sub-criteria level so that operational decisions can be prioritized.

3.3.2 Factorial Analysis at the Sub-criteria Level

Since the construct validation did not provide a conclusive outcome at criteria level, it was decided to carry out factorial analysis at sub-criteria level (Level-2). Four iterations (4-7) were carried out in this stage.

3.3.2.1 Sub-criteria level (Level-2) iteration-4

All the 24 sub-criteria of enablers (1.a to 5.e) were adopted to carry out factorial analysis for result categories. This is because the criteria score in an assessment is an aggregation of the sub-criteria score. These factors were considered as variables to perform the analysis to identify the key influencing factors. The codified data of sub-criteria and scores of the results were considered. One-way interactions of the factors were considered to reduce the number of combinations as 24 variables in a two-way interaction will have 300 combinations to deal with. The results are presented in APPENDIX A-5 for the better readability. The summary of results is tabulated in Table 3-12. In this iteration, the R^2 values were in the range of 81% to 88%. Even the model shows key influencing factors, however, the model had not reached the desired DOE acceptable principles as per the rules. The VIF value is more than 5 for the result category. Therefore, the identified factors are not the key influencers, and this iteration does not fulfil the research objective. Therefore, Iteration-5 was carried out.

3.3.2.2 Sub-criteria level (Level-2) iteration-5

Next, to magnify the key factor, the factor analysis was carried out in iteration-5 only for the sub-criteria having more than 0.75 correlation. Table 3-3 shows the cross loading and factors in bold Italic sub-criterion was considered for the analysis. For example, in the case of customer results, 21 sub-criteria were having more than 0.75 correlation. The Minitab generated results are presented in APPENDIX A-6 for the better readability of the chapter. However, the summary of results is tabulated in Table 3-12**.** The results show that the R^2 values are in the range of 69% to 87%, which is a good fit. However, the VIF (desired level of less than 5) and P-value (desired level of less than 0.05) for a number of variables is more than the desired value. Hence, it cannot be concluded that the identified factors are key influencers. The model has not reached the desired DOE acceptable principles. Therefore, next iteration (Iteration-6) was carried out.

3.3.2.3 Sub-criteria level (Level-2) iteration-6

Iteration-3 was used as the base for conducting this iteration. In iteration-3, the criteria reduction method identified the potential influencing criteria. For example, customer result is influenced by leadership and strategy as per the iteration-3. The sub-criteria of leadership and strategy are used to run the analysis. Similarly, for other categories of the results, sub-criteria of influencing criteria of iteration-3 were considered to run the analysis. Factorial reduction was considered for the analysis. A single run was carried out with one-way interaction for all four categories of results. The results were generated as in the previous iterations. The results are presented in APPENDIX A-7 from the better readability aspect of the chapter. Once again, the summary of results is tabulated in Table 3-12**.** In this iteration, the R^2 value of the analysis was in the range of 75% to 80% across all result categories. The VIF value is more than 5 for only one result category. The identified factors may be closer to the key influencers. But the results do not fulfil the research objectives.

Table 3-11: Theoretical construct and other research validation at criteria level

							Rule-1					Rule-2	Rule-3				
Sl No	**Iteration**	**Iteration description**	**Result**	**R^2 Value**	**R^2 Value (adj)**	**SD**	**No of Factors having P value less than 0.05 or close to 0.05**	**No of Factors having less than or closer to 5 VIF**	**No of Significant factors as per Normal Plot**	**Factors beyond or close to red-line in Pareto Chart of the standardized effect**	**All Factors appearing in the Pareto Chart**	**Rule-1**	**Rule-2**	**Rule-3**	**Conclusions**
1	1	All Enabler Criteria considered (Leadership, Strategy, People, P&R, PP&S)	Customer	81.87%	75.40%	7.87	3 in 15 factors	0 in 15 factors	2	Leadership, Leadership*Strategy	Leadership, Leadership*Strategy, all other factors (Factors and Factor Interactions)	Meets	No	Not favourable	The R^2 values are acceptable. However, the P-values (Rule-2) and VIF (Rule-3) are not meeting. The result of Iteration run not providing significant factors. The VIF value is more than 5 in each run against the result category.
2			People	76.35%	67.91%	6.2	1 in 15 factors	0 in 15 factors	1	People	People and other factors and factor interactions	Partial	No	Not favourable	
3			Society	73.13%	63.54%	7.29	2 in 15 factors	0 in 15 factors	2	Leadership, People	Leadership, People, Remaining factors and interactions	Partial	No	Not favourable	
4			Business	74.90%	65.93%	7.99	1 in 15 factors	0 in 15 factors	1	Strategy	Strategy	Partial	No	Not favourable	
5	2	Criteria having more than 0.75 correlations with CR - Leadership, Strategy, People, P&R, PP&S	Customer	81.87%	75.40%	7.87	3 in 15 factors	0 in 15 factors	2	Leadership, Leadership*Strategy	Leadership, Leadership*Strategy, all other factors (Factors and Factor Interactions)	Meets	No	Not favourable	R^2 values are are acceptable. However, In case of CR and BR, the P-Values (rule-2) and VIF (rule-3) are not acceptable. Once again, the analysis was inconclusive. The identified factors may not be the key influencers
6		Criteria having more than 0.75 correlation with PR - People	People	71.32%	70.80%	5.9	1 in 1 Factors	1 in 1 Factors	1	People	People	Meets	Meets	Not favourable	
7		Criteria having more than 0.75 correlation with SR - Leadership, People, PP&S	Society	68.56%	66.82%	6.96	1 in 3 Factors	3 in 3 Factors	1	People	People	No	No	favourable	
8		Criteria having more than 0.75 correlation with BR - Leadership, Strategy, People, P&R, PP&S	Business	74.90%	65.93%	7.99	1 in 15 factors	11 in 15 factors	1	Strategy	Strategy	Partial	No	partial favourable	

							Rule-1						Rule-2	Rule-3			
Sl No	**Iteration**	**Iteration description**	**Result**	**R^2 Value**	**R^2 Value (adj)**	**SD**	**No of Factors having P value less than 0.05 or close to 0.05**	**No of Factors having less than or closer to 5 VIF**	**No of Significant factors as per Normal Plot**	**Factors beyond or close to red-line in Pareto Chart of the standardized effect**	**All Factors appearing in the Pareto Chart**	**Rule-1**	**Rule-2**	**Rule-3**	**Conclusions**
9	3	Iteration-1 with reduction method	Customer	76.17%	75.30%	7.88	1 in 2 Factors	0 in 2 Factors	2	Leadership, Strategy	Leadership, Strategy	Meets	Partial	Not favourable	In this iteration, R^2 Values are in the range of 76% to 68% for all and Values are acceptable. the VIF value is more than 5 in only one run against the result category, it persists with multi-collinearity. The identified criteria may closer to the key influencers
10		Iteration-1 with reduction method	People	72.49%	71.49%	5.8	1 in 2 Factors	2 in 2 Factors	1	People	People, Strategy* Process Interaction	Meets	Partial	favourable	
11		Iteration-1 with reduction method	Society	68.41%	67.26%	6.9	2 in 2 Factors	2 in 2 Factors	2	People, Leadership	People, Leadership	No	Meets	favourable	
12		Iteration-1 with reduction method	Business	71.81%	70.20%	7.47	3 in 3 Factors	3 in 3 Factors	3	Strategy, Strategy*People, People*Process	Strategy, Strategy*People, People*Process	Partial	Meets	favourable	

Note:
1). For each result category, the factorial analysis of DOE is carried out. Following inputs to Minitab to draw the interferences. It includes; a). Main effect plot for each result category, b). Coded Co-efficient results, c). Model summary, d). Analysis of variance, e). Normal plot of the standardized effects, f). Pareto chart of the standardized effects

Table 3-12: Factorial analysis iteration analysis summary at sub-criteria level

					Rule-1			Rule-2	Rule-3							
Sl No	**Iteration**	**Iteration description**	**Result Category**	**No of Factors**	**R2 Value**	**R2 Value (adj)**	**SD**	**No of Interaction Factors having less than 0.05 or close to 0.05**	**No of Factors / Interaction Factors having less than 5 VIF**	**No of Significant factors as per the Normal Plot**	**Factors beyond /closure to red-line in Pareto Chart**	**All Factors Appearing in the Pareto Chart**	**Rule-1**	**Rule-2**	**Rule-3**	**Conclusions**
1	4	All 24 sub-Criteria	Customer	24	88.13%	79.14%	7.19	1 of 24 Factors	15 of 24 Factors	1	5.e	all 24 factors	Meets	No	Partially Favourable	In this iteration, the VIF value is more than 5 in each run against the result category, it persists with multi-collinearity. The identified factors are not the key influencers
2			People	24	82.39%	69.58%	6.03	0 of 24 Factors	0 of 24 Factors	0	Nil	all 24 factors	Partial	No	Not favourable	
3			Society	24	80.62%	66.53%	6.99	0 of 24 Factors	3 of 24 Factors	0	Nil	all 24 factors	Partial	No	Not favourable	
4			Business	24	85.37%	74.73%	6.88	3 of 24 Factors	2 of 24 Factors	3	1.b, 4.b, 2.c	all 24 factors	Partial	No	Not favourable	
5	5	Sub-criteria having more than 0.75 correlations with CR (2.b, 5.e, 1.b, 1.a, 2.a, 2.c, 2.d. 1.c,1.d,1.e, 4.d, 5.d, 3.c, 4.c, 4.e, 3.d, 4.b, 4.a, 3.a, 5.b, 5.c)	Customer	21	86.60%	78.79%	7.3	0 of 21 Factors	3 of 21 Factors	0	Nil	19 factors	Partial	No	Not favourable	
6		Sub-criteria having more than 0.75 correlations with PR (3.e, 3.a, 3.d, 3.b, 3.c, 2.a, 2.d)	People	7	72.60%	68.77%	6.11	1 of 7 Factors	2 of 7 Factors	1	2.a	7 factors	Partial	No	Not favourable	In this iteration, the VIF value is more than 5 in only one run against the result category, it persists with multi-collinearity. The identified factors are not the key influencers
7		Sub-criteria having more than 0.75 correlations with SR (1.c, 3.a, 4.c, 5.a)	Society	4	68.71%	66.34%	7	2 of 4 Factors	4 of 4 Factors	2	1.c, 3.a	4 factors	No	Partial	favourable	
8		Sub-criteria having more than 0.75 correlations with BR (2.b,4.b,1.a,2.d,5.d,2.a, 3.e,2.c,5.e,4.c,1.e,1.c, 1.d, 3.c, 3.a, 1.b, 3.b,4.d)	Business	18	81.92%	73.58%	7.04	1 of 18 Factors	2 of 18 Factors	1	1.b,	18 factors	Partial	No	Not favourable	

					Rule-1			Rule-2	Rule-3							
Sl No	**Iteration**	**Iteration description**	**Result Category**	**No of Factors**	**R2 Value**	**R2 Value (adj)**	**SD**	**No of Interaction Factors having less than 0.05 or close to 0.05**	**No of Factors / Interaction Factors having less than 5 VIF**	**No of Significant factors as per the Normal Plot**	**Factors beyond /closure to red-line in Pareto Chart**	**All Factors Appearing in the Pareto Chart**	**Rule-1**	**Rule-2**	**Rule-3**	**Conclusions**
9	6	Sub-criteria identified from Criterion Reduction of Leadership and Strategy	Customer	9	80.33%	76.64%	7.67	0 of 9 Factors	0 of 9 Factors	0	Nil	9 Factors	Meets	No	Not favourable	In this iteration, the VIF value is more than 5 in only one run against the result category, it persists with multi-collinearity. The identified factors may closer to the key influencers
10		Sub-Criteria identified from Criterion Reduction of People, Interaction of BE	People	14	75.58%	67.32%	6.22	0 of 14 Factors	4 of 14 Factors	0	Nil	14 Factors	Partial	No	Not favourable	
11		Sub-Criteria identified from Criterion Reduction of Leadership and People	Society	10	75.30%	70.10%	6.6	0 of 10 Factors	2 of 10 Factors	2	1.c, 3.b	10 Factors	Meets	No	Not favourable	
12		Sub-Criteria identified from Criterion Reduction of Strategy, Strategy*People, People*Process	Business	14	76.47%	68.81%	7.65	0 of 14 Factors	4 of 14 Factors	0	Nil	14 Factors	Partial	No	Not favourable	
13	7	All 24 Sub-Criteria of enablers - Reduction method	Customer	5	84.84%	83.38%	6.47	5 of 5 Factors	5 of 5 Factors	5	5.e, 2.a, 4.d, 5.a, 3.a	5.e, 2.a, 4.d, 5.a, 3.a	Meets	Meets	favourable	In this iteration, the VIF value is less than 5 against the result category, identified factors are key influencers for each result category
14		All 24 Sub-Criteria of enablers - Reduction method	People	6	73.83%	70.75%	5.9	6 of 6 Factors	6 of 6 Factors	5	3.c, 2.c 5.b, 4.e, 4.b, 4.d	3.c,2.c,5.b,4.e,4.b, 4.d	Meets	Meets	favourable	
15		All 24 Sub-Criteria of enablers - Reduction method	Society	5	76.75%	74.51%	6.1	5 of 5 Factors	5 of 5 Factors	5	3.b, 1.c, 5.a 5.d, 3.d	3.b,1.c,5.a,5.d,3.d	Meets	Meets	favourable	
16		All 24 Sub-Criteria of enablers - Reduction method	Business	6	77.91%	75.31%	6.8	6 of 6 Factors	5 of 6 Factors	5	2.c, 1.d, 1.b 4.b, 5.e	2.c,1.d,1.b,4.b,5.e,5.b	Meets	Meets	favourable	

Note:
1). For each result category, the factorial analysis of DOE is carried out. Following inputs to Minitab to draw the interferences. It includes; a). Main effect plot for each result category, b). Coded Co-efficient results, c). Model summary, d). Analysis of variance, e). Normal plot of the standardized effects, f). Pareto chart of the standardized effects

3.3.2.4 **Sub-criteria level (Level-2) iteration-7**

Iteration-4 was continued further, and factorial reduction was applied for this iteration. In the factorial reduction method, starts eliminating the factors with highest VIF value and P-value and continue till the model reaches a good fit and meets identified rules. The R^2 values were in the range of 73.83% to 84.84%. It is a good fit from R^2 point of view. The study also revealed factors having less than 0.05 value in the pareto chart. These factors are influential factors. These factors are having less than 5 VIF value in each result category. The obtained outcome of results does fulfil the research objectives. The Minitab reports are presented in APPENDIX A-8. The analysis of sub-criteria level iterations is depicted in Figure 3-19 showing R^2 and R^2adj, the number of components determining the R^2 value, and standard deviation (SD) of the iterations/runs. As a thumb rule in statistics, an R^2 value greater than 70% is acceptable as evidence of a strong relationship. R^2, whose values lie between 0 and 1, provides a measure of goodness of fit; values closer to 1 imply a better fit. It indicates that the number of influencing factors identified through our research determines the outcome of customer results. Customer results (top left) show that the R^2 value decreases from 88.13% to 84.84% as we move from iteration 4 to 7 but the number of influencing factors are reduced to 5 from 24 without much effect on standard deviation. Generally, an R^2 value greater than 70% is acceptable as evidence of a strong relationship. The remaining factors may not influence the outcomes as these have a marginal contribution to the outcomes. Similarly, for the other three results (SR, PR and BR), the changes in R^2, R^2adj, and SD are within acceptable range but the number of influencing sub-criteria is reduced to 5 (for SR) and 6 (for PR and BR). Summary of analysis is presented in Table 3-13, which highlights the key outcomes of the analysis. Further, the variances in SD have also reduced as shown in Table 3-13. Factorial analysis

summary at sub-criteria level validates the research outcomes and tabulated the results in Table 3-12.

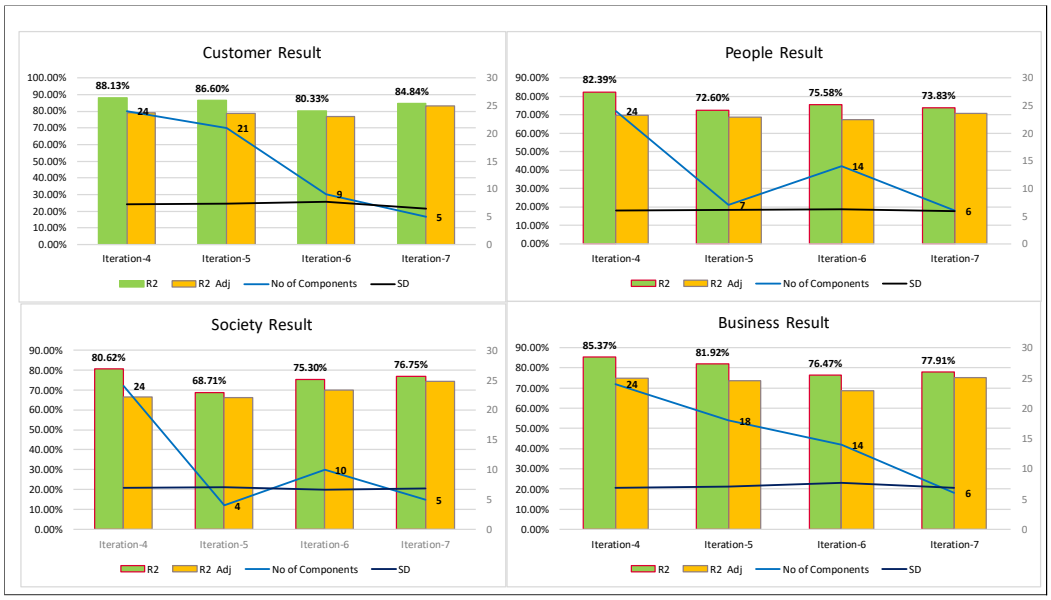


Figure 3-19: Summary of sub-criteria factorial analysis

Table 3-13: Summary of factorial analysis using DOE technique

Results	Impact on R^2	Impact on R^2 Adj	Impact on Std. Dev	Reduction in No. of sub-criteria	Revised R^2 value	No. of influencing sub-criteria
Customer	-3.29%	4.24%	-0.72	19	84.84%	5
People	-8.56%	1.17%	-0.13	18	73.83%	6
Society	-3.87%	7.98%	-0.89	19	76.75%	5
Business	-7.46%	0.58%	-0.08	18	77.91%	6

Figure 3-20: Bubble chart - iterations versus analysis outcomes

Figure 3-20 referred to as the bubble chart, represents the R^2 value concerning four iterations across all category results. Red, yellow, blue, and green colours indicate iteration 4, 5, 6, and 7 respectively. The X-axis represents iterations & Y-axis indicates the R^2 values. The size of the bubble shows the number of influencing factors at the sub-criteria level. The smaller bubble size indicates fewer number of factors required to

achieve such an R^2 value. Figure 3-20 reflects that the number of factors is drastically reduced without much effect on the R^2 values for all categories of results.

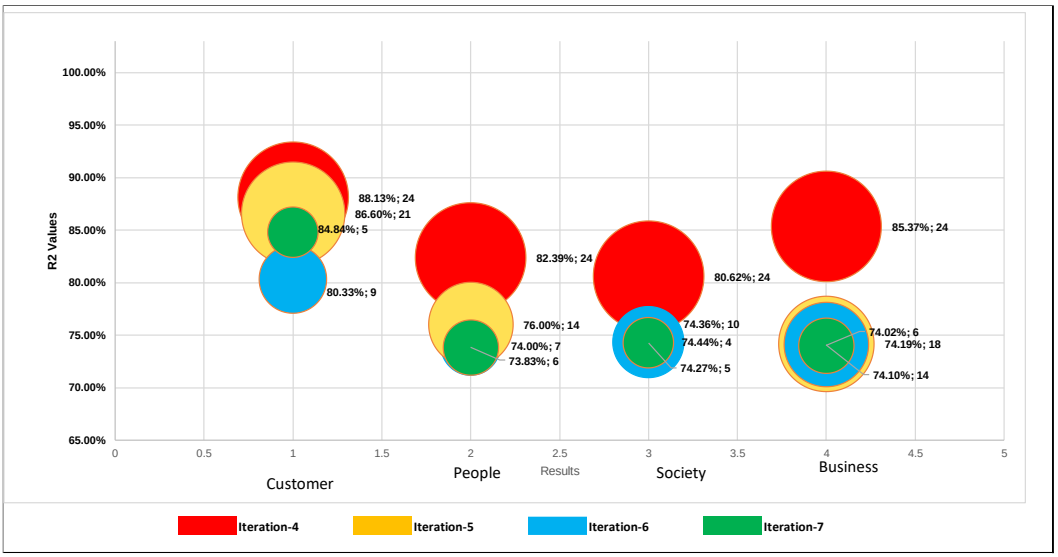


Figure 3-20: Bubble chart - iterations versus analysis outcomes

An info-graphics representation as an abacus chart is shown in Figure 3-21. It shows the key sub-criteria influencing the entire result category and provides a kaleidoscopic view of the 24 sub-criteria segregating them into influencing and passive factors. Each horizontal line represents the result category along with a listing of sub-criteria and Y-axis represents the results category. The influencing factors are represented by colour filled circles. Table3-14 provides the full description of the sub-criteria which are influencing the results.

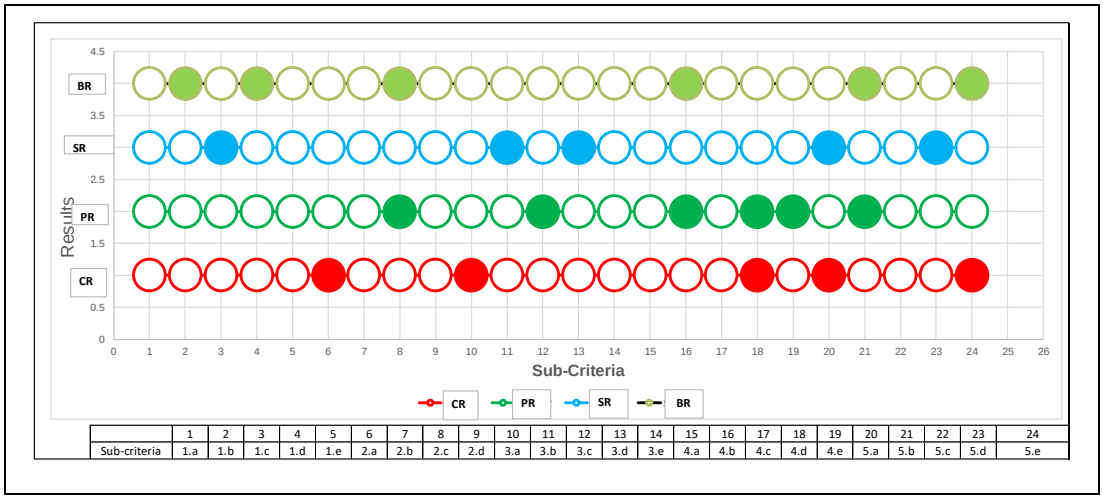


Figure 3-21: Abacus chart – factors influencing across results

Next, the data was analysed to further explore the identification of influencers of each primary influencers. These influencers are called secondary influencers. A DOE analysis was carried out using Minitab software package, keeping influence as an effect of (for example primary influencer 2.a sub-criteria, strategy is based on understanding the needs and expectations of both stakeholders and the external environment) and remaining 23 factors as a cause, factorial DOE technique analysis was run. Figure 3-22 represents the interactions as being primary and secondary, and whether these factors are positively or negatively influencing. The research output again demonstrates the multicollinearity in the model. This analysis provides information to the managers for better decision making. For example, a company wants to improve its customer results. For this, the manager has the option to improve any of the five main enablers. The managers want to focus on the people related sub-criteria to improve the customer results, then there are only one sub-criteria to be acted upon, namely ‘people plan to support the organization’s strategy. Similarly, the primary and secondary influencers of the other results are established for customer result in Figure 3-22, Figure 3-23 shows the primary and secondary influencers for people results. Figure 3-24 shows the primary and secondary influencers for society

results. Figure 3-25 shows the primary and secondary influencers for business results. Table 3-14 presents the influencing sub-criteria of each result category.

The results reflect that the organization regularly interacts with customers of each segments, to understand the needs and expectations through an open and transparent dialogue which helps in building and evolving the products and services. External environmental inputs, internal and external stakeholder's inputs are considered for developing the long term and short-term strategies and plans for the organization. To support the strategy, the organization identifies the technological road map to enhance products, processes, services and performance.

Table 3-14: Description of influencing sub-criteria of each result category

Customer results

Sub-criteria	Sub-criteria description
5.e	Customer relationships are managed and enhanced.
2.a	Strategy is based on understanding the needs and expectations of both stakeholders and the external environment.
4.d	Technology is managed to support the delivery of strategy.
5.a	Processes are designed and managed to optimize stakeholder value.
3.a	People plans support the organization's strategy

People results

Sub-criteria	Sub-criteria description
3.c	People are aligned, involved, and empowered.
2.c	Strategy and supporting policies are developed, reviewed and updated.
5.b	Products and Services are developed to create optimum value for customers.
4.e	Information and knowledge are managed to support effective decision making and to build organizational capability.
4.b	Finances are managed to secure sustained success.
4.d	Technology is managed to support the delivery of strategy.

Society results

Sub-criteria	Sub-criteria Description
3.b	People's knowledge and capabilities are developed.
1.c	Leaders engage with external stakeholders.
5.a	Processes are designed and managed to optimize stakeholder value.

Business results

Sub-criteria	sub-criteria Description
2.c	Strategy and supporting policies are developed, reviewed and updated.
1.d	Leaders reinforce a culture of excellence with the organization's people.
1.b	Leaders define, monitor, review and drive the improvement of the organization's management system and performance.

5.d	Products and Services are produced, delivered and managed.	4.b	Finances are managed to secure sustained success.
3.d	People communicate effectively throughout the organization	5.e	Customer relationships are managed and enhanced.
		5.b	Products and Services are developed to create optimum value for customers.

Capabilities and processes are designed and managed to optimize the stakeholder value, new technology, new product development and organizational process framework, necessary people plan are established. The organization involves people to create a culture of excellence, belonging and to act as an ambassador of the organization. The organizational strategies are developed by keeping in mind “people” as one of the stakeholders. People are developed to achieve organizational excellence and financial resilience is achieved through long term and short-term financial strategies by involving them in developing products and services by adopting new technology and focusing on the development of the organization’s people capability. Leaders encourage their stakeholders to participate in activities that contribute to the wider society. The organization’s focus on public health, safety and the environment while developing and manufacturing create a positive impact on society. As per the strategy, people get involved in CSR activities to improve their surroundings. The organization has established strategies and supporting policies to achieve the desired vision through leaders reinforcing the culture of excellence in the organization. The leaders understand and develop the underlying capabilities of the organization to improve organizational excellence by securing sustained financial success. The product and services are developed to create optimum value for the customer by continuously engaging with all segments of customers.

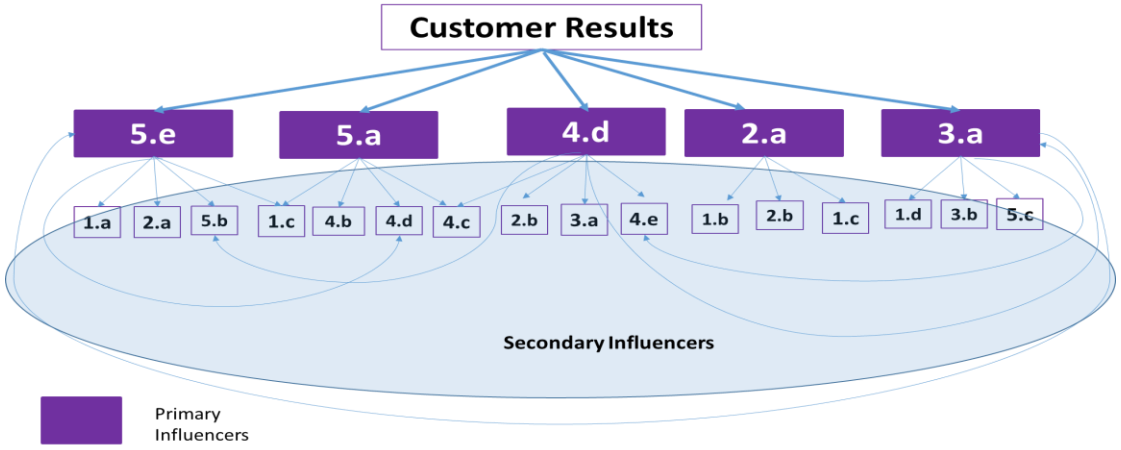


Figure 3-22: Primary and secondary influencers of customer result:

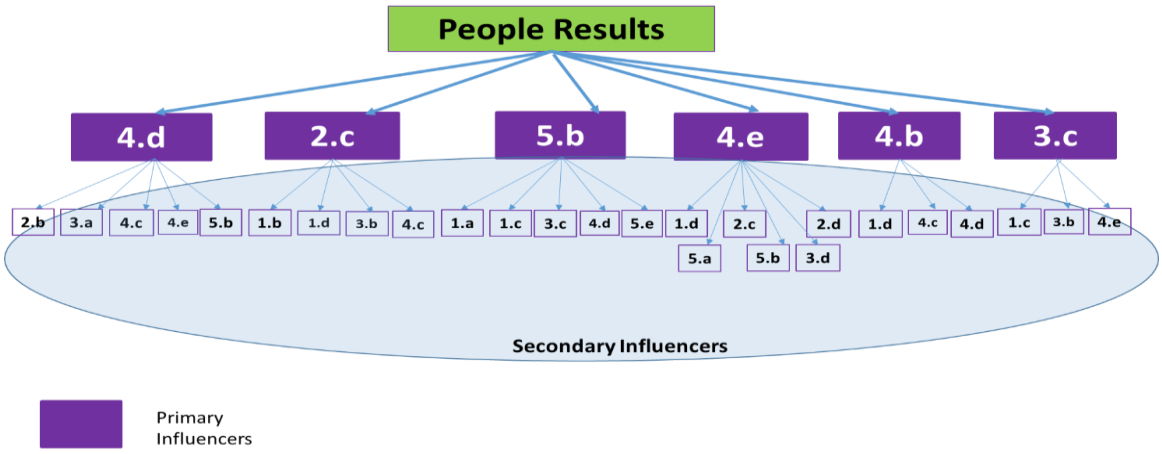


Figure 3-23: Primary and secondary influencers of people result

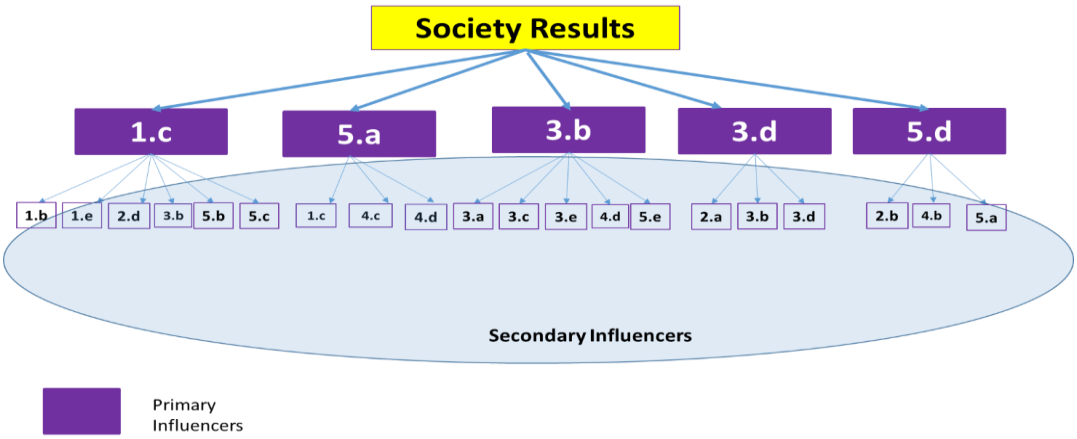


Figure 3-24: Primary and secondary influencers of society result

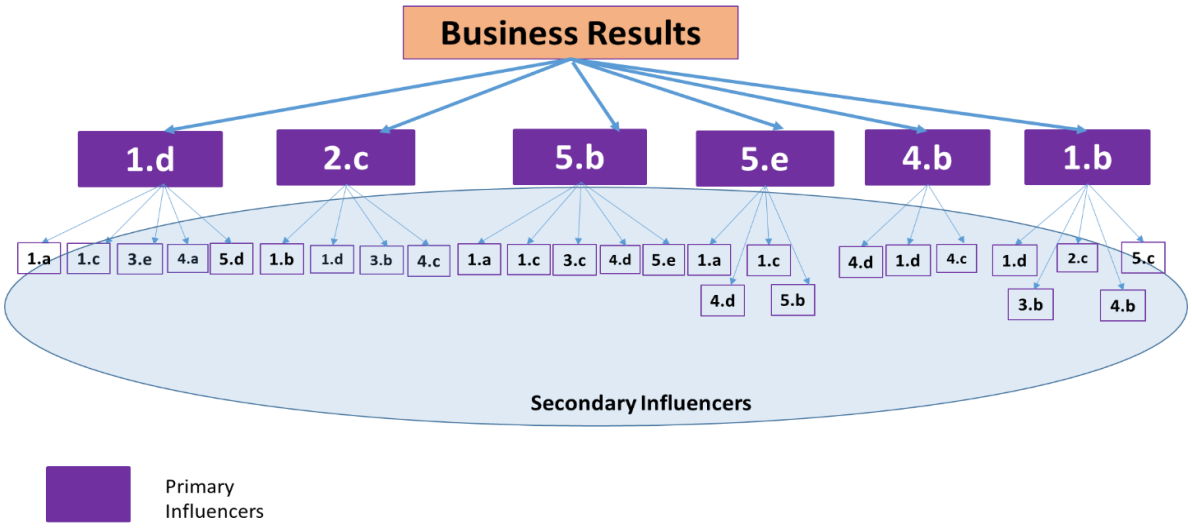


Figure 3-25: Primary and secondary influencers of business result

The opinions were solicited on the sub-criteria influencing results from the experts having experience as EFQM assessors to validate the results. The certified assessors were contacted for their input.

Figure 3-26 presents expert inputs on influencing sub-criteria affecting results. There are the expert's personal judgements. Table 3-15 shows the summary of the expert input for the result categories in terms of sub-criteria. This led to some vital information or a gap between the expert perception vis-à-vis facts from the data. This is explained in the remark's column in Table 3-15.

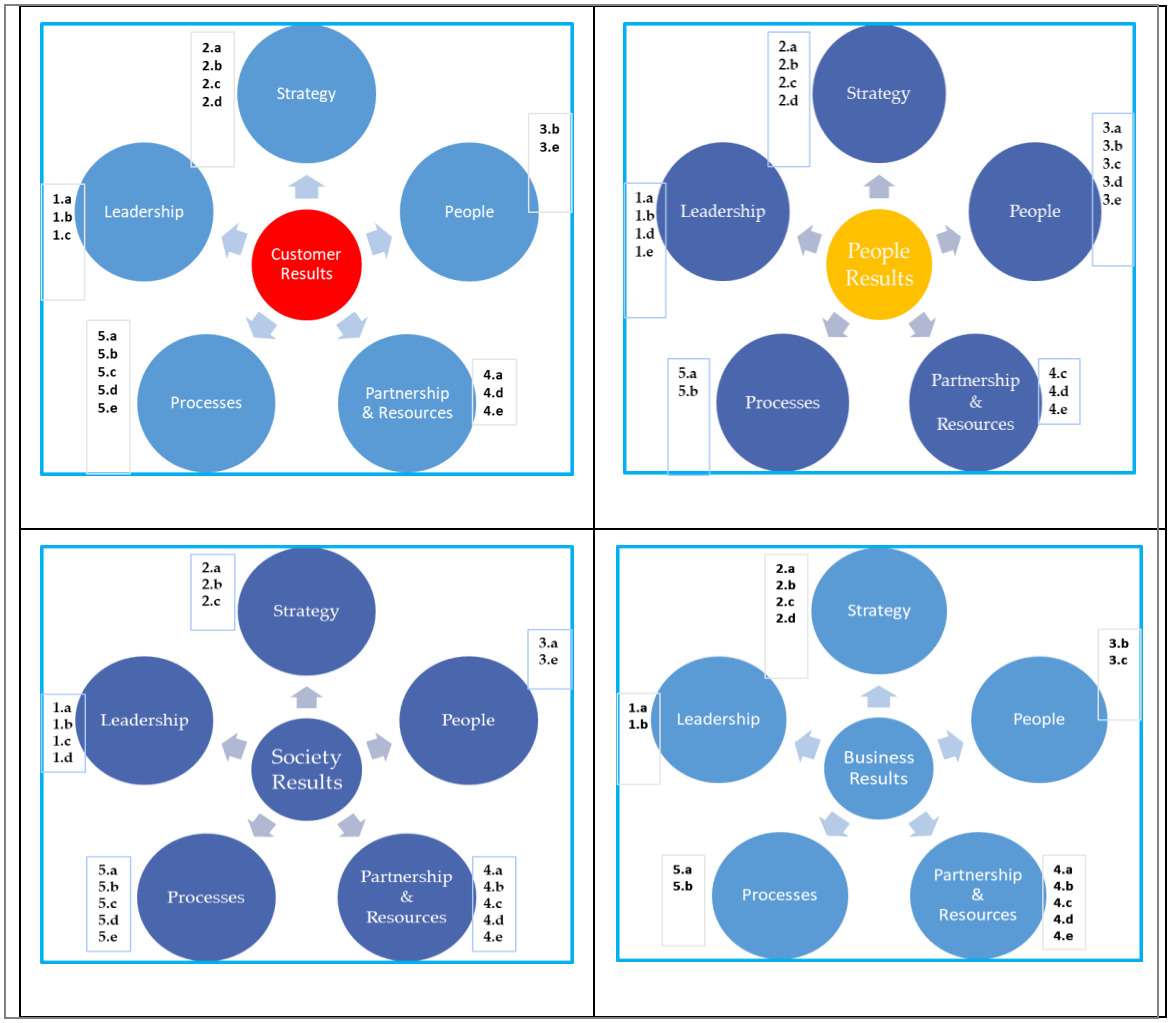


Figure 3-26: Sub-criteria influencing result (based on expert input)

Table 3-15: Comparison of expert opinion and the current research finding

Result Area	Influencing sub-criteria as per the experts	Total No. of sub-criteria	Findings of the current research		**Remarks**
			Key influencing sub-criteria	No of sub-criteria	
Customer Results	1.a, 1.b, 1.c, **2.a**, 2.b, 2.c, 2.d, 3.b, 3.e, 4.a. **4.d**, 4.e, **5.a**, 5.b, 5.c, 5.d, **5.e**	17	**5.e**, **2.a**, **4.d**, **5.a**, 3.a	5	Sub-criterion 3.a, which covers the topic of people resources are planned, managed and improved, is not considered key influencing factor by the experts.
People Results	1.a, 1.b, 1.d, 1.e, 2.a, 2.b, **2.c**, 2.d, 3.a, 3.b, **3.c**, 3.d, 3.e, 4.c, **4.d**, **4.e**	16	**3.c, 2.c,** 5.b, **4.e**, 4.b, **4.d**	6	Sub-criteria 5.b & 4.e covering the topics of improved processes, and Information and Knowledge management are not considered important influencers by the experts.
Society Results	1.a, 1.b. **1.c**, 1.d, 2.a, 2.b, 2.c, 3.a, 3.e, 4.a, 4.b,4.c, 4.d, 4.e, **5.a**, 5.b, 5.c, **5.d**, 5.e	19	3.b, **1.c**, **5.a**, **5.d**, 3.d	5	Sub-criteria 3.b & 3.d covering the topics of people development and people communication and dialogues are not considered important influencers by the experts.
Business Results	1.a, **1.b**, 2.a, 2.b, **2.c**, 2.d, 3.b, 3.c, 4.a, **4.b**, 4.c, 4.d, 4.e, 5.a, **5.b**	15	**2.c**, 1.d, **1.b**, **4.b**, 5.e, **5.b**	6	Sub-criteria 1.d & 5.e covering the topics of leaders reinforcing culture of excellence, and customer relationships management are not considered important influencers by the experts.

Note: Highlighted in the Red font, indicates sub-criteria common in current research and expert inputs

3.4 KEY INFERENCES AND MANAGERIAL IMPLICATIONS

The chapter aimed at establishing the relationship in EFQM at sub-criteria level from the managerial application point of view. The proposed model is sufficiently explicit at the sub-criteria level which guides the organization to deploy the model effectively. It can be inferenced that there are only a few sub-criteria level factors of enablers that can be focused on or should be focused on to get better results or to achieve business excellence. Since the model has multi-collinearity, the sub-criteria analysis overcomes the multicollinearity challenge and provides a method to focus efforts, time and energy on a few sub-criteria as a first step to improve business excellence. The results would serve as guidance for the deployment of the model, prioritization of the focus for improvement, and support the managerial application of the model.

3.5 SUMMARY

This chapter identifies the interlinkages/inter-connections at sub-criteria level in the EFQM model. The study identified sub-criteria (primary influencer) from the five main criteria primarily influencing the customer, people, society, and business results of an organization. It helps the managers and organizations to focus on a few and critical enablers to improve organizational performance. The secondary influencers (supporters) are also identified for each primary influencer. The multi-collinearity issue has been addressed. The key takeaways of the chapter to improve the business excellence results are:

- Customer results (CR) are primarily influenced by five sub-criteria of the model. Research revealed that four factors are positively correlated and one factor is negatively correlated to customer results. It is concluded that over-stressing on

sub-criteria (5.a) namely, “process design to optimizing the stakeholder value” would significantly affect customer results. The organization needs to make sure that a balanced approach is considered while focusing on this factor.

- People results (PR) of an organization are primarily influenced by six factors. This research revealed that four factors are positively correlated and two factors are negatively correlated to the people results. Over-stressing on “products and services to create optimum value for customers by adopting new technology without people capability development” and “integrated plan for handling organizational change” would impact people result.
- Society results (SR) are primarily influenced by five factors. The organization’s focus on developing people has shown a positive impact on society results. People would become ambassadors of their organization and create positive vibes about the organization.
- The business results (BR) of an organization are primarily influenced by six critical factors. An organization needs to be watchful while developing products of optimum value for customers and over-relying the current capabilities.

The current research study is based on the 58 company assessment scores of India for awarding the CII EXIM business excellence award. Using the research outcome, it is possible to challenge the construct of the current EFQM model to improve it for further applications as the driver of business and organizational excellence. In the next chapter the quadrant classification of sub-criteria is discussed.

CHAPTER-4

CATEGORIZATION OF EFQM ENABLER SUB-CRITERIA FOR THEIR CROSS-INFLUENCE AND IMPACT ON RESULTS

The purpose of this chapter is to examine how enabler sub-criteria of the EFQM model are structurally connected and influences each other and to quantify the influence of enabler sub-criteria on results.

4.1 INTRODUCTION

As early as 1997, Dijkstra (1997) found that the representation employing a specific unidimensional scaling model was not useful. Flynn and Saladin (2001) also emphasized the need to understand the logical relationships in excellence models. To date, there is no universal acceptance of the unidimensionality of the relationship among the EFQM criteria. This chapter is a step in this direction to find the correlation between EFQM criteria on one hand and criteria and results on the other hand.

Most of the research, as shown in the literature review chapter, tried to validate the existence of positive relation of leadership on people, strategy, and partnership & resources or the positive effects of people, strategy, and partnership & resources on processes, products, & services or the effects of the enablers on results. However, there are negative relations of some enablers on results, which need more research. Moreover, Williams *et al.* (2006) observed the lack of academic work that contrasts the relationships within the EFQM model, a basic issue for the legitimisation of any management model (Heras-Saizarbitoria, et al 2012). What Williams observed in 2006 is still valid today. Even after the use of the EFQM model for more than three decades, there is hardly any

research that contrasts the basic relationships of the model. As indicated by Bou-Llusar *et al.* (2009), despite a substantial body of literature, it is still widely recognized that the empirical validation of the causal relationships within the EFQM excellence model is limited, and it is mostly based on studies that test isolated associations. Continuing from the last chapter where the existence of interrelationship of enablers with results was identified at sub-criteria level, in this chapter, the relationship is quantified. Moreover, it is also important to understand the relationship among the different enabler sub-criteria. Therefore, the interrelationships among the enabler sub-criteria is also identified and quantified in this chapter.

This chapter is the extension of the last chapter and covers the approach to unravel (a) the role played by each sub-criterion of the model, (b) the effects of sub-criteria on the results of the EFQM model, and (c) the influence of sub-criteria on the managerial aspects of the model in an organizational context. Based on the role played, the EFQM sub-criteria are categorised as promoters, proponents, defenders, or detractors.

4.2 REVIEW OF RELEVANT LITERATURE

Some scholars (Eskildsen *et al.*2001; Williams *et al*. 2006; Bou-Lulsar *et al.* 2008; Suárez *et al*. 2014) have highlighted the complex structure in the EFQM criteria, where changes in one element can be related to changes in other elements, thus implying interdependence between criteria. Furthermore, the model assumes a causal relationship between enablers and results, since it is based on the premise that excellent results in key stakeholders are achieved through excellence in enablers, i.e. having strong leadership and clear strategic direction, developing and improving people, establishing partnerships and processes to deliver value-adding products and services to customers (EFQM, 2012). Several authors are engaged in analysing (in whole or part) the relationships in the

EFQM model, significant among these are the works of (Dijkstra, 1997; Eskildsen and Kanji, 1998; Eskildsen and Dahlgaard, 2000; Eskildsen *et al.* 2001; Westlund, 2001; Tejedor, 2004; Bou-Llusar *et al*. 2005, 2009; Calvo-Mora *et al*. 2005; Martínez-Lorente *et al*. 2009; Sadeh and Arumugam, 2010; Gómez *et al*. 2011; Safari *et al*. 2012; Heras-Saizarbitoria *et al*. 2012).

Gómez *et al.* (2015), Flynn and Saladin (2001) and Kim *et al.* (2010) said that it is critical to know the underlying logic that underpins excellence models. After reviewing the literature, it can be concluded that, although there is a general scheme in the EFQM model, it is not always reflected in the real business arena, since empirical studies do not confirm its internal relationships. It is necessary to analyse criteria interactions in detail (Gómez *et al*, 2015).

4.3 RESEARCH METHODOLOGY

The data for this research was collected from 58 firms as discussed in the last chapter. This data is the actual data used for the CII-Exim Bank business excellence (based on EFQM) scores in India. The number of organizations is 58 but the number of experts who have provided input scores is 290. The collected data has been tabulated and a data sanity check carried out. Figure 4-1 depicts the overall flow of the research methodology. The factorial method of DOE has been selected to carry out the data analysis. The goal was to find a statistical inference method for identifying the key factors rather than optimising the results.

A two-pronged approach – stage 1 and stage 2 – is adopted for the research as shown in Figure 4-1. In stage-1, sub-criteria impact on each result category (CR, PR, SR, and BR) is assessed and the strength of the effect is determined. The strength of impact is expressed as IoR (Impact on results). In stage-2, the cross-loading of sub-criteria is

assessed to find the reasons for the relationship among the various EFQM criteria. The strength of such influences is termed as Cross Influence of criteria (CiC).

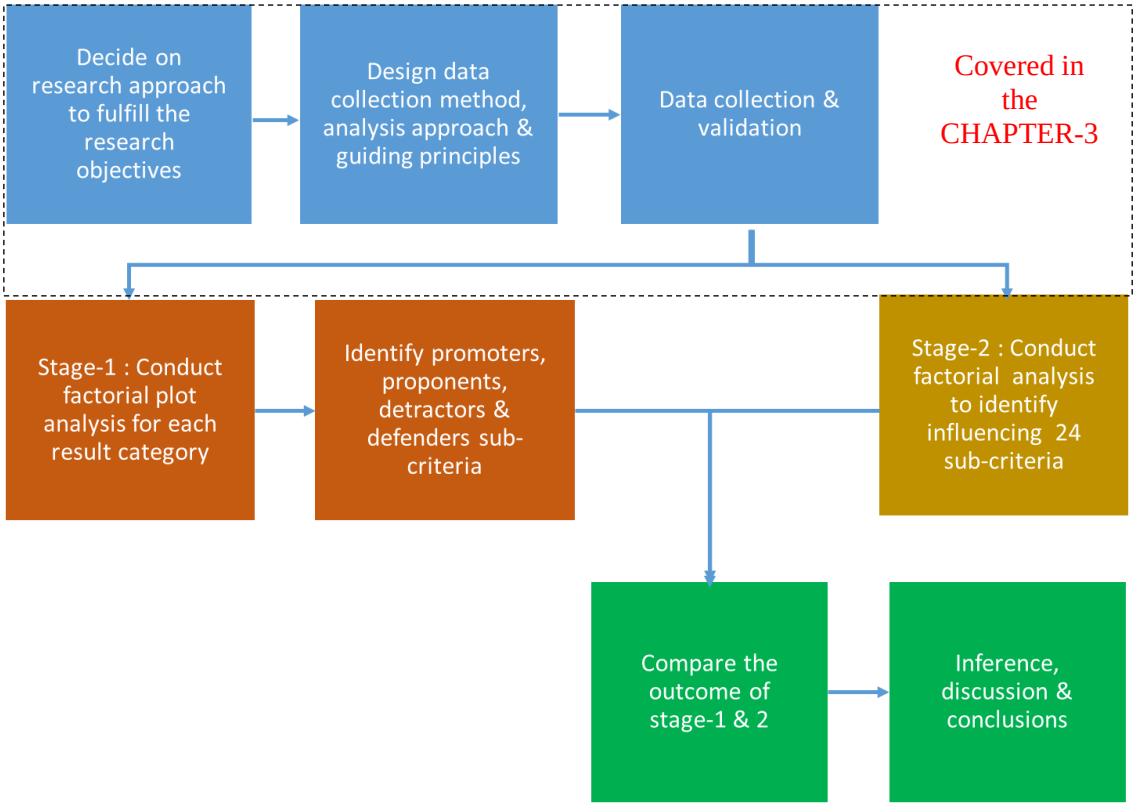


Figure 4-1 Research methodology for categorization of EFQM enabler sub-criteria

After the computation of the IoR and CiC, a quadrant model is proposed to catergorize the enabler sub-criteria as promoters, proponents, detractors and defenders.

The criteria level picture of the relationship is represented in Figure 4-2. One-way interactions show that at the criteria level, the model will have 36 relationships. The model has 32 sub-criteria, therefore the potential relationship at sub-criteria becomes 496 in one-way direction. Considering the complexity of the model construct, the peer researchers have focused on establishing the relationship at the criteria level.

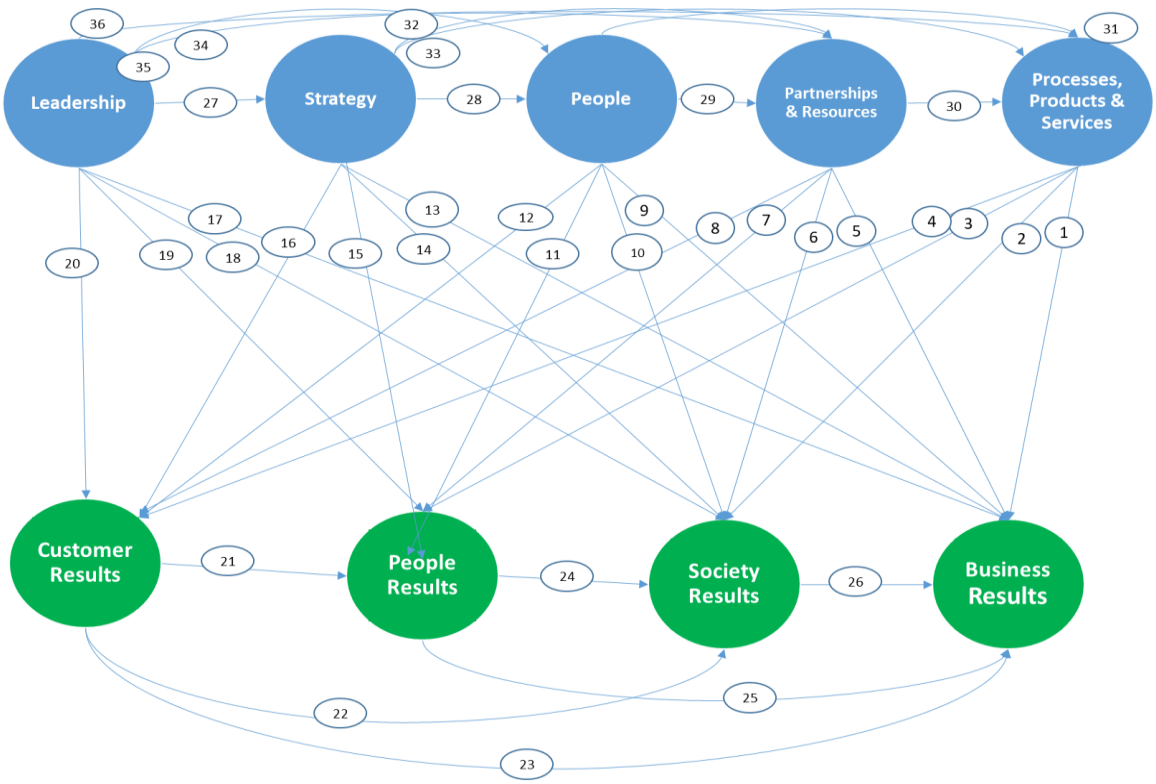


Figure 4-2: Total interactions within the model at criteria level

4.4 RESULTS AND DISCUSSION

The analysis, results and discussion are held as per the research methodology depicted in Figure 4-1.

4.4.1 Assessment of "Impact on Results"

The influence of all sub-criteria on the results was assessed and the "Impacting Magnitude on results" termed as IoR is derived using Minitab. The factorial analysis is carried out using the DOE technique and the factorial plots are obtained using 58 organizational assessment data collected from Indian organizations. Factorial plots were created for each result category (CR, PR, SR, and BR). One such plot for the customer results is shown in Figure 4-3. These plots represent the correlation effects of each sub-criterion concerning the customer results. Plots obtained from Minitab help in identifying the relationship between effects on results caused by each sub-criterion. The factorial plots show the magnitude of effects caused by each sub-criterion. When the line is

horizontal (parallel to the x-axis), there is no main effect. When the line is inclined or trending towards vertical, it has an impact. If the angle of the inclined is less than 90 degree, the sub-criteria is directly proportional. If the angle of the incline is more than 90 degree or towards 180 degrees, it shows that sub-criteria is inversely proportional. Similarly, the factorial plots were created using the factorial DOE technique for the other three categories of results (PR, SR and BR). These plots are presented Figure 4-4, Figure 4-5 and Figure 4-6 respectively.

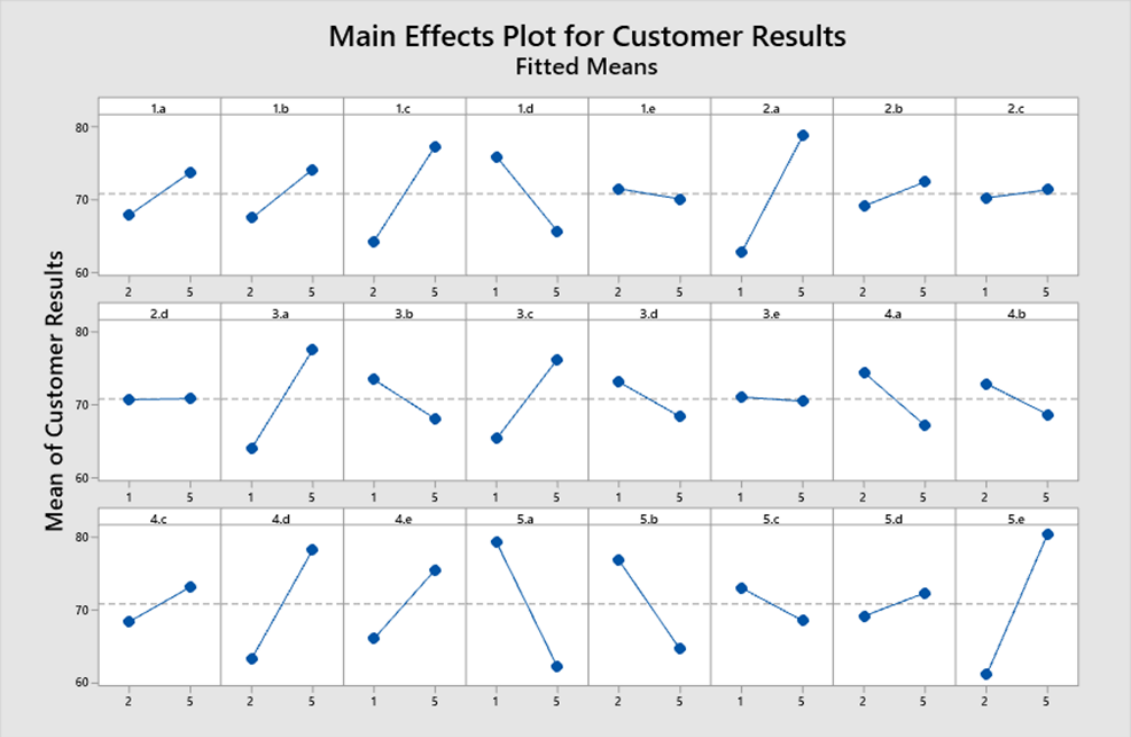


Figure 4-3: Main effect of sub-criteria on customer results

Figure 4-4: Main effect of sub-criteria on people results

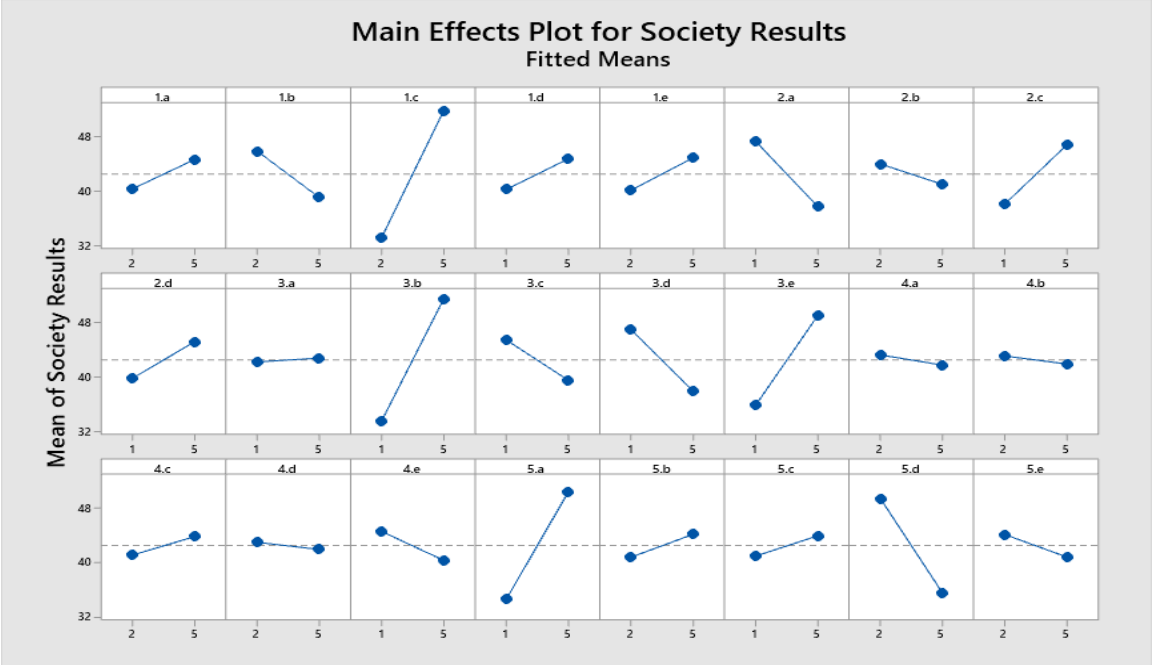


Figure 4-5: Main effect of sub-criteria on society results

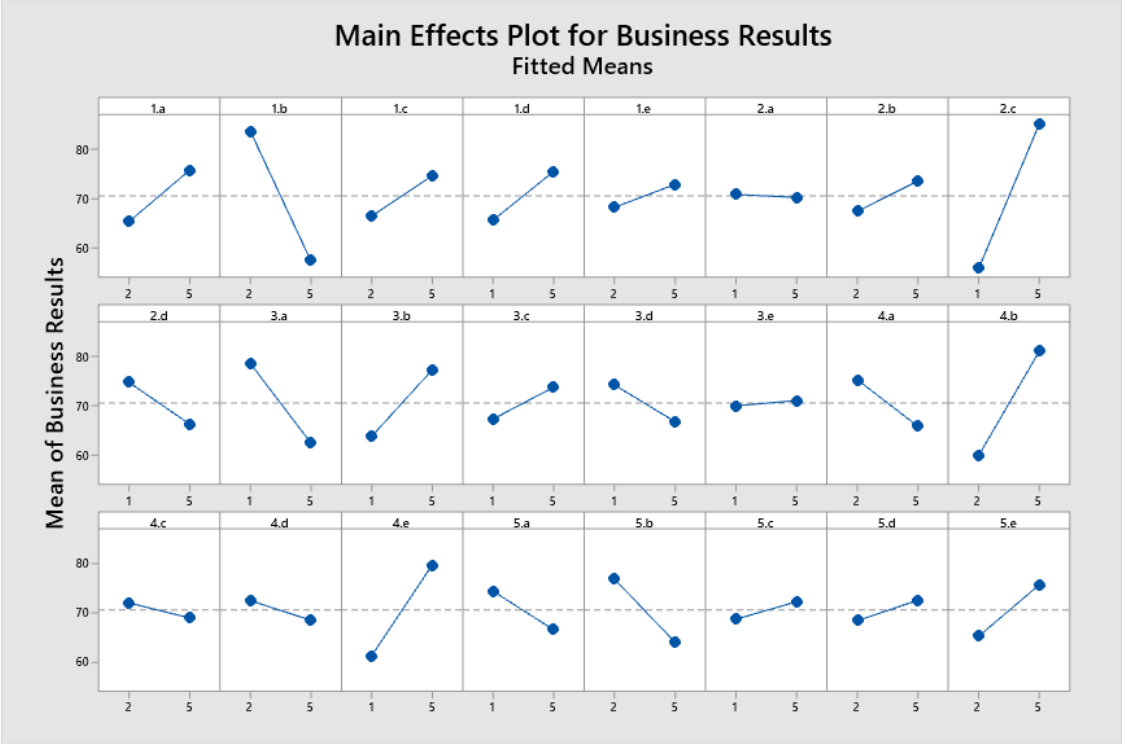


Figure 4-6: Main effect of sub-criteria on business results

Next, the gradient is computed using the main plots. For example, in Figure 4-3, the sub-criteria 1.a increases from 67.89 to 73.76 for customer result. Using this data, the gradients is calculated for each sub-criterion as follows:

- For 1.a the gradient will be a differential score (73.76-67.89) divided by the differential factor of the x-axis (5-2).
- The gradient for 1.a concerning CR is +1.96. It indicates that CR is directly proportional to 1.a and gradient indicates the rate at which the CR increases concerning sub-criteria 1.a. This value is termed as IoR (impact on result) for customer results for sub-criteria 1.a.
- The gradients for all result categories concerning all sub-criteria are computed. The computed gradient values are tabulated in Table 4-1

The negative gradient values are indirectly proportional to the effect. In the case of 1.a sub-criteria, it negatively influences the score of people results. For a good fit of factorial analysis of each result category, the remaining factorial plots gradients are considered. The natural summation of all the gradient slopes using natural summation values for each

sub-criteria are identified as positive or negative influencers across all the four results as shown in Table 4-1. The natural summation of the category is IoR representing the magnitude of each sub-criteria effect on each result category in the EFQM model. The last column in Table 4-1 indicates whether the sub-criteria has positive or negative impact on the results.

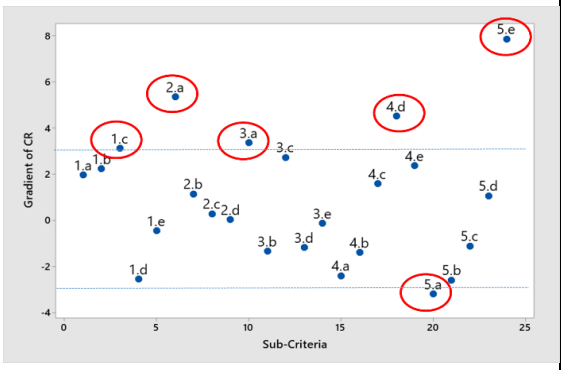
Table 4-1: Impact on results (IoR) across all four result factors

		Slope of gradients concerning results					
Sl No	Sub-criteria	Gradient with customer results - IoR of CR	Gradient with people results - IoR of PR	Gradient with society results - IoR of SR	Gradient with business results - IoR of BR	Natural Summation (Impact on results)-(IoR)	Type of Influence
1	1.a	1.95	-1.97	1.44	3.48	4.90	Positive
2	1.b	2.22	-3.68	-2.25	-3.18	-6.89	Negative
3	1.c	3.11	0.25	6.51	2.74	12.61	Positive
4	1.d	-2.56	2.30	1.12	3.26	4.12	Positive
5	1.e	-0.47	2.79	1.59	1.55	5.46	Positive
6	2.a	5.35	4.04	-3.20	-0.15	6.04	Positive
7	2.b	1.14	-1.80	-0.99	2.05	0.40	Positive
8	2.c	0.28	4.95	2.19	5.36	12.78	Positive
9	2.d	0.02	-1.45	1.34	-2.12	-2.21	Negative
10	3.a	3.35	-0.65	0.14	-4.00	-1.16	Negative
11	3.b	-1.35	1.90	7.45	3.39	11.39	Positive
12	3.c	2.72	6.65	-1.47	4.70	12.60	Positive
13	3.d	-1.19	1.89	-3.67	-1.87	-4.84	Negative
14	3.e	-0.14	0.81	3.30	0.26	4.23	Positive
15	4.a	-2.41	-3.22	-0.50	-3.13	-9.26	Negative
16	4.b	-1.41	3.46	-0.40	6.44	8.09	Positive
17	4.c	1.59	1.54	0.91	-1.02	3.02	Positive
18	4.d	4.51	-2.14	-0.34	-1.32	0.71	Positive
19	4.e	2.37	3.52	-1.07	3.57	8.39	Positive
20	5.a	-3.20	0.27	3.59	-1.94	-1.28	Negative
21	5.b	-2.60	-5.19	1.12	-5.04	-11.71	Negative
22	5.c	-1.12	0.41	0.75	0.89	0.93	Positive
23	5.d	1.06	-1.95	-3.54	1.38	-3.05	Negative
24	5.e	7.86	0.23	-1.10	3.28	10.27	Positive

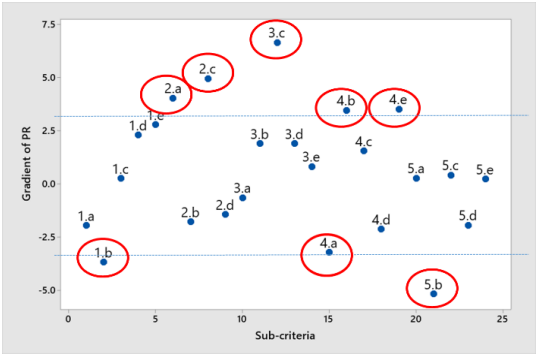
These impacts (IoR) are plotted for each result category to develop a scatter plot as shown in Figure 4-7. The red circled sub-criteria indicates the significant factors impacting the results which are having the value of IoR more than ±3. These factors are potential impact creating sub-criteria for each result category. It helps the managers to identify the sub-

criteria having high positive or negative impacts on the results at a glance. This kaleidoscopic view saves time and effort as well as provides all impacts at one glance.

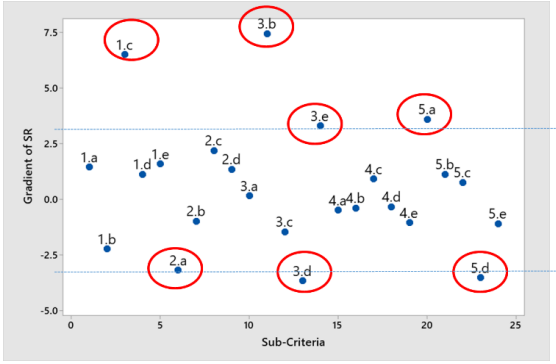
IoR - Scatter plot of customer result



IoR – Scatter plot of people results



IoR – Scatter plot of society results



IoR –Scatter plot of business results

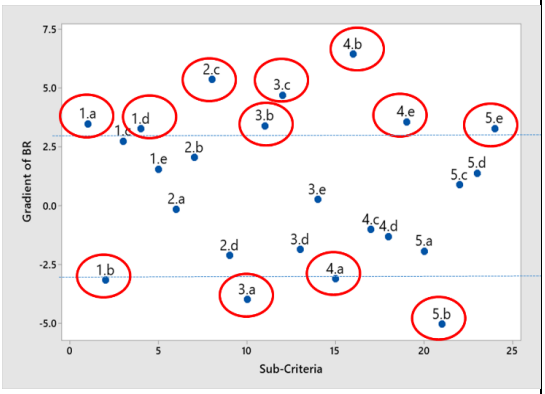


Figure 4-7: Scatter plot of the impact on results for all the four result categories

4.4.2 Assessment of Cross Influencing of Criteria

The cross-loading of factor or cross influencing of criteria (CiC) is assessed in terms of the co-relationship among all 24 sub-criteria. The co-relationships among the sub-criteria will provide the existence of relationships among criteria and also the root cause of these relationships. The factorial analysis was repeated until the model reached the predetermined rule of factorial analysis. The following points serve as guiding principles for the analysis of the outputs.

- ❖ R-squared and Adj. R-squared of more than 70% qualify as a good fit and the differences of ±5% is acceptable. (Rule-1)
- ❖ P-value is one of the key factors in DOE. Factors having a p-value below 0.05, or closer to 0.05 will provide 95% confidence and acceptable (Rule-2).
- ❖ Variance Inflation Factor (VIF) value is an acceptable influential factor if it is between 1 to 5. VIF value of 1 means no multicollinearity, between 1-5 means moderate multicollinearity exists among the factors, and a VIF value greater than 5 means strong multicollinearity exists among the factors. In this study, VIF less than 5 is acceptable (Rule-3).
- ❖ In the standardised effect of the Pareto-chart, (at alpha value of 0.05), the red line above factors influences the results.
- ❖ From the analysis variance table, if the F-value is higher and it shows that factor is significant in the model and influencing the results.

The existence of influence of all 24 sub-criteria on each other is found using factorial analysis as shown in Table 4-2 and results are summarised in Table 4-3. The cell marked with red colour indicates indirect proportionality to the affecting factor. Table 4-3 also shows the R^2 value for each sub-criterion. The R^2 value of 24 criteria ranges from 73% to 93%. It is a very good fit and shows that the identified factors would influence the outcomes. For example, sub-criteria 1.a is influenced by 1.d, 1.e, 2.d, and 3.d. These factors constitute 91% R^2 value and the higher the better. Similarly, the sub-criteria 1.a influences 1.d, 1.e, 5.b, and 5.e as seen in Table 4-4

Using the factorial analysis of DOE results, the influencing magnitude were arrived at for all the 24 sub-criteria as shown in Table 4-2. The total CiC and the gradient magnitude are computed and presented in Table 4-5.

Table 4-2: Factorial analysis of 24 enabler sub-criteria.

Factorial analysis for 1.a :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		46.533	0.441	105.52	0.000	
1.d	13.37	6.69	1.58	4.24	0.000	4.40
1.e	8.67	4.33	1.62	2.68	0.010	3.98
2.d	10.23	5.12	1.59	3.21	0.002	3.26
3.d	8.80	4.40	1.53	2.88	0.006	2.96

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.04142	90.76%	90.07%	88.75%

Factorial analysis for 1.b :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		45.668	0.467	97.85	0.000	
1.d	16.55	8.27	1.39	5.93	0.000	3.58
2.c	16.64	8.32	1.55	5.36	0.000	3.50
3.b	-5.62	-2.81	1.34	-2.09	0.041	3.02
4.d	6.66	3.33	1.07	3.11	0.003	2.32
5.c	7.40	3.70	1.38	2.68	0.010	2.37

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.97926	91.69%	90.89%	89.50%

Factorial analysis for 1.c :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		47.058	0.519	90.76	0.000	
1.b	7.45	3.72	1.20	3.12	0.003	5.09
1.e	6.35	3.18	1.20	2.66	0.011	4.90
2.d	11.02	5.51	1.69	3.26	0.002	4.64
3.b	-4.83	-2.41	1.21	-1.99	0.051	2.98
5.b	9.46	4.73	1.22	3.89	0.000	3.61
5.c	6.76	3.38	1.31	2.58	0.013	2.59

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.70154	92.74%	91.89%	90.32%

Factorial analysis for 1.d :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		46.855	0.608	77.08	0.000	
1.a	14.54	7.27	1.38	5.25	0.000	4.51
1.c	11.12	5.56	1.40	3.98	0.000	4.50
3.e	6.62	3.31	1.39	2.37	0.021	1.98
4.a	-7.46	-3.73	1.30	-2.86	0.006	3.09
5.d	9.37	4.69	1.21	3.87	0.000	2.70

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.13752	90.78%	89.90%	88.36%

Factorial analysis for 1.e:

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		47.211	0.636	74.23	0.000	
1.a	13.25	6.63	1.66	3.99	0.000	5.85
1.c	9.60	4.80	1.41	3.40	0.001	4.16
2.c	10.29	5.14	1.87	2.74	0.008	4.17
3.d	-10.29	-5.14	1.74	-2.96	0.005	3.28
4.e	10.77	5.39	1.56	3.46	0.001	2.61

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.29971	89.72%	88.73%	87.01%

Factorial analysis for 2.a :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		46.237	0.713	64.82	0.000	
1.b	8.48	4.24	1.46	2.91	0.005	3.90
2.b	10.03	5.01	1.73	2.90	0.005	5.04
2.d	14.76	7.38	2.09	3.54	0.001	3.63
5.a	5.95	2.97	1.75	1.70	0.095	2.82

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.33867	88.39%	87.52%	85.76%

Factorial analysis for 2.b:

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		45.645	0.492	92.71	0.000	
2.c	19.06	9.53	1.37	6.94	0.000	2.98
3.b	-7.37	-3.69	1.61	-2.29	0.026	4.71
3.c	10.45	5.23	1.67	3.13	0.003	4.04
4.e	10.39	5.19	1.35	3.84	0.000	2.62
5.e	10.12	5.06	1.16	4.38	0.000	2.90

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.86145	91.84%	91.05%	88.73%

Factorial analysis for 2.c :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		46.731	0.539	86.69	0.000	
1.b	14.38	7.19	1.33	5.41	0.000	4.13
1.d	-4.65	-2.32	1.70	-1.36	0.179	4.26
3.b	12.66	6.33	1.37	4.63	0.000	2.50
4.c	10.46	5.23	1.16	4.53	0.000	2.26

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.33867	88.39%	87.52%	85.76%

Factorial analysis for 2.d :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		45.036	0.571	78.85	0.000	
1.c	5.70	2.85	1.21	2.36	0.022	3.89
2.a	12.64	6.32	1.61	3.92	0.000	4.68
3.a	10.98	5.49	1.53	3.60	0.001	3.15
4.e	10.62	5.31	1.43	3.72	0.000	2.79

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.92296	91.23%	90.57%	89.30%

Factorial analysis for 3.a :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		44.667	0.517	86.40	0.000	
1.d	9.54	4.77	1.39	3.44	0.001	3.89
3.b	14.50	7.25	1.54	4.70	0.000	4.36
3.c	6.98	3.49	1.77	1.97	0.054	4.59
4.e	8.81	4.41	1.33	3.32	0.002	2.55
5.c	6.07	3.03	1.36	2.22	0.031	2.53
5.e	-6.70	-3.35	1.24	-2.71	0.009	3.34

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.84669	90.77%	89.69%	87.67%

Factorial analysis for 3.b :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		42.931	0.635	67.65	0.000	
3.a	17.54	8.77	1.92	4.58	0.000	3.91
3.c	16.51	8.25	1.94	4.25	0.000	4.11
3.e	12.10	6.05	2.06	2.94	0.005	3.93
4.d	5.07	2.54	1.15	2.20	0.032	2.21
5.e	-6.03	-3.01	1.40	-2.15	0.036	3.21

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.29370	89.60%	88.60%	85.75%

Factorial analysis for 3.c :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		46.000	0.576	79.88	0.000	
1.c	8.66	4.33	1.09	3.97	0.000	2.27
3.b	16.38	8.19	1.82	4.50	0.000	4.13
3.d	12.29	6.15	2.15	2.87	0.006	4.56

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.44892	87.69%	87.00%	85.25%

Factorial analysis for 3.d :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		44.708	0.514	86.98	0.000	
2.a	11.32	5.66	1.63	3.46	0.001	3.20
3.c	21.36	10.68	1.57	6.79	0.000	2.28
4.e	6.80	3.40	1.63	2.08	0.042	2.43

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.58675	85.60%	84.80%	83.11%

Factorial analysis for 3.e :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		45.035	0.700	64.30	0.000	
3.a	18.59	9.30	2.08	4.46	0.000	3.83
3.c	18.57	9.28	1.83	5.06	0.000	3.04
4.b	5.89	2.95	1.48	1.99	0.052	3.34
5.a	7.78	3.89	1.58	2.46	0.017	2.50
5.b	-11.09	-5.55	1.77	-3.13	0.003	4.27

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.61894	85.27%	83.86%	79.92%

Factorial analysis for 4.a :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		47.090	0.650	72.47	0.000	
1.b	-5.54	-2.77	1.49	-1.86	0.068	4.97
2.a	12.85	6.43	1.93	3.33	0.002	4.97
4.b	8.48	4.24	1.28	3.30	0.002	2.84
5.a	8.75	4.38	1.58	2.76	0.008	2.83
5.e	8.35	4.18	1.48	2.82	0.007	3.36

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.40183	84.72%	83.25%	79.62%

Factorial analysis for 4.b :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		50.236	0.521	96.37	0.000	
1.d	13.38	6.69	1.30	5.15	0.000	2.13
4.c	8.60	4.30	1.33	3.23	0.002	2.58
4.d	11.97	5.99	1.37	4.38	0.000	2.60

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.59948	85.30%	84.48%	81.94%

Factorial analysis for 4.c :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		46.485	0.503	92.41	0.000	
2.c	8.96	4.48	1.70	2.64	0.011	3.34
3.c	1.96	0.98	1.42	0.69	0.491	2.14
4.b	11.96	5.98	1.16	5.15	0.000	2.42
5.a	10.86	5.43	1.49	3.65	0.001	2.61

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.33424	85.40%	84.30%	82.47%

Factorial analysis for 4.d :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		51.111	0.682	74.97	0.000	
2.b	10.64	5.32	1.51	3.53	0.001	4.21
3.a	-12.76	-6.38	1.94	-3.29	0.002	3.36
4.c	8.73	4.37	1.51	2.88	0.006	3.35
4.e	13.61	6.81	1.86	3.67	0.001	3.13
5.b	8.20	4.10	1.75	2.34	0.023	4.22

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.59504	84.71%	83.24%	80.14%

Factorial analysis for 4.e :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		44.205	0.738	59.93	0.000	
1.d	-7.34	-3.67	1.79	-2.05	0.045	3.62
2.c	-5.07	-2.53	2.17	-1.17	0.249	4.22
2.d	15.97	7.99	2.34	3.42	0.001	4.47
3.d	7.81	3.90	1.98	1.97	0.054	3.20
5.a	14.56	7.28	1.85	3.94	0.000	3.08
5.b	11.09	5.55	1.80	3.08	0.003	3.99

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.80313	83.89%	82.00%	77.83%

Factorial analysis for 5.a :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		49.878	0.670	74.41	0.000	
1.c	12.34	6.17	1.60	3.85	0.000	2.44
4.c	7.67	3.83	1.90	2.02	0.049	2.85
4.d	8.99	4.49	1.83	2.45	0.017	2.53

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
4.88556	72.99%	71.49%	67.07%

Factorial analysis for 5.b :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		48.136	0.667	72.22	0.000	
1.a	8.97	4.49	1.75	2.56	0.013	4.96
1.c	9.37	4.68	1.60	2.93	0.005	4.07
3.c	6.73	3.36	1.78	1.89	0.064	2.63
4.d	13.40	6.70	1.37	4.89	0.000	2.37
5.e	-11.73	-5.86	1.78	-3.30	0.002	3.93

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.77830	80.14%	78.23%	73.86%

Factorial analysis for 5.c :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		47.746	0.704	67.84	0.000	
1.b	13.51	6.76	1.28	5.26	0.000	3.75
2.c	-9.74	-4.87	2.24	-2.18	0.034	5.68
3.e	14.48	7.24	1.52	4.77	0.000	1.97
5.b	8.40	4.20	1.42	2.95	0.005	3.27

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.30408	81.82%	80.39%	77.81%

Factorial analysis for 5.d :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		49.989	0.642	77.85	0.000	
2.b	8.75	4.38	1.36	3.21	0.002	3.29
4.b	8.47	4.24	1.38	3.08	0.003	2.79
5.a	9.72	4.86	1.59	3.07	0.003	2.43

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.68304	79.17%	78.01%	75.73%

Factorial analysis for 5.e :

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		48.721	0.575	84.70	0.000	
1.a	13.23	6.62	1.60	4.12	0.000	3.84
1.c	11.16	5.58	1.71	3.27	0.002	4.27
4.d	11.76	5.88	1.53	3.85	0.000	2.70
5.b	-8.57	-4.28	1.93	-2.22	0.031	4.28

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.94086	81.82%	80.45%	77.67%

Table 4-3: Cross influencing at sub-criteria level

Cross Influencing of Sub-criteria (influencing others)---------->

Influencing Sub-criteria (Getting Influenced)---------->

	1.a	1.b	1.c	1.d	1.e	2.a	2.b	2.c	2.d	3.a	3.b	3.c	3.d	3.e	4.a	4.b	4.c	4.d	4.e	5.a	5.b	5.c	5.d	5.e	Total No. of factors cross Influenced
1.a				1	1																1			1	4
1.b			1			1		1							1							1			5
1.c				1	1				1			1								1	1			1	7
1.d	1	1						1		1						1			1						6
1.e	1		1																						2
2.a									1				1		1										3
2.b						1												1					1		3
2.c		1			1		1										1		1			1			6
2.d	1		1			1													1						4
3.a									1		1			1				1							4
3.b		1	1				1	1		1		1													6
3.c							1			1	1		1	1			1				1				7
3.d	1				1							1							1						4
3.e				1							1											1			3
4.a				1																					1
4.b														1	1		1						1		4
4.c								1								1		1		1					4
4.d		1									1					1				1	1			1	6
4.e					1		1		1	1			1					1							6
5.a						1								1	1		1		1				1		6
5.b			1											1				1	1			1		1	6
5.c		1	1							1															3
5.d				1																					1
5.e							1			1	1				1						1				5
Total No. of factors Influenced by the Sub-criteria	4	5	6	5	5	4	5	4	4	6	5	3	3	5	5	3	4	5	6	3	5	4	3	4	106
R^2 Value	91%	92%	93%	91%	90%	88%	92%	88%	91%	90%	90%	88%	86%	85%	86%	86%	85%	85%	84%	73%	80%	82%	79%	82%	

Table 4-4: Cross influencing of criteria (CiC) for all sub-criteria

Cross Influencing of Sub-criteria (influencing others)---------->

Influencing Sub-criteria (Getting Influenced)---------->	1.a	1.b	1.c	1.d	1.e	2.a	2.b	2.c	2.d	3.a	3.b	3.c	3.d	3.e	4.a	4.b	4.c	4.d	4.e	5.a	5.b	5.c	5.d	5.e	Total mangitude of the gridents of cross influencing
1.a				4.84	4.41																2.99			4.41	16.65
1.b			2.48			2.82		4.79							**-1.84**							4.50			12.75
1.c				3.70	3.19				1.89			2.88								4.11	3.12			3.72	22.61
1.d	3.35	4.14						**-1.16**		2.38						3.34			**-1.84**						10.21
1.e	2.17		2.11																						4.28
2.a									3.15				2.83		3.21										9.19
2.b						3.34												3.54					2.92		9.80
2.c		4.16			2.56		4.76										2.24		**-1.26**			**-2.43**			10.03
2.d	2.56		2.76			3.69													4.00						13.01
3.a									2.74		4.39			4.64				**-3.19**							8.58
3.b		**-1.40**	**-1.26**				**-1.84**	3.16		3.62		4.09													6.37
3.c							2.61			1.74	4.12		5.34	4.65			0.49				1.68				20.63
3.d	2.20				**-2.57**							3.07							1.95						4.65
3.e				1.65							3.02											3.56			8.23
4.a				**-2.49**																					-2.49
4.b														1.96	2.82		3.98						2.82		11.58
4.c								3.48								2.86		2.91		2.55					11.80
4.d		2.22									1.69					3.99				2.99	4.46			3.92	19.27
4.e					2.69		2.59		2.64	2.21			1.70					3.40							15.23
5.a						3.51								1.94	2.18		2.46		3.64				2.43		16.16
5.b			3.16											**-3.69**				2.73	3.69			2.80		**-2.85**	5.84
5.c		1.85	1.69							1.51															5.05
5.d				3.12																					3.12
5.e							3.37			**-2.23**	**-2.00**				2.78						**-3.91**				-1.99
Total mangitude of gradients Influenced by other Sub-Criteria	10.28	10.97	10.94	10.82	10.28	13.36	11.49	10.27	10.42	9.23	11.22	10.04	9.87	9.50	9.15	10.19	9.17	9.39	10.18	9.65	8.34	8.43	8.17	9.20	240.56
R^2 Value	91%	92%	93%	91%	90%	88%	92%	88%	91%	90%	90%	88%	86%	85%	86%	86%	85%	85%	84%	73%	80%	82%	79%	82%	

4.5 KEY INFERENCES FROM THE ANALYSIS

The results of IoR and CiC analyses are used to develop the quadrant matrix as shown in Figure 4-8. To identify the centre lines of the x-axis and y-axis, the mid values of maximum and minimum values are considered. The maximum value of CiC (22.61) and minimum value of CiC (-2.49) gives the mid-point as 10.06 therefore 10.00 is taken as a centre reference line for the x-axis. Similarly, for the y-axis, the max value of IoR (12.78) and the min value of IoR (-11.71) gives the midpoint as 0.54, however, the centre reference line for the y-axis is taken as '0'. Based on this input, the quadrant matrix developed for CiC and IoR is shown in Figure 4-8. The 24 EFQM sub-criteria are categorised into four quadrants based on IoR and CiC values.

Typically, the factors in each quadrant are labelled based on the allocation of the quadrant. The labels of four quadrants are promoters, detractors, proponents, and defenders as shown in Figure 4-8.

- Promoters strongly impact the outcome of the results of the EFQM and have a strong cross influence on the other sub-criteria.
- Proponents strongly impact the outcome of the results of the EFQM and have moderate or low cross influence on other sub-criteria.
- Detractors negatively impact the outcome of the results of the EFQM and have moderate or low cross influence on the other sub-criteria
- Defenders negatively impact the outcome of the results of the EFQM and have a high cross influence on the other sub-criteria

Promoter sub-criteria are considered likely to exhibit a high level of impacting and influencing behaviours to enhance the results and other sub-criteria, respectively. Detractors are believed to be less likely to exhibit a positive influence on the results; and,

if pushed hard, could negatively influence the outcome of the results. These factors need to be handled with care and a balanced approach needs to be adopted. Proponents would impact the results positively but have fewer influencing capabilities on other sub-criteria. Defenders demonstrate more influencing abilities on other sub-criteria but less impact on results. These factors do not influence the outcomes of the results. Since EFQM is an integrated framework, the chapter tries to identify the key influencers of the model. Figure 4-8 also depicts the classification of sub-criteria based on impact and influence. The bubble size in the chart signifies the number of sub-criteria influenced by the named sub-criterion. The bigger the size of the bubble, the more factors are influenced.

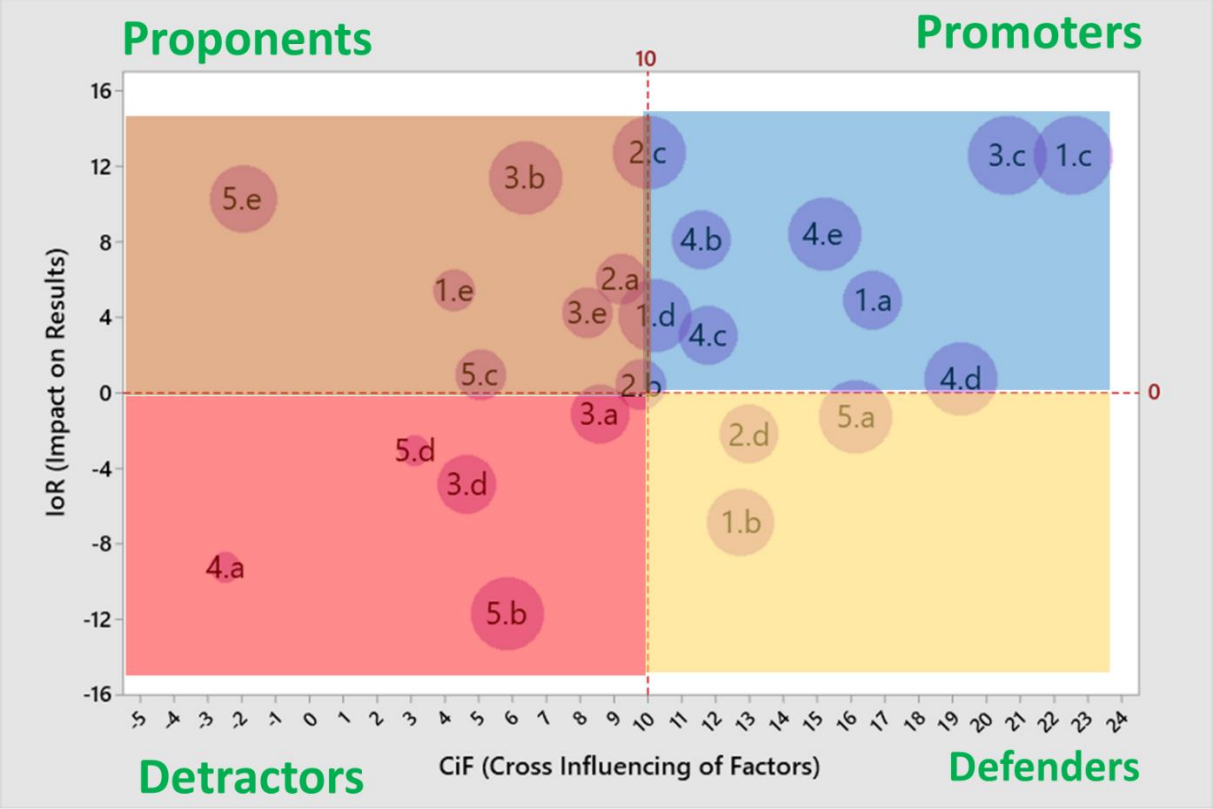


Figure 4-8: Quadrant matrix and bubble chart for sub-criteria

Note: CiF refers to CiC values

This chapter identifies the interlinkages/co-relationships among sub-criteria. While most of the earlier research have focused on the criteria level or theoretical construct of the model. This research analysed the effect of assessment scores at the sub-criteria level. It

is found that nine sub-criteria are influencing six or more other sub-criteria. The chapter adds to the theory building on the EFQM model by providing critical analysis of its different criteria by building a statistical model at the sub-criteria level. This theory-building is expected to help other organizations to validate the EFQM model relationships in their organizations, hitherto taken *a priori*. This research would help the organisations in prioritization of EFQM model implementation looking at the promoters, detractors, proponents, and defenders at the sub-criteria level. This would help the organisation to gain confidence while implementing the business excellence model.

The model adopted by most of the researchers appears to be different for the Indian context. The results show that the leadership criterion has a strong positive influence on the process criterion as evident from the CiC of 32.67 having a total of ten interactions from forward and backward interactions as shown in Figure 4-9. This research emphasises that to achieve better scores in leadership, deployment of the subsequent act of leadership in other criteria is very much important and necessary for the organisation to achieve better scores in leadership. The table shows the influence of criteria and cross interactions at sub-criteria. It can be concluded that:

- Leadership has a strong influence on strategy and process management. Leadership has a marginal influence on people and partnerships.
- The strategy has a strong influence on partnerships and marginal influence on process and people.
- People have a marginal influence on partnerships and very little influence on processes.
- Partnerships have a strong influence on processes.

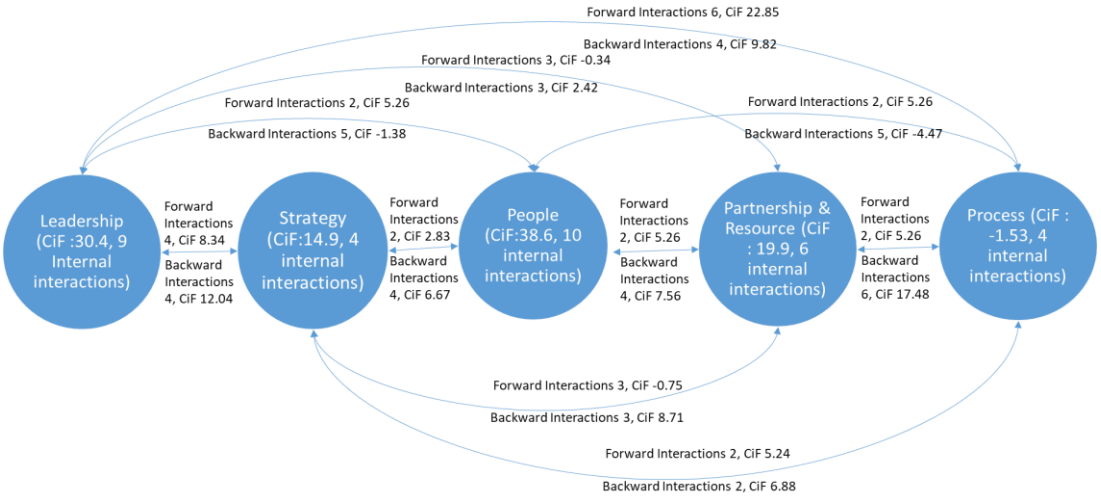


Figure 4-9: Quantified interactions among EFQM enablers

Table 4-5 provides the summarisation at the criteria level. In the Indian context, leadership influences the strategy & policy in the organization. It influences the partnership & resource aspects of the organization and helps in establishing a comprehensive process management system in the organization. As per the theoretical construct of the EFQM model, different researchers have taken strategy and policy criteria to occupy the centre stage and processes are influenced by strategy, people and partnership and resource criteria. In this research study, it is revealed that leadership would influence the outcome of the results in India. This cultural or organisational behaviour is different as compared to other countries in terms of style of leadership in managing the organisation. The leadership criteria have got maximum impact and influence on other sub-criteria of other parts of the model (i.e strategy, process, partnership and people).

Table 4-5: Cross influencing of Criteria's magnitude (CiCM) criteria

Cross Influencing of Sub-criteria (influencing others)						
		Leadership	Strategy	People	Partnership	Process
Influencing Sub-criteria (getting influenced>	Leadership	30.39	8.34	5.26	**-0.34**	22.85
	Strategy	12.04	14.94	2.83	11.73	0.49
	People	**-1.38**	6.67	38.68	**-0.75**	5.24
	Partnership	2.42	8.71	7.56	19.96	16.74
	Process	9.82	6.88	**-4.47**	17.48	**-1.53**
Cross Interactions of No. of Sub-criteria (influencing others)						
		Leadership	Strategy	People	Partnership	Process
Influencing Sub-criteria (getting influenced>	Leadership	9	4	2	3	6
	Strategy	4	4	1	5	2
	People	5	4	10	3	2
	Partnership	3	3	4	6	5
	Process	4	2	5	6	4

4.6 SUMMARY

This chapter analysed the effect of assessment scores at the sub-criteria level. This research provides the most significant factors which are influencing other sub-criteria and majorly impacting all categories of the results. The chapter has identified the managerial and organizational application point of view. Out of 32 sub-criteria, 9 sub-criteria are influencing more than six other sub-criteria namely 1.c, 1.d, 2.c, 3.b, 3.c, 4.d, 4.e, 5.a and 5.b. The seven sub-criteria are positively impacting the results and two are negatively impacting (5.a and 5.b) the results.

Leaders engage with external stakeholders (1.c): This sub-criterion influences seven other sub-criteria (1.d, 1.e, 2.d, 3.c, 5.a, 5.b, and 5.e). In an excellent organization, it is expected that leadership is actively involved in using approaches to understand, anticipate and respond to the expectations of their key stakeholders. Leadership establishes shared values, accountability, ethics and a culture of trust, openness and transparency throughout the value chain and accountability to their stakeholders and society. They ensure their

people act ethically, responsibly and with integrity and are transparent in reporting financial & non-financial results.

People are aligned, involved, and empowered (3.c): This sub-criterion influences seven other sub-criteria (2.b, 3.a, 3.b, 3.d, 3.e, 4.c, and 5.b). In an excellent organization, it is expected to establish an alignment of personal and team objectives, and empower people to realize their full potential in a spirit of true partnership. It recognizes and encourages creating a culture of creativity and innovation in areas of products, processes, organizational structures, and business models. It helps the organization by ensuring people have an open mindset and can respond quickly to challenges. These actions help in creating people belongingness and act as ambassadors of the organizations and inspire their active participation in wider societal activities. Table 4-6 summarizes the research findings.

Technology is managed to support the delivery of strategy (4.d): This sub-criterion influences six other sub-criteria (1.b, 3.b, 4.b, 5.a, 5.b, and 5.e). In an excellent organization, a technology portfolio is established by involving relevant stakeholders to improve the agility of processes, projects; and to support the overall strategy and the culture of creativity and innovation. The relevant stakeholders identify and evaluate alternative and emerging technologies to create an impact on organizational performance and capabilities.

Table 4-6: Summary of research findings

Sub-Criteria	CiC	IoR	Primary Influencer of the result (one or more)	Contribution of sub-criteria	No of Cross Influencing Sub-Criteria	Author's classification	CiC rating	IOR Rating	Influence on Results rating	Influencing Capability Rating	Total	Commentary
1.a	16.65	4.90		CiC + IoR	4	Promoters	4	4	0	4	12	
1.b	12.75	-6.89	BR	CiC + Primary for BR	5	Defenders	4	2	1	5	12	
1.c	22.61	12.61	SR	CiC + IoR + Primary for SR	7	Promoters	5	5	1	7	18	
1.d	10.21	4.12	BR	CiC + IoR + Primary for BR	6	Promoters	3	4	1	6	14	
1.e	4.28	5.46		IoR	2	Proponents	2	4	0	2	8	*
2.a	9.19	6.04	CR	IoR + Primary for CR	3	Proponents	3	4	1	3	11	
2.b	9.80	0.40			3	Proponents	3	3	0	3	9	
2.c	10.03	12.78	PR,BR	CiC + IoR + Primary for PR & BR	6	Promoters	3	5	2	6	16	
2.d	13.01	-2.21		CiC	4	Defenders	4	2	0	4	10	
3.a	8.58	-1.16	CR	Primary for CR	4	Decorators	3	3	1	4	11	
3.b	6.37	11.39	SR	IoR + Primary for SR	6	Proponents	2	5	1	6	14	
3.c	20.63	12.60	PR	CiC + IoR + Primary for PR & BR	7	Promoters	5	5	1	7	18	
3.d	4.65	-4.84	SR	Primary for SR	4	Detractors	2	2	1	4	9	
3.e	8.23	4.23		IoR	3	Proponents	3	4	0	3	10	
4.a	-2.49	-9.26			1	Detractors	1	1	0	1	3	*
4.b	11.58	8.09	PR,BR	CiC + IoR + Primary for PR & BR	4	Promoters	3	5	2	4	14	
4.c	11.80	3.02		CiC + IoR	4	Promoters	3	4	0	4	11	
4.d	19.27	0.71	CR,PR	CiC+ Primary for CR& PR	6	Promoters	5	3	2	6	16	
4.e	15.23	8.39	PR	CiC + IoR + Primary for PR & BR	6	Promoters	4	5	1	6	16	
5.a	16.16	-1.28	CR,SR	CiC + IoR + Primary for CR & SR	6	Defenders	4	3	2	6	15	
5.b	5.84	-11.71	PR,BR	CiC + IoR + Primary PR & BR	6	Detractors	2	1	2	6	11	
5.c	5.05	0.93			3	Proponents	2	3	0	3	8	*

Sub-Criteria	CiC	IoR	Primary Influencer of the result (one or more)	Contribution of sub-criteria	No of Cross Influencing Sub-Criteria	Author's classification	CiC rating	IOR Rating	Influence on Results rating	Influencing Capability Rating	Total	Commentary
5.d	3.12	-3.05	SR	Primary for SR	1	Detractors	2	2	1	1	6	
5.e	-1.99	10.27	CR,BR	CiC + IoR + Primary for CR & BR	5	Proponents	1	5	2	5	13	

Note-1:
CiC is the total Cross Influencing Criteria score from table 5
IoR is the total impact on Result by Criteria from table 3
CR : Customer Result, PR: People Result, SR: Society Result and BR: Business Result
* The role of this sub-criteria needs to be investigated

Scale:

Rating	CiC	IoR	Results
5	17.51 to 22.70	8.01 to 13.00	Four result category
4	12.51 to 17.50	3.01 to 8.00	Three result category
3	7.51 to 12.50	-2.01 to 3.00	Two result category
2	2.50to 7.50	-7.01 to -2.00	One result category
1	-2.49to2.50	-12.00 to -7.00	No influence

Information and knowledge are managed to support effective decision making and to build the organizational capability (4.e): This sub-criterion influences six other sub-criteria (1.e, 2.b, 2.d, 3.a, 3.d, and 4.d). In an excellent organization, systems and processes are established to ensure that their leaders are provided with accurate and sufficient information to support them in timely decision making, ensure that processes are established for knowledge management, protection of an organization's intellectual property. Establish and manage learning and collaboration networks to identify opportunities for creativity, innovation and improvement.

Strategy and supporting policies are developed, reviewed and updated (2.c): This sub-criterion influences six other sub-criteria (1.b, 1.e, 2.b, 4.c, 4.e, and 5.c). In an excellent organization, a clear organizational strategy and supporting policies are established to achieve the mission and vision of the organization. The core strategy, value chain and processes need to be designed to allocate the resources required to deliver the goals. The key performance indicators are established to achieve the organizational mission and evaluate progress towards the vision and strategic goals. Effective mechanisms are established to manage strategic risks and organizational key competencies.

People's knowledge and capabilities are developed (3.b): This sub-criterion influences six other sub-criteria (1.b, 1.c, 2.b, 2.c, 3.a, and 3.c). In an excellent organization, skill and competency frameworks are established; and the required people performance levels to achieve the mission, vision and strategic goals are established. People policies are established effectively to attract, develop and retain the talent required to meet these needs. Performance appraisal systems are established to improve people performance and engagement. Skills and competencies are developed to ensure future employability and opportunities.

Products and services are developed to create optimum value for customers (5.b): This sub-criterion influences six other sub-criteria (1.c, 3.e, 4.d, 4.e, 5.c, and 5.e) and is a detractor. In an excellent organization, the organizational process strives to innovate and create value for their customers; involving them and other stakeholders, wherever appropriate, in the development of new and innovative services, support and experiences. It uses market research, customer surveys and other forms of feedback to anticipate and identify improvements aimed at enhancing the product and service portfolio. It also develops its portfolio in line with the changing needs of existing and potential customer groups by designing their products and services, and actively manages the full product life cycle in a responsible way. However, from this research analysis, it is clear that over-stressing on sub-criteria 5.b (Products and services are developed to create optimum value for customers) would affect results. Therefore, the organization needs to make sure that a balanced approach is considered while focusing on this factor.

Leaders reinforce a culture of excellence with the organisation's people (1.d): This sub-criterion influences six other sub-criteria (1.a, 1.b, 2.c, 3.a, 4.b, and 4.e). In an excellent organization, leaders inspire the people with a culture of creativity and involvement, create an awareness of the existence of the organization, improve the organisational management systems and performance. Strategy and supporting policies are developed, reviewed and updated by adopting suitable people plans. Finances are managed to secure sustained success by reinforcing the culture of excellence in the organisation. Leaders reinforce the culture of decision making based on the information and build the necessary infrastructure to manage the information and knowledge.

Processes are designed and managed to optimise stakeholder value (5.a): This sub-criterion influences six other sub-criteria (2.a, 3.e, 4.a, 4.c, 4.e, and 5.d). In an excellent organization, the process framework is defined and implemented to achieve

organisational strategy. The processes are designed to meet the expectations of the stakeholders and changing external environment. To improve the efficiency of the process, people are rewarded and recognised. Partners and suppliers are managed for sustainable benefits, the resources are sustained for long term purpose, information and knowledge are managed. The products and services are produced, delivered and managed to achieve the optimised stakeholder value. This sub-criterion needs to be handled in a balanced way, overemphasizing this sub-criterion would adversely impact the outcomes.

Table 4-6 shows the research analysis and summarisation of the outcome. For each sub-criteria CiC, IoR, the primary influence of the result category, and the number of sub-criteria being influenced by this sub-criteria are presented. These factors are rated using the rating scale of 1 to 5. Higher the rating more influential in sub-criterion (lower the rating, it is lower influence in the sub-criteria. Sub-criteria 1.e, 4.a, 5.c and 5.d have low scores. This requires more deliberation and more investigation. While constructing the new version of EFQM, probably these sub-criteria needs to be combined and could be eliminated as these factors have low influence. This topic could help in the re-constitution of the model or further research deliberations.

CHAPTER-5

INTERRELATIONSHIPS AMONG EFQM MODEL RESULTS SUB-CRITERIA

This chapter examines and identifies the interrelationships among EFQM results sub-criteria to understand the structure and influences among each another.

5.1 INTRODUCTION

It is evident that the EFQM model statistically persists with the problem of multicollinearity issues at the criteria level. Several researchers have focused on evaluating the model based on hypothesis validation using the survey methodologies. The chapter uses the empirical methodology based on assessment scores of 58 organizations to gauge the underlying interconnection of the result sub-criteria, develop the construct and establish interlinkages among the various sub-criteria in the EFQM model of result criteria. Independent assessment scores of the EFQM assessments of the organizations are being adopted for the study. The outcome of the current research is to provide more insights based on the assessment scores.

The current study provides valuable inputs and important insights such as interconnections of how perception and performance indicators of the model are influencing the results section and interrelationship among the result sub-criteria. This study establishes a key finding of performance indicators of people, customer and business determiner the organisational customer results, people results, society results and business results. Most of the research focuses on enablers how they would influence the results. Researchers have focused on the cause and effect of the model to draw

conclusions. However, only a few researchers have focused on interconnections within the result criteria.

5.2 BACKGROUND

The EFQM construct clearly shows that each result category has two sub-criteria (a & b). Sub-criteria (6.a, 7.a, 8.a) represent the perception of the results and sub-criteria (6.b, 7.b & 8.b) represent the performance indicators of the organization. In the case of the business results, the sub-criteria are termed as business outcomes (9.a) and business performance indicators (9.b). Each sub-criteria have its own weightage as depicted Table 5-1.

Heras-Saizarbitoria *et al.* (2012) studied the empirical relationship of the EFQM model by conducting three hypothesis tests related to the result criteria interrelationship. They found that the customer results influence the business results, whereas the society and people result do not influence the business results. Gómez *et al.* (2015) research revealed new relationships in the model which were not established in the official construct of the model. This research highlighted the people results relationship with society results.

Some of the conclusions are not validated using the actual assessment data and interconnections are not validated properly. As per the construct of the model, each results category has got two sub-criteria, however, their impact is not considered while concluding the influence of the results. In each result criteria, two sub-criteria exist, one deals with the perception of the stakeholder and other data indicates the internal performance indicators of the organisation. To arrive at the score of the results, the weightage is applied to both sub-criteria and results are arrived at. In the practical world, these eight sub-criteria of the four result categories are overlooked. In this chapter, the focus is on the sub-criteria level influence of the results. The research objectives are:

- To assess the perception and performance indicators of the results sub-criteria on the results
- To establish the interrelationship among the results sub-criteria

Table 5-1: EFQM result sub-criteria meanings and weightages

Result Category	Sub-Criteria	Name of the Sub criteria	Weightage	Description
Customer results	6.a	Perceptions	75%	Customer perceptions could be obtained from multiple sources including customer survey, focus groups, rating, compliments, and complaints. These parameters would provide a clear understanding of the effectiveness of customer perspectives. The outcome would demonstrate effective implementation of customer strategy, policies and processes
	6.b	Performance Indicators	25%	These internal measures are used by excellence organisation to monitor, understand, predict and improve the performance of the organisation predict impact on perceptions of the customer. These indicators would demonstrate the effective implementation of customer strategy, policies and processes
People results	7.a	Perceptions	75%	People's perception of the organisation obtained from sources like surveys, focus groups, interviews and structured appraisals. The outcome would demonstrate effective implementation of people strategy, policies and processes.
	7.b	Performance Indicators	25%	These internal measures are used by excellence organisation to monitor, understand, predict and improve the performance of the organisation's people and to predict their impact on perceptions of the people. These indicators would demonstrate the effective implementation of people strategy, policies and processes
Society results	8.a	Perceptions	50%	Society's perception of organisation obtained from number of sources, including surveys, reports, press articles, public meetings, non-governmental organisations, public representatives and governmental authorities. These perceptions would demonstrate the effective implementation of societal and environmental strategy and supporting policies and processes
	8.b	Performance Indicators	50%	These internal measures used by organisation to monitor, understand, predict and improve the performance of organisation and to predict their impact on the perception of the relevant stakeholders within the society. These indicators would demonstrate the effective implementation of societal and environmental strategy and supporting policies and processes
Business results	9.a	Business Outcomes	50%	Represents key financial and non-financial business outcomes which demonstrates deployment of organisational strategy. These measures are agreed with the business stakeholders
	9.b	Business Performance Indicators	50%	The key financial and non-financial business indicators to measure the organisational operational performance. These would help monitor, understand, predict and improve the organisation's likely business outcomes

5.3 RESEARCH METHODOLOGY

The approach followed for the research is proposed in Figure 5-1. The flow describes the proposed research approach to evaluate the research objectives.

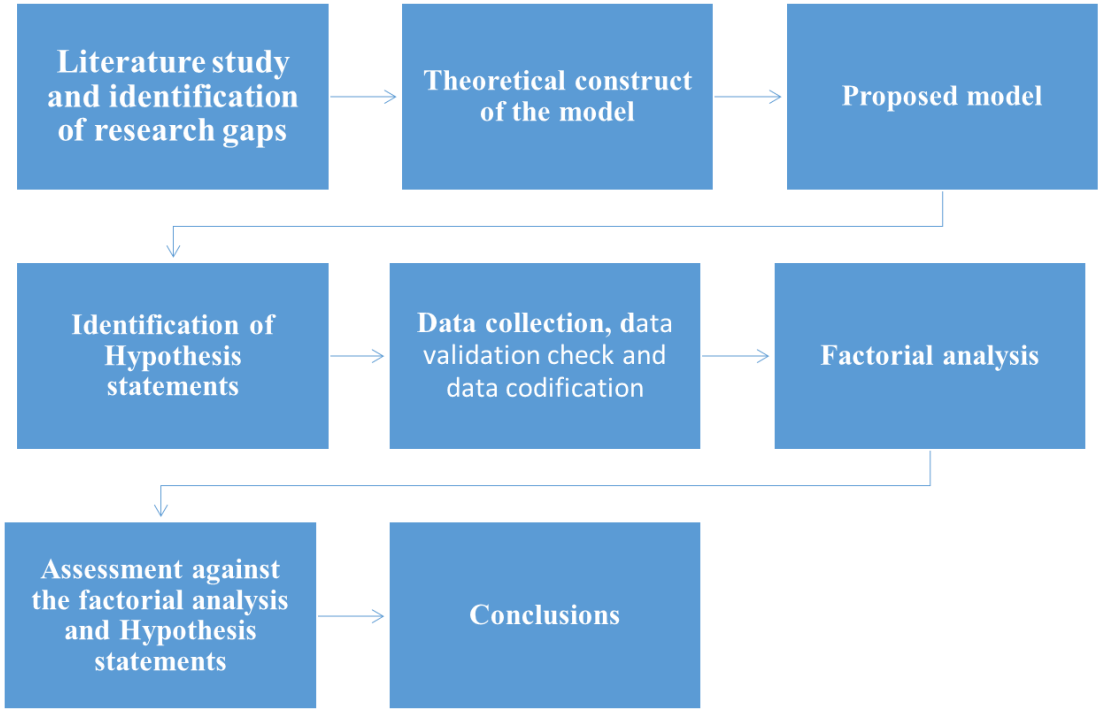


Figure 5-1: Research methodology for interrelationship among results

Stage-1 work includes: a) construction of a theoretical model of the EFQM focusing on results criteria, b) identification of the hypothesis statements of the model for results sub-criteria, and c) validation of the hypothesis statements using the field data from Indian companies.

5.3.1 Theoretical Construct of the Model and Hypotheses

As per the base construct of the model, the results are interconnected. It is depicted in Figure 5-2 and it is clear that results are interconnected. In most of the research works, as stated earlier in the literature study, the sub-criteria influence of the results is not dealt with and results are reviewed at the criteria level only. Therefore, a theoretical construct of the results is proposed as shown in Figure 5-3. Based on the proposed theoretical

construct and practical applicability of the model, following hypothesis statements are proposed;

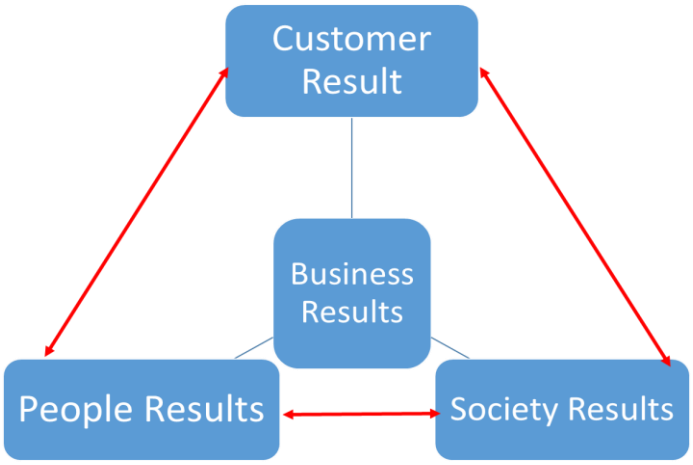


Figure 5-2: Base construct of the model at criteria level

H1 – Customer results are influenced by customer perception (6.a)

H2 - Customer results are influenced by people perception (7.a)

H3 – Customer results are influenced by business result performance indicators (9.b)

H4 – People results are influenced by people perception (7.a)

H5 – People results are influenced by business result performance indicators (9.b)

H6 – Society results are influenced by people performance indicators (7.b)

H7- Society results are influenced by society perception (8.a)

H8 – Society results are influenced by customer perception (6.a)

H9 – Business results are people performance indicators (7.b)

H10 – Business results are influenced by customer perception (6.a)

H11 – Business results are influenced by business outcomes (9.a)

H12 – Business results are influenced by internal business performance indicators (9.b)

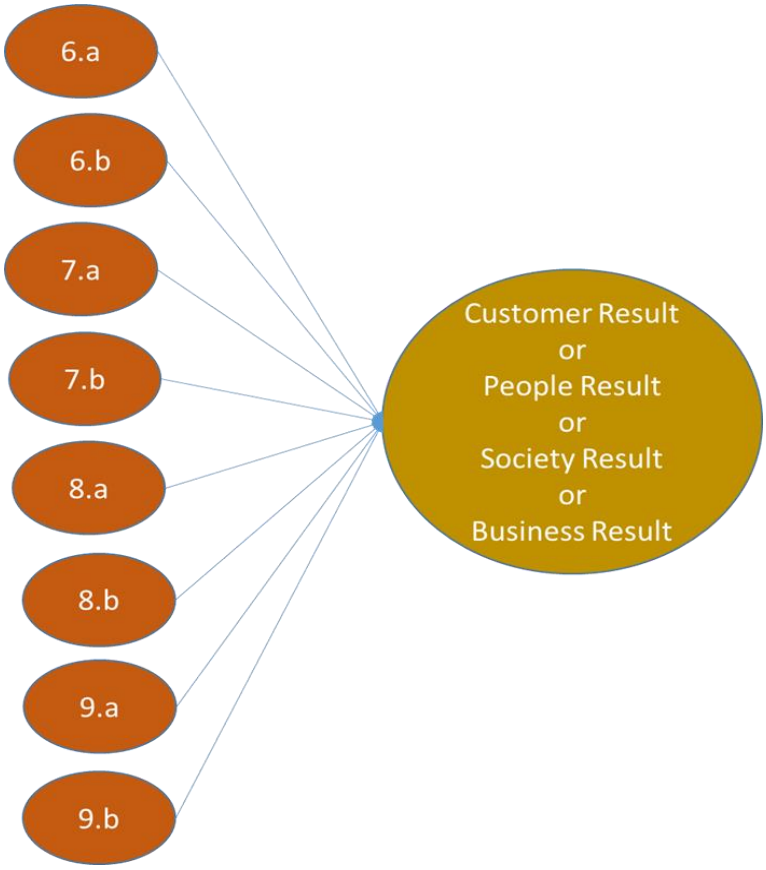


Figure 5-3: Theoretical construct of the result at sub-criteria level

5.3.2 Data Collection for Empirical Evaluation

The data is the actual data submitted by 58 Indian organisations that applied for the CII-Exim Bank Business Excellence (based on EFQM) awards as discussed in chapter 3. In this chapter, the focus will be on relationships within the results criteria.

5.3.3 Coding of Factors and Guiding Principles

The assessment scores of sub-criteria were codified to conduct the factorial DOE analysis as done in chapter 3. The raw data ranges from 22 to 75 based on the assessment scores. Practically, it will be difficult to handle this raw data range and construct the factorial design. To simplify the factorial design, the data need to be clustered. Based on the subject expertise and also in consultation with other senior assessors in the business excellence community, the raw data was clustered as per the schema presented in Table 5-2. This classification is derived based on the maturity of the assessment and

keeping the RADAR into account. The codified data of the result sub-criteria is presented in Table 5-3. The guiding principles stated in chapter 3 are adopted in this chapter also.

Table 5-2: Codification of results data for factorial analysis

Assigned code	Sub-Criteria Score
1	0-30
2	30.01-40
3	40.01-50
4	50.01-60
5	60.01-75

Table 5-3: Codified data of results sub-criteria

Company	6.a	6.b	7.a	7.b	8.a	8.b	9.a	9.b
1	2	2	1	2	4	4	2	3
2	3	2	2	3	3	4	2	2
3	3	2	2	2	2	2	3	3
4	3	3	3	3	3	3	3	3
5	4	4	4	4	5	4	4	4
6	3	3	1	2	1	3	3	3
7	2	2	5	3	3	5	3	3
8	5	5	5	4	4	2	5	5
9	5	4	4	3	2	3	4	5
10	5	5	4	3	3	4	5	4
11	3	3	4	3	3	3	4	4
12	3	3	3	3	3	3	4	4
13	1	1	1	2	1	1	3	2
14	2	2	3	2	3	2	3	2
15	5	4	4	4	4	4	5	5
16	3	3	4	4	4	4	3	3
17	3	3	3	3	3	3	3	3
18	3	3	3	2	2	2	2	2
19	3	2	2	1	1	1	2	2
20	2	2	3	3	2	2	3	3
21	2	2	2	2	2	2	2	2
22	4	4	4	4	5	5	4	4
23	5	5	3	4	4	4	5	5
24	1	2	1	1	1	1	3	3
25	2	2	4	4	1	2	4	2
26	2	3	1	1	1	1	3	2
27	2	3	4	4	4	4	5	4

Company	6.a	6.b	7.a	7.b	8.a	8.b	9.a	9.b
28	2	2	2	2	2	2	4	3
29	3	2	4	3	2	2	4	3
30	4	4	3	3	4	4	4	4
31	2	2	2	2	3	3	3	3
32	4	4	4	4	4	4	4	4
33	4	3	3	3	4	4	4	4
34	2	2	2	2	2	1	3	2
35	5	5	3	3	3	3	4	4
36	5	5	5	5	5	5	5	4
37	3	2	1	1	1	3	1	3
38	3	3	3	2	1	2	3	3
39	3	2	3	3	2	2	3	3
40	3	2	4	3	5	5	3	2
41	4	4	4	4	4	4	4	4
42	4	4	4	4	4	4	4	4
43	4	4	4	4	4	4	4	4
44	4	4	4	4	4	4	4	4
45	5	5	5	5	5	5	4	4
46	4	4	4	4	4	4	5	5
47	5	5	5	4	5	5	5	5
48	3	3	3	3	3	3	3	3
49	4	4	4	4	3	3	4	4
50	4	4	4	4	5	4	4	4
51	4	5	4	4	5	5	5	5
52	3	3	3	2	2	2	4	3
53	3	3	2	3	2	2	3	3
54	4	3	3	4	3	4	3	4
55	3	3	3	3	3	2	4	3
56	3	3	4	4	4	4	4	3
57	4	3	4	3	3	4	5	4
58	3	3	4	3	4	4	4	4

5.3.4 **Results and Discussion**

In the factorial DOE analysis, all the eight sub-criteria of results (6.a to 9.b) were adopted to carry out factorial analysis for each result category. This is because the criteria score in the assessment being an aggregation of the sub-criteria scores. These factors (6.a to 9.b) were considered as variables and each result considered as an effect for the analysis to identify the key influential factors. While running the factorial DOE, the codified data

of sub-criteria from Table 5-3 is considered as a variable and each result (customer, people, society and business) is considered as an effect. Only one-way interactions of the factors are considered. Based on the rules identified for factorial analysis and outcomes guiding principles defined in chapter-3 were adopted. Minitab factorial analysis output is presented in

Table 5-4 and Figure 5-4, for the four result categories (5.4 a for customer results, 5.4 b for people results, 5.4 c for society results and 5.d for business results). Multiple iterations are carried out to arrive at the outcomes and outcomes are summarized in Table 5-5.

Table 5-4: Factorial analysis outcomes for the four results (a,b,c,d)

a). Customer results - factorial analysis outputs

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		66.898	0.578	115.68	0.000	
6.a	34.94	17.47	2.11	8.29	0.000	4.86
6.b	16.28	8.14	2.23	3.65	0.001	5.44
9.b	8.42	4.21	1.43	2.95	0.005	2.98

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.83422	94.46%	94.16%	93.63%

b). People results - factorial analysis outputs

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		44.241	0.335	132.19	0.000	
7.a	26.81	13.40	1.01	13.25	0.000	3.14
7.b	12.22	6.11	1.22	5.01	0.000	3.52
9.b	2.591	1.296	0.689	1.88	0.065	1.73

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.42498	95.34%	95.08%	94.56%

c). Society results - factorial analysis output

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		44.386	0.372	119.25	0.000	
6.b	2.758	1.379	0.886	1.56	0.125	1.67
8.a	22.25	11.13	1.15	9.68	0.000	3.95
8.b	15.95	7.98	1.13	7.03	0.000	3.44

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.75122	95.08%	94.81%	93.84%

d). Business results - factorial analysis output

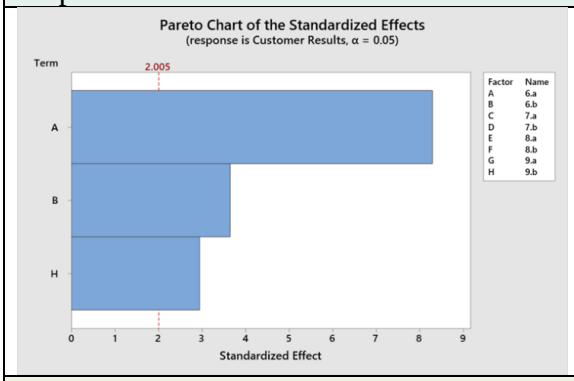
Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		70.974	0.677	104.83	0.000	
7.b	10.95	5.48	1.26	4.35	0.000	1.97
9.a	22.73	11.36	1.59	7.14	0.000	2.81
9.b	21.76	10.88	1.17	9.34	0.000	2.60

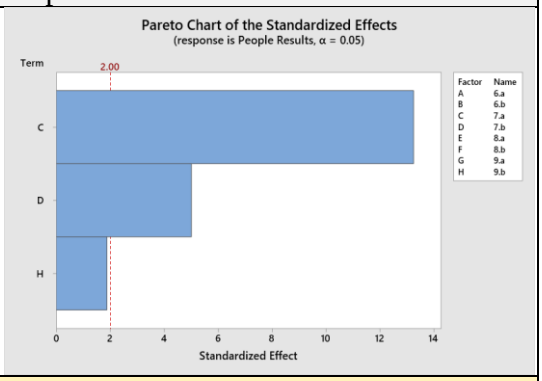
Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.34694	94.34%	94.02%	93.04%

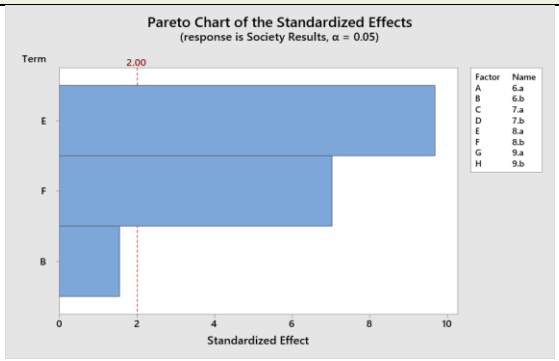
a). Customer results - factorial analysis outputs



b). People results - factorial analysis outputs



c). Society results - factorial analysis output



d). Business results - factorial analysis output

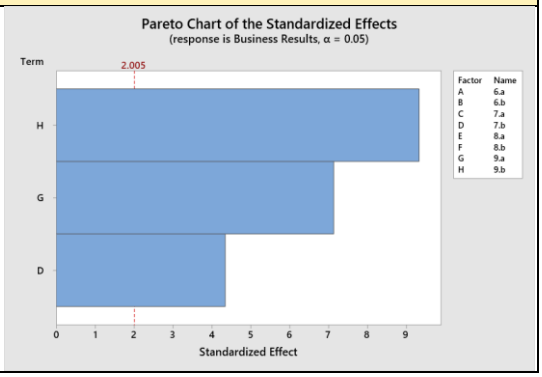


Figure 5-4: Pareto chart of the standardized effects from factorial analysis

The summary of the outcomes is tabulated in Table 5-5 and it shows the factorial analysis results, R Squared value, Standard Deviation, No. of factors influencing the results.

Table 5-5: Summary of Factorial analysis

Result	R^2 Value	R^2 Value (adj)	SD	Factors having less than 0.05 or close to 0.05 P-value	Factors having less than 5 VIF	Factors beyond or close to red-line in pareto chart	Remarks
Customer Results	94.56%	94.16%	3.83	6.a,6.b, 9.b	6.a,6.b, 9.b	6.a,6.b, 9.b	All three factors are influential
People Results	95.34%	95.08%	2.43	7.a, 7.b, 9.b	7.a, 7.b, 9.b	7.a, 7.b, 9.b	All three factors are influential
Society Results	95.08%	94.81%	2.75	8.a, 8.b,	6.b, 8.a, 8.b	8.a, 8.b,	Factors8.a & 8.b are influential and factor 6.b is close to be influential
Business Results	94.34%	94.02%	3.35	9.b, 9.a, 7.b	9.b, 9.a, 7.b	9.b, 9.a, 7.b	All three factors are influential

Next, the factorial analysis outcome and theoretical construct of the model are compared.

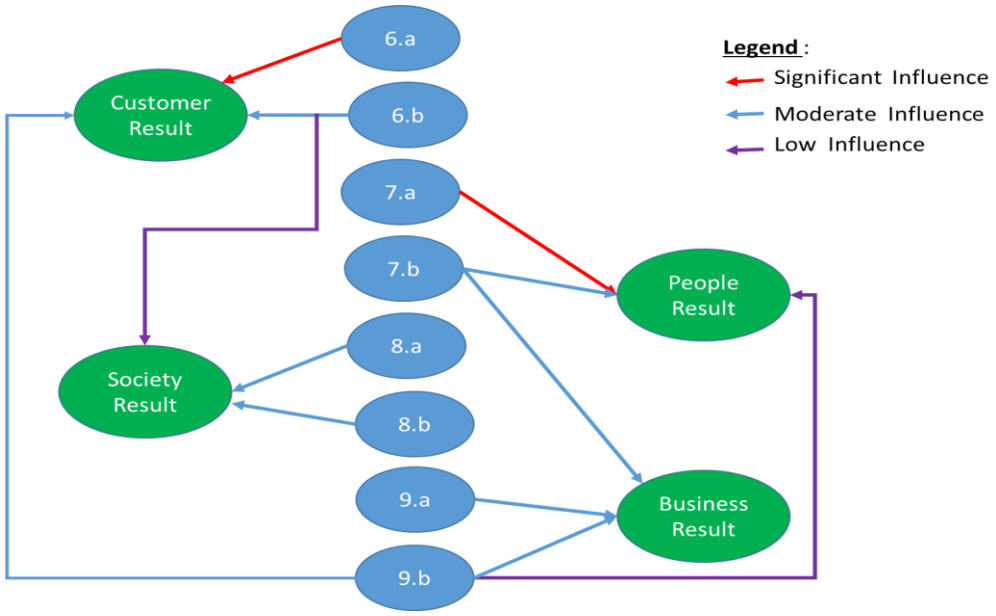


Figure 5-5: Actual interaction of results at sub-criteria

Figure 5-5 reflects the outcomes of this comparison. Based on the VIF and p-values from Figure 5-4 and Table 5-6, the influencers on the results are identified. These influencers are marked in three distinct colours to identify the influence. Significant influencers are identified with the red line, moderate influencers are identified with blue lines and low influencers are identified with violet colour. Figure 5-5 is the actual construct of the model as compared to the theoretical construct of the model proposed in Figure 5-3.

From the factorial analysis and rule-2, it is clear that factors influencing the outcome of the results are identified through factorial analysis and the Pareto chart of standardised effect. Since the factorial analysis identifies the influencing factors, separate hypothesis validation is not required. The factorial analysis is used to identify the relationship, influencing parameters and validation of hypothesis statements. Table 5-6 presents the results of hypotheses analysis, four of the twelve identified hypotheses are rejected.

Table 5-6: Identified Hypotheses

Hypothesis Statement	Acceptable / Not acceptable
H1 – Customer results are influenced by customer perception (6.a)	Acceptable
H2 - Customer results are influenced by people perception (7.a)	Not Acceptable
H3 – Customer results are influenced by business result performance indicators (9.b)	Acceptable
H4 – People results are influenced by people perception (7.a)	Acceptable
H5 – People results are influenced by business results performance indicators (9.b)	Acceptable
H6 – Society results are influenced by people performance indicators (7.b)	Not Acceptable
H7- Society results are influenced by society perception (8.a)	Acceptable
H8 – Society results are influenced by customer perception (6.a)	Not Acceptable
H9 – Business results are people performance indicators (7.b)	Acceptable
H10 – Business results are influenced by customer perception (6.a)	Not Acceptable
H11 – Business results are influenced by business outcomes (9.a)	Acceptable
H12 – Business results are influenced by business internal performance indicators (9.b)	Acceptable

5.4 KEY INFERENCES AND MANAGERIAL IMPLICATIONS

The scores results are arrived at based on the two sub-criteria scores (a & b) of each category. As mentioned earlier, customer result and people result sub-criteria (a & b) carry 75% and 25% weights. The perception (a) carries more weight than performance indicators. In the case of society results and business results, the perception (a) and performance indicators (b) are equally weighted in the model. It indicates that perception

and performance carry considerable weights and these sub-criteria of each result category would be the potential influencers.

The study, based on the field data, establishes the influencing sub-criteria of results. In the case of enabler, sub-criteria are highly interlinked and whereas in the case of the result sub-criteria, the interactions are limited. Enablers are the causes and results are the effect. Chapter 3 highlighted the relationship of enablers to results.

Prabhu (2000), Santos-Vijande and Alvarez-Gonzalez (2007, and Heras-Saizarbitoria (2012) have claimed the existence of positive influence of customer results with society and people results. Prabhu (2000), Eskildsen (2000), Santos-Vijande and Alvarez-Gonzalez (2007), Martinez-Lorente *et al.* (2009), Sadeh and Arumugam (2010), Gómez *et al.* (2011), Heras-Saizarbitoria (2012) and Gorji (2012) said that the customer results are influenced by business results. Based on the current research, it is clear that customer results are not influenced by people results and society results. However, from the study, it is evident that customer results are influenced by business performance indicators (9.b). This finding confirms the claim made by the many other researchers.

Eskildsen (2000) and Martinez-Lorente *et al.* (2009) studies revealed that people results have a relationship with customer results. Prabhu (2000), Eskildsen (2000), Santos-Vijande and Alvarez-Gonzalez (2007), Martinez-Lorente *et al.* (2009), Sadeh and Arumugam (2010), and Gorji *et al.* (2012) confirm the positive relationship between people results and society results. However, Gómez *et al.* (2011) and Heras-Saizarbitoria *et al.* (2012) found no influence of business results on people results. As per the current empirical research also, people results are not influenced by customer results and society results. People results are influenced by the business results as sub-criterion 9.b influences the people results and customer results. Typically, the business performance indicators (9.b) are the key financial and non-financial business indicators used to

measure the organisation's operational performance. This helps to monitor, understand, predict, and improve the organisation's business outcomes. These performance indicators are operational performance indicators and people are involved in collecting, monitoring, and analysing the data. These metrics reflect the reality at the ground and status is known to the employees. It is real-time information, and the positivity or negativity of the outcomes are transparent to the team. In the case of the perception indicators, there is a lag and a complete view of the performance will not be available to the employees. It is logically right that these metrics influence the results. Based on the operational performance indicators, the employees can draw meaningful conclusions and influence the results. Similarly, the customer would also get influenced by the interactions with the employee, body language and tone of the communication in the organisation. These would influence the perception of the customer. Santos-Vijande and Alvarez-Gonzalez (2007) and Gómez *et al.* (2011) studies confirm the relationship of society results with people results.

There are three research works conducted to validate the relationship between society results and customer results. Eskildsen (2000) and Martinez-Lorente *et al.* (2009) confirm the positive influence meanwhile Gómez *et al.* (2011) confirms no influence. Eskildsen (2000), Westlund (2001), Santos-Vijande and Alvarez-Gonzalez (2007), Martinez-Lorente *et al.* (2009), Sadeh and Arumugam (2010), and Gorji *et al.* (2012) confirmed the positive relationship between society results and business results.

Society results are not influenced by business results as per Heras-Saizarbitoria *et al.* (2012). The studies from Santos-Vijande and Alvarez-Gonzalez (2007) and Gómez *et al.* (2011) confirm the positive relationship between society results and people results. The current research indicates that the customer performance indicators influence the society result outcomes. Gómez *et al.* (2011) and Martinez-Lorente *et al.* (2009) also confirm

this claim. Sub-criterion 6.b, which measures the performance indicators of customer results, influences the society results. Typically, in 6.b sub-criterion, product and service delivery performance measures, and customer service, relationships and support metrics are monitored; complaint handling metrics are collected and reviewed; and the involvement of customers and partners in the design of products and processes is also monitored. It means these parameters are internal indicators of the customer perception. The customers are part of the society and act like ambassadors of the organisation. This group would influence the outcome of society results. Society perception largely covers the environmental impact, organization image and reputation, society impact, workplace impact, awards and media coverage, etc. The internal performance indicators of the customer results would provide insights into the operational performance thereby influencing the society results. Employees based on operational performance indicators play a major role in influencing society results.

Not many research studies are available that reflect the relationships of business results with customer, people and society results. The society results do not influence the business results. People performance indicators (7.b) influences the business result. Here, various performance indicators are involvement and engagement activities of people, competency and performance management activities, leadership performance, training and career development activities, and internal communications. People performance indicators indicate the positive mindset of the people of the organisation. From this research work, it is clear that operational metrics representing performance indicators (9.b, 7.b and 6.b) are cross influencing the other results as depicted in Figure 5-5. If the organisation focuses on improving operational performance, it is most likely to excel and move towards business excellence. The outcome of the chapter highlights the importance of defining, monitoring and improving the performance indicators of the customer,

people and business results by the managers. The improvement of these metrics would influence the overall scores of customer, people, society, and business results of the organisation. Managers can drive the operational performance indicators effectively to achieve excellent results apart from the identified enabler sub-criteria which influence the results. Table 5-7 shows the comparison of literature review findings and the results from this study.

Table 5-7: Comparison of results obtained in this research with literature review

Based on the Literature Reviews							
Sl No	**Interconnections of criteria**	**Total of P**	**Total of N**	**Total researcher**	**% of positive relationships**	**Results from this study**	**Remarks**
1	Customer results influenced by people results	4	0	4	100%	N	No influence evident
2	Customer results influenced by society results	3	0	3	100%	N	No influence evident
3	Customer results influenced by the business results	9	0	9	100%	Y (9.b)	Influence evident
4	People results influenced by customer results	2	0	2	100%	N	No influence evident
5	People results influenced by societal results	0	0	0	NA	N	No influence evident
6	People results influenced by business results	7	3	10	70%	Y (9.b)	Influence evident
7	Society results influenced by the customer results	2	1	3	67%	Y (6.b)	Influence evident
8	Society results influenced by the people results	2	0	2	100%	N	No influence evident
9	Society results influenced by the business results	7	2	9	78%	N	No influence evident
10	Business results with the customer results	0	0	0	NA	N	No influence evident
11	Business results with the people results	0	0	0	NA	Y (7.b)	Influence evident
12	Business results with society results	0	0	0	NA	N	No influence evident

Note : ‘P” Denotes positive relationship between criteria, ‘N’ Denotes negative relationship between criteria

5.5 SUMMARY

This chapter has identified the relationship within the result criteria based on the assessment scores of the model. The study unravels the relationship among the results sub-criteria and their significance based on the assessment scores of the 58 Indian companies. It shows differences between the theoretical construct and the actual construct. The theoretical model could be revisited based on these inputs. This model is helpful to the EFQM deployment team to focus their efforts and energies effectively for better results. The factorial analysis result confirms the positive relationship between people to business results, business results to people results, business results to customer results, customer to society results. However, the existence of relation between People to customer results, people results to customer results and business to society results are not evidenced from Indian context.

In the next chapter, the results are validated through an expert survey.

CHAPTER-6

VALIDATION OF EFQM MODEL CONSTRUCT AT SUB-CRITERIA LEVEL

This chapter validates the interrelations among EFQM enablers and results at sub-criteria level found in chapters 3, 4 and 5.

6.1 INTRODUCTION

The purpose of this chapter is to validate how the sub-criteria of the EFQM model are structurally connected and influence one another and to validate the sub-criteria influencing the results. An empirical methodology based on a survey is used to validate the outputs the chapters 3, 4 and 5 by using factorial analysis, structure equation modelling, path analysis, and NPS. From the literature studies in chapter 2, it is clear that researchers have mainly focused on establishing the relationship of criteria influence on results. In chapter 3, the identification of the key sub-criteria influencing the four result categories of business excellence were established using the study at the sub-criteria level. Similarly, chapter 4 conducted classification of sub-criteria into promoters, proponents, detractors and defenders. Both the studies were based on the assessment scores of the Indian region. Chapter 5 focused the interrelationships among results at sub-criteria level. The primary objective of these studies was to provide an indication of content validity, rather than build a new theory. These findings established a comprehensive analysis of the literature assuring content validity adequately.

This chapter attempts to validate the outcomes, of chapter 3, 4 and 5, which is based on organizational assessment data of 58 organizations in India. A structured questionnaire is

designed to seek feedback and validate the outcome through a survey. Figure 6-1 shows the proposed research methodology. Block-1 of the study addresses the validation of the enablers' influence on the results at the sub-criteria level (chapter 3). The Block-2 of the study addresses the validation of the empirical classifications of the enablers (chapter 4). Block-3 addresses the interrelationship within the result sub-criteria (chapter 5). The validation is based on the field survey of data response received from subject matter experts, assessors and industry experts.

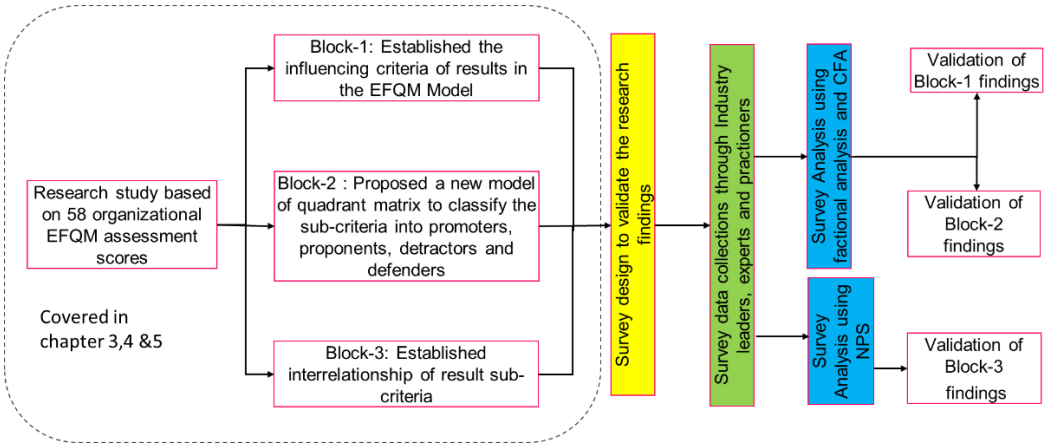


Figure 6-1: Research methodology for validation of interrelationships

6.2 RESEARCH METHODOLOGY

6.2.1 Questionnaire Design

A questionnaire is constructed to address the needs of the research objectives. The survey construct was divided into two sections. The first section of the study aims to identify the profile of the respondent, which covers the proficiency on the business excellence model, industry and professional experience, size of the industry working with, and role on using the business excellence model. The next section of the study aimed at seeking feedback on the designed questionnaire to validate the research findings. The questionnaire consists of 64 questions, eight questions are profile related, 22 questions are as per block-1, 24 questions are as per block-2, six questions are as per block-3, and one question was

open-ended to seek feedback and comments from the respondents. This mapping was done *a priori* as a part of the survey design; however, respondents did not know it as the questions were randomised to overcome any bias. In the survey a five-point Likert scale was adopted with 1 being "Strongly disagree" and 5 being "Strongly Agree". The other three scale ratings are: 4 for "Agree", 3 for "Neither Agree nor Disagree" and 2 for "Disagree". This type of scale is often used in research and due to the equal spacing between the single scoring numbers, an interval scale is simulated to allow further statistical analysis (Mittal and Sangwan 2014). This type of scale is used to force respondents to make an exclusive and decisive choice. To verify and improve the survey instrument, a pilot study was carried out involving two business excellence experts, two academicians and two industry experts. This pilot study was used constructively, and the feedback and inputs enhanced the final survey instrument. The survey questionnaire is presented in APPENDIX (A-9) and communication message/e-mail for the response is presented in APPENDIX (A-10).

6.2.2 **Sampling Approach**

It is often not possible to survey the entire population due to practical viewpoint and cost reasons, and a subset or a sample of the population is suitable for research purposes (Brewerton and Milward, 2001). The survey instrument was used to get the feedback from industry professionals, academicians, and business excellence assessors cum practitioners. The survey instrument was designed using a SurveyMonkey tool. The survey instrument link was triggered through electronic media for 500 respondents and received 173 responses within 30 days. This response rate largely attributed to the interest in the topic and eagerness to share their point of view on the topics. The authors approached the respondents through personalised email, phone calls and follow-up. The

easiness of response, instrument design, anonymity and sharing of the final report of the survey were the incentives.

6.2.3 Data Preparation and Purification

To prepare the received response for the data analysis, the necessary coding of data was carried out. Missing values were found in some of the responses. The SPSS missing value estimation techniques was used to arrive at the missing numbers. In four of the responses, the survey response was poor, and a lot of questions were unanswered. Based on the review, it was decided to ignore such a response. As a part of the initial data scrutiny, SPSS software was used to conduct descriptive statistics, normality of distribution and basic correlations. 0.15 % of missing data were found in the exercises and decided to estimate the same using SPSS.

6.2.4 Reliability of the Measuring Instrument

The reliability of the data is one of the key factors in the survey data analysis. Cronbach's alpha measurement is a widely used technique to assess the internal consistency and degree to which items are homogeneous (Cooper and Emory, 1995; Saraph *et al.* 1989). The value of Cronbach alpha was calculated for all questions, and it was 0.924 well above the recommended value of 0.6 for further analysis and acceptable reliability. The descriptive statistics of the data are presented in Table 6-1

Table 6-1: Descriptive statistics of the survey responses

Survey Q	No of Responses	Minimum	Maximum	Mean	Std. Deviation
Q9_1	169	1	5	4.791	0.606
Q10_1	169	3	5	4.798	0.416
Q11	169	3	5	4.817	0.403
Q12	169	2	5	4.615	0.636
Q13	169	3	5	4.645	0.538
Q14	169	3	5	4.609	0.589
Q15_1	169	2	5	4.434	0.678
Q16	169	2	5	4.728	0.520
Q17	169	2	5	4.639	0.582

Survey Q	No of Responses	Minimum	Maximum	Mean	Std. Deviation
Q18_1	169	2	5	4.289	0.673
Q19	169	2	5	4.432	0.738
Q20	169	4	5	4.822	0.383
Q21	169	2	5	4.426	0.761
Q22	169	1	5	4.544	0.626
Q23	169	2	5	4.574	0.584
Q24	169	2	5	4.396	0.692
Q25	169	1	5	3.876	0.908
Q26	169	2	5	4.396	0.765
Q27	169	1	5	3.834	0.829
Q28	169	1	5	4.426	0.753
Q29	169	1	5	4.118	0.872
Q30	169	2	5	4.598	0.620
Q31	169	3	5	4.722	0.488
Q32	169	2	5	4.609	0.589
Q33	169	1	5	4.503	0.647
Q34	169	2	5	4.367	0.753
Q35	169	1	5	3.698	0.892
Q36	169	1	5	4.467	0.646
Q37	169	1	5	4.178	0.804
Q38	169	2	5	4.260	0.766
Q39	169	2	5	4.361	0.736
Q40	169	2	5	4.172	0.724
Q41	169	2	5	4.361	0.668
Q42	169	2	5	4.290	0.702
Q43	169	3	5	4.615	0.500
Q44_1	169	1	5	3.653	0.919
Q45_1	169	1	5	3.078	0.906
Q46	169	1	5	3.373	0.937
Q47_1	169	1	5	3.541	1.034
Q48	169	1	5	3.876	0.983
Q49	169	2	5	4.331	0.754
Q50	169	1	5	4.030	0.848
Q51	169	1	5	4.166	0.877
Q52	169	1	5	4.071	0.910
Q53_1	169	1	5	3.964	0.872
Q54	169	2	5	4.183	0.713
Q55_1	169	3	5	4.673	0.494
Q56	169	2	5	4.343	0.810
Q57_1	169	2	5	4.428	0.669
Q58	169	1	5	3.935	0.867
Q59	169	1	5	3.456	0.970
Q60	169	2	5	3.817	0.864
Q61	169	2	5	4.302	0.644
Q62	169	2	5	3.757	0.835
Q63	169	2	5	4.189	0.787
Valid N (listwise)	169				

Barlett's test assesses the overall significance of the correlation matrix. If the value of the test statistic for sphericity is large and the associated significance level is small, it can be concluded that the variables are correlated. Bartlett's test of sphericity demonstrated Chi-Square value of 3690, degree of freedom (df) of 1485, and significant level value of 0.000, which are sufficient to conclude that variables are correlated. The test result showed the KMO measure of 0.805, which is above the suggested minimum value of 0.5 required for running factor analysis. From the reliability analysis and descriptive statistics, it is clear that the data is reliable for further analysis and inferences.

6.2.5 Validity of the Measuring Instrument

The validity of the measuring instrument refers to the survey instrument that should fulfil the purpose as per the intended need (Copper and Emory, 1995). A three steps approach was used to validate the measuring instrument. Content validity is achieved by involving three categories of people to evaluate the preliminary construction of the instrument. The instrument was fine-tuned based on their feedback. The second step of validity happened through a literature review of similar kind of research work by fellow researchers. It is typically "analysis of target domain" exploration as per Brewerton and Millward (2001). As part of step 3 validation, the feedback was obtained from three different types of respondents: academicians, business excellence assessor's community and industry experts. Three analyses were done: Cronbach's alpha analysis to assess the reliability, factor analysis to assess the construct of the model, and SEM modelling to narrow down the factors influencing the outcomes.

Figure 6-2 shows the profile of respondents. 63% are from industry, 23% are business excellence experts cum practitioners, and 10% are academicians. Figure 6-3 shows that more than 80% of the respondents have more than 20 years of experience in the industry, the survey respondents bring rich industry/ professional experience to respond to the

survey. The feedback from such experienced professionals is very much valuable for the survey. Figure 6-4 shows that more than 38% of the respondents belong to the organizations having more than 1000 employees. Figure 6-5 shows that more than 85% of the respondents are from the Indian region, the remaining 15% respondents from the USA, European and other regions. Figure 6-6 shows that 11% of them are expert and 49% are proficient in the business excellence models. Figure 6-7 shows that more than 48% of them are having more than 10 years of exposure to business excellence models.

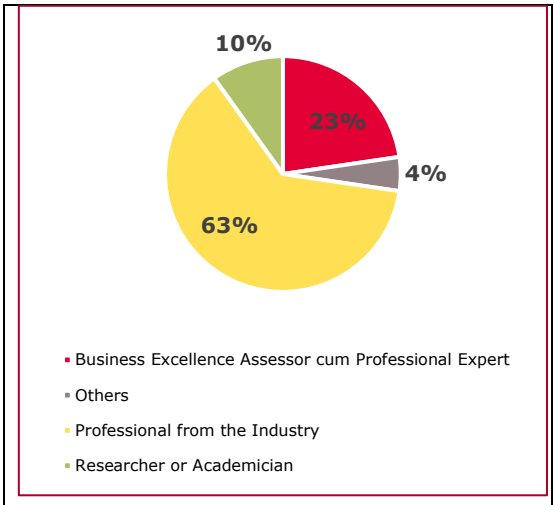


Figure 6-2: Respondent Professional profile

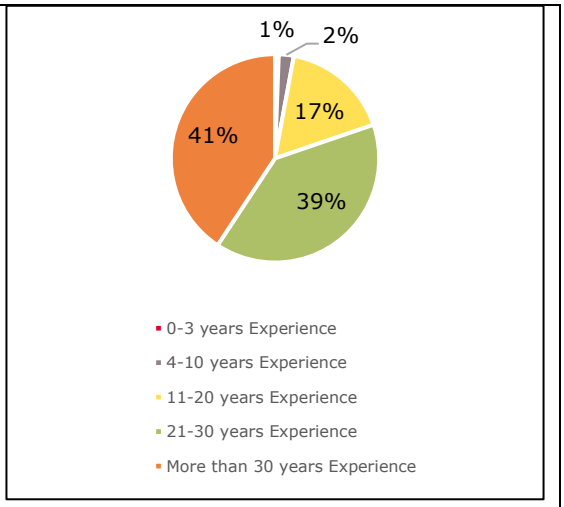


Figure 6-3: Professional experience of the respondents

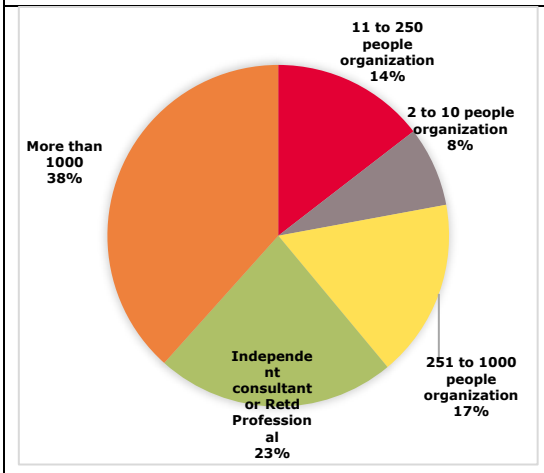


Figure 6-4: Size of the representing organization (no of people)

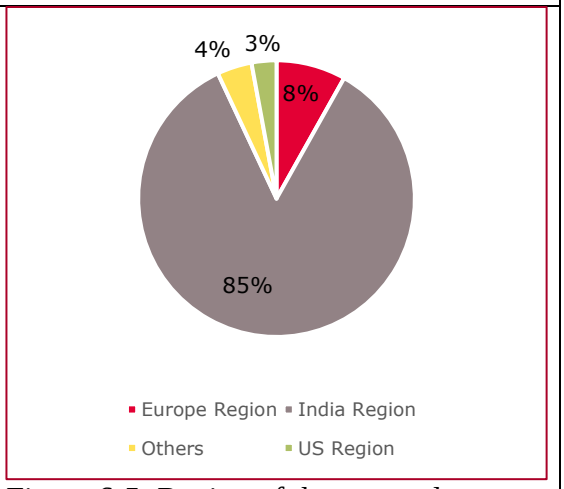


Figure 6-5: Region of the respondents

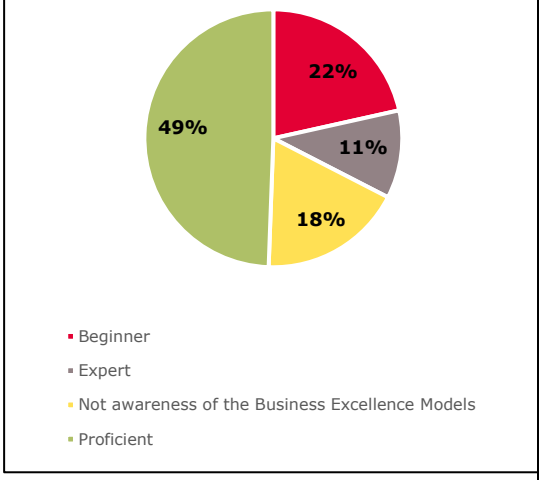


Figure 6-6: Level of proficiency in business excellence model

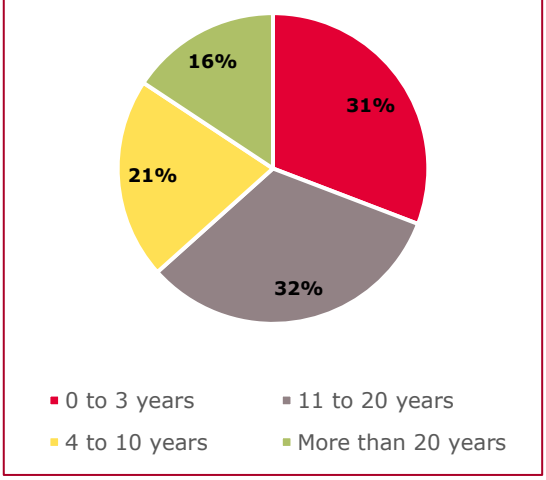


Figure 6-7: Professional exposure to business excellence models

6.2.6 Factor Analysis

The key concept of factor analysis is that multiple observed variables have similar patterns of responses because they are all associated with a latent (not directly measured) variable. Factor analysis is a method for modelling observed variables, and their covariance structure, in terms of a smaller number of underlying unobservable (latent) "factors." The factors typically are viewed as broad concepts or ideas that may describe an observed phenomenon. These unobserved factors are more interesting to the social scientist than the observed quantitative measurements. Factor analysis is generally an exploratory/descriptive method that requires many subjective judgments. It is a widely used tool and often controversial because the models, methods, and subjectivity are so flexible that debates about how interpretations can occur.

Confirmatory factor analysis is to confirm the fitment of the factors to the model when the factors are already identified in the theoretical model. In the case of exploratory factor analysis, the factor relationships or intercorrelations of grouping is not known to the researcher. The exploratory factor analysis is used to analyse the data to identify the

underlying relationships among factors. Structural equation modelling is a multivariate statistical analysis technique that is used to analyse structural relationships. This technique is the combination of factor analysis and multiple regression analysis and it is used to analyse the structural relationship between measured variables and latent constructs. This method is preferred by the researchers because it estimates the multiple and interrelated dependence in a single analysis. Path analysis is a statistical technique that allows users to investigate patterns of effect within a system of variables. It is one of the several types of the general linear models that examines the impact of a set of predictor variables on multiple dependent variables.

6.2.6.1 **Confirmatory Factor Analysis**

Confirmatory Factor Analysis (CFA) is a multivariate statistical procedure that is used to test how well the measured variables represent the number of constructs. Confirmatory factor analysis (CFA) and Exploratory factor analysis (EFA) are similar techniques, but in exploratory factor analysis (EFA) data is simply explored and provides information about the numbers of factors required to represent the data. In exploratory factor analysis, all measured variables are related to every latent variable. But in confirmatory factor analysis researchers can specify the number of factors required in the data and which measured variable is related to which latent variable. Confirmatory factor analysis (CFA) is a tool that is used to confirm or reject the measurement theory. The board level steps involved in conducting the CFA are;

- Defining individual construct: The first step involves the procedure that defines the constructs theoretically. This involves a pre-test to evaluate the construct items, and a confirmatory test of the measurement model that is conducted using CFA.
- Developing the overall measurement model theory: In CFA, the researchers should consider the concept of unidimensionality between construct error variance and

within construct error variance. At least four constructs and three items per construct should be present in the research.

- Designing a study to produce the empirical results: The measurement model must be specified. Most commonly, the value of one loading estimate should be one per construct. Two methods are available for identification; the first is the rank condition, and the second is the order condition.
- Assessing the measurement model validity: Assessing the measurement model validity occurs when the theoretical measurement model is compared with the real model to see how well the data fits. Indicators are used to check the measurement model validity. For example, the factor loading, Chi-square test, and other goodness of fit statistics like RMR, GFI, NFI, RMSEA, SIC, BIC, etc., are some key indicators that help in measuring the model validity

6.2.6.2 **Overview of Structural Equation Modelling**

SEM is a statistical methodology that takes a confirmatory, i.e., hypothesis-testing approach to the analysis of a structural theory bearing on some phenomenon. Typically, this theory represents "causal" processes that generate observations on multiple variables (Bentler, 1988). The term structural equation modelling conveys two important aspects of the procedure: (a) that the causal processes under study are represented by a series of structural (i.e., regression) equations and (b) that these structural relations can be modelled pictorially to enable a clearer conceptualization of the theory under study. The hypothesized model can then be tested statistically in simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data. If goodness-of-fit is adequate, the model argues for the plausibility of postulated relations among variables; if it is inadequate, the tenability of such relations is rejected.

6.3 RESULTS AND DISCUSSION

6.3.1 Validation of Enabler Sub-criteria Effects on Results (BLOCK-1)

The theoretical construct of the interaction model was constructed and depicted in Figure 6-8

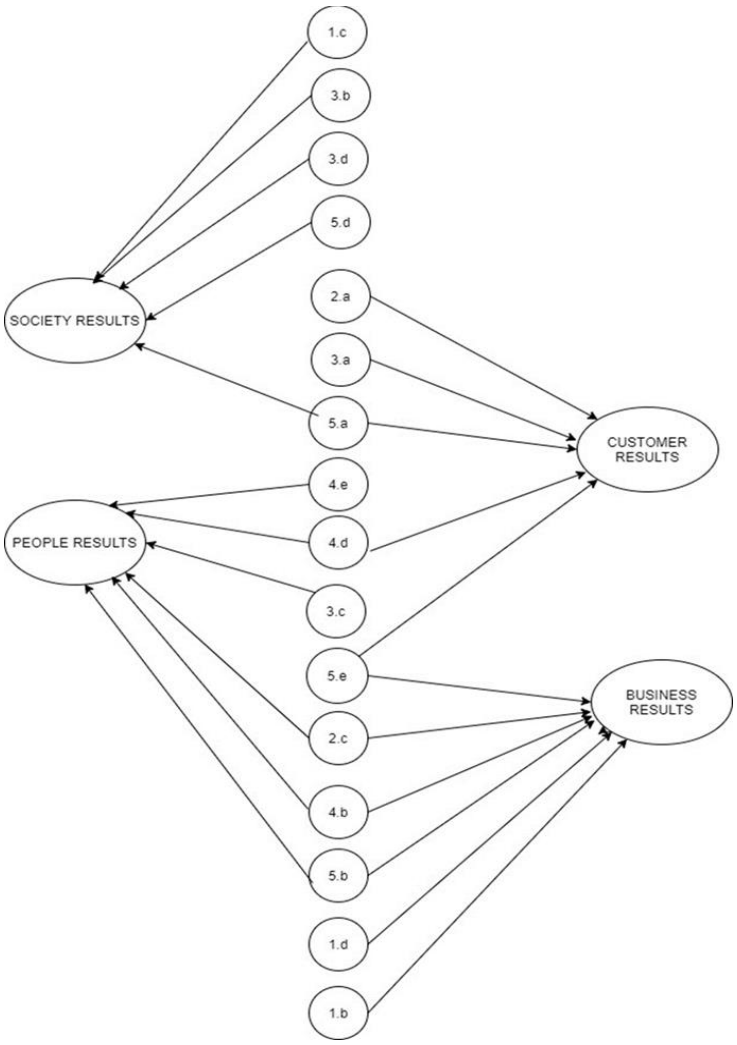


Figure 6-8: Construct of the enabler sub-criteria influencing result categories

The construct establishes the interaction between sub-criteria and business excellence results based on the empirical study in chapter 3. Following hypothesis statements are constructed to validate the findings of chapter 3.

H1: "Customer relationships are managed and enhanced (5.e)" criterion influences the customer results

H2: “Strategy is based on understanding the needs and expectations of both stakeholders and the external environment (2.a)” criterion influences the customer results

H3: “Technology is managed to support the delivery of strategy (4.d)” criterion influences the customer results

H4: “Processes are designed and managed to optimize stakeholder value (5.a)” criterion influences the customer results

H5: “People plans support the organization’s strategy (3.a)” criterion influences the customer results

H6: “People are aligned, involved and empowered (3.c)” criterion influences the people results

H7: “Strategy and supporting policies are developed, reviewed and updated (2.c)” criterion influences the people results

H8: “Products and services are developed to create optimum value for customers (5.b)” criterion influences the people results

H9: “Information and knowledge are managed to support effective decision making and to build the organizational capability (4.e)” criterion influences the people results

H10: “Finances are managed to secure sustained success (4.b)” criterion influences the people results

H11: “Technology is managed to support the delivery of strategy (4.d)” criterion influences the people results

H12: “People’s knowledge and capabilities are developed (3.b)” criterion influences the society result

H13: “Leaders engage with external stakeholders (1.c)” criterion influences the society result

H14: “Processes are designed and managed to optimize stakeholder value (5.a)” criterion influences the society result

H15: “Products and services are produced delivered and managed (5.d)” criterion influences the society result

H16: “People communicate effectively throughout the organization (3.d)" criterion influences the society result

H17: “Strategy and supporting policies are developed, reviewed and updated (2.c)” criterion influences the business results

H18: “Leaders reinforce a culture of excellence with the organization’s people (1.d)” criterion influences the business results

H19: “Leaders define, monitor, review and drive the improvement of the organization’s management system and performance (1.b)” criterion influences the business results

H20: “Finances are managed to secure sustained success (4.b)” criterion influences the business results

H21: “Customer relationships are managed and enhanced (5.e)” criterion influences the business results

H22: “Products and services are developed to create optimum value for customers (5.b)” criterion influences the business results

6.3.1.1 Factorial analysis for Block-1

The 22 hypothesis statements were mapped to CFA. Cronbach's Alpha value is 0.837 well above the recommended value. The KMO is 0.826, Chi-Square value stands at 1066, degree of freedom is 231, and significance level is at 0.000 The 22 statements were mapped to this construct of the model. As per the theoretical construct, survey questions mapping and output obtained using AMOS SPSS software results are developed, and loading was analysed. The business results (BR) related questions are Q12, Q16, Q20, Q36, Q51 and Q55. Similarly, for society results (SR) related questions are Q15, Q29, Q33, Q45 and Q52. The customer results (CR) are related by Q26, Q39, Q44, Q46 and Q56. The people results (PR) related questions are Q21, Q30, Q37, Q40, Q40, Q42 and Q49 in the survey. Using AMOS software, the model was constructed, and multiple iterations were carried out to arrive at a good fit for the model. The loading of regression weights is presented in the path analysis diagram (Figure 6-9).

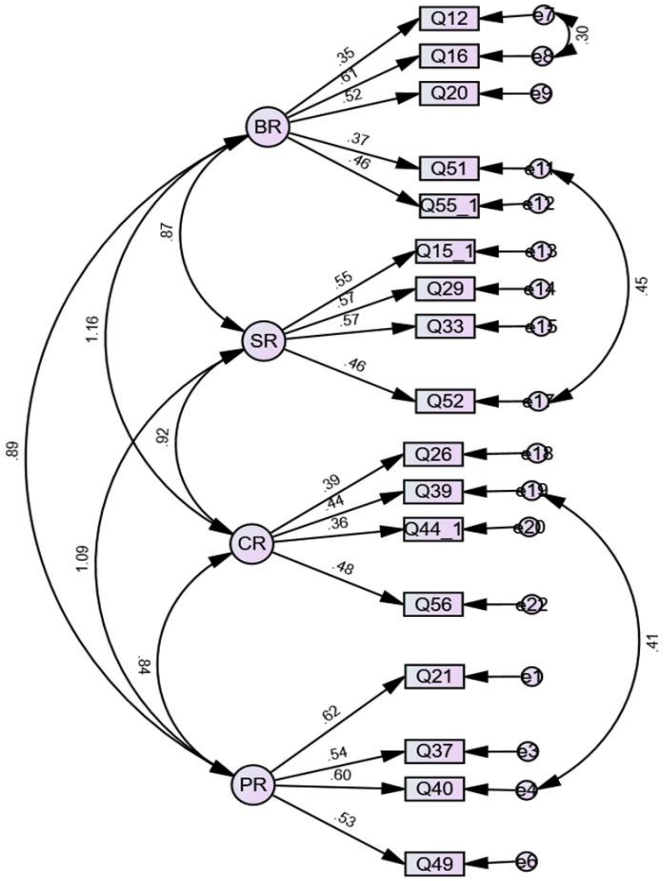


Figure 6-9: Path diagram of Block-1

6.3.1.2 **Regression results and model fit summary for Block-1**

Table 6-2 depicts the regression weights and interactions. The composite reliability metric is calculated for the path analysis model using the below equation as per Raykov (1997):

$$CR = \frac{\left(\sum \lambda_i\right)^2}{\left(\sum \lambda_i\right)^2 + \sum Var\left(\varepsilon_i\right)}$$

where

λi is standardized loading for the i^{th} indicator,

$V(\delta i)$ is variance of the error term for the i^{th} indicator, and

p is number of indicators

Table 6-2: Regression weights of CFA of Block-1

Interactions			Estimate	Standard Error	Critical Ratio	P Label	Standardized Regression Weights	Composite Reliability
Q21	<---	PR	1				0.623	0.66
Q37	<---	PR	0.919	0.154	5.956	***	0.541	
Q40	<---	PR	0.916	0.14	6.54	***	0.604	
Q49	<---	PR	0.84	0.144	5.831	***	0.528	
Q12	<---	BR	1				0.349	0.58
Q16	<---	BR	1.438	0.319	4.507	***	0.614	
Q20	<---	BR	0.896	0.241	3.716	***	0.52	
Q51	<---	BR	1.458	0.456	3.201	0.001	0.367	
Q55_1	<---	BR	1.027	0.289	3.549	***	0.462	
Q15_1	<---	SR	1				0.547	0.62
Q29	<---	SR	1.347	0.234	5.764	***	0.573	
Q33	<---	SR	1	0.173	5.766	***	0.573	
Q52	<---	SR	1.12	0.226	4.959	***	0.46	
Q26	<---	CR	1				0.391	0.46
Q39	<---	CR	1.088	0.275	3.955	***	0.442	
Q44_1	<---	CR	1.099	0.315	3.484	***	0.358	
Q56	<---	CR	1.301	0.317	4.108	***	0.481	

The acceptable levels of the model fit results observed values of the model are depicted in Table 6-3. The model fit summary shows that the proposed model has a good fit. Cronbach's alpha is used to verify the internal consistency of the variables when EFA is carried out. In the case of CFA, composite reliability (CR) is used to construct validity (Carmines and Zeller, 1979, Hair *et al.* 1998, Reza *et al.* 2017). In the path analysis, the composite reliability of the factor was found to be from 0.46 to 0.66. These values are acceptable. Standardized regression weights of each variable are significant (0.358 to 0.623). P-value is also significant to except for Q51. From the analysis, it is clear that all remaining factors of PR, BR and SR show significant regression loading and composite reliability. In the case of the CR group, the regression loadings are moderate and the composite reliability of the set is also moderate. From this, it is clear that all the remainder

factors belong to the same set and confirm that the factors are influential in the set. The eliminated factors are tabulated and discussed in the next section.

Table 6-3: Model fit summary of Block-1

Model fit Indices	Description	Acceptable Level	Observed values in the proposed model
Chi-square			146.575
Degrees of freedom			110
Probability level (p-value)		<0.05	.010
CMIN/DF	CMIN is Chi-square statistic comparing the tested model and the independence model to the saturated model. CMIN/DF, the relative chi-square, is an index of how much the fit of data to the model has been reduced by dropping one or more paths	< 5	1.342
GFI	GFI, the goodness of fit index, relates the proportion of the variance in the sample variance-covariance matrix accounted for by the model	> 0.9	0.909
Fit Indices AGFI	AGFI (adjusted GFI) is an alternate GFI index in which the value of the index is adjusted for the number of parameters in the model. The fewer the number of parameters in the model relative to the number of data points (variances and covariances in the sample variance-covariance matrix), the closer the AGFI will be to the GFI.	> 0.9	0.873
CFI	The Comparative Fit Index (CFI) uses a similar approach (with a noncentral chi-square) and is said to be a good index for use even with small samples	> 0.9	0.94
RMSEA	The Root Mean Square Error of Approximation (RMSEA) estimates lack of fit compared to the saturated model	< 0.05	0.045

6.3.1.3 **Inferences of Block-1**

From the result analysis, it is clear that regression loading is considered high and a good fit model exists. In summary, the following factors are mapped and some factors that are eliminated will arrive at the good fit model, these variables need further deliberation and reason for not fitting into the group. The factors which are conforming to the model are presented in Table 6-4**.** The hypothesis statements H20, H14, H4, H6, and H9 are not accepted. The remaining hypothesis statements are accepted based on the SEM results.

Table 6-4: Summary of the Block-1 CFA outcome

Result category	Questions mapped as per the previous empirical study	Questions mapped as per the CFA	Eliminated Factors	% of variables to confirming to previous empirical study	Hypothesis Statement	Accepted?
Business results (BR)	Q12, Q16, Q20, Q36, Q51, Q55	Q12, Q16, Q20, Q51, Q55	Q36	83%	H20	No
Society results (SR)	Q15, Q29, Q33, Q45, Q52	Q15, Q29, Q33, Q52	Q45	80%	H14	No
Customer results (CR)	Q26, Q39, Q44, Q46, Q56	Q26, Q39, Q44, Q56	Q46	80%	H4	No
People results (PR)	Q21, Q30, Q37, Q40, Q42,Q49	Q21, Q37, Q40, Q49	Q30, Q42	67%	H6 & H9	No
Total	22	17	5	77%		

From this study, it is clear that, in 22 variables, 17 variables are mapping and 77% empirical study finding has been accepted through survey response and the respondents acknowledge our research finding. From the hypothesis statements, 17 statements are

accepted and 5 statements are not accepted. The validated enablers influencing results at sub-criteria level are presented in Table 6-5.

Table 6-5: Validated enablers influencing results at sub-criteria level(Block-1)

Results	Criteria	Influencing factors validated through survey, factor analysis and path Analysis
Customer Results	5.e	Customer relationships are managed and enhanced.
	2.a	Strategy is based on understanding the needs and expectations of both stakeholders and the external environment.
	4.d	Technology is managed to support the delivery of strategy.
	5.a	Processes are designed and managed to optimize stakeholder value.
	3.a	People plans support the organization's strategy
People Results	2.c	Strategy and supporting policies are developed, reviewed and updated.
	5.b	Products and services are developed to create optimum value for customers.
	4.b	Finances are managed to secure sustained success.
	4.d	Technology is managed to support the delivery of strategy.
	3.b	People's knowledge and capabilities are developed.
Society Results	1.c	Leaders engage with external stakeholders.
	5.d	Products and services are produced, delivered and managed.
	3.d	People communicate effectively throughout the organization
	2.c	Strategy and supporting policies are developed, reviewed and updated.
	1.d	Leaders reinforce a culture of excellence with the organization's people.
Business Results	1.b	Leaders define, monitor, review and drive the improvement of the organization's management system and performance.
	5.e	Customer relationships are managed and enhanced.
	5.b	Products and services are developed to create optimum value for customers.

6.3.2 Validation of Cross Influencing Effects among Enabler Sub-criteria (BLOCK -2)

Figure 4-8 in CHAPTER-4 depicts the representation. The 24 hypothesis statements for the theoretical construct to be evaluated are:

H23: "Leaders develop the Mission, Vision, Values and ethics and act as role models (1.a)" criterion act as a Promoter

H24: "Leaders engage with external stakeholders (1.c)" criterion act as a Promoter

H25: "Leaders reinforce a culture of excellence with the organization's people (1.d)" criterion act as a Promoter

H26: "Strategy and supporting policies are developed, reviewed and updated (2.c)" criterion act as a Promoter

H27: "People are aligned, involved, and empowered (3.c)" criterion act as a Promoter

H28: "Finances are managed to secure sustained success (4.b)" criterion act as a Promoter

H29: "Buildings, equipment, materials and natural resources are managed sustainably (4.c)" criterion act as a Promoter

H30: "Technology is managed to support the delivery of strategy (4.d)" criterion act as a Promoter

H31: "Information and knowledge are managed to support effective decision making and to build the organizational capability (4.e)" criterion act as a Promoter

H32: "Leaders ensure that the organization is flexible and manages change effectively (1.e)" criterion act as Proponent

H33: "Strategy is based on understanding the needs and expectations of both stakeholders and the external environment (2.a)" criterion act as a Proponent

H34: "Strategy is based on understanding internal performance and capabilities (2.b)" criterion act as a Proponent

H35: "People's knowledge and capabilities are developed (3.b)" criterion act as a Proponent

H36: "People are rewarded, recognized and cared for (3.e)" criterion act as a Proponent

H37: "Products and Services are effectively promoted and marketed (5.c)" criterion act as a Proponent

H38: "Customer relationships are managed and enhanced (5.e)" criterion act as a Proponent

H39: "Leaders define, monitor, review and drive the improvement of the Organization's management system and performance (1.b)" criterion act as a Defender

H40: "Strategy and supporting policies are communicated, implemented and monitored (2.d) criterion act as a Defender

H41: "Processes are designed and managed to optimize stakeholder value (5.a)" criterion act as a Defender

H42: "People plans support the organization's strategy (3.a)" criterion act as a Detractor

H43: "People communicate effectively throughout the organization (3.d)" criterion act as a Detractor

H44: "Partners and suppliers are managed for sustainable benefit (4.a)" criterion act as a Detractor

H45: "Products and Services are developed to create optimum value for customers (5.b)" criterion act as a Detractor

H46: "Products and Services are produced, delivered and managed (5.d)" criterion act as a Detractor

6.3.2.1 Factor analysis for Block-2

The analysis of data results gives Cronbach Alpha value of 0.837, KMO value of 0.812, Chi-Square value of 1022.89, Degree of freedom of 276, and Significance level of 0.000. From these statistical measurements, the dataset is suitable for further factorial analysis. As per the theoretical construct (6-11), the CFA model was constructed using the AMOS SPSS software, and loading was analysed and multiple iterations were carried out to arrive at a good fit for the model. The loading of regression weights is presented in the path analysis diagram (Figure 6-10). The path diagram represents a measurement model containing four latent constructs/variables/factors and corresponding observed variables,

which acts as indicators of the latent or unobserved construct/variable. The circular blocks connecting to the observed variables through a single headed arrow represents measurement errors in measuring the value of the corresponding observed variables. The path diagram depicts the loading of each variable. The loading varies from 0.16 to 1.01.

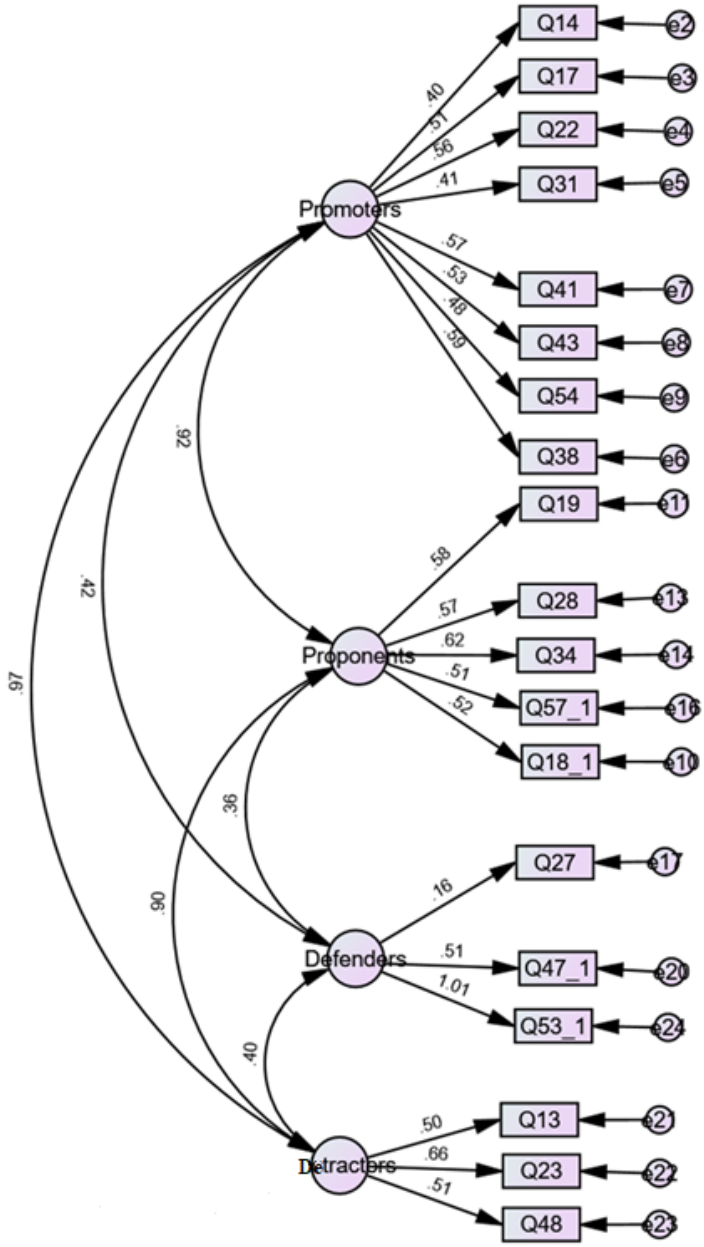


Figure 6-10: Path diagram of Block-2

6.3.2.2 **Regression results and model fit summary for Block-2**

Table 6-6 depicts the regression weights and interactions. The composite reliability metric is calculated for the path analysis model. In the unstandardized regression weight, the regression weight of one variable under each factor is fixed and rest are estimated. The unstandardized weight signifies that when latent construct goes up by one, then the individual variable goes up by the unstandardized regression weight mentioned against the variable. Similarly, the standardized regression weight signifies that when the latent construct goes up by one standard deviation, then the standard deviation of the individual variable goes up by the standardized weight of the variable.

Table 6-6: Factorial analysis of Block-2

Interactions			Estimate	Standard Error	Critical Ratio	P Label	Standardized Regression Weights	Composite Reliability
Q13	<-	Detractors	1				0.503	0.58
Q23	<-	Detractors	1.431	0.254	5.624	***	0.663	
Q48	<-	Detractors	1.836	0.381	4.815	***	0.505	
Q27	<-	Defenders	1				0.16	0.626
Q47_1	<-	Defenders	3.987	1.945	2.05	0.04	0.511	
Q53_1	<-	Defenders	6.65	3.654	1.82	0.069	1.011	
Q14	<-	Promoters	0.526	0.118	4.461	***	0.402	0.736
Q17	<-	Promoters	0.662	0.122	5.444	***	0.511	
Q22	<-	Promoters	0.776	0.133	5.814	***	0.557	
Q31	<-	Promoters	0.441	0.098	4.512	***	0.407	
Q41	<-	Promoters	0.841	0.143	5.884	***	0.566	
Q43	<-	Promoters	0.588	0.105	5.587	***	0.528	
Q54	<-	Promoters	0.758	0.147	5.162	***	0.478	
Q38	<-	Promoters	1				0.587	
Q19	<-	Proponents	1.264	0.242	5.226	***	0.581	0.697
Q28	<-	Proponents	1.27	0.245	5.176	***	0.572	
Q34	<-	Proponents	1.386	0.255	5.438	***	0.624	
Q57_1	<-	Proponents	1				0.507	
Q18_1	<-	Proponents	1.029	0.211	4.875	***	0.518	

Model fit summary is presented in Table 6-7 which shows that proposed model is valid. The observed values are either within the acceptable range or very close to the acceptable values. The minimum value of 'critical ratio' which is a ratio of variable estimate to the standard error is much above the |2| (|2| is generally considered significant at 0.01 level). The promoter variables demonstrate composite reliability of 0.736, proponent variables demonstrate composite reliability of 0.697, defender variables demonstrate composite reliability of 0.626, and detractor variables demonstrate composite reliability of 0.58. All four sets of variables demonstrate significant composite reliability scores, which means that variables belong to the groups and have a significant influence on the construct.

Table 6-7: Model fit summary of Block-2

Model fit Indices	Acceptable level	Observed Values in this model
Chi-square		223.942
Degrees of freedom		146
Probability level		.000
CMIN/DF	Less than 5	1.534
GFI	Greater than 0.9	0.88
Fit Indices AGFI	Greater than 0.9	0.844
CFI	Greater than 0.9	0.885
RMSEA	Less than 0.05	0.056

6.3.2.3 **Inferences of Block-2**

Table 6-8 shows identical factors as per the conformity analysis are being grouped. From the Table 6-8, it is clear Q9, Q25, Q50, Q32, Q35 do not belong to this designated group. This would call for deliberation and further analysis. Based on the results, it is clear that the H23, H34, H37, H43 and H44 hypothesis statements are not accepted and the remaining statements are accepted.

Table 6-8: Summary of validation of Block-2

Result category	Factors as per chapter 4	Factors as per CFA	Eliminated Factors	% of variables confirming to chapter 4 construct	Hypothesis statement	Accepted?
Promoters	Q9, Q14, Q17, Q22, Q31, Q38, Q38, Q41, Q43, Q54	Q14, Q17, Q22, Q31, Q38, Q38, Q41, Q43, Q54	Q9	89%	H23	No
Proponents	Q18, Q19, Q25, Q28, Q34, Q50, Q57	Q18, Q19, Q28, Q34, Q57	Q25, Q50	72%	H34 & H37	No
Detractors	Q27, Q32, Q35, Q47, Q53	Q27, Q47, Q53	Q32, Q35	60%	H43 & H44	No
Defenders	Q13, Q23, Q48	Q13, Q23, Q48	-	100%		
Total	24	19	5	79%		

The validated quadrant matrix diagram based on the factorial analysis and path analysis is shown in Figure 6-11. The model had 24 factors based on the initial classification study but five factors are deleted in this study leaving only 19 validated factors.

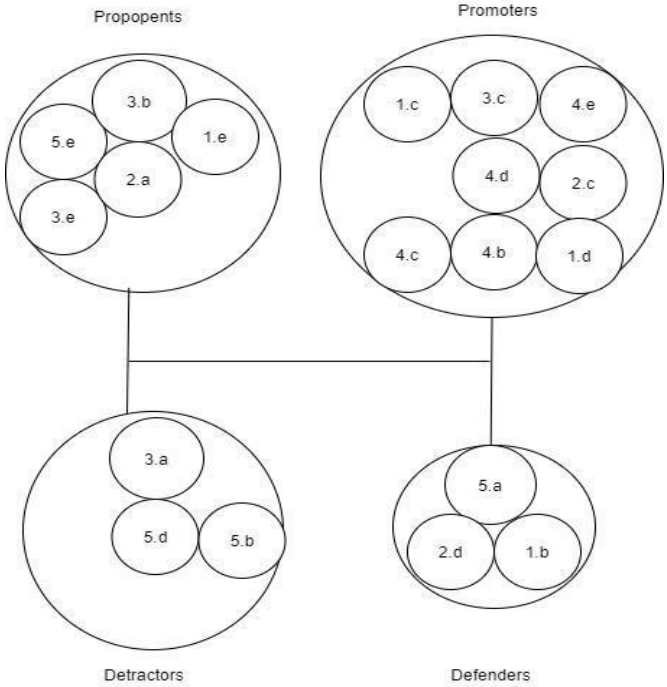


Figure 6-11: Validated factors of Quadrant matrix (Block-2)

6.3.3 Validation of the Results Sub-criteria Interrelationships (BLOCK-3)

Following statements related to the results interrelationship were validated using NPS (Table 6-9). Since the no of questions are only six and CFA not feasible option such as small set hence NPS used to validate.

Q 58: Business results are directly related to customer perception of the organization

Q 59: Customer's perception is directly related to people's satisfaction in the organization

Q 60: Better customer perception of the organization leads to better society perception of the organization

Q 61: Business results influence the positive perception among the people of the organization

Q 62: Society's perception directly connects to people's perception of the organization

Q 63: Better operational performance leads to business excellence in the organization

NPS is a management tool that is used to gauge the loyalty of a customer and his satisfaction. NPS index value ranges from -100 to +100. If the company has an NPS value that lies above 0, it is deemed as a good score. An NPS of 50 and above is great, while a score above 70 is top-notch. The NPS method of calculating satisfaction has been gaining popularity and is a good management decision tool. The author decided to adopt the NPS to validate the survey feedback. Since the author is not measuring customer satisfaction here, the measurement is to check how strongly the respondents agree with the statement.

6.3.3.1 Inferences of Block-3

In this case, the scores of the promoters are 4 & 5 (agree/strongly agree to the statement), 1 & 2 are for detractors (disagree /strongly disagree to the statement), and 3 for passive statement in the overall perception. Table 6-9 presents the Net Promoter Scores for this

Net Promoters Score = % of Promoters - % of Detractors

Table 6-9: The NPS analysis results of Block-3

Q No	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Promoters	Detractors	NPS	Statement Supports
Q59	1%	17%	34%	33%	15%	49%	18%	31%	Low Confirmation
Q62	0%	9%	23%	51%	17%	68%	9%	59%	Moderate Confirmation
Q60	0%	9%	21%	49%	21%	70%	9%	61%	Moderate Confirmation
Q61	0%	1%	7%	53%	39%	92%	1%	91%	Strong Confirmation
Q58	1%	4%	23%	45%	27%	72%	5%	67%	Moderate Confirmation
Q63	0%	5%	9%	49%	37%	86%	5%	82%	Strong Confirmation

Table 6-10: Table of acceptance statements of Block-3

Q. No.	**Question**	**NPS Score**	**Acceptance?**
Q58	Business results are directly related to customer perception about the organization	67%	Accepted
Q59	Customer's perception is directly related to people's satisfaction in the organization	31%	Not Accepted
Q60	Better customer perception of the organization leads to better society perception of the organization	61%	Accepted
Q61	Business results influence the positive perception among the people of the organization	91%	Accepted
Q62	Society's perception directly connects to people's perception of the organization	59%	Accepted
Q63	Better operational performance leads to business excellence in the organization	82%	Accepted

Table 6-10 it is clear that Q59 does not strongly support respondents. The remaining 5 statements are confirmed and accepted by the respondents. The validated model of interrelationships among results criteria is shown in Figure 6-12

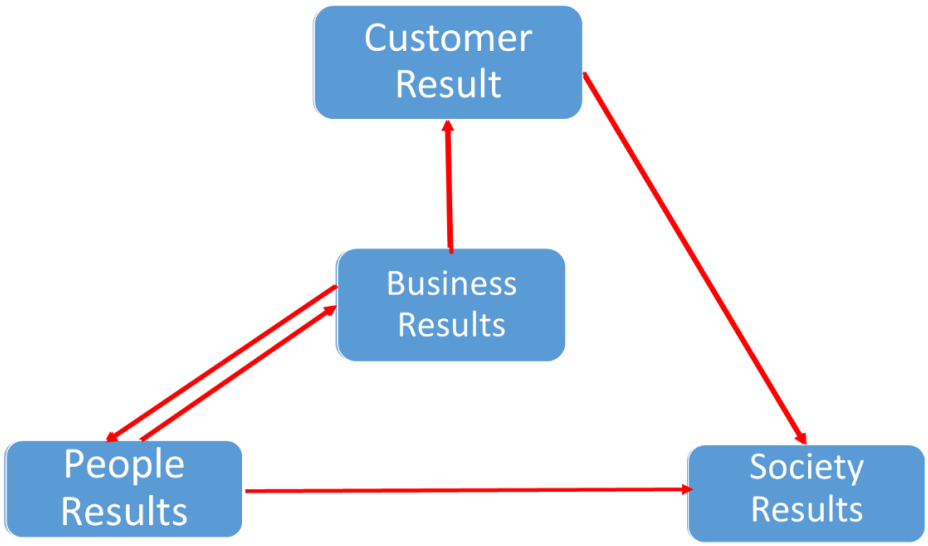


Figure 6-12: Validated interrelationships among results sub-criteria (Block-3)

6.4 SUMMARY

The chapter develops a questionnaire instrument to validate the interrelationships established in chapters 3, 4 and 5. Feedback from 169 industry experts, subject matter experts and from academicians was obtained for the validation using statistical tools of factorial analysis, path analysis, SEM and NPS.

The analysis of enabler sub-criteria influencing the results validated 17 enablers as influencing the results at sub-criteria level. Five sub-criteria eliminated by the SEM analysis are Finances are managed to secure sustained success; Processes are designed and managed to optimise the stakeholder value; Processes are designed and managed to optimise the stakeholder value; People are aligned, involved and empowered; and Information and knowledge are managed to support effective decision making and to build the organization's capability.

Five factors were eliminated during the validation of proponents, promotors, detractors, and defenders of EFQM enablers at sub-criteria level. The two proponents of 'Over-relying on the current capabilities (infrastructure, tools, technologies) would not help in

improving the business results' and 'Promoting and marketing products by itself does not lead to business excellence' were eliminated during the SEM analysis. Similarly, two factors of detractors namely 'The two-way communication between employee and management helps the Organization to Excel' and 'Over-focus on partnership and supplier management does not guarantee the excellence of business' were eliminated. One of the promotors namely 'Defining and communicating a vision of the organizations by its leaders sets the tone of the organizational behaviour' was not validated by the data.

It was found during the net promotor analysis of results sub-criteria that one of the sub-criteria 'Customer's perception is directly related to people's satisfaction in the organization' was eliminated.

In the next chapter, the high and low maturity of business excellence organizations enablers will be discussed.

CHAPTER-7

IDENTIFICATION OF CRITERIA FOR ACHIEVING HIGH MATURITY OF BUSINESS EXCELLENCE

This chapter identifies the criteria influencing the organisation to achieve high maturity in business excellence, comparison with high maturity behaviour of Indian and Spanish organizations and presents the organizational performance of award / prize winning organizations.

7.1 INTRODUCTION:

The introduction of the business excellence models like MBNQA and EFQM created a new way of quality assurance for the industries, industrial bodies and national forums. These models focused on creating a competitive spirit and excellence in their field of work. The business excellence models made it possible for organizations to achieve higher levels of business results and quality. Excellent organizations embraced the best practices by learning from one another. The business excellence models provided perspective guidance, criteria and sub-criteria for achieving excellence in the organizations. The leadership demands or looks for new organizational approaches for a long-term strategy to realise their organizational vision. Many organizations in the world embraced the business excellence journey. By adopting different quality improvements frameworks available at the country level or regional level, however, their motto was to achieve their organizational ‘maturity of excellence’. Adopting a well-prepared business excellence framework helps the organization to adopt and run quickly instead of experiential learning which would take a longer time for arriving at a good solution. The

EFQM model provides a highly matured process framework for business excellence. The category of awards received by the organization determines the measure of the maturity of the organization in the business excellence journey.

This chapter aims to examine how the organization with high maturity and low maturity differ in the EFQM business excellence adoption. This chapter also explores the path of attaining the high maturity of business excellence and performance of award-winning organizations. The study uses an empirical methodology based on assessment scores of 58 different organizations to gauge the scoring pattern at the criteria and sub-criteria level. Box plot analysis has been carried out at criteria level, Signal to Noise ratio analysis and Logistic Regression have been carried out for underpinning differences of low and high maturity organizations. Statistical analysis is used to find the impact of organizational performance of the award and prize-winning organizations. This chapter addresses the following objectives:

- Which criteria influence the high maturity organizations to march ahead as compared to low maturity organizations?
- Which enablers best predict high stakeholder related performance results?
- Study of organisational performance of award/prize winning organizations

7.2 ORGANIZATIONAL MATURITY MODEL

A maturity model is a tool or framework to help organizations assess the strengths and weaknesses of their business processes and practices. This helps to establish a roadmap for improvement and evaluates the organization by comparing the quality standards and best practices with other organizations. An organization’s process maturity can be explained as a measure of an organization's readiness, its capability expressed through its

people, processes, data, and technologies; and the consistent measurement practices that are in place identifies the degree to which processes are formally defined, managed, , measured, and effective. In mature organizations, processes are defined, executed and managed, as per the business needs. These processes are continuously and constantly evaluated and evolved for further improvements based on the business requirements. The roles and responsibilities are clearly defined and understandable to those who carry out related activities. As a result, the significance and benefits of the maturity of processes in the organization are clear.

7.2.1 Types of Maturity Models and Description

Albliwi *et al.* (2014) map the maturity models adopted by the industry and the evolution of maturity models over the years. Table 7-1 presents some of the key process maturity models adopted globally.

Table 7-1: Process maturity frameworks and their characteristics

Name of the model	Year of introduction	Purpose	Limitation(s)
Crosby's Grid	1979	To show where the company is in the quality management spectrum	Lack of theoretical base
Bessant's Model	1997	To assess the maturity level by using the framework to improve what the organization is doing currently, and to determine the behaviours that need to be developed	The application of this model has not been tested in the public sector or large organization. Moreover, some important elements and critical success factors are missing. For Example, model does not provide a framework for measuring level of Continuous Improvement maturity
CMM (Capability Maturity Model)	1987	To measure practices in certain disciplines and to guide the effort of process improvement in the software industry	Lack of theoretical base. Needs a team to assess the process by conducting a full-scale audit which is costly, in terms of time and efforts. Better suited for large software organizations. Ignores cultural factors and people capabilities.
CMMI (Capability Maturity	2000	To develop an integrated framework that includes current and future models for solving the	It suits large and bureaucratic organizations.

Model Integrated)		problem of using many CMM versions and overlapping of versions. To address project management and process issues in developing products and services.	Exclusive focus on the process Better suited for large software organizations. Ignores cultural factors and people capabilities. Lack of theoretical base.
OMG (Object Management Group)	2002	To improve business process related to products and services in an organization, and to work as a roadmap that managers can use for benchmarking and monitoring business processes.	The role of IT support is missing in the model. Lack of validity and accuracy testing of the model.
PCMM (People Capability Maturity Model)	1995	To measure people practices in a specific discipline, and to guide the efforts of people for process improvement in the industry	Needs a team to assess the process by conducting a full-scale audit which is costly in terms of time and efforts.
Test Maturity Model integration (TMMi)		-To measure testing practices in a certain discipline. -To guide the efforts of test process improvement in the industry	Needs a team to assess the integrated approach process model by conducting a full-scale audit which is costly in terms of time and efforts.

Source: Adopted from Albliwi *et al.* (2014).

The process maturity does address the maturity of processes and practices, but it does not address holistically the various dimensions of the organization like leadership, strategy, partnership and business results and their influence on the level of maturity. However, business excellence frameworks provide a holistic view of the organization. But, the organizations use the process maturity frameworks to improve the process maturity or practices.

7.2.2 **Maturity Path of EFQM**

EFQM assessors follow the RADAR scale for measuring excellence and using guidance points as a base for judging the score. RADAR has two parts; RADAR for assessing the enablers and RADAR for assessing the results. Table 7-2 shows the RADAR for enablers and Table 7-3 shows the RADAR for results. The enabler RADAR represents the path to maturity by the effective deployment of enablers. The assessors look for a sound and integrated approach. In the next stage, the assessors look at whether the deployment is done in a structured approach or not, a proper measurement system for measuring the

effectiveness of the deployment, learning and creativity approaches. In the last phase, the assessors look for the use of learning and creativity for improvement & innovation.

Table 7-2: EFQM RADAR framework for assessing enablers

	Relevance & Usability	Guidance	Unable to demonstrate	Limited ability to demonstrate	Able to demonstrate	Fully able to demonstrate	Recognised as global role model
Approaches	Sound	The approaches have clear rationale, based on the relevant stakeholder needs, and are process based.					
	Integrated	The approaches support strategy and are linked to other relevant approaches					
Deployment	Implemented	The approaches are implemented in relevant areas, in a timely manner					
	Structured	The execution is structured and enables flexibility and organisational agility					
Assessment & Refinement	Measurement	The effectiveness & efficiency of the approaches and their deployment is appropriately measured					
	Learning & Creativity	Learning & creativity is used to generate opportunities for improvement & innovation					
	Improvement & Innovation	Outputs from measurement, learning & creativity are used to evaluate, prioritise, and implement improvements & innovations					
	Scale		**0%**	**25%**	**50%**	**75%**	**100%**
	Overall Scores						

Source: EFQM booklet IP Agreement no: 248/1212/0191

In the results' RADAR, the relevance and usability are focused on. The scope & relevance of the results, integrity of data, and segmentation of the results are assessed. The performance is reviewed; and trends, targets, comparisons of the performance, and confidence level in terms of cause-and-effect relationships are assessed.

Table 7-3: EFQM RADAR framework for assessing the results

	Relevance & Usability	Guidance	Unable to demonstrate	Limited ability to demonstrate	Able to demonstrate	Fully able to demonstrate	Recognised as global role model
Relevance & Usability	Sound & Relevance	A coherent set of results, including key results, are identified that demonstrate the performance of the organisation in terms of its strategy, objectives, needs, and expectations of the relevant stakeholders					
	Integrity	Results are timely, reliable & accurate					
	Segmentation	The approaches support strategy, and are linked to other relevant approaches					
Performance	Trends	Positive trends or sustained good performance over at least 3 years					
	Targets	Relevant targets are set and consistently achieved for the key results, in line with the strategic goals					
	Comparisons	Relevant external comparisons are made, and are favourable for the key results, in line with the strategic goals					
	Confidence	There is confidence that performance levels will be sustained into the future, based on established cause & effect relationships					
	Scale		**0%**	**25%**	**50%**	**75%**	**100%**
	Overall Scores						

Source: EFQM booklet IP Agreement no: 248/1212/0191

Figure 7-1 shows the typical maturity curve of the organization. It is clear that organizations who have deployed the practices in a more integrated way, able to implement in a structured way, and able to measure the effectiveness, learn from the implementation, improve and innovate can move up the maturity practices. This leads from low maturity practices to high maturity practices.

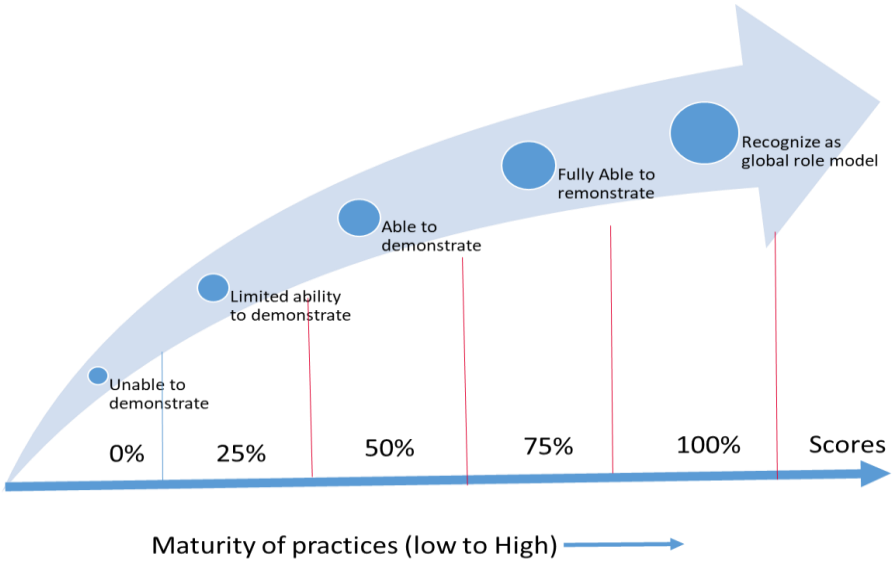


Figure 7-1: Maturity curve of business excellence

The organization gets recognised based on the total scores. This also represents the maturity of practices in the organization. These awards serve as motivators and promote the culture of excellence in the organization. EFQM framework provides excellent organisational characteristics and a framework for the assessment of organizational excellence. This assessment process is like a benchmark process of excellence and helps the organizations to learn from one another. The categories of prizes demonstrates the maturity of the organization in the management of excellence and continuous improvement of organizational excellence. Apart from Award-winners and Prize-winners (top award), organizations are commended who have made good progress in their journey towards excellence but fall short of the level set for award and prize winners. The other two lower levels of categories are:

- Significant Achievement (SA) in the journey towards excellence.
- Strong commitment to excel in the journey towards excellence. (This level is lower than the Significant Achievement level).

Typically, the award forum or body classifies the organizations based on the scores obtained in the assessment. The award-winning organizations are broadly categorised as

high maturity and low maturity organizations based on the assessment scores. An organization, which scores more than 525 points is called a high maturity (HM) organization as per the award administration; and organizations that score less than 525 points are called low maturity (LM) organizations. This classification helps the researchers, award forums and industrial forums to study the organizational practices to improve upon. The literature review on the adoption of EFQM business excellence in chapter 2 shows that the factors to achieve business excellence have been established by few researchers. But the research on what causes the organizations to score high to achieve higher levels of business excellence is lacking in the literature.

7.3 RESEARCH METHODOLOGY

The data for the research was collected from 20 high maturity firms (scoring more than 525 in their assessment) and 38 low maturity firms (less than 525 scores). This data is the actual data used for the CII (Confederation of Indian Industries) - Exim Bank business excellence (based on EFQM) awards in India. The data was obtained from the results of the assessment process of firms during 2012 – 2018. This assessment was carried out based on 2012 EFQM model. To support the research objectives, the data was collected at the criteria level and sub-criteria level. The number of organizations is 58 but the number of experts who have provided input scores is 290 as every team has five members. To meet the research objectives, a research model construct is developed to assess the data set and arrive at key inferences based on the research model and analysis. Figure 7-2 depicts the research model construct or research methodology involved in addressing the research objectives. The various phases of the research are:

- Phase-1: Analysis of organizations based on maturity level
    - Analysis of high maturity and low maturity organizations at the criteria level

- Analysis of high maturity and low maturity organizations at the sub-criteria level
- Signal to noise ratio analysis of high maturity and low maturity organizations
- Logistic regression to identify the significant factors and probability of the occurrence

- Phase-2: Path for attaining the high maturity
- Phase-3: Performance review of award/prize-winning organizations

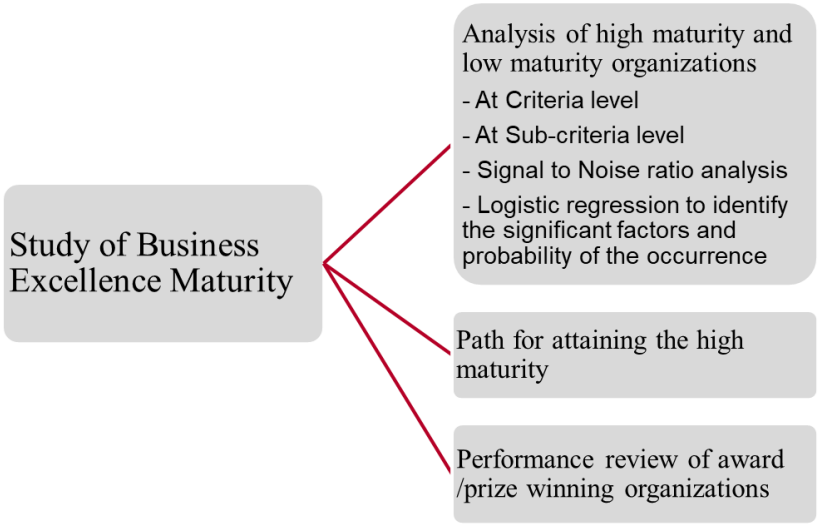


Figure 7-2: Research methodology for assessing high maturity BE

7.4 RESULTS AND DISCUSSION

The results are analysed and discussed as per the research model construct.

7.4.1 Analysis of High Maturity and Low Maturity Organizations at Criteria Level

In this section, the influential criteria to achieve high maturity are identified using Box plots. The Box plots are plotted using Minitab to identify the potential influencers (criteria) of the total scores of the organizations. Figure 7-3 depicts the Box plot generated through Minitab. The ‘customer results’ and ‘business results’ show higher values because the actual scores are multiplied by 1.5 times the originally assessed score as per the scoring construct of the model to emphasize the importance of these two criteria.

While analysing the data, the research needs to look at the same scale level. The author adopted the median plots of the criteria scores as medians provide the real effect of the influencing criteria. Box plots show that all enablers of the high maturity organizations operate in the range of 56 to 59. As per the RADAR score matrix of the EFQM, the enablers are sound, integrated, implemented, and structured. The measurement, learning & creativity, and improvement & innovation are evident. The organizations can demonstrate this capability and move towards higher maturity by adopting an integrated approach to model deployment. The high maturity organizations are scoring in the range of 55 to 59 on a 0-100 scale for the result categories. It demonstrates that in high maturity organizations, enablers and results are equally focused. It is also clear that the leadership and partnership criteria have slightly better scores than the other three criteria (strategy, people management, and process management). It suggests that leadership drives the vision, engages with external stakeholders, ensures the culture of excellence, manages the flexibility and change management aspects of the organization. It is also evident that excellent organizations plan and manage the external partnerships, suppliers and internal resources effectively to support their strategies, policies and processes. One more key observation, in the case of the people management and process management, is that the width of the box is too narrow and the range of the dataset is also small, which means by and large the people and process management practices in the higher maturity organizations are similar. The "interquartile range", abbreviated "IQR", is just the width of the box in the box-and-whisker plot. That is, IQR = (Quartile 3 – Quartile 1). The IQR can be used as a measure of how spread out the values are in the collected dataset. Similarly, the ‘business results’ score width is also narrow, suggesting that the business results score patterns of the high maturity organizations are also similar. In the case of low maturity organizations, this kind of pattern is not evident.

In the case of the low maturity organizations, the enabler scores are range from 43 to 46 and result scores range from 39 to 44. It appears that people management, process management, partnership and resource management criteria are slightly ahead compared to leadership and strategy. The 'people results' and 'business results' are slightly ahead as compared to 'customer results' and 'society results. From this, it is clear that enablers are not fully integrated and sound, the deployments of enablers may not be followed with necessary refinements; partially fulfilling an integrated and structured approach. The tails of the box plots in lower maturity organizations are very lengthy, indicating that the practises are not uniform. The range of partnership criteria is small and IQR is also smaller in lower maturity organizations as compared to other criteria. It indicates that low maturity organizations focused more on partnerships and resources enablers. Figure 7-4 depicts the median line graph at the criteria level. The blue line represents the high maturity and red line represents the low maturity for various criteria.

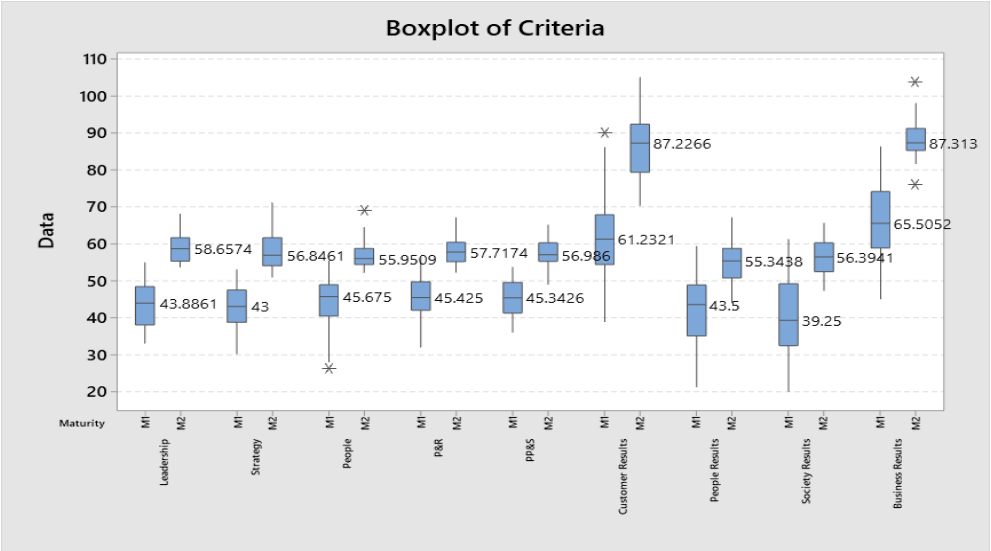


Figure 7-3: Box plot at the criteria level

Note: M1 represents low maturity organizations and M2 represents high maturity organizations and data refers to assessment score

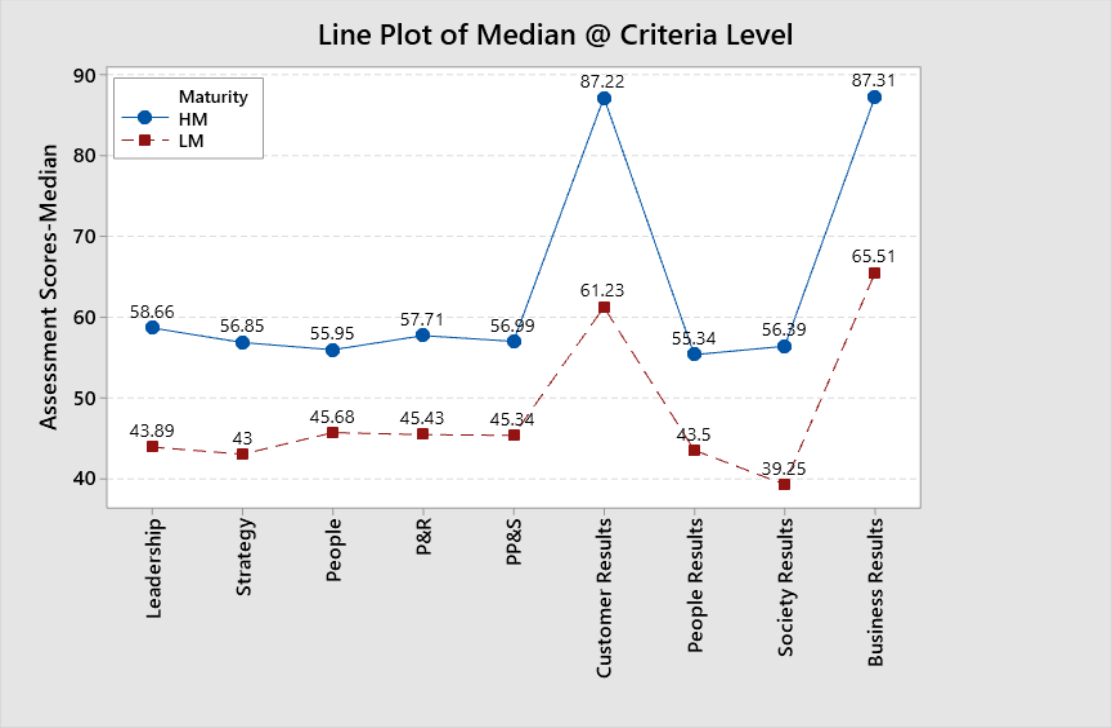


Figure 7-4: Median line graph at the criteria level

Note : P&R stands for Partnership and Resources. PP&S stands for Processes, Products and Services in both the Figures.

7.4.2 Analysis of High Maturity and Low Maturity Organizations at the Sub-criteria Level

The analysis at the criteria level may not be sufficient for managerial applications. Therefore, the distribution of scores of high maturity and lower maturity organizations at the sub-criteria level was analysed. From the box plot (Figure 7-5) for high maturity organizations, the sub-criteria assessment scores range from 55 to 61 for the 24-enabler sub-criteria and in the case of eight results, sub-criteria scores range from 55 to 60. It is once again evident that enabler sub-criteria and results sub-criteria scoring patterns are equally balanced.

To analyse the data further, four parameters of statistics – median, IQR, Whisker's range, and outliers – are used as given in Table 7-4. Following inferences can be drawn based on the results:

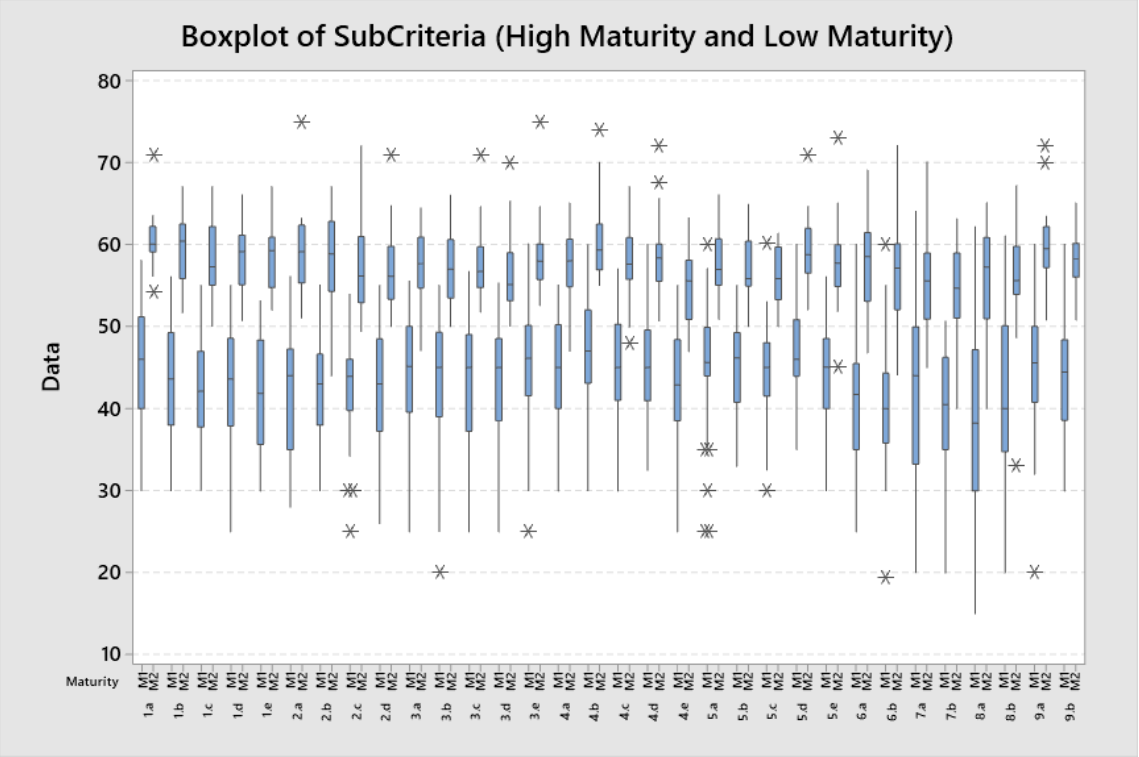


Figure 7-5: Box plot at the sub-criteria level for high and low maturity organisations

Note: M1 represents low maturity organizations and M2 represents high maturity organizations. Data refers to assessment score.

- High maturity organization's median of sub-criteria 1.a, 1.b, 1.c, 4.b, and 9.a are slightly on the higher side as compared to low maturity organizations.
- The IQR for high maturity organizations varies from 3.13 to 9.91 as compared to low maturity organization's values of 7.36 to 34.12. This indicates that in high maturity organizations, the performance of enablers is concentrated and more predictable.
- The Whisker range of high maturity organizations varies from 7.36 to 34.12 and in the case of low maturity organizations, it varies from 18 to 47.17. It indicates that criteria deployments are not integrated and a common approach is not evident in low maturity organizations.

Table 7-4: Summary of high maturity and low maturity organisation EFQM deployments

	High maturity organisations				**Low maturity organisations**			
Sub-criteria	Median	IQR	Whicker Range	No. of Outliers	Median	IQR	Whicker Range	No. of Outliers
1.a	60.00	3.13	7.36	2	46.00	8.40	18.00	
1.b	60.39	6.67	16.33		44.86	11.39	26.00	
1.c	57.27	7.15	17.00		43.73	7.65	26.00	
1.d	59.10	6.07	16.28		44.72	9.58	36.00	
1.e	59.21	6.15	16.00		41.08	11.28	23.11	
2.a	59.11	7.03	12.14	1	46.00	12.92	28.06	
2.b	58.83	8.53	23.00		43.36	6.51	26.00	
2.c	56.13	8.07	22.61		44.39	6.10	19.72	3
2.d	56.11	6.46	14.67	1	44.33	9.50	29.00	
3.a	57.63	6.19	17.31		46.00	8.37	30.50	
3.b	56.99	7.12	16.00		46.00	10.98	30.00	1
3.c	56.70	4.97	12.80	1	46.00	8.93	31.67	
3.d	56.11	6.85	16.22	1	46.00	7.57	30.28	
3.e	57.94	4.31	12.08	1	47.89	7.20	30.00	1
4.a	57.96	6.83	18.00		46.90	8.68	26.00	
4.b	59.28	6.58	18.00	1	49.14	10.47	30.00	
4.c	57.59	6.09	17.09	1	46.97	9.71	27.00	
4.d	58.33	4.49	14.89	2	46.60	7.04	27.50	
4.e	56.55	7.23	16.23		43.69	9.76	30.00	
6.a	56.92	6.66	16.12		46.08	6.35	21.72	5
6.b	56.81	6.46	14.81		46.60	7.80	22.00	
6.c	56.81	6.42	11.33		46.62	6.37	19.50	1
6.d	58.74	6.41	12.61	1	46.10	6.57	26.00	
6.e	57.71	6.07	13.15	1	44.70	8.99	26.00	
6.a	58.51	8.37	22.23		43.00	13.78	26.00	
6.b	57.08	8.03	27.88		40.00	12.83	26.00	1
7.a	56.53	8.04	26.00		44.50	14.89	44.00	
7.b	54.67	7.93	23.13		41.40	10.92	30.63	
8.a	57.23	9.91	26.03		37.88	22.72	47.14	
8.b	56.56	6.83	34.12		38.89	18.13	41.00	
9.a	59.46	6.00	21.24	2	49.22	8.11	32.00	1
9.b	58.19	4.08	14.20		46.00	9.51	30.00	

- The outliers of the HM organizations are 15 and LM organizations are 13. In the case of HM organizations, the outliers are more on the higher score side, which indicates that in some organizations, the practices are more matured as compared to their peers in the same group. In the case of the low maturity organizations, most of the outliers are on the lower score side. It indicates that the organizations have not adopted the business excellence practices in an integrated way.
- One more important observation in high maturity organizations is that sub-criteria 1.a is focused well. It means that leadership has developed the mission, vision, values, and ethics properly and is demonstrating the role model behaviour in the organization. Three of the top-scoring sub-criteria are from leadership criterion.
- In low maturity organizations, the enabler median scores range from 37.88 to 49.22 as compared to the result's median scores of 41.08 to 49.14 for high maturity organizations. The Whisker range of results varies from 25 to 47.14. It indicates that the low maturity organizations have a low focus on results monitoring and improvising even though they have implemented the necessary enablers. In order to improve the maturity, organization need to adopt enablers in a much more integrated way and maturity curve (Figure 7-1) would explain the rationale for achieving the higher maturity.

7.4.3 Signal to Noise Ratio Analysis of High Maturity and Low Maturity Organizations

Taguchi developed a methodology for applying statistical approaches to improve the quality of manufactured goods. Genichi Taguchi proposed a figure of merit called signal to noise ratio to determine the significant factors. The signal-to-noise ratio measures how the response varies relative to the nominal or target value under different noise conditions. In a Taguchi design, the standard deviation is the variability in the response

because of the noise. Usually, the goal is to choose factor levels that minimize the standard deviation.

Table 7-5 : Signal to noise ratio of high and low maturity organizations

	High maturity organisations			**Low maturity organisations**		
Sub Criteria	Mean	Standard Deviation	Signal to Noise Ratio	Mean	Standard Deviation	Signal to Noise Ratio
1.a	60.45	3.43	17.62	46.05	7.30	6.17
1.b	59.61	3.97	16.01	43.74	7.70	6.68
1.c	58.21	4.28	13.58	43.74	6.17	7.09
1.d	58.46	4.22	13.85	43.12	6.89	6.26
1.e	58.42	4.16	14.05	41.36	6.74	6.13
2.a	59.19	6.06	11.70	42.96	6.30	6.82
2.b	58.12	6.70	10.19	43.60	6.44	8.02
2.c	57.45	6.58	10.30	43.30	6.43	6.74
2.d	57.10	6.52	10.34	43.78	6.10	7.18
3.a	57.40	4.61	12.45	44.33	7.17	6.18
3.b	57.25	4.63	12.35	44.16	8.26	6.35
3.c	57.70	4.82	11.98	43.94	6.80	7.57
3.d	56.61	6.26	10.76	44.94	6.12	7.34
3.e	58.66	4.93	11.90	46.68	6.75	6.91
4.a	57.53	4.26	13.50	46.40	6.59	7.04
4.b	60.62	4.79	12.65	48.11	6.54	7.35
4.c	57.67	4.51	12.78	46.39	7.13	6.36
4.d	58.67	6.14	11.42	46.57	6.88	6.77
4.e	56.03	4.22	13.04	42.87	7.88	6.44
6.a	57.86	3.91	14.79	46.44	8.31	6.46
6.b	56.97	4.07	13.99	46.21	6.88	7.86
6.c	56.13	3.37	16.66	46.93	4.78	9.61
6.d	59.30	4.22	14.07	47.34	6.29	7.52
6.e	57.70	6.52	10.45	44.72	6.36	7.03
6.a	57.76	6.40	10.69	42.53	8.28	6.14
6.b	56.56	6.29	8.99	41.50	8.14	6.10
7.a	56.53	6.64	9.85	42.82	9.21	4.65
7.b	54.26	6.76	9.42	41.02	8.56	4.79
8.a	56.72	6.93	8.04	39.41	12.60	3.13
8.b	56.70	7.05	7.90	41.64	10.40	4.00
9.a	59.82	4.89	12.23	46.78	8.27	6.66
9.b	58.00	3.54	16.40	44.39	7.08	6.27

Higher values of the signal to noise ratio (S/N) identify control factor settings that minimize the effects of the noise factors. The signal to noise ratio is adopted to assess the impact of various sub-criteria in the high maturity organizations and compare it with low maturity organization. The mean of the sub-criteria (as signal) and standard deviation (noise) of the high maturity organizations and low maturity organizations were calculated and shown in Table 7-5. S/N ratios can be direct or indirect. Direct means 'more is better' and indirect means 'less is better'. Here, all the S/N ratios are direct.

The top ten sub-criteria having higher influence are marked in red colour. From this analysis, it is clear that all sub-criteria of leadership (1.a, 1.b, 1.c, 1.d. 1.e) and process management (6.a, 6.b, 6.c, 6.d) and business performance indicator (9.b) of an organization influence the high maturity of the organizations. In the case of the low maturity organizations, the signal to noise ratio is very low and the focus on various enablers are scattered.

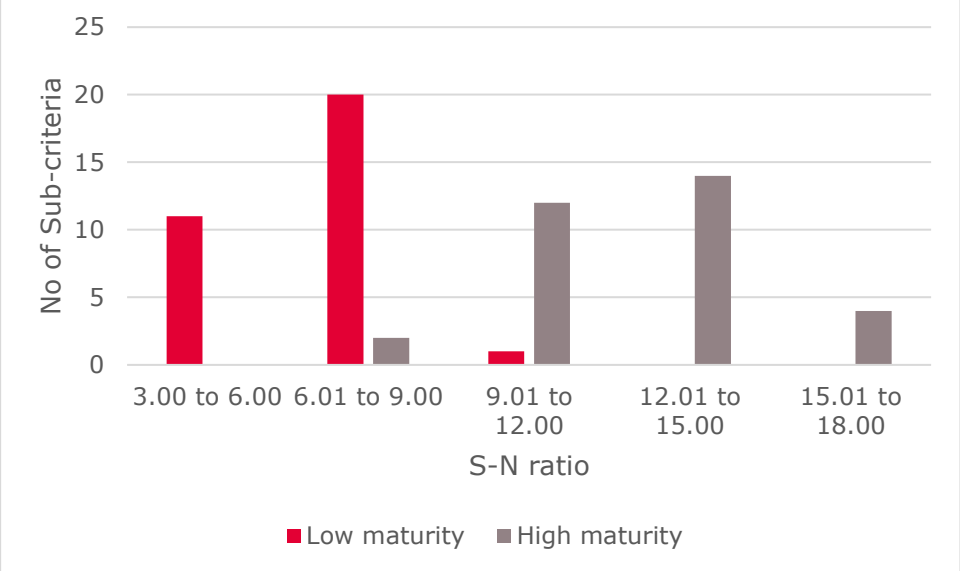


Figure 7-6: Distribution of S/N ratio for high and low maturity organizations

Figure 7-6 depicts the distribution of the S/N ratios based on sub-criteria scores. It is skewed towards the lower end, to move from lower maturity to higher maturity, the organization needs to focus on the right enablers to improve the performance. The lower maturity organizations need to reduce the variations and improve the mean of the assessment scores. If they can improve the mean and minimise the variations, the low maturity organizations can move from low to high maturity organizations. From the managerial application point of view, these organizations can look at high maturity organization scores and prioritise the actions.

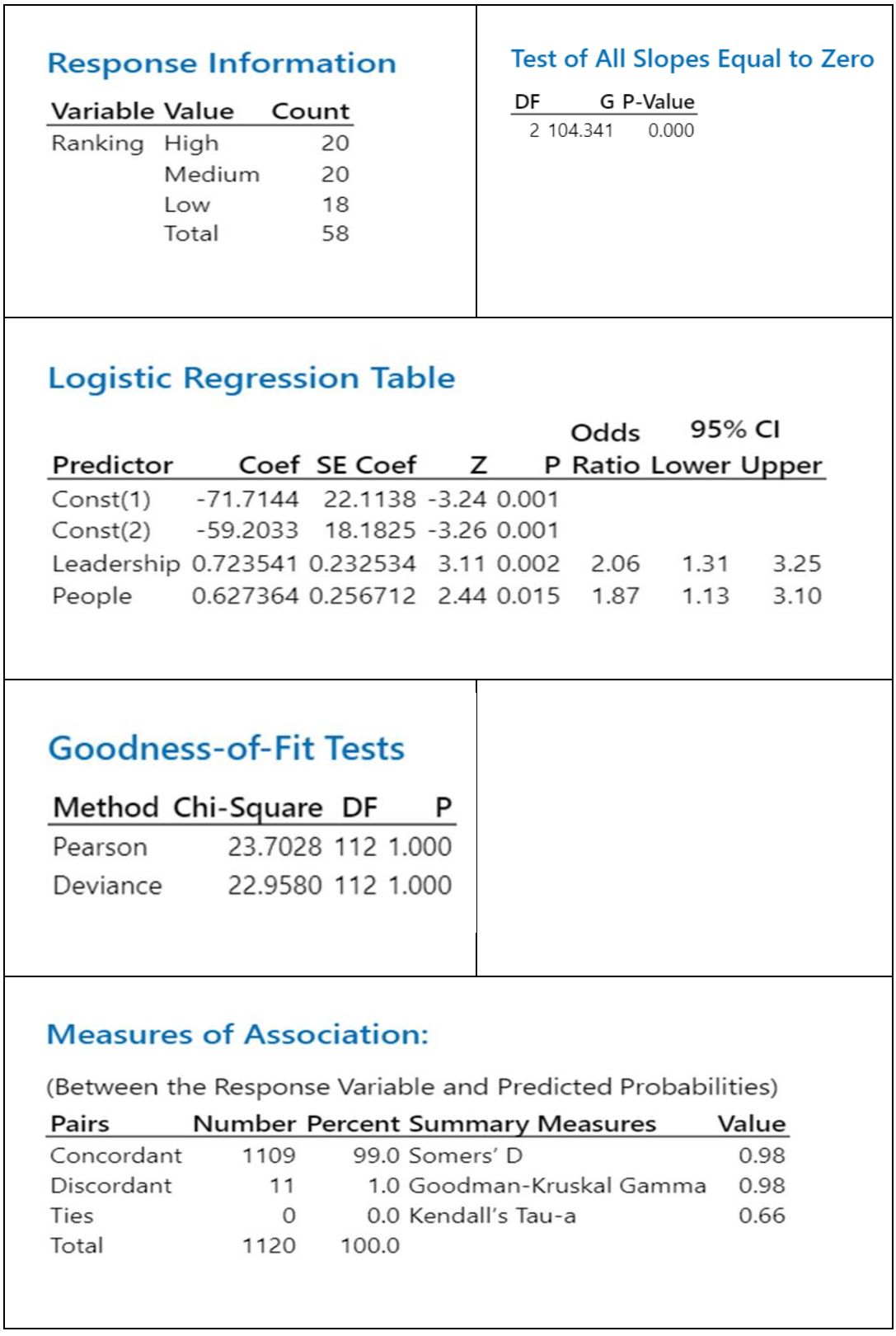
7.4.4 Logistic Regression to Identify the Significant Factors and Probability of the Occurrence

Logistic Regression is one of the basic and popular algorithms to solve a classification problem. It is named 'Logistic Regression' because its underlying technology is quite the same as Linear regression. The term "Logistic" is taken from the Logit function that is used in this method of classification. Logistic regression is a technique for modelling the probability of an event. It describes and estimates the relationship between one dependent binary variable and independent variables. In this research, five enablers would influence the outcomes of the business excellence organizational maturity. Logistic Regression model is adopted to assess the probability of achieving the different maturity levels based on the assessment scores and identify the key criteria that would influence the moving up in the maturity level. To conduct the logistic regression, a three-level ranking is done: more than 525 scores are high maturity organizations, between 425 and 525 score means moderately matured organizations, and less than 425 score represents low matured organizations. Five enabler criteria are equally important to achieve organizational excellence since they all have equal weightage. To carry out the logistic regression, these enablers are treated like five variables and ranked based on the assessment scores. Based

on the model, the leadership and people criteria are found as the key influencers of maturity. The total number of concordant pairs are counted and divided by the total number of pairs. This will give us the value of the concordance ratio. The higher the concordance ratio, the better is the model. In this model, the concordance ratio stands at 99% which means a good fit of the model. In the test of all slopes to zero metrics, slopes equal to zero indicate a good fit. In the output portion of the logistic regression table, the P-value is less than 0.05, which means that these factors significantly influence the response. Leadership and people criteria have been the significant criteria influencing the high-performance behaviour and the other three factors are statistically not significant in influencing the high performance. The odds ratio represents which group (leadership and people criteria) has better odds of success, and it's given by calculating the ratio of odds for each group. The odds ratio indicates that as leadership criteria go by 1.0 point, the probability of moving the organization maturity level moves up by 2.06%. Similarly, as the people criteria go by 1.0 point, the probability of moving the organization maturity level moves up by 1.87%. The goodness-of-fit shows that it is a good fit and it has passed the Null Hypothesis and both factors are influential. Table shows the Logistic Regression analysis extract.

Figure 7-8: shows the probability of leadership and strategy influencing the maturity of an organization. The Minitab output of graph EPROB01 indicates the probability of high maturity organizations, EPROB02 indicates the probability of medium maturity organizations and EPROB03 indicates the probability of low maturity organization. In these results, the equation is written as the probability of success. The response value of 1 on the y-axis represents a success. The EPROB01 plot shows that the probability of success increases as the assessment score increases. When the assessment score in the

data is near 58 in the leadership category and 56 in the people criteria, the organizations are likely to make it to a high maturity organizations



Response Information

Variable	Value	Count
Ranking	High	20
	Medium	20
	Low	18
	Total	58

Test of All Slopes Equal to Zero

DF	G	P-Value
2	104.341	0.000

Logistic Regression Table

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Const(1)	-71.7144	22.1138	-3.24	0.001			
Const(2)	-59.2033	18.1825	-3.26	0.001			
Leadership	0.723541	0.232534	3.11	0.002	2.06	1.31	3.25
People	0.627364	0.256712	2.44	0.015	1.87	1.13	3.10

Goodness-of-Fit Tests

Method	Chi-Square	DF	P
Pearson	23.7028	112	1.000
Deviance	22.9580	112	1.000

Measures of Association:

(Between the Response Variable and Predicted Probabilities)

Pairs	Number	Percent	Summary Measures	Value
Concordant	1109	99.0	Somers' D	0.98
Discordant	11	1.0	Goodman-Kruskal Gamma	0.98
Ties	0	0.0	Kendall's Tau-a	0.66
Total	1120	100.0		

Figure 7-7: Logistic regression summary

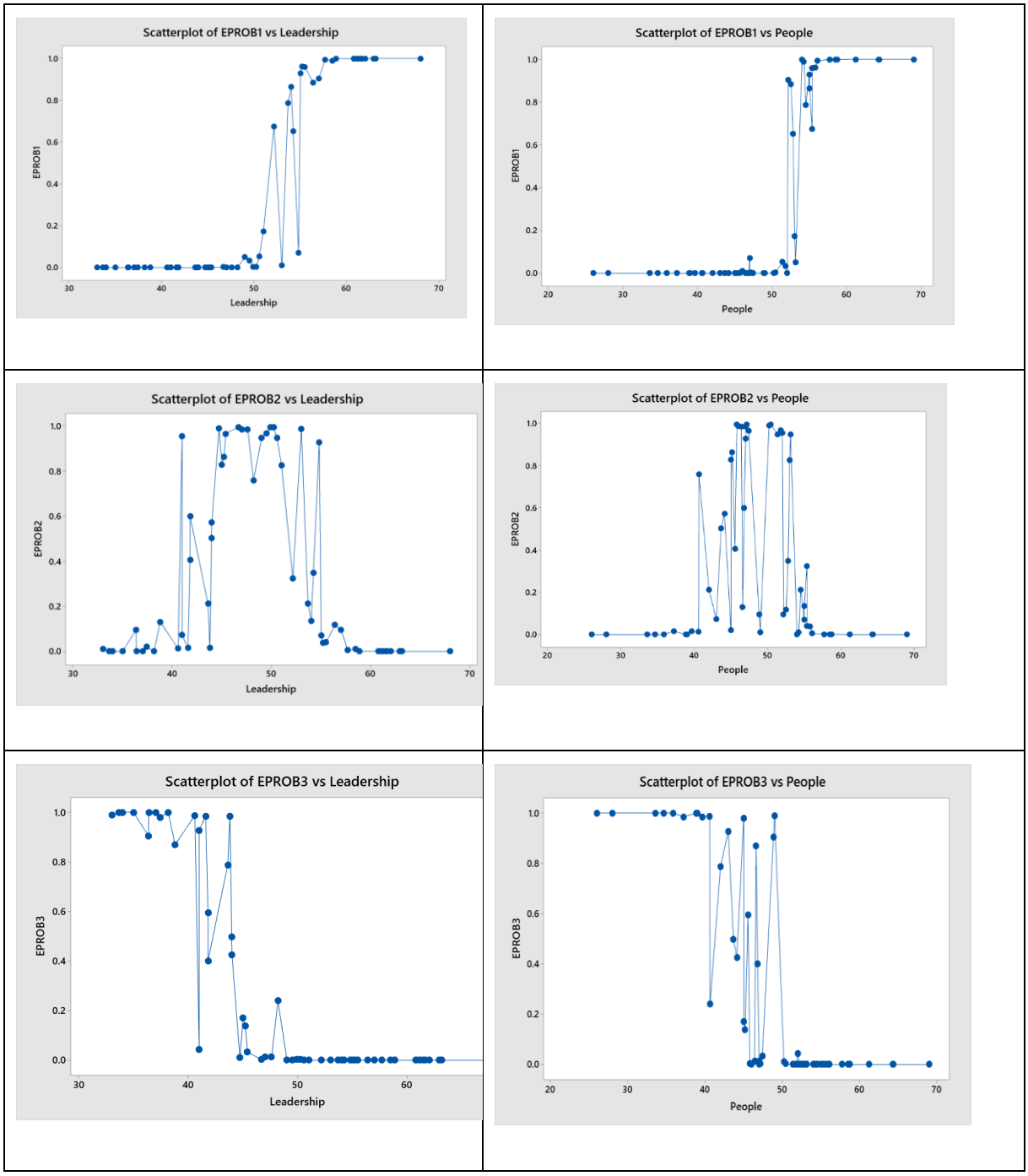


Figure 7-8: Scatter plots of the probability versus influencing factors of the maturity

In EPROB02, the scatter plot for medium maturity organization, the scores are varying from 45 to 55 for leadership and the probability of making it to medium maturity varies from 0.76 to 0.994. From the scatter plot, it is clear that in medium maturity organizations, the practices are not uniform or integrated. In EPROB03, the leadership scores are between 33 to 45.

Table 7-6 shows the summary of the scatter plots. From this table, it is clear that if an organization scores more than 58 in leadership criteria or 56 in people criteria, the organization will likely to be high maturity organisations with a probability of 0.994. Similarly, the scores of leadership and people criteria were identified along with the probability of the occurrence for medium and low maturity organizations as given in Table 7-6.

Table 7-6: Summary of Logistic Regression results

Maturity of the Organisation	Leadership criteria		People criteria	
	Scores	Probability	Scores	Probability
EPROB1 (Organisations with scores more than 525)	> 58	0.994	> 56	0.994
EPROB2 (Organisations with scores between 426 to 524)	45 to 58	0.76 to 0.994	41-56	0.76 to 0.994
EPROB3 (Organisations with scores less than 425)	33 to 44	0.78 to 0.989	26 to 40	0.987 to 1.000

Research conducted by Escrig and Menezes (2015), based on the study of Spanish organizations, indicated that people criterion has a high influence on the high maturity behaviour of the organizations. It is evident from this study also that good people practices make an organization high performing in business excellence. Even though in the case of the Spanish organizations, the leadership criterion was not found to be a prime factor influencing high maturity behaviour; but in the Indian context, leadership criterion influences the high maturity behaviour.

7.4.5 The Path for Attaining the High Maturity

From the CII website, the business excellence recognition and award-winning company names were captured to get meaningful data for the research. Over the 24 years, the award body has recognised 229 companies with 539 recognitions. The recognitions are covers

four categories: SCE (Strong Commitment to Excel), SA(Significant Achievement), PW (Prize Winner) and AW (Award Winner). To measure the penetration of the EFQM model, the number of awards awarded in all categories are analysed. The multiple research papers indicate that the nominations for the award have been declining over the years of EFQM awards (https://www.businessexcellencetools.com/business-excellence/).

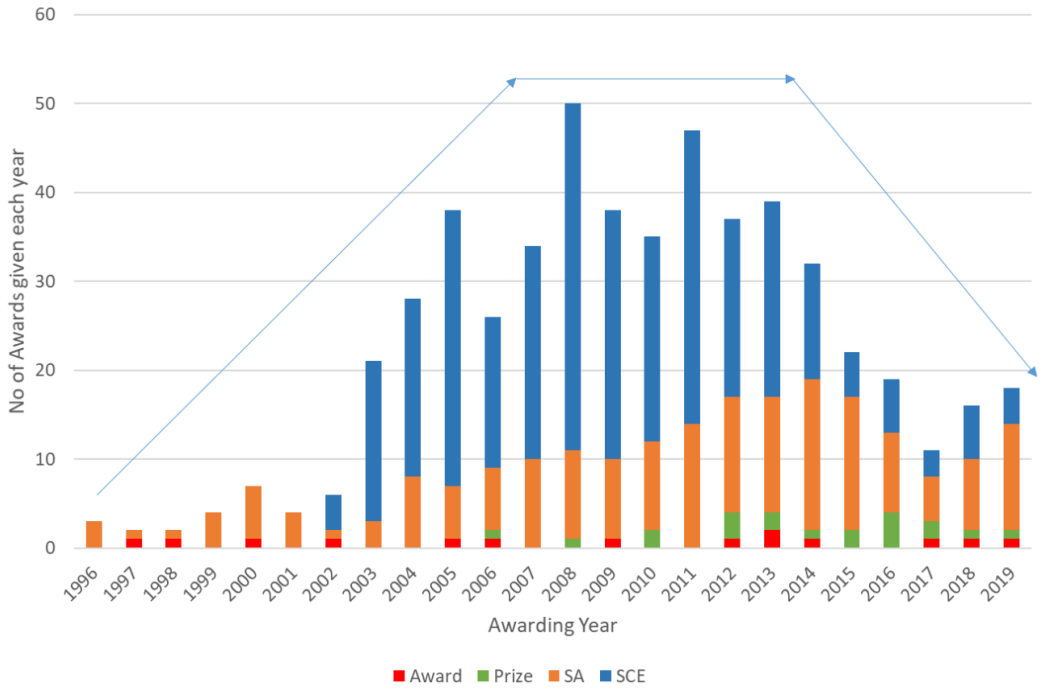


Figure 7-9: Trend of number of awards awarded over the years

Figure 7-9: shows the EFQM awards awarded between 1996-2019. Typically, the analyst would see this type of graphs in the product maturity trend. The number of awards saw a significant upward trend from 1996 to 2007. 2007 - 2013 can be termed as a steady stage, and it is evident that the number of awards is coming down from 2014 onward. Typical award nominations and awarding patterns would be the same. The number of award applications is confidential data and organisers are not ready to reveal. The nomination companies are ISO certified companies and any ISO company would be in the range of 350 to 400 score and is expected to make it into the SCE category of award. The number

of organizations participating in the award process has come down in numbers. This trend throws up the following questions.

- Why is there a drop in the number of awards given by the award forum?
- Is the award process or winning difficult?
- A correlation of this graph to the evolution/amendment of the EFQM model throws interesting questions. Introduction of EFQM 2003 version saw upward trend and a peak in 2008. This was followed by 2010 version and a steady number up to 2013. The numbers are declining after the introduction of 2012 version. This requires further investigation. Is there any correlation between the version and decline in applications? Is the version of 2012 not well accepted by the organizations? Is the emergence of Industry 4.0 around the same time responsible for this decline?

The data construct has been further analysed to identify critical observations and findings. The descriptive analysis of the data is presented in Figure 7-10: to Figure 7-15:.

- Figure 7-10: indicates that 75% of the organizations that participated in the award process are from the private sector and the remaining are public sector undertakings.
- Figure 7-11: depicts that 84% of the participating organizations are large enterprises and only 16% of the organizations are small and medium enterprises (SMEs). India has a large number of SMEs and the contribution of these enterprises is significant in terms of employment generation. However, their interest in adopting EFQM or business excellence models seems to be limited. This requires a major focus and shift in promoting the EFQM model among SMEs.
- Figure 7-12: shows the distribution of the corporate-driven initiative of EFQM adoption. 60% of the participation of the EFQM awards are from 24 groups of

companies. These show that 24 large group companies have adopted EFQM. To make the EFQM business excellence adoption in Indian industry, it is necessary to ensure that large-scale adoption happens across the country.

- Figure 7-13: shows the types of awards given by the award committee over the years. It is clear that a large number of companies are not able to move from lower maturity to higher-level maturity and 58% of distributed awards are at SCE (level-1), 35% of the awards are in the significant achiever category (level 2) and only 7% of the organizations are Award-winners or Prize-winners in 24 years.
- Figure 7-14: depicts the type of organizations that participated in the award process. Close to 70% of the organizations are based on manufacturing sector. The remaining 30% of the organizations come from the other eight sectors.

Figure 7-15: shows the award-winning company distribution. Even though 25% of participating organizations are public sector only 17% of total award winning and prize-winning companies are from the public sector. Out of these award-winning companies, only seven of them are not group companies. Apart from this, only three non-manufacturing sector companies make it into the winning category. Is there any complexity involved for public sector companies to make changes and to go ahead and win the award? Next, the number of attempts made by the organization in the award process is analysed.

Figure 7-16: depicts the number of attempts made by the organizations during the award process. 48.9% of the organizations made a single attempt in the award process and 20% of the organizations made the second attempt. Only 21% of the organizations pursued further on the business excellence award application and tried applying and winning the next category of award. It is important to note that 48% of the organizations have stopped applying after the first attempt. Is the award process so complicated or they did not see

the value of business excellence? Or did the organization perceive the EFQM model like an ISO standard to get the certification.? This requires a deep-dive analysis of why certain organizations are not coming forward for re-application of the award nominations.

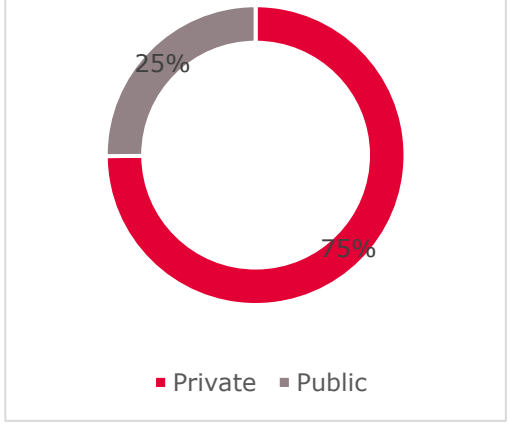


Figure 7-10: Distribution of public versus private organizations

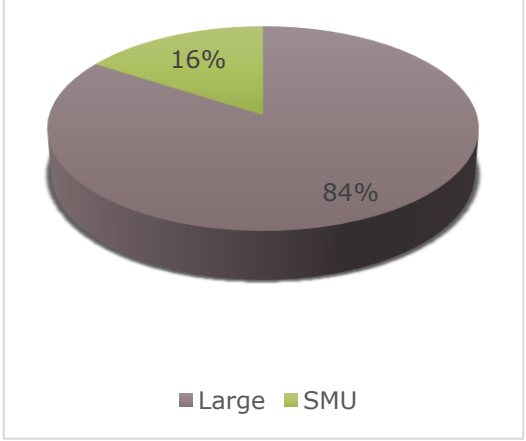


Figure 7-11: Size-wise participations of organizations

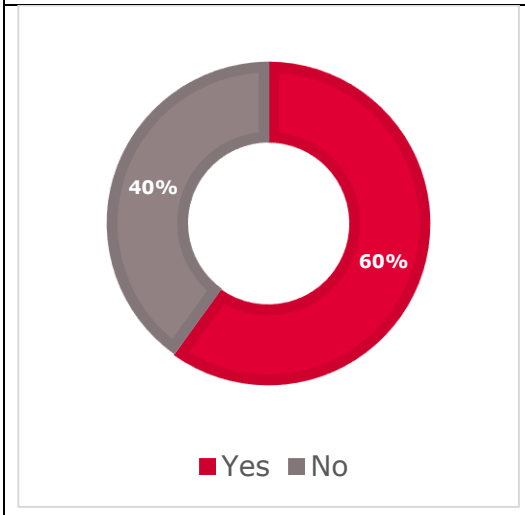


Figure 7-12: BE driven as a corporate initiative

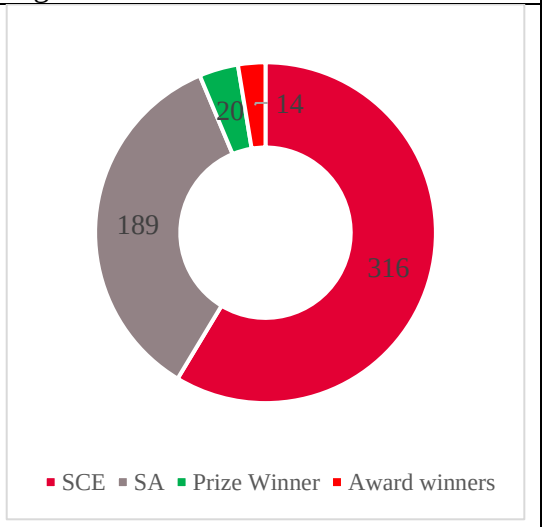


Figure 7-13: Category-wise number of awards

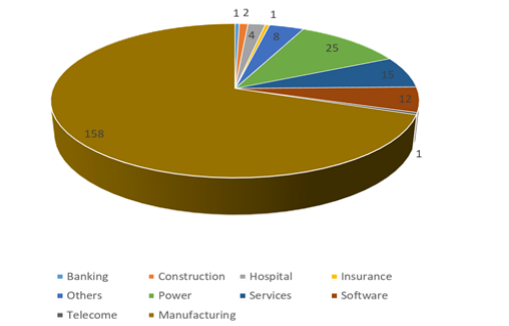


Figure 7-14: Distribution of industrial segments

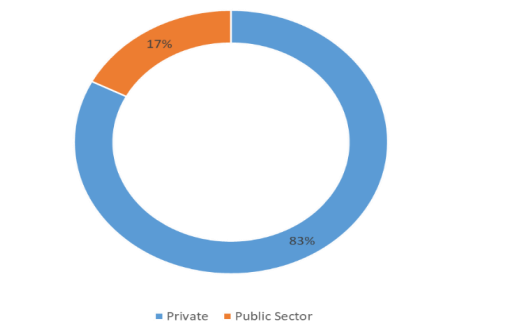


Figure 7-15: Award and prize winners from private and public sectors

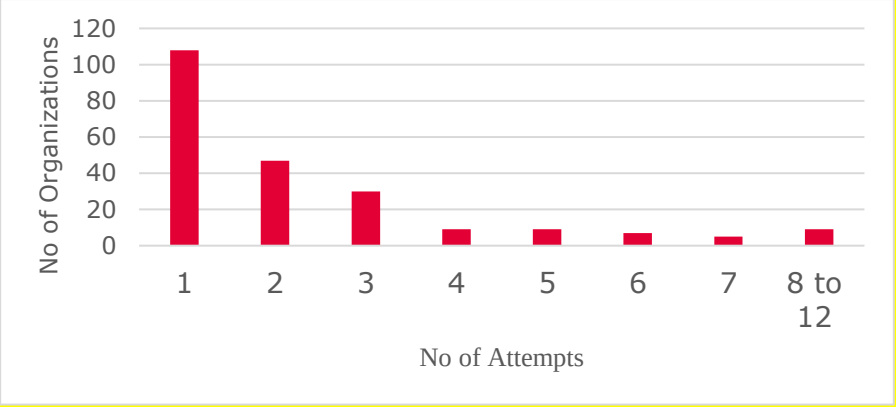


Figure 7-16: Number of attempts made by the organization in the award process

Table 7-7 shows that 60% of the companies are not able to cross the SCE category award. 48.9% of the organizations have made only one attempt, 41.3% of the total organizations not pursuing their nominations award or these organisations stopped their excellence journey. It appears that the organization lost their interest in crossing over from the SCE and SA stage. This needs to be investigated. 1-2 year's period in the award process could be the infant mortality syndrome of the organizations. Only 12.9% of the organizations could sustain the momentum of the excellence journey beyond fourth attempt. Organisations are trying to use the excellence model as an award-winning channel rather than making the excellence model as a culture of the organization. Figure 7-16: shows the distribution of attempts using a matrix plot to present the spread of the attempts against each category of award

Table 7-7: Summary of highest category award attained versus No. of attempts made

No of Attempts													
Type of Max Award won	Att-1	Att-2	Att-3	Att-4	Att-5	Att-6	Att-7	Att-8	Att-9	Att-10	Att-11	Att-12	Total
SCE	93	27	12	2		1							135
SA	17	11	15	4	7	5	3	2	1		1	1	67
Award			2	2	1	1	2		1				9
Prize		7	1	3				1	1	1			14
Total	110	45	30	11	8	7	5	3	3	1	1	1	225
No of Attempts in percentage													
Type of Max Award won	Att-1	Att-2	Att-3	Att-4	Att-5	Att-6	Att-7	Att-8	Att-9	Att-10	Att-11	Att-12	Total
SCE	41.3%	12.0%	5.3%	0.9%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	60.0%
SA	7.6%	4.9%	6.7%	1.8%	3.1%	2.2%	1.3%	0.9%	0.4%	0.0%	0.4%	0.4%	29.8%
Award	0.0%	0.0%	0.9%	0.9%	0.4%	0.4%	0.9%	0.0%	0.4%	0.0%	0.0%	0.0%	4.0%
Prize	0.0%	3.1%	0.4%	1.3%	0.0%	0.0%	0.0%	0.4%	0.4%	0.4%	0.0%	0.0%	6.2%
Total	48.9%	20.0%	13.3%	4.9%	3.6%	3.1%	2.2%	1.3%	1.3%	0.4%	0.4%	0.4%	100.0%

Note: Att represents number of attempts.

Further analysis was carried out to measure the span of business excellence initiatives in the organizations. Span is determined based on the difference of the time of the last attempt minus time of the first-time application submission by the organization. The author assumed that the organization would have started the excellence journey one year before submission. This would give the indicative performance of the span of business excellence journey in an organization. It is argued that this could be one of the measures for the sustainability of the business excellence initiative in the organization. Figure 7-17: shows the distribution of number of attempts against the category of awards.

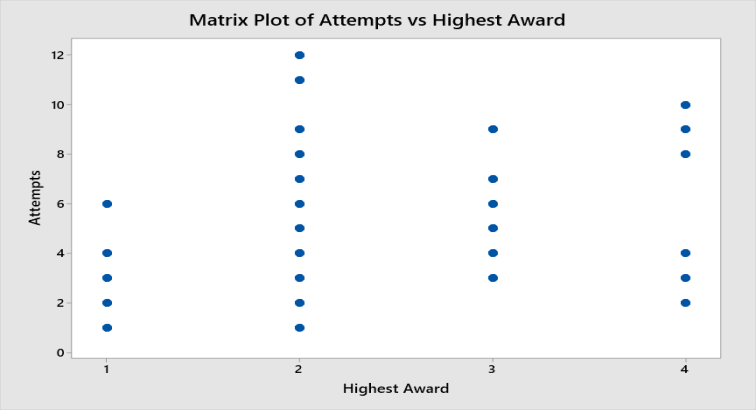


Figure 7-17: Matrix plot of attempts versus highest Award

Note: Each dot indicates 3 data points

- Table 7-7 shows that only 20% of the organizations can sustain the initiative beyond fourth year and re-apply for the award process. This table reveals some of the key information about sustaining the initiative across the years. 16 out of 23 award-winning and prize-winning organizations have sustained the initiative beyond three years. Figure 7-17: shows the graphical representation of the data spread.
- Figure 7-18: presents the Box plot of the data using number of attempts, the span (the number of years) and the highest award attained by the organization. It is clear that for the SCE award, the span and number of attempts by the organizations are similar.

Table 7-8: Span of business excellence initiative running in the organization

	Numbers of Years (Span)														
Award won	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	Total
SCE	96	15	15	7	1	1									135
SA	19	5	10	3	7	5	4	4	4	2	1		1	2	67
Award				2	2	1		3						1	9
Prize		3	4	1	2		1	1	1				1		14
Total	115	23	29	13	12	7	5	8	5	2	1	0	2	3	225

Award won	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	Total
SCE	42.7%	6.7%	6.7%	3.1%	0.4%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	60.0%
SA	8.4%	2.2%	4.4%	1.3%	3.1%	2.2%	1.8%	1.8%	1.8%	0.9%	0.4%	0.0%	0.4%	0.9%	29.8%
Award	0.0%	0.0%	0.0%	0.9%	0.9%	0.4%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	4.0%
Prize	0.0%	1.3%	1.8%	0.4%	0.9%	0.0%	0.4%	0.4%	0.4%	0.0%	0.0%	0.0%	0.4%	0.0%	6.2%
Total	51.1%	10.2%	12.9%	6.8%	6.3%	3.1%	2.2%	3.6%	2.2%	0.9%	0.4%	0.0%	0.9%	1.3%	100.0%

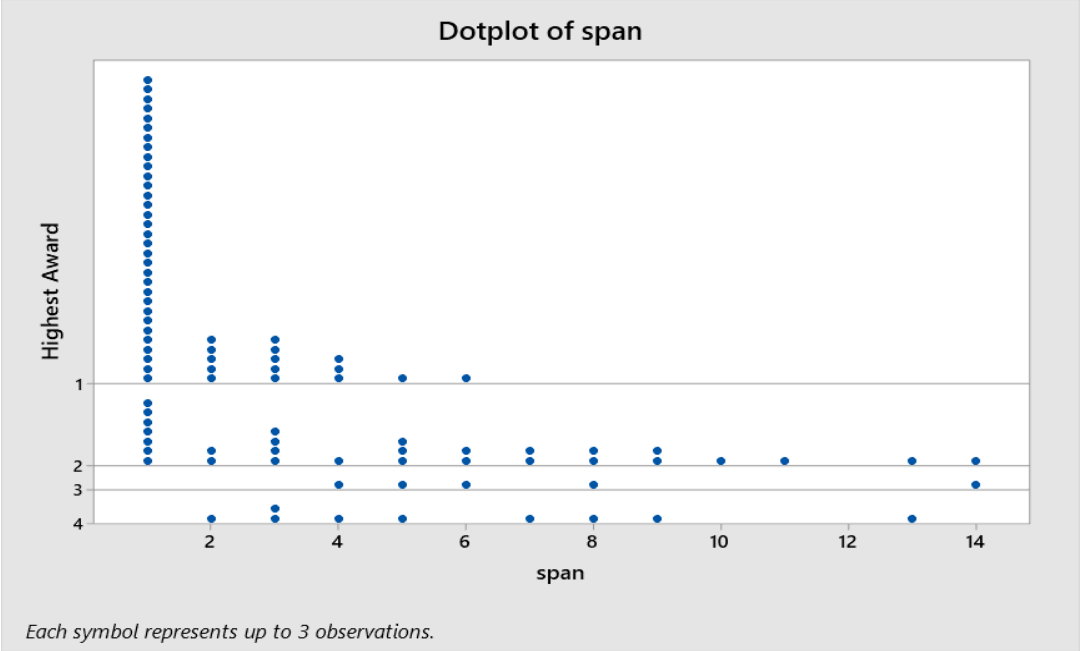


Figure 7-18: Dot plot of highest award versus span of years

Note 1=SCE, 2=SA, 3=AW and 4=PW

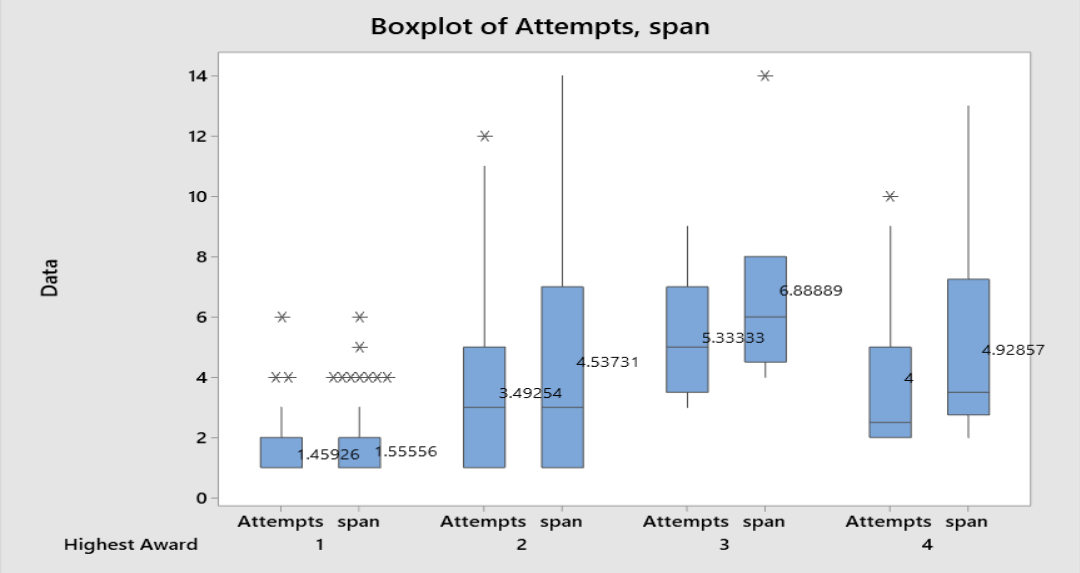


Figure 7-19: Shows the box plot profile of the organization's attempts, and span against the various categories of awards

Note 1=SCE, 2=SA, 3=AW and 4=PW

- For the SA award, the span is much wider compared to the number of attempts made by the organization. For prize and award-winning organizations, IQR remains similar whereas the Whisker length is different. An average 1.5 attempts

are made by each SCE organization as shown in Figure 7-19:. Similarly, 3.5 attempts are made in the SA category, Award-winning organization shows 6.33 attempts and prize-winning companies have taken about 4 attempts to win the award as shown in the Table 7-8.

- As a part of this analysis, 67 companies have made progress into SA. Out of 67 companies, 17 companies have directly made into SA, the remaining companies took time between 1- 13 years. About 70% of the companies took 1-4 years to progress from SCE to SA band of awards. The organizations that have applied every year to award nominations took longer to reach the next level.
- The organizations, which took a break between the attempts were able to move faster. This is evident from the assessment cycle point of view, typical applications are received by end of April every year, position report of the applicant organization by 15th June, consensus and site assessment by 15th Oct and assessment report sharing by CII to the applicant organization by November or December of every year. After receipt of the assessment report, the organization needs to analyse the findings and identify the actions for improvements. The applicant organization would have only four months to respond to deploy improvement action and monitor the results. Due to this, organizations are not in a position to show improvement from the last assessment to the subsequent assessment. The organization ends up showing the marginal or same status of scores in their excellence journey. The organising forum should not encourage the organizations to apply in subsequent years, they should ask them to work on improvements and come and submit alternate years. 90% of the organization could move from SA to Prize winning category within 4 years of

their SA advancement. It appears that progressing from SCE level to SA tougher than SA to Prize category. Table 7-9 shows the distribution of the data.

The organizations would take an average of 1.45 years and an average of 1.55 attempts to achieve SCE (Table 7-9). It is clear that to attain the SA category, the average span of years is 4.5 and the average number of attempts is 3.6. The award winners have taken 6.89 years and 6.33 attempts to reach this level. Prize winners understood the model quickly and they took 4.9 years and 4 attempts. It seems that organizations, to sustain the excellence initiative, take at least 5 years to achieve the Prize-winning category. Organisations trying to achieve an incremental maturity level of business excellence would take more time to achieve it. From the Table 7-9, Seven prize winners have achieved this within three years, which have a strong focus on process management and leadership, can achieve the status quickly.

Table 7-9: Matrix of average span and attempts to attain the award categories

Award category	Average span of years to achieve the award category	The average number of attempts made to reach the category
Strong Commitment to Excel	1.45	1.55
Significant Achiever	4.50	3.50
Award winners	6.89	6.33
Prize winners	4.90	4.00

7.4.6 **Performance Review of Award/Prize Winning Organizations**

Next, a review of business excellence performance was done for the award/prize-winning organizations. The objective was to assess the business excellence impact on award/prize winning (award + prize) organizations. As per Table 7-10, 23 organizations have achieved the award-winning and prize-winning categories. In general, the organizational performance needs to be assessed using the seven key performance indicators of total revenue, profit after tax, the share price of the organization, capital employed, the capital

investment made by the organization towards improvement, R&D spent, and headcount growth of the organization. The 23 organizations received their award/prize from 1997 to 2019. An attempt was made to capture the data of these organizations on all the seven parameters. However, the author was able to capture the data for 13 organizations on three parameters (revenue, profit, and share price) only. This also includes multiple units of large organizations like Godrej and Bosch as seen in APPENDIX A2. For this study, award years ± two years are considered for performance review. Since the unit performances are of different magnitudes and there are different segments, Y-2 is used as the base and arrived at the ratio of performance for respective organizations. Here, Y-2 refers to two years before the assessment, Y-1 refers to one year before the assessment, Y refers to the assessment year, Y+1 refers to the first year after assessment, and Y+2 refers to two years after assessment. Table 7-10 depicts the revenue, profit, and share price progression of the award/prize-winning organizations in India. To check the impact of business excellence on the award organizations, following single factor hypothesis tests were carried out:

H1: Is the revenue progression over years influenced by business excellence adoption by the award/prize-winning organizations?

H2: Is the profit progression over the years influenced by business excellence adoption by the award/prize-winning organizations?

H3: Is the share price progression over the years influenced by business excellence adoption by award/prize-winning organizations?

The following single-factor hypothesis was carried out using Minitab to validate the above three statements.

H0 – $\mu y1=\mu Y2=\mu Y3=\mu Y4=\mu Y5$

Ha - $\mu y1 \neq \mu Y2 \neq \mu Y3 \neq \mu Y4 \neq \mu Y5$

Table 7-10: Key performance progression indicators over the years

					Revenue (Factors of Y-2)					Profit (Factors of Y-2)					Shareprice (Factors of Y-2)				
COMPANY	SECTOR	Services	Highest Award	latest attempt year	Y-2	Y-1	Y	Y+1	Y+2	Y-2	Y-1	Y	Y+1	Y+2	Y-2	Y-1	Y	Y+1	Y+2
The Tinplate Company of India Limited	Private	manufacturing	PW	2010	1.00	0.76	1.11	1.34	1.16	1.00	0.47	0.78	1.75	1.25	1.00	0.40	0.36	0.40	0.50
Tata Motors	Private	manufacturing	AW	2005	1.00	1.33	1.54	2.05	2.13	1.00	1.53	1.89	1.13	2.50	1.00	0.98	0.91	1.50	1.31
Tata Iron and Steel Co Limited	Private	manufacturing	AW	2000	1.00	1.03	1.10	1.24	1.21	1.00	1.14	1.49	1.95	0.72	1.00	0.81	0.93	1.00	0.83
Tata Consultancy Services	Private	IT services	AW	2006	1.00	1.65	2.33	2.87	3.37	1.00	1.62	2.30	2.74	2.87	1.00	1.31	1.83	2.09	1.61
Rallis India Limited	Private	manufacturing	PW	2015	1.00	1.14	1.12	0.98	1.06	1.00	1.23	1.22	1.06	2.24	1.00	1.43	1.87	1.40	2.16
National Stock Exchange of India Limited	Public	Services	PW	2016	1.00	1.57	1.75	1.92	2.09	1.00	2.31	2.63	2.75	3.25	data not available				
Infosys Technologies	Private	IT services	AW	2002	1.00	1.91	2.55	3.75	5.01	1.00	1.18	1.54	2.28	3.04	1.00	1.02	1.27	1.06	1.44
Godrej Appliances Division, Godrej & Boyce Mfg Co Limited	Private	manufacturing	AW	2019	1.00	1.16	1.09	1.18	1.17	1.00	1.12	1.10	1.05	0.96	data not available				
Crompton Greaves Limited	Private	manufacturing	PW	2010	1.00	1.13	1.29	1.40	1.54	1.00	1.55	1.75	1.27	1.12	1.00	3.60	3.63	1.22	2.34
Bosch Limited, Diesel Systems business - Jaipur	Private	manufacturing	PW	2016	1.00	1.09	1.17	1.32	1.38	1.00	1.71	1.63	1.55	1.81	1.00	2.50	1.86	2.22	1.95
Bhilai Steel Plant , Steel Authority of India Limited	Public	manufacturing	PW	2016	1.00	0.85	0.97	1.25	1.47	1.00	-1.92	-1.35	-0.23	1.04	1.00	0.63	0.90	1.03	0.79
Bharat Heavy Electricals Limited, Haridwar	Public	manufacturing	PW	2006	1.00	1.41	1.81	2.07	2.71	1.00	1.76	2.53	3.00	3.29	1.00	2.75	2.80	2.69	1.92
Bharat Electronics Limited, Bangalore Unit	Public	manufacturing	AW	2018	1.00	1.17	1.34	1.56	1.60	1.00	1.19	1.07	1.48	1.37	1.00	1.30	1.29	0.88	0.64

Regarding statement H1, the analysis of variance (ANOVA) results are presented in Table 7-11. The hypothesis results show that means are different over the years. Hence, the null hypothesis is rejected. However, P-value is less than 0.05 which indicates that business excellence has influenced the revenue progression of the award-winning companies. System approach of practices, processes, strategy, and leadership had played a role in improving the business results. The Box plot in Figure 7-20: shows the progress made by the organization over the years.

Table 7-11: ANOVA results for revenue progression

Source	DF	Adj SS	Adj MS	F-value	P-Value
Year	4	8.153	2.0381	4.51	0.003
Error	60	27.133	0.4522		
Total	64	36.285			

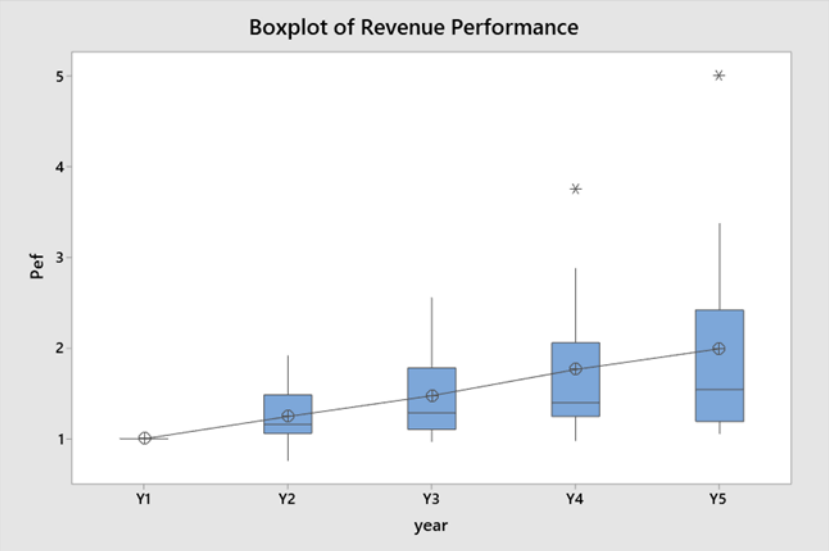


Figure 7-20: Box plot representing the revenue progression

ANOVA results for the statement H2 are presented in Table 7-12. Since the means of the factors are different, the null hypothesis is again rejected. However, the box plot (Figure 7-21:) shows the profitability of the organization has shown progress over the

years. The P-value is less than 0.05 which reflects that the business excellence model has a significant influence on the profitability of the winning organizations.

Table 7-12: ANOVA results for profit progression

Source	DF	Adj SS	Adj MS	F-value	P-Value
Year	4	7.885	1.9713	2.64	0.043
Error	60	44.865	0.7477		
Total	64	52.750			

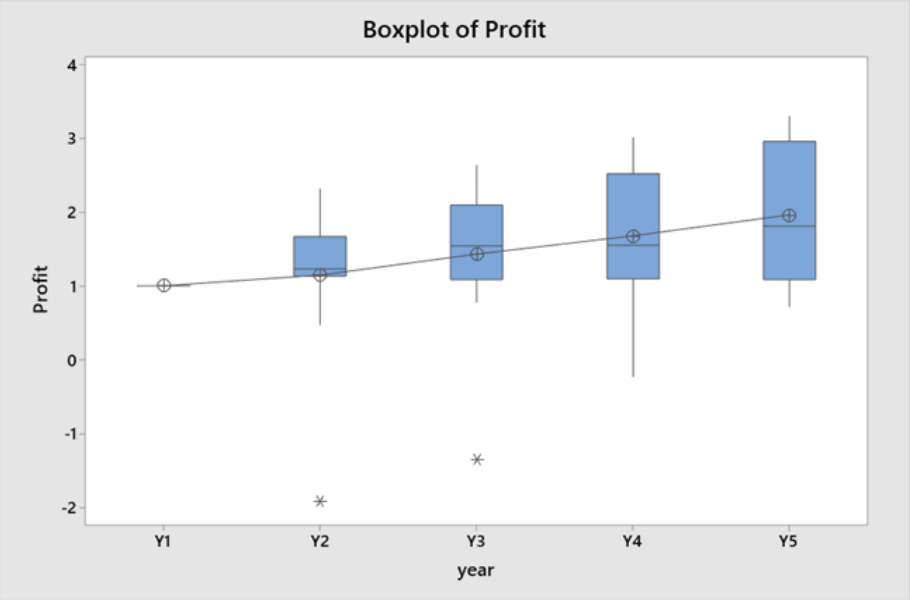


Figure 7-21: Box plot representing the profit progression

Regarding statement H3, ANOVA results (Table 7-13) show that the business excellence model has not significantly influenced the share price of the winning organization as the P-value is much above 0.05 and F-value is also much lower than the acceptable value of 4.0. The means of the factors are different, the null hypothesis is rejected. Box plot (Figure 7-22:) shows that the share price of the organization has no significant progress over the years.

Table 7-13: ANOVA results for share price progression

Source	DF	Adj SS	Adj MS	F-value	P-Value
Year	4	2.372	0.5929	1.07	0.379
Error	50	27.600	0.5520		
Total	54	29.971			

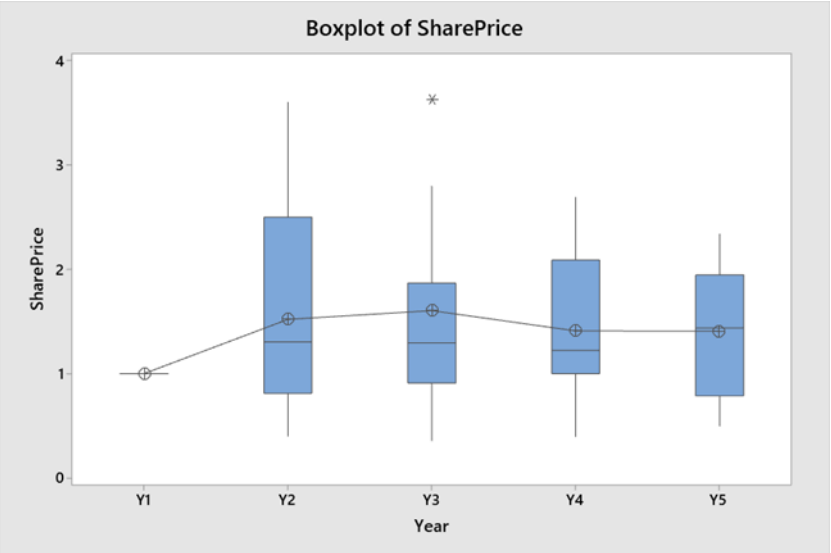


Figure 7-22: Box plot representing the share price progression

The key practices and frameworks adopted by the award/prize-winning organizations were collected from the public domain. This information is declared as a part of their financial reporting during the award-winning year. From Table 7-14, it is clear that ISO 9000 and other management systems would form the basis for most of the award/prize-winning organizations. This management system would form a foundation for adopting business excellence. Based on their business needs and nature of business, organizations have adopted suitable frameworks and practices.

Table 7-14: Adoption of frameworks and practices for award/prize winning journey

Sl. No.	Award/prize-winning company	Framework and key practices adopted
1	Godrej Interio Division, Godrej Appliances Division, Locks Division, Godrej & Boyce Mfg. Co. Limited	1. Group-wide business excellence adoption 2. Enterprise risk management committee integrated into business management 3. Risk enabled performance management system 4. Structured CSR activities, strategy, and monitoring mechanism. Partners for implementing CSR activities
2	Bharat Electronics Limited, Bangalore Unit	1. ISO 9000/14000/27000/18000 certifications 2. Companywide EFQM adoption in 2002 3. Six Sigma program 4. Suggestion scheme for employees 5. CSR executive management committee review the program 6. SAP ERP system for business processes
3	Raychem	1. ISO 9000/14000/27000/18000 certifications 2. TQM approach 3. EFQM adoption in 2001 4. COE (centre of excellence) for innovation 5. Setup of Raychem Innovation Centre 6. The great place to work practises
4	Rallis India Ltd	1. Initiative for skill enhancement in the organization 2. Development/assessment centre and mentoring approach for people development 3. Operational excellence focused on using Tata business excellence model 4. Integrated sustainability approach (energy, industrial waste, environment, and green) 5. Sustainability and CSR executive council
5	Bhilai Steel Plant, Steel Authority of India Limited	1. ISO 9000/14000/27000/18000/45000/50000/SA 8000 management systems 2. TQM principles 3. Labour productivity improvement initiatives 4. ERP implementation
6	Bosch, Bangalore - Diesel Systems business Bosch Limited, Diesel Systems business - Nashik Bosch Limited, Diesel Systems business - Jaipur	1. Bosch production system 2. Business excellence framework 3. Continuous improvement program 4. Six sigma 5. Industry 4.0 6. BRIDGE CSR initiative to improve employability
7	The Tinplate Company of India Limited	1. Integrated management system, ISO9001, ISO14001, OSHAS 18001, ISO27000 and ISO22000 2. Adoption of business excellence framework
8	Tata Motors	1. SAP ERP, PLM, Knowledge-Based Engineering system 2. Adoption of business excellence framework
9	Infosys	1. Capability Maturity Model Integration (CMMI) level 5 2. MBNQA, ISO 9001 3. TickIT 4. Six Sigma 5. People Capability maturity Model (people CMM, PCMM)
10	Crompton Greeves	1. One World Quality, Manufacturing excellence, Unipower Initiatives 2. Six Sigma initiative

Sl. No.	Award/prize-winning company	Framework and key practices adopted
		3. Business excellence initiative
11	Bharat Heavy Electricals Limited	1. Companywide TQM 2. EFQM adoption 3. Integrated ISO9000, ISO14001, OHSAS 18001
12	Tata Consultancy Services	1. Capability Maturity Model Integration (CMMI) level 5 2. MBNQA, Tata business excellence model 3. ISO 9001, TL9000 4. Six Sigma 5. People Capability Maturity Model
13	National Stock Exchange of India Limited	1. DevOps Adoption 2. Modernization of IT 3. COE implementations 4. Adoption of business excellence framework 5. Rigorous business continuity planning (BCP) initiative 6. Adoption of quality practices in the stock exchange 7. Real-time KPIs

7.5 INFERENCES

This study, based on the available samples of the assessment data, shows that only 20 out of 58 organizations were able to achieve high maturity. It was found that the high maturity organizations have an integrated approach for all the enablers, and scores for all enablers are almost similar. However, Logistic Regression analysis highlights the leadership and people criteria influence on the outcomes, which is not evident from the Box plots. In the remaining 38 organizations, the approach of adopting the EFQM model was not an integrated one. It is evident from their scoring pattern; they would be adopting the model as per the organizational preferences, and management direction and vision. High maturity organizations have adopted the 4P approach – a clear purpose for the organization; right practices in place; deployed necessary performance indicators; and perfected their practices, purpose and performance through constant learning and improvising. From the Box plots, it is clear that enablers are equally weighted in the actual practice in the high maturity organizations. Based on this research study, it is clear that in Indian organizations, leadership plays a key role in high maturity behaviour by

setting a clear purpose and direction to the organization. In Indian high maturity organizations, the EFQM model is used as a vehicle for excellence and deployed holistically. It seems that high maturity organizations adopted the model holistically whereas the low maturity organization's approach was based on the importance of the enablers. Organisations adopting the EFQM model want to embrace the organizational changes and drive an excellent culture in the organization. The low maturity organizations can take the proven approach of leading organizations and adopt.

A comparison of the current research results for Indian organizations is carried out with the results of Escrig and Menezes (2015) for Spanish organizations. The comparison is presented in Table 7-15 and Figure 7-23:. The trend chart shows that the high maturity profiles of both the data sets is almost similar. In the high maturity organizations assessment scores are in the range of ±5 of the median assessment score. This difference is negligible. Out of 24 enabler sub-criteria, 17 are in this range. Seven sub-criteria are outside this range. It is clear that in the Indian context, leadership plays a major role as evident from the higher scores for 1.b, 1.c, 1.d, 1.e. 3.d, 3.e, and 4.b sub-criteria as compared to Spanish organizations. It is found that the organizations have not implemented the EFQM model in an integrated way. Hence, the scores are not consistent in lower maturity organizations. As per the EFQM model construct, RADAR is the tool used for assessing organizations. This scale of the tool and method for assessment is internationally standardized. The comparison of high maturity scores of Indian organizations and Spanish organizations shows that the scoring pattern is the same. From this, it is clear the assessment process followed by both the award forums are also the same.

Table 7-15: Comparison of current research results (Indian organizations) and Escrig and Menezes (2015) results (Spanish organizations)

	High maturity Organisations			Low Maturity Organisations		
Sub Criteria	HM Org - Median of this paper	HM org Median of the study from Escrig and Menezes Study (5 star)	Difference of HM scores	LM Org. Median of this paper	LM Org. Median of the study from Escrig and Menezes Study (4 star)	Difference of LM scores
1.a	60.00	56.25	3.75	46.00	45.00	1.00
1.b	60.39	55.00	5.39	44.86	45.00	-0.14
1.c	57.27	52.00	5.27	43.73	42.50	1.23
1.d	59.10	52.50	6.60	44.72	42.50	2.22
1.e	59.21	52.50	6.71	41.08	40.00	1.08
2.a	59.11	55.00	4.11	45.00	44.00	1.00
2.b	58.83	55.00	3.83	43.36	45.00	-1.64
2.c	56.13	55.00	1.13	44.39	45.00	-0.61
2.d	56.11	55.00	1.11	44.33	42.50	1.83
3.a	57.63	53.33	4.30	46.00	40.00	6.00
3.b	56.99	55.00	1.99	45.00	42.50	2.50
3.c	56.70	52.50	4.20	45.00	40.00	5.00
3.d	55.11	50.00	5.11	45.00	42.50	2.50
3.e	57.94	50.33	7.61	47.89	40.00	7.89
4.a	57.96	52.50	5.46	46.90	40.00	6.90
4.b	59.28	58.33	0.95	49.14	47.50	1.64
4.c	57.59	56.67	0.92	46.97	42.50	4.47
4.d	58.33	57.50	0.83	46.60	45.00	1.60
4.e	55.55	53.75	1.80	43.69	42.50	1.19
5.a	56.92	60.00	-3.08	46.08	52.50	-6.42
5.b	55.81	56.67	-0.86	46.60	45.00	1.60
5.c	55.81	55.00	0.81	45.62	45.00	0.62
5.d	58.74	59.50	-0.76	46.10	47.50	-1.40
5.e	57.71	56.25	1.46	44.70	45.00	-0.30

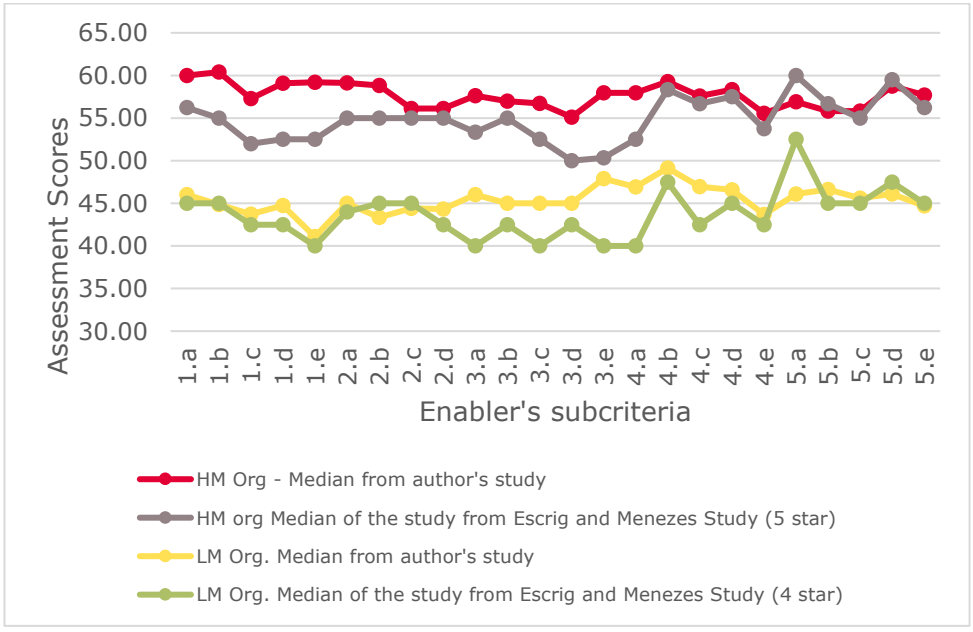


Figure 7-23: Median assessment score line chart of this study and Escrig and Menezes (2015) study

7.6 MANAGERIAL IMPLICATIONS

The managerial implications of the research are as follows:

EFQM model and guidance point: The EFQM model construct is well structured and calls out the characteristics of an excellent organization. Adoption of such best practices would take the organization to a high maturity level. The low maturity organizations can take a clue from approaches adopted by leading organizations to achieve higher maturity. It is clear that identified best practices of the EFQM can be quickly copied and adopted by low maturity organizations instead of re-inventing the wheel. The organizations need to focus on clustering the improvements, and an integrated approach would help them to succeed in their excellence journey.

Prioritisation of improvement plans to fix the gaps: This would also help the organizations to prioritise and fix the issues or gaps identified during self-assessment or external assessments.

Path for achieving high maturity of excellence: As discussed in the earlier section of the path for attaining excellence, the managers and leaders need to sustain the journey of excellence. To attain a high maturity in the organizations, the leaders and managers should focus on an integrated approach of adopting the best-in-class described by the model and be constantly reviewed for effective implementation.

Sustaining the excellence journey of the organization: Leaders and managers should not approach the EFQM adoption like an ISO standard certification. It has been observed some organizations attempted once or twice to get the award. The high maturity organizations adopted EFQM like management framework. Various award/prize-winning organizations have adopted other complementary management systems and practices to comprehend the excellence journey.

7.7 SUMMARY

The empirical research in this chapter identified the two key influencers – leadership and people criteria – driving the organizations for the transition from low maturity to high maturity of business excellence. 58 Indian organizations of EFQM assessment scores were assessed for business excellence during the period 1997-2018. From the research study, it is clear that organizations would exploit their strengths while adopting the EFQM framework, rather than take a universal approach that interprets the model as sets of rules that must be followed in the road towards excellence. Escrig and Menezes (2015) study highlight the different taxonomies for QM that have been proposed in the literature based on which distinct approaches to the adoption of the best practices in the EFQM model can be inferred.

From the S-N ration analysis, the top ten sub-criteria having higher influence sub-criteria of leadership (1.a, 1.b, 1.c, 1.d. 1.e) and process management (5.a,5.b,5.c,5.d) and business performance indicators (9.b) of an organization influence the high maturity of the organizations. In the case of the low maturity organizations, the signal to noise ratio is very low and the focus on various enablers are scattered. However, logistic regression analysis highlights leadership and people criteria influence the outcome which is not evident from the box plots. In the remaining 38 organisations, the approach of adopting the EFQM model is not an integrated one. It is evident from their scoring pattern; they would be adopting the model as per the organisation preferences, and management direction and vision.

High maturity organisations have adopted the 4P approach: a clear **p**urpose for the organisation, right **p**ractices in place, deployed necessary **p**erformance indicators and **p**erfected their practices, purpose and performance through constant learning and improvising. From the box plots, it is clear that enablers are equally weighted in the actual

practices in the high maturity organisations. In high maturity organisations of India, the EFQM model is used as a vehicle for excellence and deployed holistically. It seems that high maturity organisations adopted the model holistically whereas the low maturity organizations approach was based on the importance of the enablers.

Organisations adopting the EFQM model wants to embrace the organisational changes and drive an excellent culture in the organisation. The low maturity organisations can take the proven approach of leading organisations and adopt. This study also highlights the cultural differences in EFQM model deployment. The research conducted by Escrig and Menezes (2015) in Spanish organizations indicates that people criterion is the main influencer and leadership is not influencing high maturity behaviour. Whereas, in the Indian context, leadership, as well as people criteria, are the influencing factors. A comparison of the current research results is carried out with the results of Escrig and Menezes (2015) study. The trend chart shows that the high maturity profile of both the data sets is almost the same. In the high maturity organisation comparison, it is clear that assessment scores are in the range of ±5 of the median assessment score. This difference is negligible. Out of 24 enabler sub-criteria, 17 are in this range. Seven sub-criteria are outside this range. As per the EFQM model construct, RADAR is the tool used for assessing organisations. This scale of the tool and method for assessment is internationally standardized. The comparison of high maturity scores of Indian organisations and Spanish organisations shows that the scoring pattern is the same. From this, it is clear the assessment process followed by both the award forums are also the same.

The EFQM model construct is well structured and clearly called out the characteristics of an excellent organisation. Adoption of such best practices would take the organization to a high maturity level. The low maturity organisations can take a clue from approaches

adopted by leading organisations to achieve higher maturity. From this study, it is also clear that identified best practices of the EFQM can be quickly copied and adopted by low maturity organisations instead of re-inventing the wheel. It is evident that the organisations need to focus on clustering the improvements and an integrated approach would help them to succeed in their excellence journey

Award-winning and prize-winning organizations took an average of 6.89 years and 6.33 years respectively to achieve the excellence. Similarly, these organizations took an average of 4.9 and 4.0 attempts respectively to attain the status. The impact of key performance indicators of award/prize-winning organizations has been studied by performing ANOVA to validate the hypotheses. As per this analysis, the business excellence model adoption shows a significant influence on 'Revenue' and 'Profitability' and no impact on the share price of the organization. The award-winning organization and prize winnings took 6.89 years and 6.33 years respectively to achieve this status based on the last 22 years data. To attain path of excellence, the managers and leaders need to sustain the journey of excellence.

Most of the award and prize-winning organisations have adopted the ISO 9000 quality management system as a base for building the process management and adopted the EFQM business excellence model as an overarching system or vehicle to embrace the business excellence journey in the organisations.

In the next chapter, the contextual study of EFQM in Industry 4.0 Era is presented.

CHAPTER-8

CONTEXTUAL STUDY OF EFQM IN INDUSTRY 4.0 ERA

This chapter traces the evolution of EFQM model since its inception, presents an in-depth analysis of the progressive evolution of the EFQM 2020 vis-a-vis the EFQM 2012 model, identifies the relationship between EFQM 2020 model and Industry 4.0, and maps the key performance indicators (KPIs) of EFQM and Industry 4.0.

8.1 INTRODUCTION

The basic structure of the new EFQM model (EFQM 2020 model) has completely changed and the description of certain recommendations in the model is confusing as pointed out in the literature review (chapter 2). However, Fonseca *et al.* (2021) highlights the EFQM 2020 model's novelties and its relationships with the Industry 4.0 paradigm. The EFQM has completed 30 years of journey as a forum, the look and feel of the branding did changed but the basic motive did not change until 2019. The model continues to focus on excellence as a basis. Whereas, in the latest 2020 version, the excellence word itself is removed from the model. Is it because of the introduction and diffusion of Industry 4.0 in Europe? Evolution of the new EFQM model needs to be studied and its relationship with Industry 4.0 to be explored to answer this question.

Fonseca *et al.* (2021) proposed a mixed inductive–deductive approach for the detailed analysis of the EFQM 2020 model and its comparison with the previous version of 2012 as well as the deductive approach for dealing with known dimensions of the EFQM models. Fonseca *et al.* (2021) identified linkages between the EFQM 2020 model and Industry 4.0 at the sub-criteria level. This mapping of business excellence and Industry

4.0 may support the digital transformation, but there is no specific reference to the Industry 4.0 pillars. Additionally, role of leadership and strategy, an important aspect of business excellence and EFQM, is not evident which might be a concern for business and technology transformation strategies (Fonseca *et al.* 2021). Therefore, it is important to identify the critical success factors of Industry 4.0 and map these to EFQM to comprehend the relationship for the successful business outcomes. The linkages at the abstract or criteria level are important to understand the underpinning logics and take strategic decisions, but the actual success is measured by the KPIs at the operational level. Žižek *et al.* (2020) highlighted the role of KPIs in implementing Industry 4.0 and opined that KPIs are important when implementing Industry 4.0. This research identifies the common KPIs by mapping KPIs to EFQM 2020 model and Industry 4.0 at the common platform. This chapter focuses on the following:

- Studies the new EFQM model (2020) and compares it with the last EFQM model (2012) using deep-dive technique.
- Assesses the magnitude of adoption from EFQM 2012 to EFQM 2020 version.
- Compares EFQM 2020 model and industry 4.0.
- Identifies the critical success factors of Industry 4.0
- Identifies the KPIs for EFQM 2020 and industry 4.0 on a common platform

8.2 RESEARCH METHODOLOGY

This research is carried out in four stages: Stage-1 deals with evolution of EFQM during the last three decades. Stage-2 of the study focuses on the deep-dive comparison between the 2012 and 2020 versions of the EFQM model. In Stage-3, the key enablers or critical success factors for Industry 4.0 (I4) are identified from the literature. These enablers are

essential for I4 adoption or implementation. The study is carried out to identify the relationship between I4 and EFQM 2020 model. The stage-4 of the study is focused on the KPIs for Industry 4.0 and EFQM 2020. Further, the comprehensive KPI research work done by Sangwa and Sangwan (2018) and ISO 22400-2: 2014 are used to map the KPI of EFQM 2020 and Industry 4.0. Figure 8-1 shows the proposed research approach and broad level steps adopted.

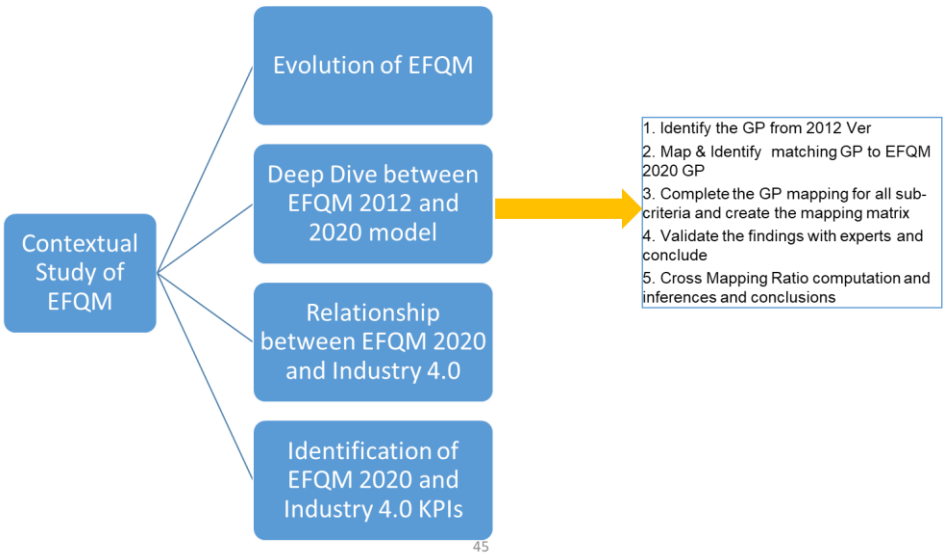


Figure 8-1: Research methodology for assessing EFQM in Industry 4.0 Era

8.3 EVOLUTION OF EFQM

The evolution study of the EFQM model has been carried out taking cues from the literature to articulate the changes through the various periods of the EFQM model's existence. The model's evolution is broken down into five phases. The initial phase being the period between 1991-1999 and the second phase is reckoned as the period between 2000-2002. The third phase is identified between 2003-2010, the fourth phase is identified as the period between 2011-2018, and the last and the fifth phase is the period from 2019 onwards. The periods are not the same in each phase. The phases are based on the evolution or modifications in the EFQM model.

Initial Phase (1991-99)

To facilitate the identification of the business excellence organisations, the EFQM forum, in 1991, created a framework consisting of enablers and results. The five enablers representing leadership, policies & strategies, processes, resources, and people practices that an organisation uses to develop and deliver its strategy. The four results criteria track the progress against the needs and expectations of the stakeholders. To emphasize the organisational role in society, the forum included the category titled "Impact on Society" which became a part of the awards process. This step expects the excellent organisations to focus on social needs and expectations by considering society as a key stakeholder. Figure 8-2 shows the initial construction of the model. This initiative set the tone for expectations from an excellent organisation and formed the yardstick for measuring organizational excellence and the organisational mechanisms that drive excellence. In this period, it is observed that the organizations from the private sector were getting recognitions and the public sector organizations hardly participated. During 1997, the model was extended to the public sector and in 1999; the formal release of 'Fundamental Concepts of Excellence' took place leading to the creation of a network of national partners to associate with the forum for strengthening the adaptability, improvement and enhancement of the EFQM model.

Second phase (2000-02)

Considering the inputs of the award cycle and based on the various academic, research and professional experiences; the forum started focussing on revamping the structure of the model. In this period, the model became popular and more organizations joined the forum. The 'resource' criterion got strengthened and was renamed as 'partnership and resources'. The 'results' got relabelled and moved from satisfaction to the full-fledged

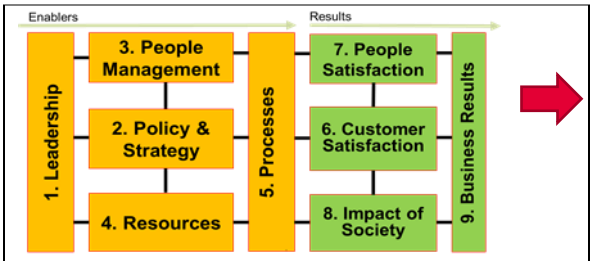


Figure 8-2: Initial construct of the model (1991-99)

Source: Nabitz *et al*. (2000)

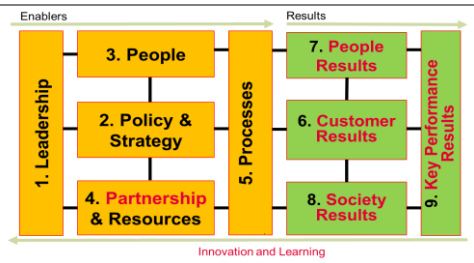


Figure 8-3: Second phase construct of the model (2000-02):

Source: Adapted from Eskildsen *et al.* (2001)

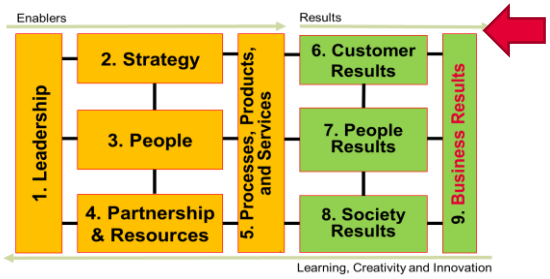


Figure 8-4: The phase-4 construct of the model (2011-2018)

Source: EFQM Excellence Model (2010)

Figure 8-5: The phase-3 construct of the model (2003-2010)

Source: EFQM Excellence Model (2012)

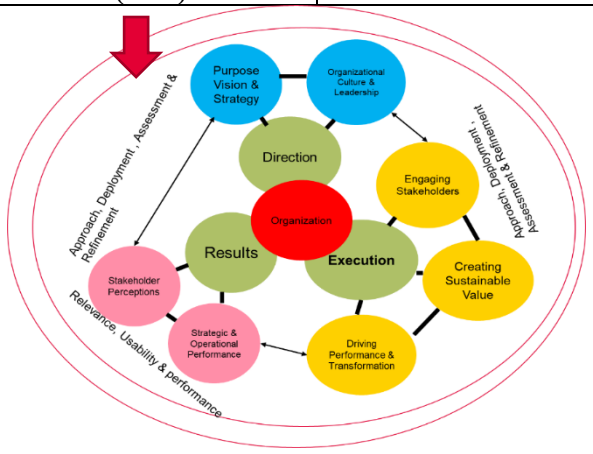


Figure 8-6: EFQM 2020 model

Source: www.efqm.org

results section. The results categories were termed as the customer, people, society, and key business results. The changes from the initial version to the second phase are marked in the red-colour fonts in Figure 8-3 To encourage the award process, learning and internal mechanism; 'innovation and learning' was added in the model to focus across the enablers and results as shown in the Figure 8-3. In 2001, the EFQM level excellence

award was introduced (A new award category). There were three levels of recognition, from 3 stars to 5 stars, depending on the maturity observed during the assessment.

Third phase (2003-2010)

In this phase, the model started reaching a more mature state and the popularity of the model significantly increased. The national networks started cooperating well and the model created a great image in the marketplace. The award process became more competitive, and this started putting pressure on the organisations to win the coveted EFQM award. This step helped thousands of organisations to move towards EFQM levels of excellence to support their quality journey. The 'processes' criterion got relabelled as 'products, processes and services' to reflect the importance of products and services. In the results category, the key performance results were relabelled as key results. Apart from learning and innovation across results and enablers; creativity was also added as one of the key ingredients in the model as shown in Figure 8-5.

Fourth Phase (2011-2018)

In this phase, the model got major penetration using acknowledgements from senior management and executives to adopt this model as a vehicle for an organisational improvement journey. Model and fundamental concepts were revised to meet the demands of the changing organisational and business environments. Fine-tuning of the model at sub-criteria and guideline levels was done. However, there are no major changes to the construct of the model.

Figure 8-4 shows the construct of the model in this phase

Fifth Phase (2019 onwards)

In this phase, the contour of the model got changed significantly; the earlier enabler and results criteria got revamped. The five enablers and four results got restructured into five

enablers and two results categories. The model got sub-divided into three categories: Direction, Execution and Results. The direction has got two criteria, execution got three criteria and the results got two criteria. The new EFQM model is a result of a co-creation involving nearly 2000 change experts, 24 organised workshops, face to face discussion with leaders in over 60 diverse organisations (https://efqm.org/). The award forum created a core team of experts and contributors from across industries and academia to re-design the EFQM model. The construct of the model is shown in Figure 8-6.

The 2020 version was based on research feedback, change of organizational operating models and ecosystems, and encouraging a co-creation culture. Creating sustainable value is the heartbeat of the new model. Focus on transformational & performance culture in the organization provides a flexible & adaptive environment for model adoption (Source: EFQM 2020 booklet and www.efqm.org).

8.3.1 Evolution of the Fundamental Concepts of Excellence

The initial eight components of 'fundamental concepts of excellence' were built on the foundation of basic human rights, with an assumption of universal application, which could be used for achieving sustainable excellence in any organization. It outlined the attributes of excellent organizational culture to serve as a common language for top management. However, now the model is oriented towards the emerging trends and challenges faced by the community and organizations. In the subsequent years as the model developed, the concepts moved beyond simple high-level statements until these changes ended up with a duplication of bullet points between the criteria and the concepts, which started confusing the process of assessment and ambiguity in rating by the assessor community. Table 8-1 highlights the evolution of the fundamental concepts of excellence.

Table 8-1: Evolution of Fundamental Concepts of Excellence

Second Phase (2000-02)	Third Phase (2003-2010)	Fourth Phase (2011-2018)	Progression of the Fundamental Concepts
Results orientation	Achieving balanced results	Creating a suitable future	The model shifted from simple results to involve all the stakeholders. The new model focuses on investing in the future than just addressing the present (short term goals)
Customer focus	Adding value for customers	Adding value for customers	The initial thrust of customer focus shifted to proactively adding value to the customer
Leadership and constancy of purpose	Leading with vision, inspiration & integrity	Leading with vision, inspiration & integrity	The model started with leaders defining a purpose and adhering to it. It later matured to lead with the future in mind, retaining the purpose for which the company was established and working within a framework of core values.
Management by processes and facts	Managing by processes	Managing agility	Began with process management and using data for analysing issues, moved to control excellence by managing at the process level and eventually is focusing on the agility of processes adapting to the changes in the ecosystem of the business.
People development and involvement	Succeeding through people	Succeeding through talents	Started with a focus on developing people and communicating the strategy to involve them. It moved to motivate people to deliver results. The current expectation is to focus on the talent of the people and use them to succeed.
Partnership development	Building partnerships	Developing organizational capability	Began with organizations owning the responsibility to build capability for the partners. Moved from a supplier-customer relationship (which was transactional in nature) to encouraging partnerships that would make the partner align and proactively work towards the organisation success. The current focus on developing creating a seamless organisation among the partnerships
Corporate social responsibility	Taking responsibility for a sustainable future	Sustaining outstanding results	Started with a drive to bring CSR as a part of the business focus, moved to expanding the commitment to sustainability and ensuring the business strategies are aligned to global sustainability initiatives.
Continuous learning, innovation & improvement	Nurturing creativity & innovation	Harnessing creativity & innovation	The initial focus was on the continuous development of the team for performance improvement. Moved to nurturing creativity among the individuals in the team and eventually to the building of an ecosystem to make use of the creativity of individuals to enhance business performance

Base Source: Adapted from www.efqm.org

The fundamental concepts were creating confusion among the assessors and applicant organisations and were not being used effectively in the assessment process; hence these are removed in the new version of 2020. Based on the researcher's assessment experience, the assessors used the fundamental concepts to structure the executive summary of their feedback reports.

In the initial phase, the model had 25 enabler criteria. It was refined to 24 enablers in the second, third and fourth phases and in version 2020, the criteria are revised to 23. In the case of the results category, the number of sub-criteria changed from 4 to 8 and the current version of the model has only 2 sub-criteria. The sub-criteria 6.b, 7.b, 8.b & 9.b are covered in the new criterion-7. The new model focuses on the futuristic growth and execution of the plan. The results are focused on strategic goals, performance to satisfy its key stakeholders, future performance sustainability, etc. Table 8-2 shows a summary of changes over different phases.

Table 8-2: Number of sub-criteria of EFQM model in five phases

Category	Initial phase (1991-99)	Second phase (2000-02)	Third phase (2003-2010)	Fourth phase (2011-2018)	Fifth phase (2019 onwards)
Enablers	25	25	24	24	23
Results	4	8	8	8	2
Total	29	33	32	32	25

8.3.2 Evolution of Assessment and Criteria Weightage

Each sub-criterion assessment is done on the 0-100 scale to arrive at the consensus score as a part of the assessment process. However, weightage was attached to each criterion. The weightage between enabler criteria and results criteria was equally distributed till 2019 with each carrying 500 points. In the 2020 model, the enabler contribution has gone up to 600 points and the results contribution has come down to 400. The enablers would

play a major role in achieving the results, results are post facto. What matters most is that the organization knows why it exists and whom it serves (customers). The organizations are to focus on creating a culture of success and delivering the best sustainable value. Table 8-3 shows the evolution of scoring over phases.

Table 8-3: Evolution of scores over the phases

Phase	Criteria Number in the Model								
	1	2	3	4	5	6	7	8	9
Initial Phase (1999-99)	100	80	90	90	140	200	90	60	150
Second Phase (2000-02)	100	80	90	90	140	200	90	60	150
Third Phase (2003-10)	100	80	90	90	140	200	90	60	150
Fourth Phase (2011-18)	100	100	100	100	100	150	100	100	150

Note: * The criteria names remain the same till the fourth phase, however, in the new model, the criteria are reduced to 7 from 9. Hence, one-to-one comparison based on the criteria names is not possible.

Criterion-1 is leadership and direction setting and its score remains 100. Criterion-2, which addresses the strategy or policy of the organization, weightage improved from 80 to 100 points over the years. Criterion-3 moved from 90 to 100 points. The weightage of criterion-4 has moved from 90 to 200 in the recent version. Even though the model construct is not comparable one on one. Criterion-5 is focused on process management, and its contribution decreased from 140 to 100. In the new version, the elements of the process management are considered as fundamental expectations and no specific criterion exists. Criterion-6 weight dropped from 140 to 100 and again increased to 200. The model has always endeavoured to be non-prescriptive, and the new model promotes even greater flexibility in thinking. However, it does outline certain expectations about management systems, governance, the link between direction and execution, etc.

In the earlier constructs, the model had four result categories: customer, people, society, and business results. Under each of these categories, the model had two sub-criteria to

fulfil. One of the sub-criteria results across all four categories indicated the performance. And second was related to the perception data of people, society and customers. In the case of business results, feedback from key stakeholders about their personal experience of dealing with the organization used to be recorded as perception. This includes customer, people, business & governing stakeholders, society, partners & suppliers. Criterion-7 focuses on strategic and operational performance to measure the ability to fulfil its purpose, deliver the strategy, and create sustainable value, and its fitness for the future. In all the phases, the total score stands at 1000.

8.4 DEEP-DIVE ANALYSIS OF EFQM 2012 AND 2020 MODELS

The EFQM 2012 model construct is used as a basis to compare the EFQM 2020. The guidance points of EFQM model 2012 are mapped to EFQM 2020. Many of these guidance points are directly linked to the fundamental concepts referred to in the 2012 version. Table 8-4 explains the EFQM 2020 sub-criteria description. The guidance points are used as guidance for assessment but are not mandatory. These provide examples and characteristics of organisations that have achieved a certain degree of excellence. The 119 guidance points are for enablers and 53 guidance points are for the results criteria. In this chapter, the author has focused on the mapping of GP of enablers at sub-criteria level. Comparison is based on the keyword-driven description of the guidance points. For example, sub-criteria of EFQM 2012 model states “Leaders develop the mission, vision, values and ethics and act as role models”. For this sub-criterion, there are four GPs (Figure 8-7). The keywords from each GP and the expectations from GP are mapped to the new model. This GP has been mapped to “Define purpose and vision” GP1.1 in EFQM 2020 model. The GPs of 2012 model are mapped to the new model. It is called forward mapping as shown in Figure 8-8 and shows the criteria description for both the models.

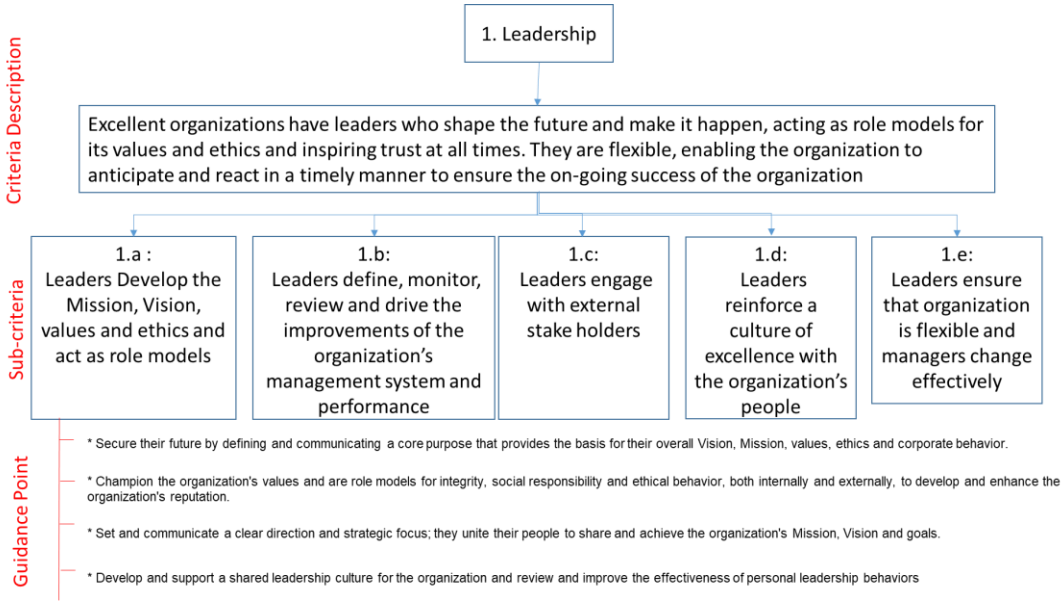


Figure 8-7: Drill down of criteria to guidance point – an example

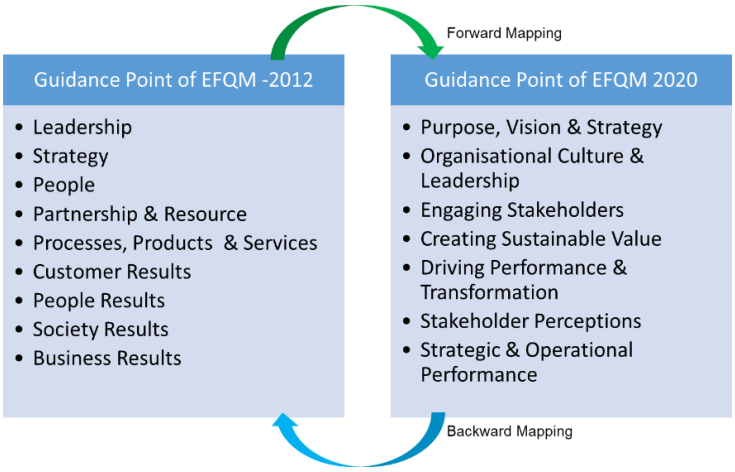


Figure 8-8: Deep dive of the EFQM model 2012 and 2020

APPENDIX A-1 provides information on EFQM sub-criteria and guidance point information explains the description of the sub-criteria, the guidance point of the EFQM 2012 model. A matrix of 127 x 29 is generated keeping the 2012 guidance points as a base and comparing against the guidance points listed in 2020 model. A simplified presentation of complete mapping of the 2012 model to 2020 model is depicted in Table 8-5. The rows in the table represent the sub-criteria no of EFQM 2020, the first two column in the table represents the sub-criteria and guidance point of EFQM 2012. The mark of "I" in matrix refers to the existence of linkage between the criteria of the 2012

model to the 2020 model. Fonseca *et al.* (2021) adopted a similar kind of approach and the results are comparable. However, the current research also establishes further analysis by forward and backward mapping and results as presented in the next section.

Table 8-4: EFQM 2020 sub-criteria description

Criteria No	Criteria Description
1.1	Define purpose and vision
1.2	Identify & understand stakeholder needs
1.3	Understand the ecosystem, own capabilities & major challenges
1.4	Develop strategy
1.5	Design & implement a governance & performance management system
2.1	Steer the organisation's culture & nurture values
2.2	Create the conditions for realising change
2.3	Enable creativity & innovation
2.4	Unite behind & engage in purpose, vision & strategy
3.1	Customers: build sustainable relationships
3.2	People: attract, engage, develop & retain
3.3	Business & governing stakeholders - secure & sustain ongoing support
3.4	Society: contribute to development, well-being & prosperity
3.5	Partners & suppliers: build relationships & ensure support for creating sustainable value
4.1	Design the value & how it is created
4.2	Communicate & sell the value
4.3	Deliver the value
4.4	Define & implement the overall experience
5.1	Driver performance & manage risk
5.2	Transform the organisation for the future
5.3	Drive innovation & utilise technology
5.4	Leverage data, information & knowledge
5.5	Manage assets & resources
6.1	Customer perception results
6.2	People perception results
6.3	Business & governing stakeholders perception results
6.4	Society perception results
6.5	Partners & suppliers perception results
7.1	Achievements in delivering its purpose and creating sustainable value
7.2	Financial performance
7.3	Fulfilment of key stakeholders
7.4	Achievements of strategic objectives
7.5	Achievements in driving performance
7.6	Achievements in driving transformation
7.7	Predictive measures for the future

Table 8-5: Matrix of EFQM 2012 criteria mapping to EFQM 2020 criteria

S/C	GP	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	7.0	Total
1.a	GP1	1																													1
1.a	GP2						1			1																					2
1.a	GP3	1					1			1																					3
1.a	GP4						1																								1
1.b	GP5		1		1																										2
1.b	GP6			1																											1
1.b	GP7	1		1																											2
1.b	GP8			1																			1								2
1.b	GP9					1														1											2
1.c	GP10		1		1																										2
1.c	GP11						1			1																					2
1.c	GP12					1	1						1	1																	4
1.c	GP13					1	1																								2
1.c	GP14													1																	1
1.d	GP15						1	1	1	1																					4
1.d	GP16									1																					1
1.d	GP17											1																			1
1.d	GP18						1					1																			2
1.d	GP19							1	1																						2
1.d	GP20						1					1																			2
1.e	GP21			1		1															1		1								4
1.e	GP22																														0
1.e	GP23									1																					1
1.e	GP24							1													1										2
1.e	GP25																														0
1.e	GP26																														0
2.a	GP27		1		1			1															1								4
2.a	GP28			1	1																		1								3
2.a	GP29				1	1		1																							3
2.a	GP30			1				1														1	1								4
2.b	GP31			1	1																										2
2.b	GP32			1											1								1								3
2.b	GP33				1																1	1									3
2.b	GP34								1																						1
2.c	GP35				1	1																									2
2.c	GP36				1																										1
2.c	GP37				1	1			1											1											4
2.c	GP38			1					1											1											3
2.c	GP39								1																						1
2.d	GP40																				1										1
2.d	GP41					1														1											2
2.d	GP42																				1	1									2

S/C	GP	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	7.0	Total
2.d	GP43				1																										1
2.d	GP44			1		1			1																						3
2.d	GP45									1			1																		2
3.a	GP46					1														1	1										3
3.a	GP47																				1										1
3.a	GP48																														0
3.a	GP49											1																			1
3.a	GP50											1																			1
3.a	GP51																														0
3.b	GP52											1																			1
3.b	GP53											1																			1
3.b	GP54											1																			1
3.b	GP55											1																			1
3.b	GP56																														0
3.c	GP57									1		1																			2
3.c	GP58				1				1																						2
3.c	GP59								1																						1
3.c	GP60													1																	1
3.c	GP61													1																	1
3.d	GP62																														0
3.d	GP63									1																					1
3.d	GP64																						1								1
3.d	GP65								1																						1
3.e	GP66											1																			1
3.e	GP67						1		1																						2
3.e	GP68								1			1																			2
3.e	GP69						1		1			1																			3
3.e	GP70						1		1			1																			3
4.a	GP71														1																1
4.a	GP72														1																1
4.a	GP73														1																1
4.a	GP74														1																1
4.a	GP75														1																1
4.b	GP76																							1							1
4.b	GP77																							1							1
4.b	GP78																							1							1
4.b	GP79					1							1											1							3
4.b	GP80																							1							1
4.c	GP81																							1							1
4.c	GP82																			1				1							2
4.c	GP83																							1							1
4.c	GP84																			1				1							2
4.c	GP85																														0
4.d	GP86																					1									1

S/C	GP	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	7.0	Total
4.d	GP87																					1									1
4.d	GP88																					1									1
4.d	GP89																					1									1
4.d	GP90								1													1									2
4.e	GP91					1																	1								2
4.e	GP92																						1								1
4.e	GP93								1	1													1								3
4.e	GP94																						1								1
4.e	GP95								1														1								2
4.e	GP96																						1								1
5.a	GP97															1															1
5.a	GP98															1															1
5.a	GP99															1															1
5.a	GP100															1															1
5.a	GP101								1							1															2
5.b	GP102															1															1
5.b	GP103									1						1															2
5.b	GP104										1					1															2
5.b	GP105															1															1
5.c	GP106										1																				1
5.c	GP107										1						1														2
5.c	GP108																1	1													2
5.c	GP109																1														1
5.d	GP110																	1													1
5.d	GP111																	1													1
5.d	GP112																	1	1												2
5.d	GP113															1		1													2
5.d	GP114								1							1		1													3
5.e	GP115										1																				1
5.e	GP116										1								1												2
5.e	GP117										1								1												2
5.e	GP118										1								1												2
5.e	GP119										1								1												2
6.a	GP120																								1						1
6.b	GP121																													1	1
7.a	GP122																									1					1
7.b	GP123																													1	1
8.a	GP124																										1				1
8.b	GP125																													1	1
9.a	GP126																											1		1	2
9.b	GP127																													1	1
Total GP		3	3	10	12	12	12	6	19	11	8	14	3	4	6	11	3	6	5	7	7	8	13	9	1	1	1	1	0	5	201

Table 8-6: Summary of cross-mapping at sub-criteria level

EFQM 2012 Sub-criteria guidance Influence on EFQM 2020				**Adoption in EFQM 2020**			
Sub-criteria of EFQM 2012	No of Guidance Points (A)	No of Guidance points mapped to EFQM 2020 (B)	Ratio (B/A)	Sub-criteria of EFQM 2020	No of New Guidance Points (C)	No of Guidance points mapped to sub-criteria of 2020 (D)	Ratio (D/C)
1.a	4	7	1.8	1.1	5	3	0.6
1.b	5	9	1.8	1.2	5	3	0.6
1.c	5	11	2.2	1.3	5	10	2.0
1.d	6	12	2.0	1.4	5	12	2.4
1.e	6	7	1.2	1.5	5	12	2.4
2.a	4	14	3.5	2.1	6	12	2.0
2.b	4	9	2.3	2.2	5	6	1.2
2.c	5	11	2.2	2.3	6	19	3.2
2.d	6	11	1.8	2.4	5	11	2.2
3.a	6	6	1.0	3.1	8	8	1.0
3.b	5	4	0.8	3.2	6	14	2.3
3.c	5	7	1.4	3.3	6	3	0.5
3.d	4	3	0.8	3.4	4	4	1.0
3.e	5	11	2.2	3.5	4	6	1.5
4.a	5	5	1.0	4.1	5	11	2.2
4.b	5	7	1.4	4.2	4	3	0.8
4.c	5	6	1.2	4.3	4	6	1.5
4.d	5	6	1.2	4.4	5	5	1.0
4.e	6	10	1.7	5.1	5	7	1.4
5.a	5	6	1.2	5.2	5	7	1.4
5.b	4	6	1.5	5.3	5	8	1.6
5.c	4	6	1.5	5.4	6	13	2.2
5.d	5	9	1.8	5.5	4	9	2.3
5.e	5	9	1.8	6.1	1	1	
6.a		1		6.2	1	1	
6.b		1		6.3	1	1	
7.a		1		6.4	1	1	
7.b		1		6.5	1	0	
8.a		1		7.1	1	5	
8.b		1					
9.a		2					
9.b		1					
Total	**119**	**201**			**124**	201	

Note: For the results category, one to one mapping of guidance points is not feasible, hence it is not considered

The ratio column indicates the magnitude of the interaction between available guidance point to total interaction against the model. To infer meaningful results of the empirical study, the ratio and results are depicted in Table 8-6. The EFQM 2012 criteria are classified based on the influence on EFQM 2020 as high (ratio more than 2), moderate

(ratio between 1 and 2) or low influence (ratio less than 1). 'Strategy and business result' criterion has a high influence while framing the EFQM 2020 model. Whereas the remaining seven criteria (except strategy and business results) have a moderate influence on EFQM 2020. Sub-criteria like 1.c, 2.a, 2.b, 2.c, 3.e, 9.a & 9.b have high influence on EFQM 2020 construct based on analysis presented in the previous section. Sub-criteria 3.a, 3.b, 3.d and 4.a have low influence on EFQM 2020 model. The remaining sub-criteria are having a moderate influence on the new model construct. The Table 8-7 represents the inference table of EFQM 2012 on EFQM 2020.

Table 8-7: Inference table of EFQM 2012 on EFQM 2020

EFQM 2012 criterion	Less Influence (Ratio ≤ 1.0)	Moderate Influence (1.0 < Ratio ≤ 2.0)	High Influence (Ratio > 2.0)	Influence on EFQM 2020 model
Leadership	---	1.a, 1.b, 1.d 1.e	1.c	Moderate
Strategy	---	2.d	2.a, 2.b,2.c	High
People	3.a,3.b, 3.d	3.c	3.e	Moderate
Partnership & Resource	4.a	4.b, 4.c, 4.d, 4.e	---	Moderate
Product, Process & Services	---	5.a, 5.b, 5.c,5.d,5.e	---	Moderate
Customer Results	---	6.a, 6.b	---	Moderate
People Results	---	7.a, 7.b	---	Moderate
Society Results	---	7.a, 7.b	---	Moderate
Business Results	---	---	9.a, 9.b	High
No. of sub-criteria	4	21	7	Moderate

Table 8-8: Adoption of guidance points of EFQM 2012 in EFQM 2020

EFQM 2020 criterion	**Low Influence** (Ratio ≤ 1.0)	**Moderate Influence** (1.0 < Ratio ≤ 2.0)	**High Influence** (Ratio > 2.0)	Adoption of Guidance points from EFQM 2012 to EFQM 2020
Purpose, Vision & Strategy	1.1, 1.2	1.3	1.4, 1.5	High
Organisational Culture & Leadership		2.1, 2.2	2.3, 2.4	High
Engaging Stakeholders	3.1, 3.3, 3.4	3.5	3.2	Moderate
Creating Sustainable Value	4.2, 4,4	4.3	4.1	Moderate
Driving Performance & Transformation		5.1, 5.2, 5.3	5.4, 5.5	High
Stakeholder Perceptions *		6		Moderate
Strategic & Operational Performance *		7		Moderate
No of sub-criteria	7	10	8	Moderate

* Guidance level mapping not possible, assessed based on expert judgement

Similarly, an analysis is carried out for the adoption of guidance points to the EFQM 2020 model from the EFQM 2012 model. Table 8-8 provides a summary of the adoption of guidance points from EFQM 2012 in EFQM 2020. Criterion-1 (Purpose, Vision & Strategy) and criterion-2 (Organisational culture & leadership) and criterion-5 (Driving performance & transformation) have received high adoption from EFQM 2012. The remaining criteria have got moderate adoption from the EFQM 2012. It appears that the 'Engaging stakeholders' criterion has got the least adoption from EFQM 2012. Sub-criteria 1.4, 1.5, 2.3, 2.4, 3.2, 4.1 & 5.4 of EFQM 2020 have maximum adoption, and sub-criteria1.1, 1.2, 3.1, 3.3, 3.4, 4.2, & 4, 4 have got the least adoption.

8.4.1 Inferences from Deep-Dive Analysis

Following inferences can be drawn from the deep-dive analysis:

Model Direction, Construct and Framework

- The official title of the model is changed to "The EFQM Model" in 2020 from "The EFQM Excellence Model". According to EFQM forum communication, in Europe, the contributors and industry leaders felt that the term "Excellence" is seen as old-fashioned, and any initiative can be managed by the quality or business excellence manager. The model has become more generic with widespread applications. Even though the model has changed from excellence to broader perspective, the EFQM model would face challenges in establishing its identity in the quality world.
- The new model adopts eco-system as a keyword, yet the definition of eco-system is not clearly defined. It is expected that the adopting organisations would create an eco-system suitable for the organisation and integrate it to arrive at the desired outcomes.

- The EFQM model was based on the benchmark concerning the excellent organisation. The new model appears to be self-driven, vision-based, and fit for purpose. At the outset, the model moved away from the EFQM excellence model to a framework for the transformational / organisational governance model.
- The construct of the model has changed significantly from nine criteria to seven criteria and sub-criteria dropped to 25 from 32. Well settled constructs of five enablers and four results categories are dislodged and the names of criteria have changed.
- Creating sustainable value is the heartbeat of the new model. The model has emphasized more on stakeholder expectations. The capturing and prioritisation of stakeholder expectations are focused, and a strategy based on the monitoring of these expectations is developed. Each stakeholder community has its priorities to drive the organisation to the next level. It would be a challenge to manage the stakeholder expectations and prioritisation could be a major challenge for organisations in managerial applications of the model.
- For many years, 'fundamental concepts of excellence' used to be the fulcrum of the model and these are dropped from the EFQM 2020. It is a good sign. In the past, the fundamental concepts were not effectively used in the assessment process and it was confusing to the assessors and applicant organisations.
- The 2012 model provides articulation of the guidance points and examples of excellent organisation but the new model appears to be more broader perspective.
- The model construct has assumed pre-conditions of strategy, people management, and process management. It appears that these factors are assumed to be pre-existing and are basics for good organisations. It could be a danger for the adoption of the model and managerial application could be an issue.

Criteria Related

- The broad level construct of the model consists of direction, execution, and results. It is easy to remember; however, it would take some time to register the next level construct.
- In the new model, linkage to strategy for operationalisation is not clearly articulated. Even though the model is transformational, the transformational topics are dealt with very late in criteria 5.2. If an organisation needs to focus on a transformational topic, it must start at the vision level and then move to strategy. The linkage is not established for transformation initiatives in the organisation. This could lead to a major issues if a strategy is not properly tied together with technology strategies and transformational strategies.
- The model has been transformation focussed and futuristic driven. This could help an organisation to focus on Industry 4.0 adoption based on creating sustainable value to the stakeholders.
- In the previous versions, the technology focus (4.d) and leadership challenges were addressed as two separate sub-criteria. In the new model, transformational leadership appears to be more emphasised. However, the sub-criterion 4.d, which dealt with technology has not been given suitable importance in the new construct of the model.
- The previous model had focused on the periodic review of strategy, leadership effectiveness, and communication strategy as the essential elements for marching towards excellence or transformational initiative. However, in the new model it is either completely ignored or due importance is not provided. In the new model, "convey" words are used to manage communication in the organization. The convey does not fully address the communication strategy, timeliness and channel

of communication in the organization. It may not be good enough to handle the expectations of communication strategy.

- Competency or skill development is one of the less focused topics in most of the organizations. In a transformational organisation, this would be a key topic to address as a strategy but has not received adequate importance in the new model. Modern organisations would suffer due to the lack of internal competency and organisational structure. Going forward, in industry 4.0 or digital factory, CIO would play a major role than the COO.
- It appears that resource planning, organisational structural change, perception of people in the organisation, connecting to strategy, preparedness for change, and competency development of people are less focused in the new model. These topics are the foundation for a transformational organisation.
- The new model replaces the criterion 'Products, Processes and Services' with sustainable value. It appears to be generic, and the scope is broad. However, most of the guidance points of the criterion have been adopted in the new model.
- The construct of the result criterion-6 (stakeholder perceptions) appears to be well thought of. However, criterion-7 (strategic & operational performance) appears to be more generic and it may create more confusion during the assessment process including the self-assessment.
- It appears that the new model overemphasizes creativity and innovation as there are more than eight references in the guidance points.

RADAR, Scores and Assessment process

- The RADAR logic is slightly fine-tuned but it would take some time for the assessors to settle down in the new attributes.

- The scores distribution ratio between enablers and results is changed from 50:50 to 60:40. It indicates that the new model is focusing more on enablers to obtain the desired outcomes or results. The cause and effect links are much more visible in the new model.
- The assessment process appears to be judgement driven based on the competence or knowledge of the assessment team. This could be a risky proposition to manage any administration of the award process. In a system driven assessment, conducting awards based on the subjective assessment may lead to operational issues.
- In the new model, 'partnership & supplier perception' results are one of the key result parameters. It is a good move to get the partner(s) feedback in the new global business environment.
- The fulfilment of key stakeholder expectations is one of the major constituents of the new model. The EFQM model does not clearly describe the stakeholders. In the previous version, customer, society, and people were identified as stakeholders and the related performance and perceptions measured. In the new model, the framework does not specify the stakeholders. As per the EFQM model, for some organisations, it was not completely relevant to place stakeholders in the boxes of customers, people and society. Under the new model, the organisation is expected to consider which stakeholders are the most important (Key) in the context of its purpose, vision, and strategy, and ensure that the perceptions of these stakeholders are measured. The achievement of the strategic objective, driving performance, driving transformation, and predictive measure for the future metrics are at a very high level in the result criteria and left to the applicant

organisation and assessors to judge. This would create ambiguity while assessing and will be based on the judgemental ability of the assessors.

8.5 RELATIONSHIP BETWEEN EFQM 2020 AND INDUSTRY 4.0

Before analysing the relationship, it is necessary to understand a few key topics of Industry 4.0 (I4.0). The term Industry 4.0 was coined in 2011 by a group of representatives from different fields in Germany to enhance the competitiveness of their manufacturing sector. The idea was adopted by the federal German government as a part of their high-tech strategy for 2020.

According to Infopulse (www.infopulse.com), the Fourth Industrial Revolution or Industry 4.0 is an umbrella term that refers to changes happening in the industrial value chain process. These changes are powered by emerging technologies, offering a better way to organize and manage all standard processes (prototyping, development, production, logistics, supply, etc.) within the manufacturing industry. Industry 4.0 refers to a new phase of the industrial revolution that focuses heavily on interconnectivity, automation, machine learning, and real time data. It has also been referred to as smart manufacturing/factories or digital manufacturing. The I4.0 creates a more holistic and better-connected ecosystem for businesses to focus on manufacturing and supply chain management.

Industry 4.0 has emerged due to the emphasis of digital technologies on businesses. It connects the physical & digital, allowing for better collaboration and access among departments, partners, suppliers, products, and people. Industry 4.0 enhances automation and connectivity with cyber physical systems (CPS). The full-fledged industry 4.0 would involve machine-to-machine communication (M2M) and the integration of internet of things (IoT) for increased automation, improved communication, self-monitoring, and

self-production on smart machines. These technologies are being used to analyse and diagnose issues without the need of human interventions. Žižek et al. (2020) deliberated on the concept of I4.0 based on Lasi *et al.* (2014).

These days research is being carried out on multiple aspects of Industry 4.0 and since it is a contemporary research topic, several new ways of thinking are being evolved. The Critical Success Factors (CSFs) are variables or circumstances necessary to enable a positive outcome for a business program or strategy. These factors would influence the outcome of the practices, strategy or implementation of a business process. Typically, the CSFs would be more of enablers who help in realising the outcomes. The outcomes consist of results realised from the enablers. Table 8-9 shows the key research carried out with respect to critical success factors of Industry 4.0.

Table 8-10 indicates the CSFs identified by the respective literature paper and maps these CSFs to EFQM 2020 criteria. One of the CSFs identified by the peer authors is "Communication with employees regarding I4.0 implementation". This factor is identified by two authors in their research. This enabler or CSF is mapped to EFQM 2020 sub-criteria "Develop Strategy" and sub-criteria number 1.4 and guidance point 3. The guidance point refers to "Involves key stakeholders in defining the strategy to enable subsequent engagement, deployment and communication". Industry 4.0 will be a strategic initiative or objective, which requires a strategy to deploy this. The "communication and involving the stakeholder" CSF maps to guidance point 3. A similar approach is taken for all other CSFs and the results are presented in Table 8-10

Table 8-9: A literature review of Industry 4.0 Critical Success Factors

Sl No	Literature	No of the factors identified for successful implementation of Industrial 4.0	Approach / Research Summary
1	Bhatia and Kumar (2020)	**14 factors** (Organization leadership, information system and technology infrastructure, financial aspects, external support, data governance, collaboration and teamwork, involvement of workforce, strategic integration, legal aspects, operational performance, product performance, economic performance and responsiveness)	Empirically established the CSFs for implementing I4.0. The relationships between CSFs and performance outcomes are examined by regression analysis
2	Jabbour et. al. (2018)	**11 factors** (Management leadership, readiness for organisational change, top management commitment, strategic alignment, training and capability building, empowerment, teamwork and the implementation team, organisational culture, communication, project management and national culture & regional differences)	Evaluated the effect on environmentally sustainable manufacturing.
3	Peter (2018)	**6 factors** (Business benefits, strategic alignment, business process focus, operating model changes, capability uplift and end-to-end security)	The white paper highlights the six key CFSs and the relevance of the implementation.
4	Shinohara et. al. (2017)	**4 Main factors and 34 sub-factors** Technical, organizational, project management, and externals.	CSFs influence in an automotive assembly factory are identified.
5	Marnewick and Marnewick (2019)	**6 factors** (Leadership, change, organisational agility, empowerment, collaboration and teamwork, and project management)	Focus on the leadership styles which are appropriate for the implementation of the new technologies.
6.	Bolatan and Gözlü (2019)	**9 factors** (Strategic vision, organizational structure, horizontal integration in value chain, vertical integration, information system and technology infrastructure, smart factories, big data management, qualified workforce structure and security	Identification of the CSFs for transition to Industry 4.0.

Table 8-10: Industry 4.0 Critical Success Factors' mapping to EFQM 2020

Critical Success Factor	Sub-Factors	Bhatia and Kumar (2020)	Lopes et al. (2018)	Klement (2018)	Carolina et al. 2017	Marnewick and Marnewick (2019)	Bolatan and Gözlü (2019)	Total Occurrences	Criteria No	Criteria description	Guidance Point
Organization Leadership Commitment	Support and commitment of top management	✕	✕		✕	✕		4	2.1 to 2.4	Steer the organisation culture & nurture values, create the conditions for realising change, enable creativity & innovation, unite behind & engage in purpose, vision & strategy	Full
	Transformational leadership style	✕	✕		✕			3	5.2	Transform the organisation for the future	1
	Communication with employees regarding I4.0 implementation	✕	✕					2	1.4	Develop strategy	3
	Reviewing the progress of the implementation		✕					1	1.5	Design & implement a governance & performance management system	1
Organisational structure	Setting up organisations suitable for I4.0						✕	1	5.2	Transform the organisation for the future	3
Strategic Alignment	Organisation strategy to IT road map alignment		✕	✕			✕	3	1.4	Develop strategy	1 &2
	Technology road map		✕	✕	✕			3	1.4	Develop strategy	1&2
	Customer expectations and experience			✕	✕		✕	3	4.4	Define & implement the overall experience	1
	Operating model of the business / dynamic design of business process / engineering			✕				1	1.4 & 5.2	Develop strategy, transform the organisation for the future	4&5
	Operational excellence expectations			✕				1	5.1	Driver performance & manage risk	4
Information System and Technology Infrastructure	Industrial internet for I4.0 Implementation	✕			✕			2	5.1	Driver Performance & Manage Risk	1,5
	Implementation of cyber physical system	✕			✕		✕	3	5.1	Driver Performance & Manage Risk	1,5
	Creation of SMART networks	✕			✕		✕	3	5.1	Driver Performance & Manage Risk	1,5

Critical Success Factor	Sub-Factors	Bhatia and Kumar (2020)	Lopes et al. (2018)	Klement (2018)	Carolina et al. 2017	Marnewick and Marnewick (2019)	Bolatan and Gözlü (2019)	Total Occurrences	Criteria No	Criteria description	Guidance Point
	Implementation of technologies such as additive manufacturing, cloud computing, etc.	×			×		×	3	5.1	Driver Performance & Manage Risk	1,5
	Appropriate IT infrastructure to capture, store and analyse data	×	×		×		×	4	5.4	Leverage Data, Information & Knowledge	1 to 6
	Information security practices		×	×	×		×	4	1.5	Design & Implement a Governance & Performance Management System	5
Financial aspects	Investment in the latest equipment	×					×	2	5.5	Manage Assets & Resources	1
	Availability of financial resources for I4.0 implementation	×						1	5.5	Manage Assets & Resources	1
External Support	Support by academic researchers for implementing I4.0 technologies	×						1	3.5	Partners & Suppliers: Build Relationships & Ensure support for Creating Sustainable Value	1
	Support by consultants for implementing I4.0 Technologies	×						1	3.5	Partners & Suppliers: Build Relationships & Ensure support for Creating Sustainable Value	1
	Strong support from government to implement I4.0 technologies	×						1	5.2	Transform the Organisation for the Future	
Data Governance	Comprehensive collection of data	×			×		×	3	5.4	Leverage Data, Information & Knowledge	1 to 6
	Regular use of available company data	×			×		×	3	5.4	Leverage Data, Information & Knowledge	1 to 6
	Exploitation of data and simulation tools	×			×			2	5.3	Drive Innovation & Utilise Technology	1
Collaborating and teamwork	Proper collaboration among supply chain members	×						1	3.5	Partners & Suppliers: Build Relationships & Ensure support for Creating Sustainable Value	1
	Sharing of information between the supply chain members	×						1	3.5	Partners & Suppliers: Build Relationships & Ensure support for Creating Sustainable Value	3

Critical Success Factor	Sub-Factors	Bhatia and Kumar (2020)	Lopes et al. (2018)	Klement (2018)	Carolina et al. 2017	Marnewick and Marnewick (2019)	Bolatan and Gözlü (2019)	Total Occurrences	Criteria No	Criteria description	Guidance Point
	Team work to achieve common objectives	×				×		2	2.4	Unite behind & Engage in Purpose, Vision & Strategy	4
Involvement of workforce/ Organisational Change management	Imparting proper training and skills to the employees/Competency Development	×	×	×		×		4	3.2	People: Attract, Engage, Develop & Retain	3
	Employee empowerment that allows them to have autonomy and be innovative	×	×	×	×	×		5	3.2	People: Attract, Engage, Develop & Retain	4
	Managing the change management		×			×		2	2.2	Create the conditions for Realising Change	3
	Communication strategy	×	×					2			
Strategic integration	Integration of industrial internet and production machines	×						1	5.3	Drive Innovation & Utilise Technology	2.3
	Strategic alignment between adoption of new technologies and desired objectives	×						1	5.3	Drive Innovation & Utilise Technology	4
	Integration of customers in design and manufacturing processes	×			×			2	4.1	Design the Value & how it is created	1,2
Legal aspects	Improved IT security and standards	×			×			2	1.5	Design & Implement a governance & Performance Management system	5
	Legislative regulations on I4.0 implementation	×			×			2	1.5	Design & Implement a governance & Performance Management system	5
Project management	Assign a project champion for the project		×		×	×		3	2.2	Create the conditions for Realising Change	5
	Establish a project management team		×		×			2	5.2	Transform the Organisation for the Future	3
	Establish a common objective for the project team		×		×	×		3	5.2	Transform the Organisation for the Future	3
Organisational Culture	Encourage problem solving culture during new technology adoption		×					1	2.2	Create the conditions for Realising Change	5

Critical Success Factor	Sub-Factors	Bhatia and Kumar (2020)	Lopes et al. (2018)	Klement (2018)	Carolina et al. 2017	Marnewick and Marnewick (2019)	Bolatan and Gözlü (2019)	Total Occurrences	Criteria No	Criteria description	Guidance Point
	Focus on Environmental stewardship			×				1	3.4	Society: Contribute to development, well-being & prosperity	1
	Work place health and safety practices			×				1			
National culture and regional differences	Cultural differences which would impact the I4.0 initiatives		×					1	2.1	Steer the Organisation's Culture & Nurture Values	1
Horizontal and Vertical integrations	Alignment with vendors and suppliers				×		×	2	3.5	Partners & Suppliers: Build Relationships & Ensure support for Creating Sustainable Value	2
	Cross company data integration. Horizontal and vertical IT integrations				×		×	2	3.5	Partners & Suppliers: Build Relationships & Ensure support for Creating Sustainable Value	3
Operational Performance	Increase in productivity	×						1	7	Strategic & Operational Performance	
	Increase in efficiency of manufacturing processes	×						1	7	Strategic & Operational Performance	
	Increase in flexibility of production processes	×						1	7	Strategic & Operational Performance	
	Reduction in Product delivery time	×						1	7	Strategic & Operational Performance	
	Reduction in machine downtimes	×						1	7	Strategic & Operational Performance	
	Increase in visualization and control of processes	×						1	7	Strategic & Operational Performance	
	Increase collaboration in operation	×						1	7	Strategic & Operational Performance	
Product Performance	Improved product quality	×						1	6.1	Customer Perception Results	1
	Improved product customisation	×						1	6.1	Customer Perception Results	3,4
	Production of highly customised products at low volume	×						1	6.1	Customer Perception Results	3,4
Economic Performance	Better consumption of resources	×			×			2	7	Strategic & Operational Performance	

Critical Success Factor	Sub-Factors	Bhatia and Kumar (2020)	Lopes et al. (2018)	Klement (2018)	Carolina et al. 2017	Marnewick and Marnewick (2019)	Bolatan and Gözlü (2019)	Total Occurrences	Criteria No	Criteria description	Guidance Point
	Reduction in operational costs	x			x			2	7	Strategic & Operational Performance	
	Reduction in production costs	x			x			2	7	Strategic & Operational Performance	
Responsiveness	Reduction of product launch time	x			x			2	7	Strategic & Operational Performance	
	improved response to demands of customers	x						1	7	Strategic & Operational Performance	
	Enabled last minute changes in production processes	x						1	7	Strategic & Operational Performance	
	Enhanced sharing of information	x						1	7	Strategic & Operational Performance	

Note: X denotes the mapping to these topic and author.

Table 8-11 shows that 18 sub-criteria of EFQM 2020 maps to Industry 4.0. However, sub-criteria 1.1, 1.2, 1.3, 3.1, 3.3, 4.2, 4.3, 4.5 are not mapped to any CSFs. From the study, it is evident that 'stakeholder expectation' and 'define the purpose and vision' are two important sub-criteria. While investing in Industry 4.0, the organisations should have a clear purpose and vision for the initiative and the road map needs to be clear. Secondly, the organization should identify and understand stakeholder needs & expectations, the essential ingredients of Industry 4.0. While adopting industry 4.0, the organisations need to seek all the stakeholders (starting from investors, customers, employees, partners, and society) before deciding on the key initiatives like Industry 4.0. The sub-criterion 1.3 "understand the ecosystem, own capabilities & major challenges' ' is appearing as a critical success factor. This is also important for the adoption of the Industry 4.0. However, this factor is not mapped as CSF. Therefore, based on these inputs, the revised CSFs for the Industry 4.0 implementation are proposed Figure 8-9 and Table 8-11 depicts the criteria which are connected to Industry 4.0

Table 8-11: Summarization of Industry 4.0 related criteria of EFQM 2020

Sub-criterion No	Description
1.4	Develop strategy
1.5	Design & implement a governance & performance management system
2.1	Steer the organisation's culture & nurture values
2.2	Create the conditions for realising change
2.3	Enable creativity & innovation
2.4	Unite behind & engage in purpose, vision & strategy
3.2	People: Attract, engage, develop & retain
3.4	Society: Contribute to development, well-being & prosperity
3.5	Partners & Suppliers: Build relationships & ensure support for creating sustainable value
4.1	Design the value & how it is created
4.4	Define & implement the overall experience
5.1	Drive performance & manage risk
5.2	Transform the organisation for the future
5.3	Drive innovation & utilise technology
5.4	Leverage data, information & knowledge
5.5	Manage assets & resources
6.1	Customer perception results
7	Strategic & operational performance

Figure 8-9: Proposed critical success factors of Industry 4.0

8.6 KPIs FOR INDUSTRY 4.0 AND EFQM 2020

Key performance indicators (KPIs) are critical for understanding the performance of an organization. KPIs are not only financial but also non-financial that organizations use in order to estimate and define how successful they are, aiming at previously established long-term or short-term goals. An organisation should have two types of indicators: Key Performance Indicators (KPIs) and Monitoring Indicators (MIs). The KPIs are essential and key for organisational success while MIs are necessary to monitor. The failure to measure the MIs would impact the organisational performance. ISO 22400-part I proposed a set of KPIs which could be used in a manufacturing setup. KPIs are derived directly from or through an aggregation function of physical measurement data and/or

other key performance indicators. The selection and implementation of KPIs is influenced by the organizational structure (line-line or process organizational structure or some other), as well as the type of production process, such as non-serial or serial production. The measure of performance indicators would vary based on the hierarchical level. For example, the production line will have multiple assembly stages. One or more production lines leads to the factory. When the KPIs are defined at stage level, the KPIs could be different, for example at the assembly stage, the stage output and first pass yield are the key metrics. For the line supervisors, the entire line output and first pass yield could be key metrics. For the factory manager, it could be capacity utilisation, conversion cost, fulfilment of the order or manufacturing lead time. In the above example, it is just picturised to differentiate the level of metrics. Figure 8-10 shows the stack up of the metrics at various levels in the organization. The metrics adopted at different levels would be different and the complexity would increase based on the level of the organization where the metrics intend to measure. The performance measure should be consistent throughout the hierarchical structure of the organizations (Bititci *et al.* 1997). Bourne *et al.* (2000) argued that there is an integration between performance measures (indicators) and hierarchy of the organization. Moreover, performance indicators should be aligned with organizational functions throughout organizational hierarchy (Hon, 2005).

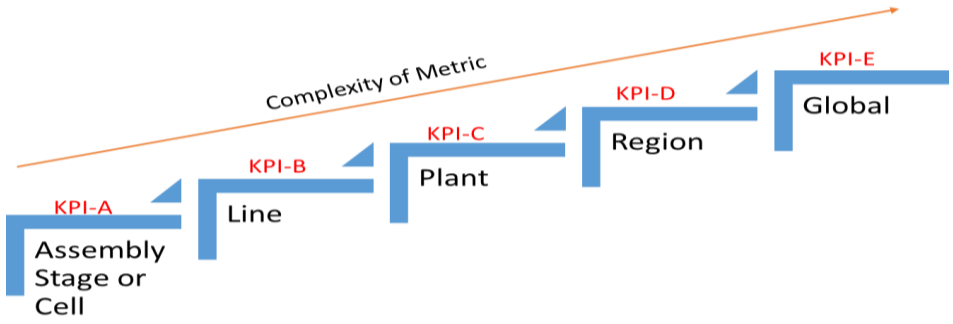


Figure 8-10: General hierarchical levels for KPIs in a typical manufacturing plant

The EFQM Model 2012 version highlighted the four types of results namely customer results, people results, society results, and business results. These results were further divided into two parts: perception metrics and performance metrics. It is explained in detail in CHAPTER-4, Table 4-1. However, in the EFQM 2020 version, these structures got changed and the new model focuses on three areas namely stakeholder perceptions, creating sustainable value, and driving performance and transformation. The stakeholder perception is essential to run the organisation effectively. The suggested key stakeholders are customer perception results, people perception results, business & governing stakeholders perception results, society perception results, and partners & suppliers perception results. The model also focuses on strategic & operational performance results. These results are a) achievements in delivering its purpose and creating sustainable value, b) financial performance, c) achievements of strategic objectives, d) achievements in driving performance, e) achievement in driving transformation, and f) predictive measures for the future.

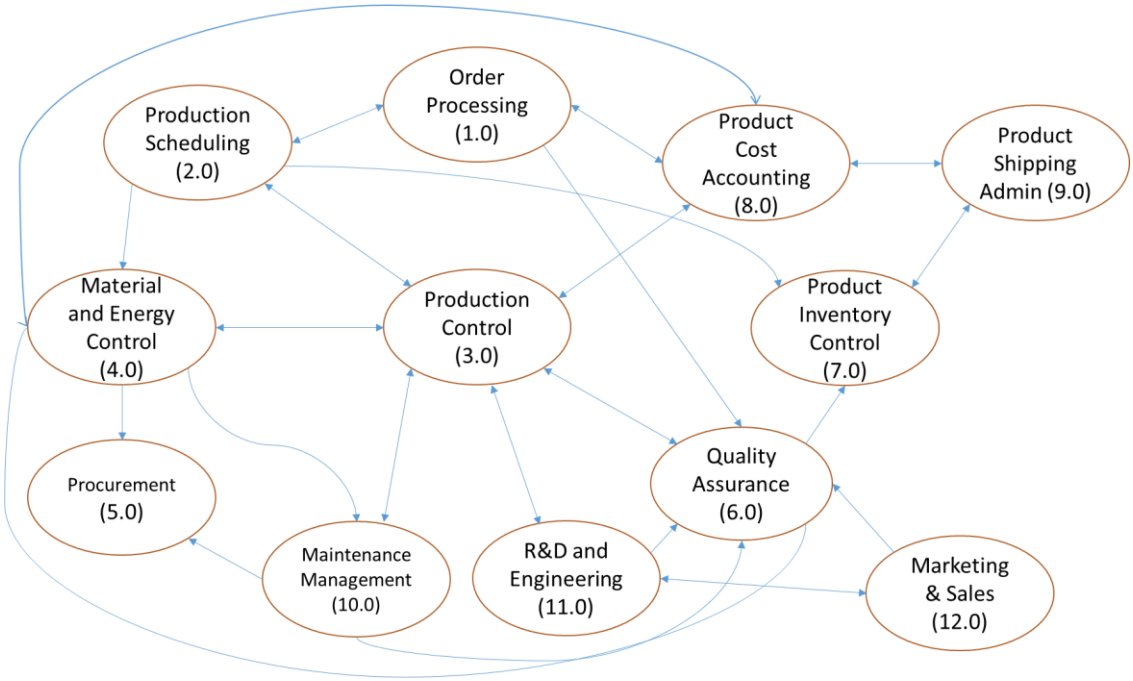
Prior to diving into the KPIs for Industry 4.0 and EFQM, it is necessary to understand the current research work and available information in this area. ISO standard ISO 22400-2: 2014, recommends 34 KPIs for production companies in order to establish a common vocabulary of metric for manufacturing setup as depicted in Table 8-12

Table 8-12: KPI recommended in ISO 22400

▪ Worker Efficiency	▪ Production process ratio	▪ Finished goods ratio
▪ Allocation Ratio	▪ Actual to planned scrap ratio	▪ Integrated goods ratio
▪ Throughput rate	▪ First pass yield	▪ Production loss ratio
▪ Allocation efficiency	▪ Scrap ratio	▪ Storage and transportation loss ratio
▪ Utilization efficiency	▪ Rework ratio	▪ Other loss ratio
▪ Overall equipment effectiveness index	▪ Fall off ratio	▪ Equipment load ratio
▪ Net equipment effectiveness index	▪ Machine capability index	▪ Mean operating time between failures
▪ Availability	▪ Critical machine capability index	▪ Mean time to failure
▪ Effectiveness	▪ Process capability index	▪ Mean time to restoration
▪ Quality Ratio	▪ Critical process capability index	▪ Corrective maintenance ratio
▪ Setup Rate	▪ Comprehensive energy consumption	
▪ Technical efficiency	▪ Inventory turns	

Source: ISO 22400-2, 2014, p. 34

ISA-95 presented a functional model of data flow between processes. The typical manufacturing organisation construct is as depicted in Figure 8-11. The figure presents the process and information flow in the setup. The KPI definition has to take care of the complexity of the various manufacturing functions in an organisation. In order to measure the outcome of any process or process system, metrics are essential components. A performance measurement system is important. It consists of a set of procedures and indicators that precisely and constantly measure the performance of activities, processes and the organization as a whole, and is a vital aspect in regard to the management of companies (Bourne *et al.* 2003; Varisco *et al.* (2018) Lohman *et al.* (2004)). mentioned that a performance measurement system should be able to provide data for monitoring both past and the future performance, to strengthen the strategies, to support providing data for benchmarking and avoid introducing the conflicting indicators.

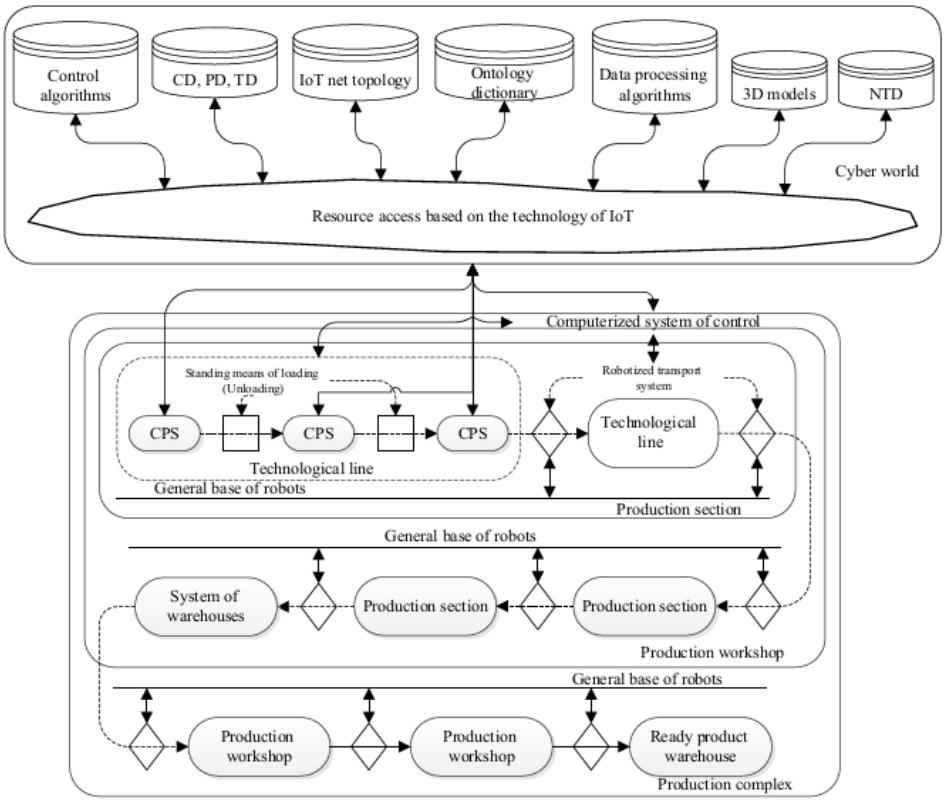


Source: ISA-95 Functional model of data flow between functions

Figure 8-11: ISA-95 Functional model of data flow between processes

The comprehensive research work by Sangwa and Sangwan (2018) presented the various KPIs used in a manufacturing setup. They identified 119 metrics and 26 performance dimensions across the seven functional areas of new product development, human resource management, finance, administration, customer management, supplier management, and manufacturing processes.

Zakoldaev *et al*. (2019) described mechanical and assembly productions for Industry 4.0. The basic components of a smart factory and their interconnection to organize a fully automated production activity are defined. Figure 8-12 explains how the organization converted their traditional manufacturing setup to Industry 4.0. A production section of Industry 4.0 compliant company showing the unification of automatic systems for automated and paperless process of manufacturing is shown in Figure 8-12. The figure also includes the implementation of progressive digital technologies (cloud technologies, industrial Internet of Things technologies, and other) in the company.



Source: Zakoldaev *et al*. (2019)

Figure 8-12: Interaction scheme of digital production the Industry 4.0 company

The dimensions and associated KPIs (Table 8-13), relevant to Industry 4.0, have been identified after the review of ISO 22400, Sangwa and Sangwan (2018), Zakoldaev *et al* (2019), ISA-95 functional model, and discussion with experts. The KPIs have been mapped to as strategic or operational with respect to EFQM 2020 model. The sub-section column maps to results of strategic and operational KPIs of EFQM 2020 model. The sub-sections are explained as part of the legend in the Table 8-14. The EFQM 2020 recommends the perception results and mapped them as P1 to P5. The KPIs are classified as lead or lag indicators. Leading indicators are about trying to predict the future. Lagging indicators look backwards and show the performance of the past. The column presents the KPIs recommended for the Digital Manufacturing or Industry 4.0.

Table 8-13: Industry 4.0 & EFQM-2020 KPI Dimensions

Sl No	KPI Dimensions	Elaboration
1	Quality (D1)	Quality is the key to the success of every organization. The quality is checked mainly at three levels input, output and throughput or process quality
2	Time (D2)	Time is a very important determinant of the manufacturing performance of the organizations. Time-based manufacturing is an important concern for the manufacturing organizations in the world
3	Delivery (D3)	Perceived relative reliability, reliability relative to competitors, percentage on-time delivery, due date adherence, the percentage increase in the portion of delivery promises met.
4	Cost/Financial (D4)	Financial measures are the best measures to evaluate the company's performance,
5	People (D5)	Perception and performance metrics are covered in this area
6	Customer (D6)	Customer Perception and performance metrics are covered in this area. The post-delivery support, responsiveness, warranty, responsiveness are covered in this
7	Compliance (D7)	This dimension covers process compliance, statutory and regulatory compliance metrics
8	Digital Infrastructure and application improvements (D8)	This dimension covers the digital or technology related KPIs, service desk support and application improvements
9	Sustainability / Improvements (D9)	This dimension covers the energy, environment, sustainability initiatives and CSR related metrics
10	Safety (D10)	The reliability of complex work systems in achieving organizational goals safely depends on work structures
11	Partnership (D11)	This dimension covers the partnership improvements, involvement, index, perception metrics
12	Information Security (D12)	Information security incidents

Table 8-14: KPIs mapping for Industry 4.0 and EFQM 2020

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
1	D1	Defect rate	PPM	QT	LG	O	3		X
2	D1	Engineering changes after design completion	Number	QT	LG	O	1		X
3	D1	First pass yield (FPY)	%	QT	LG	O	1		X
4	D1	Incoming parts/material defect rate	%	QT	LG	O	1		X
5	D1	Number of incidents where senior management needed to instigate the remedial action	Number	QT	LG	O	1		
6	D1	Order entry error rate	Number	QT	LG	O	1		X
7	D1	Percentage of bids or proposals accepted	Number	QT	LG	O	1		
8	D1	Percentage of cost of poor quality	%	QT	LG	O	2		X
9	D1	Processes made foolproof	%	QT	LG	O	1		X
10	D1	Product changes to correct design deficiencies	%	QT	LG	O	1		X
11	D1	Quality problems detected during product audits in the field	Number	QT	LG	S	1		
12	D1	Rework rate or change requests	Number	QT	LG	O	4		X
13	D1	Scrap ratio	%	QT	LG	O	1		X
14	D1	Service Quality Index	Number	QL	LD & LG	S	1	P1	
15	D1	FMEA of Critical Processes	%	QT	l	S	7		X
16	D1	Process Stability (no of process having Cpk more than 1.75)	%	QT	l	S	4		X
17	D2	Actual client projects on time (percent of total) and cost versus budget (percent of budget)	Number	QT	LG	O			X

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
18	D2	Allocation efficiency	%	QT	LG	O	1		
19	D2	Asset utilization rates of major machines	%	QT	LG				
20	D2	Average recruitment cycle time	Number	Q	LG	O	2		X
21	D2	Average time from customer enquiry to sales team response	Number	Q	LG	O	2		X
22	D2	Changeover time	Minutes	QT	LG	O	1		X
23	D2	Completion of projects on time and budget (% or $ of total projects)	Number	QT	LG	O			X
24	D2	Credit request processing time	Number	QT	LG	O			
25	D2	Days in accounts payable	Number	QT	LG				X
26	D2	Days in inventory	Number	QT	LG				X
27	D2	Days sales in receivables	Number	QT	LG				X
28	D2	Design cycle time	Hours	QT	LG	O	6		X
29	D2	Machine down time	Minutes	QT	LG	O	1		X
30	D2	Manufacturing cycle effectiveness = processing/ throughput time	Number	QT	LG	O	1		X
31	D2	Manufacturing cycle time	Minutes	QT	LG	O	4		X
32	D2	Manufacturing lead time	Months/days	QT	LG	O	1		X
33	D2	On-time Development	%	QT	LD & LG	O	4		X
34	D2	Overall equipment effectiveness (OEE) index	%	QT	LG	O	1		X
35	D2	Percentage of sales invoices issued on time	%	QT	LG	O	1		
36	D2	Product design cycle time	Man-Days or Months	QT	LG	O	4		X
37	D2	Product design lead time	Months/days	QT	LG	O	4		X

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
38	D2	Production schedule delays because of material shortages	Number	QT	LG	O	1		X
39	D2	Production set-up/changeover time	%	QT	LG	O	1		X
40	D2	Responsiveness satisfaction index	Number	QL	LG	S		P1	X
41	D2	Synchronized scheduling	%	QL	LG	O	6		X
42	D2	The mean time between QA failures	Number	QL	LG				X
43	D2	Throughput rate (TPR)	Units/hours	QT	LG	O	1		X
44	D2	Time to market	Month	QT	LG	S	4		X
45	D2	Total hours employees spend in mentoring	Number	QT	LG	S	5		
46	D2	Utilization efficiency	%	QT	LG	O	1		
47	D2	Ontime delivery to Customer Committed date	%	Q	LG	S	3		X
48	D2	Ontime delivery to Distribution Centre Committed date	%	QT	LG	S	3		X
49	D3	Lot size or Batch size reduction	Number	QT	LG	S	4		X
50	D3	No of Backlog customer orders	Number	QT	LG	O	3		X
51	D3	Number of leads generated by agents	Number	QT	LG	O	1		
52	D3	Number of stock outs	Number	QT	LG	O	1		
53	D3	Number/percentage of projects completed on time/budget	Number	QT	LG	O	1		
54	D3	Percentage of invoices processed within the week	Number	QT	LG	O	1		
55	D3	Percentage of successful tenders	Number	QT	LG	O	1		
56	D3	Ratio of new products (less than X years old) to full company catalog (%)	Number	QT	LG	O	1		
57	D3	Unplanned versus planned maintenance	%	QT	LG	O	1		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
58	D3	Value of Backlog orders	Number	QT	LG	O	3		X
59	D3	Supply / Demand Match (Forecast Accuracy)	%	QT	LG	S	3		X
60	D4	Actual project cost to budgeted cost	%	QT	LG	O	2		X
61	D4	Average cost of maintaining a customer account ($)	Number	QT	LG	O	4		
62	D4	Average cost of training per year	$	QT	LG	O	2		X
63	D4	Average labour wage rate	$/ labour	QT	LG	S	2		X
64	D4	Average loaded cost per employee	Number	QT	LG	O	2		X
65	D4	Average recruitment cost of new hires	Number	QT	LG	O	2		X
66	D4	Bad debt percentage to turnover	Number	QT	LG	O	2		
67	D4	Billing accuracy	Number	QT	LG	O	2		
68	D4	Business development expense/administrative expense	Number	QT	LG	O	2		
69	D4	Cash flow ($)	Number	QT	LG	O	2		
70	D4	Competence development expense/payroll cost	Number	QL	LG	S	1		
71	D4	Composite conversion cost	INR	Q	L	S	6		X
72	D4	Current ratio	Number	QT	LG	S	2		X
73	D4	Dealer profitability	Number	QT	LG	S	2		
74	D4	Debt-to-equity ratio	Number	QT	LG	O	2		
75	D4	Dollar revenue gained from top customers in the week	Number	QT	LG	S	2		
76	D4	Economic value added per employee ($)	Number	QT	LG	S	2		X
77	D4	Gross margin by business	Number	QT	LG	O	2		
78	D4	Indirect expenses as a percentage of sales	Number	QT	LG	O	2		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
79	D4	Inventory system accuracy	%	QT	LG	O	2		
80	D4	Inventory turns	Number	QT	LG	O	2		X
81	D4	Investment in development of new markets ($)	Number	QT	LG	S	4		
82	D4	Investment in new product support and training ($)	Number	QT	LG	S	4		
83	D4	Investment in research ($)	Number	QT	LG	S	4		
84	D4	IT expense as a percentage of total administrative expense	Number	QT	LG	S	4		X
85	D4	Marketing expense per customer ($)	Number	QT	LG	S	4		
86	D4	Net profit margin	%	QT	LG	S	2		X
87	D4	New market development or growth	%	QL	LD	S	2		X
88	D4	Number of accounts payable invoices paid late	Number	QT	LG	S	1		
89	D4	Number of credits/returns from key customers	Number	QT	LG	S	2		
90	D4	Outstanding Accounts receivable	Number	QT	LG	S	1		
91	D4	Percentage of administrative costs	%	QT	LG	S	2		X
92	D4	Percentage of brand dominance in market	Number	QL	LG	S	4		
93	D4	Percentage of development cost	%	QT	LG	O	4		X
94	D4	Percentage of finished goods inventory	%	QT	LG	O	2		
95	D4	Percentage of inventory cost	%	QT	LG	O	2		X
96	D4	Percentage of labour cost	%	QT	LG	O	2		X
97	D4	Percentage of maintenance cost	%	QT	LD & LG	O	2		X
98	D4	Percentage of profit from new product	%	QT	LG	S	4		X
99	D4	Percentage of profitability per major project	%	QT	LG	O			

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
100	D4	Percentage of raw material cost	%	QT	LG	O	2		X
101	D4	Percentage of raw material inventory	%	QT	LG	O	2		X
102	D4	Percentage of sales from new products	%	QT	LG	S	4		X
103	D4	Percentage of sales that have arisen from cross-selling among business units	%	QT	LD	S	2		X
104	D4	Percentage of top ten customers' business	%	QT	LD	S	2		
105	D4	Percentage of work in process (WIP) inventory	%	QT	LD & LG	O	2		
106	D4	Percentage revenues from new products or service	%	QT	LD	O	2		
107	D4	Percentage unprofitable customers	%	QT	LG	O	2		
108	D4	Percentage of marketing cost	%	QT	LD & LG	S	2		
109	D4	Potential revenue in sales pipeline	Number	QT	LD	S	2		
110	D4	Pricing accuracy	%	QT	LG	O	1		
111	D4	Procurement cost/ total sales	%	QT	LG	S	2		
112	D4	Profits from new products or business operations ($)	Number	QT	LG	S	4		
113	D4	Progress on major IS CAPEX projects	Number	QT	LG	S	4		
114	D4	Rate of return on capital employed	%	QT	LG	S	2		
115	D4	Return on assets (ROA)	%	QT	LG	S	2		
116	D4	Return on capital employed	%	QT	LG	S	2		
117	D4	Return on equity	%	QT	LG	S	2		
118	D4	Return on investment (ROI)	%	QT	LG	S	2		
119	D4	Return on net asset value	%	QT	LG	S	2		
120	D4	Return on sales (ROS)	%	QT	LG	S	2		
121	D4	Revenues/employee ($)	Number	QT	LG	S	2		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
122	D4	Revenues/total assets (%)	Number	QT	LG	S	2		
123	D4	Sales growth rate by market segment	Number	QT	LG	S	2		
124	D4	Sales to selling costs ratio	Number	QT	LG	S	2		
125	D4	Sales volume or turnover	Number	QT	LG	S	2		
126	D4	Slow-moving and obsolete inventory	Number	QT	LG	S	2		
127	D4	Total cost of capital employed/ total sales	%	QT	LG	S	2		
128	D4	Waste—all forms: scrap, rejects, underutilized capacity, idle time, downtime, excess production, etc.	Number	QT	LG	S	2		
129	D4	Warranty Cost	$	QT	l	S	4		X
130	D5	Absenteeism rate	Days/ employee/ year	QT	LG	O	4		
131	D5	Average employee years of service with company	Number	QT	LG	O	1		
132	D5	Commitment of top management satisfaction	Number	QL	LD	S		P2	
133	D5	Customer perception about competency of the team	Number	QL	LG	S		P1	X
134	D5	Employee complaint resolution timelines and effectiveness	Number	QL	LG	S		P2	
135	D5	Employee satisfaction index	Number	QL	LD & LG	S		P2	X
136	D5	Employee training and satisfaction	Number	QL	LD & LG	S		P2	X
137	D5	Employees complying with their development plan	Number	QL	LG	S	1		
138	D5	Employees on self-managing teams	Number	QL	LG	S	1		
139	D5	Employment security satisfaction index	Number	QL	LD	S		P2	X

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
140	D5	Empowerment index, number of staff and managers who say they are empowered (from staff survey)	Number	QL	LD	S		P2	
141	D5	Indirect to Direct Labour Deployment	%	QT	L	O	1		X
142	D5	Knowledge management	Number	QL	LD	S		P2	X
143	D5	Labour turnover (attrition rate)	%	QT	LG	O	1		X
144	D5	Leadership index (based on responses from a section in the employee survey)	%	QL	LG	O	1	P2	
145	D5	Leadership initiatives targeted to rising stars	Number	QT	LG	O	1		
146	D5	Length of service of staff who have left	Number	QT	LG	O	1		
147	D5	Motivation index (based on responses from a section in the employee survey)	Number	QL	LG	O		P2	
148	D5	No. of Industry awards and Customer awards received	Number	QT	LG	S		P4	X
149	D5	Number of employees	Number	QT	LG	S			X
150	D5	Number of in-house training courses	Number	QT	LG	S			
151	D5	Number of initiatives implemented from the staff survey	Number	QL	LG	S		P2	
152	D5	Number of internal applications for job applications closed in month	Number	QT	LG	S	1		
153	D5	Number of internal promotions	Number	QT	LG	S	1		
154	D5	Number of mentoring meetings by each high performer (rising star)	Number	QT	LG	S	1		
155	D5	Number of new staff (less than three months) who attended an induction program	Number	QT	LG	S	1		
156	D5	Number of staff trained in first aid	Number	QL	LG	S	1		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
157	D5	Number of staff who have agreed to development plans	Number	QT	LG	S	1		
158	D5	Number of staff who have attended an induction within four weeks of starting	Number	QT	LG	S	1		
159	D5	Number of succession plans for key positions	Number	QT	LD	S	1		
160	D5	Number of teams with a balanced scorecard (BSC)—rollout of a BSC system	Number	QT	LG	S	1		
161	D5	Percentage of managers who are women	Number	QT	LG	S	1		
162	D5	Percentage of performance reviews completed on time	Number	QT	LG	S	1		
163	D5	Percentage of rising stars with mentors	Number	QT	LD	S	3		
164	D5	Percentage of skilled or multifunctional workforce	%	QL	LD & LG	S	3		X
165	D5	R&D resources/total resources	Number	QT	LG	S	4		
166	D5	Recruitment rating (survey on all new employees)	Number	QL	LG	S	1		
167	D5	Resource utilization	%	QL	LG	O	1		X
168	D5	Respect for people satisfaction Index	Number	QL	LD & LG			P2	X
169	D5	Social and Environmental Fulfilment Index	Number	QL	LD & LG	S		P3	X
170	D5	Strategic competence	Number	QL	LD	S		P2	X
171	D5	Strategic planning	Number	QL	LD	S		P2	X
172	D5	Training hours per employee per year	Hours/ employee/ year	QT	LG	S	3		X
173	D5	Transparency and Ethical behaviour	Number	QL	LD & LG	S		P3	X
174	D5	Turnover of female staff	Number	QL	LD	S			

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
175	D5	Use of multifunctional task forces/teams	Number	QL	LD & LG	S	3		
176	D5	Versality Index of Operators	Number	Q	l	S	7		X
177	D5	Worker efficiency	%	QT	LG	O	1		X
178	D5	Work-related flexibility	Number	QL	LD & LG			P2	
179	D5	Diversity & Inclusion	%	Q	l	S	4		X
180	D6	Annual customer complaints	Number	QT	LG	O	1		
181	D6	Average time to resolve complaints, to get credits for product quality problems, etc.	Number	QT	LG	O	1		
182	D6	Brand image index (%) based from market research	%	QT	LG			P1	X
183	D6	Branding and Reputation index	Number	QL	LD & LG	S		P3	X
184	D6	Complaints not resolved on first call	Number	QL	LG	O	1		
185	D6	Customer acquisition (rate business unit attracts or wins new customers or business)	Number	QL	LG	O	1		
186	D6	Customer involvement in Joint Development	Number	Q	LD & LG	S	3		
187	D6	Customer loyalty index (percentage of customer retention within customer categories)	Number	QL	LG	S	1	P1	
188	D6	Customer retention rate	Number	QT	LG	S	3		
189	D6	Customer satisfaction	Number	QL	LD & LG	S		P1	
190	D6	Customer satisfaction of top 10% of customers	Number	QL	LG	S		P1	
191	D6	Customers lost (number or percentage)	Number	QL	LG	O	1		
192	D6	Customization order fulfilment	%	QL	L	S	6		X
193	D6	Faults or service requests closed in month	Number	QL	L	O	1		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
194	D6	Market share (proportion of business in a given market)	%	QT	LD	S	2		X
195	D6	No of Design/Contract Wins	Number	QT	LG	O	1		X
196	D6	Number of customer referrals	Number	QT	LG	O	1		
197	D6	Number of proactive visits to top 10% of customers	Number	QT	LG	O	1		
198	D6	Number of profitable customers	Number	QT	LG	O	1		
199	D6	Percentage of requests for help fixed by Help Desk during the first phone call	Number	QT	LG	O	1		
200	D6	Product customization	%	QL	LD & LG	S	3	P1	X
201	D6	Resolution of queries in same day	%	QT	LG	S	1		
202	D6	Sales closed as a percentage of total sales proposals	%	QT	LG	S	1		
203	D6	Service requests outstanding (faults, works requests) at month end	Number	QT	LG	O	1		
204	D6	Value of Design/contract Wins	Number	Q	LG	O	2		X
205	D7	Good Manufacturing Practise score	%	Q	LG	O	4		X
206	D7	No of open Non-Conformity	Number	Q	LG	O	4		X
207	D7	Statutory and Regulator compliance	Number	QL	LD & LG	S		P3	X
208	D8	% of Memory Utilisation of Servers running beyond thrush-hold	%	Q	LG	S	5		X
209	D8	% of Servers utilisation running beyond thrush-hold	%	Q	LG	S	5		X
210	D8	Availability of IT system	Number	QT	LG	O	1		
211	D8	Digital Infrastructure cost (plan v/s actual)	%	Q	LG	O	6		X
212	D8	Manual transaction to automated electronic transaction ratio	Number	QT	LG	S	7		X

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
213	D8	Number of critical assets in a catastrophic state	Number	QT	LG	O	1		
214	D8	Number of IT contractors as a percentage of IT employees	Number	QT	LG	O	1		
215	D8	Outage hours per month	Number	QT	LG	O	1		
216	D8	Resolution Compliance – L1	%	Q	l	O	4		X
217	D8	Resolution Compliance – L2	%	Q	l	O	4		X
218	D8	Resolution Compliance – L3	%	Q	l	O	4		X
219	D8	Self Service Calls	%	Q	l	O	7		X
220	D8	Service Quality Index of Digital infrastructure support	Number	Q	LG	O	5		X
221	D9	% of Recurring Digital issues	%	Q	LG	O	4		X
222	D9	% of Utilisation of the Internet Bandwidth	%	Q	LG	S	4		X
223	D9	Accomplishment of quality improvement implementation milestones	Number	QT	LG	S	1		
224	D9	Adherence to Strategic objectives	%	Q	L	S	4		X
225	D9	Community/environmental satisfaction index from external survey	Number	QL	LG	S		P4	
226	D9	Cost saving through sustainable initiatives	INR	Q	LG	S	1		X
227	D9	Digital Maturity Competency Development	%	Q	L	S	6		X
228	D9	Digital Maturity Index	Number	Q	L	S	6		X
229	D9	Dollars saved by employee suggestions	Number	QT	LG	O	1		
230	D9	Emissions from production into the environment (number)	Number	QT	LG	O	1		
231	D9	Energy consumed per unit, BTU/sales	Number	QT	LG	O	1		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
232	D9	Entries to environment/community awards to be completed in next three months	Number	QT	LG	O	1		
233	D9	Improvement in productivity (%)	Number	QT	LG	O	1		
234	D9	Innovativeness rating	Index	QL	LG	S		P3	X
235	D9	Investment in Societal Initiatives	%	Q	L	S		P3	X
236	D9	No of IT problem reports	Number	Q	LG	O	4		X
237	D9	No of Successful events of Business Continuity tests	Number	Q	LG	S	4		X
238	D9	No of sustainable improvements are carried out Year on Year	Number	Q	L	S	1		X
239	D9	Number of design changes in specification	Number	QL	LG	O			
240	D9	Number of employees involved in community activities	Number	QT	LG	S	1		
241	D9	Number of environmental complaints received in a week	Number	QT	LG	O	1		
242	D9	Number of media coverage events	Number	QT	LG	O	1		
243	D9	Number of patents filed	Number	QT	LG	S	4		X
244	D9	Number of photos in paper	Number	QT	LG	O	1		
245	D9	Number of research papers generated	Number	QT	LG	S	4		
246	D9	Number of sponsorship projects undertaken by company	Number	QT	LG	S	1		
247	D9	Number of suggested improvements from employees by department	Number	QT	LG	O	1		
248	D9	Number of suggestions implemented per worker per month	Number	QT	LG	O	1		
249	D9	Patents filed and issued that have been incorporated into products	Number	QT	LG	O	1		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
250	D9	Percentage of current projects that are environmentally friendly	Number	QT	LG	O	1		
251	D9	Percentage of recycled material used as raw material input	Number	QT	LG	O	1		
252	D9	Percentage of waste generated/recycled	Number	QT	LG	O	1		
253	D9	Reduction of paperwork in office areas	%	QL	LG	S	6		X
254	D9	Reduction of parts count on products	%	QT	LG	S	1		
255	D9	Relevancy to Strategic Objectives	%	Q	l	S	4		X
256	D9	Self Sufficiency of Digital technology	%	Q	L	S	6		X
257	D9	Space productivity	%	QT	LG	O	1		X
258	D9	Time spent on quality improvement activities	Number	QT	LG	O	1		
259	D9	Total No. of Energy Conservations	KWh	Q	LG	O	1	P3	X
260	D9	Waste and scrap produced	Number	QT	LG	O	1		
261	D9	Water consumption and/or discharge per production unit (or by per employee, or per sales dollar)	Number	QT	LG	O	1		
262	D9	No. of Green Lines	%	Q	LG	S	4		X
263	D10	Emergency response time (Fire Drill)	Number	QT	LG	O	1		
264	D10	Health and safety of employees satisfaction Index	Number	QT	LD & LG	O	1	P3	X
265	D10	Lost time injury frequency (graph)	Number	QT	LG	O	1		X
266	D10	Number of accidents or incidents occurred per year	Number	QT	LG	O	3	P3	X
267	D11	Business relationship with partners	Number	QL	LD	S		P4	X
268	D11	Contract length with important suppliers (in years)	Number	QT	LD	S	3		

						KPI of EFQM 2020			KPI for Industry 4.0
Sl No	Performance dimension	KPI	Unit	Qualitative/ Quantitative	Leading/ Lagging	Strategic/ Operational	Sub-section	Stakeholder Perception	Relevant metric for Industry 4.0
269	D11	Involvement of suppliers in product development	Number	QT	LD	S		P5	
270	D11	Number of strategic supply relationships	Number	QT	LG			P5	
271	D11	Number of students recruited for holiday work	Number	QT	LG			P5	
272	D11	Number of systems that have been integrated with other company systems	Number	QT	LG			P5	X
273	D11	Percentage of certified suppliers	%	QT	LG	S	1		X
274	D11	Percentage of distant supplier eliminated	%	QT	LG	S	1		X
275	D11	Relationship satisfaction index of suppliers	Number	QL	LD	S		P5	X
276	D11	Supplier involvement in design	Number	QL	LD & LG	S	1		X
277	D12	Data Back-up Retrievals	%	QT	LG	O	4		X
278	D12	Data Back-up Successful events	%	QT	LG	O	4		X
279	D12	No of Security Incident reported	Number	QT	LG	O	4		X
280	D12	No of Security threads and attacks on the network	Number	QT	LG	O	7		X

Note: Here, QT=Quantitative, QL=Qualitative, S=Strategic, O=Operational, LD=leading, LG=Lagging, ST=Static, X = Relevant to Industry 4.0.
KPIs related to EFQM 2020- Strategic and operational performance indicators are further classified. 1=Achievements in delivering its purpose and creating sustainable value, 2=Financial performance, 3=Fulfilment of key stakeholders' expectations, 4= Achievements of strategic objectives, 5=Achievements in driving performance, 6=Achievements in driving transformation, and 7=Predictive measure for the future.

EFQM-2020 Stakeholder results are further classified. P1=Customer perception results, P2=People perception results, P3=Business & governing stakeholders perception results, P4=Society perception results, P5=Partners & supplier perception results

8.7 SUMMARY

The chapter compares the EFQM 2012 model against the EFQM 2020 MODEL. The chapter establishes the magnitude of adoption of guidance point (GP) of EFQM 2012 in the EFQM 2020 version. The research concludes that the EFQM model is moving towards a generic model with a focus on the futuristic requirements of the organisations rather than merely a business excellence model and/or just a quality award enablement model. The broad level construct of the new version consists of direction, execution, and results. The new model is more futuristic or transformative. The EFQM 2020 model has a strong relationship with Industry 4.0. The study also shows that the adoption of the new EFQM model could accommodate Industry 4.0 implementation as well as monitoring its impact.

However, few parts of the 2020 model are subjective and the assessment is left to the imagination and judgement of the assessors and the organisation. Since the latest version of the EFQM model has just now been introduced, it would take some more time for the stakeholders to understand the model more correctly and apply them in an organisational setting. The current research has thus provided a breadth cum depth on the evolutionary path of the EFQM model in its journey towards contributing to the drive of quality and excellence in organizations where they are deployed across the globe. Even though the model focused on transformation, the foundation and mechanics of the organisation can't be ignored. In the new model, it appears that some of the key mechanics like communication strategy, the realisation of strategy, competency, skill development, and few interactions are missing. This research has been carried out based on the availability of information on the new model. However, this research would provide a platform for future research to enhance the current research work. Since the new model is evolving

and has not reached a mature state, it would provide more avenues to overcome gaps, if any, in the current research.

Critical success factors for Industry 4.0 adoption have been identified based on the literature review and the discussion with experts. The chapter also presents the comprehensive list of KPIs for Industry 4.0 and EFQM 2020. This would serve as a guide for the manufacturing plants in their Industry 4.0 and EFQM 2020 journey.

CHAPTER-9

CONCLUSIONS AND FUTURE SCOPE OF WORK

During the last three decades, the national bodies have developed or adopted suitable business excellence models based on the regional requirement, and business environment with an objective of enhancing national economic performance by promoting quality and excellence awards. In 1988, European industry leaders and practitioners came together to create a platform for learning and sharing to improve organisational performance. This led to the benchmarking of other European organisations for achieving sustainable economic growth and improving the organisation maturity. This forum was called the European Foundation for Quality Management (EFQM) and they introduced an excellence award called EFQM.

The EFQM excellence model is a non-prescriptive framework based on nine criteria. Five of these are called enablers and four are called as results. The enablers cover how to achieve excellence by ways and means of an organization. The result criteria cover what an organization achieves by enablers. ‘results’ are caused by ‘enablers’ and ‘enablers’ are improved using feedback from the ‘results. There are 32 sub-criteria (24 for enablers and eight for results). In recent days, the influence of Industry 4.0 is evident in all part of life. Considering this view, as a part of this research, following are set as objectives of this thesis research:

- Establish the interrelationship of the EFQM model at the sub-criteria level
- Establish the characteristics of high and low maturity organisations on the path of business excellence journey
- Identify the path of the excellence journey for the award-winning organisations

- Study the evolution of the EFQM model over the last 30 years.
- Establish the linkage between the EFQM 2020 model and Industry 4.0.

Chapter -2 presents a literature review of 154 articles and descriptive analysis of the literature. The study also traces the key research work carried out by peer reviews over the years. The main conclusions of the review are summarized as:

- The literature review reflects the existence of research to ascertain the relationship of enablers and results, however, there is hardly any research getting into sub-criteria level studies based on the assessment score. Most of the empirical studies are based on the survey data or organizational performance data or self-assessment scores. This does not provide an unbiased view for the organization about the inter-relationship.
- EFQM model has been widely practiced by industry, but the existence of logics in this model has not been explored
- There is no universal acceptance of the unidimensionality of the relationships among the EFQM criteria. There is a need to find the correlation among EFQM criteria on one hand and between criteria and results on the other hand.
- Despite a substantial body of the literature, empirical validation of the causal relationships within the EFQM model is limited, and it is mostly based on studies that test isolated associations. There is a lack of research that deals with investigating: (1) the role played by each sub-criteria of the model; (2) the relationships that are produced between these sub-criteria on the EFQM results and (3) how sub-criteria would influence the managerial aspects in an organizational context.
- The review of existing literature provides interesting results contradicting the general perception of the EFQM model that the relationship between criteria and results is through the process criterion. Some of the papers show positive and others show negative relationships between the criteria interactions.

- The relationship between the EFQM 2020 model and Industry 4.0 needs to be explored at the different levels to support successful digital transformation in the industry. It requires the mapping of KPIs from EFQM model to Industry 4.0.

Chapter-3 identifies the interrelationships at sub-criteria level in the EFQM model. The study identified sub-criteria (primary influencer) from the five main criteria primarily influencing the customer, people, society, and business results of an organization. It helps the managers and organizations to focus on a few and critical enablers to improve organizational performance. The secondary influencers (supporters) are also identified for each primary influencer. The multi-collinearity issue has been addressed. The key takeaways from this chapter to improve the business excellence results are:

- Customer results (CR) are primarily influenced by five sub-criteria of the model. Research revealed that four factors are positively correlated and one factor is negatively correlated to customer results. It is concluded that over-stressing on sub-criteria (5.a) "process design to optimizing the stakeholder value" would significantly affect customer results. The organization needs to make sure that a balanced approach is considered while focusing on this factor.
- People result (PR) of an organization are primarily influenced by six factors. This research revealed that four factors are positively correlated and two factors are negatively correlated to the people results. Over-stressing on "products and services to create optimum value for customers by adopting new technology without people capability development and integrated plan for handling organizational change" would impact people result.
- Society results (SR) are primarily influenced by five factors. The organization's focus on developing people has shown a positive impact on society results. People would

become ambassadors of their organization and create positive vibes about the organization.

- The business results (BR) of an organization are primarily influenced by six critical factors. An organization needs to be watchful while developing products of optimum value for customers and over-relying the current capabilities.

Chapter-4 identifies the interrelationships among EFQM sub-criteria. While most of the earlier research papers have focused on the criteria level or theoretical construct of the model. This research analysed the effect of assessment scores at the sub-criteria level. It is found that nine sub-criteria are influencing six or more other sub-criteria. The chapter adds to the theory building on the EFQM model by providing critical analysis of its different criteria by building a statistical model at the sub-criteria level. This theory-building is expected to help other organizations to validate the EFQM model relationships in their organizations, hitherto taken *a priori*. This research would help the organisations in prioritisation of EFQM model implementation looking at the promoters, detractors, proponents, and defenders at the sub-criteria level. This would help the organisation to gain confidence while implementing the business excellence model.

The model adopted by most of the researchers appears to be different for the Indian context. The results show that the leadership criterion has a strong positive influence on the process criterion. This research emphasises that to achieve better scores in leadership, deployment of the subsequent act of leadership in other criteria is very much important and necessary for the organisation to achieve better scores in leadership. The cultural or organisational behaviour is different as compared to other countries in terms of style of leadership in managing the organisation. The leadership criteria have got maximum impact and influence on other sub-criteria of other parts of the model (i.e strategy, process, partnership and people). It can be concluded that:

- Leadership has a strong influence on strategy and process management. Leadership has a marginal influence on people and partnerships.
- The strategy has a strong influence on partnerships and marginal influence on process and people.
- People have a marginal influence on partnerships and very little influence on processes.
- Partnerships have a strong influence on processes.

Chapter-5 identifies the relationship within the result criteria based on the assessment scores of the model. It has revealed the relationship between the result sub-criteria and its significance. The factorial analysis result confirms the positive relationship between people to business results, business results to people results, business results to customer results, customer to society results. However, the existence of relation between people to customer results, business to society results are not evidenced from Indian context.

Chapter-6 develops a questionnaire instrument to validate the interrelationships established in chapters 3, 4 and 5. Feedback from 169 industry experts, subject matter experts and from organizational respondents was obtained for the validation using statistical tools of factorial analysis, path analysis, SEM and NPS.

The analysis of enabler sub-criteria influencing the results validated 17 enablers as influencing the results at sub-criteria level. Five sub-criteria eliminated by the SEM analysis are: Finances are managed to secure sustained success; Processes are designed and managed to optimise the stakeholder value; Processes are designed and managed to optimise the stakeholder value; People are aligned, involved and empowered; and Information and knowledge are managed to support effective decision making and to build the organization’s capability.

Five factors were eliminated during the validation of proponents, promotors, detractors, and defenders of EFQM enablers at sub-criteria level. The two proponents of 'Over-relying on the current capabilities (infrastructure, tools, technologies) would not help in improving the business results' and 'Promoting and marketing products by itself does not lead to business excellence' were eliminated during the SEM analysis. Similarly, two factors of detractors namely 'The two-way communication between employee and management helps the Organization to Excel' and 'Over-focus on partnership and supplier management does not guarantee the excellence of business' were eliminated. One of the promotors namely 'Defining and communicating a vision of the organizations by its leaders sets the tone of the organizational behaviour' was not validated by the data.

It was found during the net promotor analysis of results sub-criteria that one of the sub-criteria.

Chapter-7 identifies and deliberates upon the key influencers in the EFQM model, which drive the high maturity behaviours of the organizations. Further, the chapter identifies that the leadership and people criteria are the main influencers driving the organizations for the transition from low maturity to high maturity organizations. This empirical research conducted based on of EFQM assessment scores of 58 organizations that were assessed for business award-winning and prize-winning organizations took an average of 6.89 years and 6.33 years respectively to achieve their status. Similarly, these organizations took an average of 4.9 and 4.0 attempts to attain the status. This study also compares the findings with a similar study of Spanish organizations and concluded that Indian organizations are highly influenced by leadership, unlike Spanish organizations. In nutshell, organizational excellence is the outcome of 4Ps: Purpose, Practice, Performance, and perfecting the 3Ps. The S/N ratio, Logistic regression and box plots to analyse the data. The author has presented the impact of key performance indicators of

award/prize-winning organizations over years and performed ANOVA to validate the hypothesis. It is evident that public sector pursues the model more rigorously than private sectors. The private sector looks for quick wins and shorter lead time results. It is also evident that organisational groups or amalgamation of the organizations have more perseverance in the model.

The assessment process takes almost eight months from the date of application to formal report of the assessment. It is too long a period to wait for getting to know the gaps, it will be good to revisit the assessment process and make it simplified. To improve the nominations for applications, it will be good to review the fee structure of the assessment and make it reachable to MSMEs.

Chapter-8 compares the EFQM 2012 model against the EFQM 2020 MODEL. The chapter establishes the magnitude of adoption of guidance point (GP) of EFQM 2012 in the EFQM 2020 version. The research concludes that the EFQM model is moving towards a generic model with a focus on the futuristic requirements of the organisations rather than merely a business excellence model and/or just a quality award enablement model. The broad level construct of the new version consists of direction, execution, and results. The new model is more futuristic or transformative. The EFQM 2020 model has a strong relationship with Industry 4.0. The study also shows that the adoption of the new EFQM model could accommodate Industry 4.0 implementation as well as monitoring its impact.

However, few parts of the 2020 model are subjective and the assessment is left to the imagination and judgement of the assessors and the organisation. Since the latest version of the EFQM model has just now been introduced, it would take some more time for the stakeholders to understand the model more correctly and apply them in an organisational setting. The current research has thus provided a breadth cum depth on the evolutionary

path of the EFQM model in its journey towards contributing to the drive of quality and excellence in organizations where they are deployed across the globe. Even though the model focused on transformation, the foundation and mechanics of the organisation can't be ignored. In the new model, it appears that some of the key mechanics like communication strategy, the realisation of strategy, competency, skill development, and few interactions are missing. This research has been carried out based on the availability of information on the new model. However, this research would provide a platform for future research to enhance the current research work. Since the new model is evolving and has not reached a mature state, it would provide more avenues to overcome gaps, if any, in the current research.

Critical success factors for Industry 4.0 adoption have been identified based on the literature review and the discussion with experts. The chapter also presents the comprehensive list of KPIs for Industry 4.0 and EFQM 2020. This would serve as a guide for the manufacturing plants in their Industry 4.0 and EFQM 2020 journey.

SIGNIFICANCE OF THE RESEARH WORK

The thesis contributes to the existent body of knowledge on EFQM for academicians, researchers, and practitioners alike.

- Most of the study conducted in the past are passed on the self-assessment score or survey outcome. This study is based on the external assessment data and conclusions are based on real practice scenarios in the organizations.
- This study presents the interrelationship of the EFQM model at the sub-criteria level. In the past, most of the studies were carried out at the criteria level. The study at sub-criteria provides more meaningful insights to the organizations to prioritize their actions to improve the business excellence.

- The thesis developed a quadrant matrix for the classification of EFQM enablers as proponents, promotors, detractors, and defenders. This will be useful for the managers and the management to identify the areas of focus.
- The study identified the characteristics of high maturity organizations. The low maturity organizations can learn from it to develop a path to focus on the right sub-criteria to improve their maturity. This helps the managers to prioritize the EFQM improvements based on the desired maturity of the organization and helps them to utilize the resources effectively.
- The study focuses on the interrelationship of the EFQM 2020 version with Industry 4.0. The study of EFQM 2020 and Industry 4.0 on the same platform would serve the researcher and academician to develop further on the concepts proposed in this thesis.
- The KPIs proposed for Industry 4.0 and EFQM-2020 on the same platform would help researchers to quickly establish relationships between EFQM and Industry 4.0, which will be mutually beneficial for both.
- The study also highlights the award and prize-winning organizations path for success. The award information available at the CII website is converted into meaningful data to reflect on the progress from one level to another level of award.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The current research study is based on the 58 company assessment scores of India. Though it is fairly a good sample size, future research with more sample data covering organizations from the other regions has to be attempted. Even though the sample size is from India, the construct and approaches of the EFQM model worldwide are same. While the conclusions from the current research findings could be used to broader aspects, the users are expected to keep this limitation of geography in mind. This research could provide pointers for further studies on technology influence on EFQM model, industry

4.0, comparison of high maturity industry, EFQM influence factors based on region. Using the research outcome, it is possible to challenge the construct of the current EFQM model to improve it for further applications as the driver of business and organizational excellence. Deep dive into the enabler practices adopted by high maturity organizations could be one area the researchers could focus on in future. Similarly, further research could look at the comparison of high maturity organization behaviour in other regions to uncover any regional bias on the organizational performance or influencing factors. The analysis of the research has thrown up some open question to be further delibrated and answered. Some of the outcomes to be developed further are:

Award process and award forum-related deliberation: The organizations are experiencing infant mortality syndrome in the assessment cycle. Around 40% of the organizations are not able to reappear next time. This throws up the following questions

- Why these organizations did not pursue the business excellence initiative further? Is it a lack of support from senior management or leadership? Is the leadership team convinced with the business excellence model and process? As a part of the award forum, did the forum spend adequate time educating the leadership?
- Is the organization not seeing adequate value addition from the first assessment process? Is the organization spending more time in driving excellence than operational excellence in the organization?
- Did the leadership or management team perceive the business excellence like one more ISO certification? Have they not understood the essence of business excellence and mechanisms of excellence? Mann (2011) highlighted that 36% of organizations use business excellence as a framework to assess the company's management system

and performances. The organizations struggle with time for driving the business excellence, resources, and funding for the business excellence initiatives.

- It is realized that adoption of business excellence was not a priority for 40% of the organizations. Leadership had some other pressing needs and priority topics to drive rather than to drive business excellence. Did the organisation change the leaders in this company? Did this disruption make the organization suffer? It is also interesting to research the companies that have not adopted business excellence after the first attempt and measure their progress in terms of their business goals and achievements.
- Is the award process too cumbersome or time-consuming?
- Is there a gap between self-assessment of the organization to the actual assessment of the organization?

MSMEs and business excellence: In the Indian industry scenario, the country possesses more than 63.39 Million MSMEs. 40 organizations participating in 63.39Million SME is almost negligible compared to MSME base in India. This requires more education, awareness and promotion of business excellence in the SME sector. It will be interesting to conduct a deep dive into the reasons for such less participation in the award process. Mann (2004) highlights that business excellence for SME is not properly positioned as an attractive option and it appears that the model is too complex and long-term benefits are not clearly articulated.

EFQM version change and Industry 4.0: There are three thoughts on the EFQM model maturity. One, the model is following the product maturity model and it seems to have reached the product maturity cycle during the 2010-2012 time. Two, it has to do something with the version 2012 model or it is a coincidence that EFQM 2012 and declining trends of applicants are the same patterns? Three, the decline in the second

decade of new millennium is due to the introduction of new paradigm in manufacturing – Industry 4.0. It will take some time to get the answers to these questions.

Since the new model is evolving and has not reached a mature state, it would provide more avenues to overcome gaps, if any, in the current research. The author has proposed the KPI for EFQM 2020 and industry 4.0, this could set a base for developing the KPI structure for EFQM 2020 and industry 4.0. The author deliberated on the interconnection between EFQM 2020 and industry 4.0, This would be a good start to compare both the approaches. The author also adopted logistic regression to identify the characteristic of high and low maturity organizations. The Future studies could be considered in the area of Industry 4.0 and EFQM 2020 relationships, KPI framework and significance of EFQM 2020 model in the modern industrial world.

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APPENDIX - A

APPENDIX A-1: INFORMATION ON EFQM SUB-CRITERIA AND GUIDANCE POINT INFORMATION

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
1.a	GP1	Leaders develop the Mission, Vision, Values and ethics and act as role models.	Secure their future by defining and communicating a core purpose that provides the basis for their overall Vision, Mission, values, ethics and corporate behaviour.
1.a	GP2		Champion the organisation's values and are role models for integrity, social responsibility and ethical behaviour, both internally and externally, to develop and enhance the organisation's reputation.
1.a	GP3		Set and communicate a clear direction and strategic focus; they unite their people to share and achieve the organisation's Mission, Vision and goals.
1.a	GP4		Develop and support a shared leadership culture for the organisation and review and improve the effectiveness of personal leadership behaviours
1.b	GP5	Leaders define, monitor, review and drive the improvement of the organisation's management system and performance.	Define and use a balanced set of results to review progress, provide a view of long- and short-term priorities and manage the expectations of the key stakeholders.
1.b	GP6		Understand and develop the underlying capabilities of the organisation.
1.b	GP7		Evaluate the set of results achieved to improve future performance and provide sustainable benefits to all their stakeholders
1.b	GP8		Base decisions of factually reliable information and use all available knowledge to interpret current and predicted performance of the relevant processes
1.b	GP9		Deliver high levels of stakeholder confidence by adopting effective mechanisms to understand future scenarios and effectively manage strategic, operational and financial risks.
1.c	GP10	Leaders engage with external stakeholders.	Use approaches to understand, anticipate and respond to the different needs and expectations of their key stakeholders.
1.c	GP11		Establish shared values, accountability, ethics and a culture of trust and openness throughout the value chain
1.c	GP12		Are transparent and accountable to their stakeholders and society at large for their performance and ensure their people act ethically, responsibly and with integrity.

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
1.c	GP13		Ensure transparency of financial & non-financial reporting to relevant stakeholders, including appropriate governance bodies, in line with their expectations
1.c	GP14		Encourage their stake holders to participate in activities that contribute to the wider society
1.d	GP15	Leaders reinforce a culture of excellence with the organisation's people.	Inspire people and create a culture of involvement, ownership, empowerment, improvement and accountability through their actions, behaviours and experience.
1.d	GP16		Recognise sustainable advantage is dependent on the ability of leaders to learn quickly and rapidly respond when necessary
1.d	GP17		Support people throughout the organisation to achieve their plans, objectives and targets.
1.d	GP18		Recognise their efforts and achievements in a timely and appropriate manner
1.d	GP19		Promote a culture which supports the generation of new ideas and new ways of thinking to encourage innovation and organisational development.
1.d	GP20		Promote and encourage equal opportunities and diversity.
1.e	GP21	Leaders ensure that the organisation is flexible and manages change effectively.	Are flexible; they demonstrate their ability to make sound, timely decisions, based on available information, previous experience and knowledge, with consideration of their potential impact.
1.e	GP22		Consider " People, Planet and Profit" as a reference when balancing the sometimes conflicting imperatives that they face
1.e	GP23		Involve and seek support and contributions from all relevant stakeholders for changes necessary to ensure the sustainable success of the organisation.
1.e	GP24		Effectively manage change through structured project management and focused process improvement.
1.e	GP25		Use a structured approach for generating and prioritising creative ideas.
1.e	GP26		Test and refine the most promising ideas, allocating resources to realise them within appropriate timescales.
2.a	GP27	Strategy is based on understanding the needs and expectations of both stakeholders	Gather the various stakeholders' needs, expectations and interactions for input to the development and review of their strategy and supporting policies, remaining alert to any changes.
2.a	GP28		Identify, analyse and understand external indicators, such as global and local economic, market and societal trends, which may affect the organisation
2.a	GP29		Understand and anticipate the long and short-term global and local impact of changes to relevant political, legal, regulatory and compliance requirements.

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
2.a	GP30	and the external environment.	Use mechanisms to identify changes in their external environment and translate these into potential future scenarios for the organisation.
2.b	GP31	Strategy is based on understanding internal performance and capabilities.	Analyse operational performance trends to understand their current and potential capabilities and capacities and identify where development is needed to achieve the strategic goals.
2.b	GP32		Analyse data and information regarding existing and potential partners' core competencies and capabilities to understand how they complement the agency's capabilities.
2.b	GP33		Determine the potential impact of new technologies and business models on the performance of the organisation.
2.b	GP34		Compare their performance with relevant benchmarks to understand their relative strengths and areas for improvement.
2.c	GP35	Strategy and supporting policies are developed, reviewed and updated.	Create and maintain a clear strategy and supporting policies to achieve the Mission and Vision of the organisation
2.c	GP36		Integrate the concepts of sustainability within their core strategy, value chain and process design and allocate the resources required to deliver these goals
2.c	GP37		Identify and understand the key results required to achieve their mission and evaluate progress towards the vision and strategic goals
2.c	GP38		Adopt effective mechanisms to manage the strategic risks identified through scenario planning
2.c	GP39		Understand their key competencies and how they can generate shared value to benefit wider society
2.d	GP40	Strategy and supporting policies are communicated, implemented and monitored.	Translate their strategies into aligned processes, projects and organisational structures, ensuring changes can be implemented with appropriate speed through the value chain
2.d	GP41		Establish targets based on comparisons of their performance with other organisations, their current and potential organisational capability and their strategic goals.
2.d	GP42		Ensure that financial, physical and technological resources are available to support organisational development.
2.d	GP43		Deploy strategy and supporting policies in a systematic manner to achieve the desired set of results, with clearly defined "cause and effect" relationships.
2.d	GP44		Set clear goals and objectives for innovation, based on an understanding of the market and opportunities, supported by appropriate policies and resources
2.d	GP45		Communicate strategy and supporting policies with relevant stakeholders.
3.a	GP46		Have clearly defined the people performance levels required to achieve the strategic goals.

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
3.a	GP47	People plans support the organization's strategy	Align people plans with their strategy, the organisational structure, new technologies and key processes.
3.a	GP48		Rapidly adapt their organisational structure to support the achievement of the strategic goals.
3.a	GP49		Involve employees, and their representatives, in developing and reviewing the people strategy, policies and plans, adopting creative and innovative approaches when appropriate.
3.a	GP50		Manage recruitment, career development, mobility and succession planning, supported by appropriate policies, to ensure fairness and equal opportunities.
3.a	GP51		Use people surveys and other forms of employee feedback to improve people strategies, policies and plans
3.b	GP52	People's knowledge and capabilities are developed.	Define the skills, competencies and people performance levels required to achieve the Mission, Vision and strategic goals.
3.b	GP53		Effectively plan to attract, develop and retain the talents required to meet these needs.
3.b	GP54		Appraise and help people improve their performance and engagement.
3.b	GP55		Develop people's skills and competencies to ensure their future employability.
3.b	GP56		Ensure their people have the necessary competencies, resources and opportunity to be able to maximise their contribution
3.c	GP57	People are aligned, involved, and empowered.	Align personal and team objectives, and empower people to realise their full potential in a spirit of true partnership.
3.c	GP58		Recognise that innovation can apply to products, processes, marketing, organisational structures and business models:
3.c	GP59		Create a culture of creativity and innovation across the organisation, ensuring people have an open mind-set and can respond quickly to challenges they face
3.c	GP60		Encourage their people to be ambassadors of the organisations' image and reputation.
3.c	GP61		Inspire participation in activities that contribute to wider society
3.d	GP62	People communicate effectively throughout the organisation	Understand the communication needs of their people and use appropriate strategies and tools to maintain a dialogue.
3.d	GP63		Communicate a clear direction and strategic focus to ensure that people understand and can demonstrate their contribution to the organisation's on-going success.
3.d	GP64		Enable and encourage the sharing of information, knowledge and best practices, achieving a dialogue throughout the organisation.
3.d	GP65		Develop a culture that continually seeks to improve the effectiveness of collaboration and teamwork throughout their value chain
3.e	GP66		Align remuneration, benefits and terms of employment with transparent strategies and policies.

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
3.e	GP67	People are rewarded, recognized and cared for.	Motivate people to become involved in improvement and innovation and recognise their efforts and achievements
3.e	GP68		Ensure a healthy work / life balance in the reality of 24/7 connectivity, increasing globalisation and new ways of working.
3.e	GP69		Promote a culture of mutual support, recognition and care between individuals and between teams.
3.e	GP70		Respect and embrace the diversity of their people and the communities and markets the organisation serves
4.a	GP71	Partners and suppliers are managed for sustainable benefit.	Segment partners and suppliers, in line with the organisation's strategy and adopt appropriate policies' and processes for effectively working together
4.a	GP72		Build a sustainable relationship with partners and suppliers based on mutual trust, respect and openness.
4.a	GP73		Ensure partners and suppliers operate in line with the agency's strategies and values.
4.a	GP74		Establish appropriate networks to enable them to identify potential partnership opportunities to enhance their capabilities and ability to generate additional stakeholder value
4.a	GP75		Work together with partners to achieve mutual benefit and enhanced value for their respective stakeholders, supporting one another with expertise, resources and knowledge.
4.b	GP76	Finances are managed to secure sustained success.	Use financial strategies, policies and processes to support the overall strategy of the organisation and ensuring financial resilience.
4.b	GP77		Design the financial planning, control, reporting and review processes to optimise the use of resources.
4.b	GP78		Allocate resources to provide for long-range needs rather than just short term gain and where relevant, become and remain competitive
4.b	GP79		Use Financial governance processes, tailored to all appropriate levels in the organisation
4.b	GP80		Evaluate, select and validate investment in, and divestment of, both tangible and non-tangible assets, respecting their long-term economic, societal and ecological effects.
4.c	GP81	Buildings, equipment, materials and natural resources are managed in a sustainable way.	Use strategies, policies and processes for managing buildings, equipment and materials in a financial and environmentally sustainable way.
4.c	GP82		Optimise the use and effectively manage the lifecycle and physical security of their tangible assets, including buildings, equipment and materials.
4.c	GP83		Measure and optimise the impact of their operations, product life cycle and services on public health, safety and the environment

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
4.c	GP84		Minimise their local and global environmental impact, including setting challenging goals for meeting and exceeding legal standards and requirements.
4.c	GP85		Actively advance the economic, environmental and social standards within their sector.
4.d	GP86	Technology is managed to support the delivery of strategy.	Manage a technology portfolio that supports the organisation's overall strategy.
4.d	GP87		Evaluate and develop the technology portfolio to improve the agility of processes, projects and the organisation.
4.d	GP88		Involve relevant stakeholders in the development and deployment of new technologies to maximise the benefits generated.
4.d	GP89		Identify and evaluate alternative and emerging technologies in the light of their impact on organisational performance and capabilities and the environment.
4.d	GP90		Use technology to support the culture of creativity and innovation.
4.e	GP91	Information and knowledge are managed to support effective decision making and to build the organizational capability.	Ensure that their leaders are provided with accurate and sufficient information to support them in timely decision making.
4.e	GP92		Transform data into information and where relevant into knowledge that can be shared and effectively used.
4.e	GP93		Establish approaches to engage relevant stakeholders and use their collective knowledge in generating ideas and innovation.
4.e	GP94		Provide and monitor access to relevant information and knowledge for their people and external users, whilst ensuring both security and the organisation's intellectual property are protected.
4.e	GP95		Establish and manage learning and collaboration networks to identify opportunities for creativity, innovation and improvement.
4.e	GP96		Transform ideas into reality within timescales that maximise the advantages that an be gained
5.a	GP97	Processes are designed and managed to optimize stakeholder value.	Use a framework of key processes to implement the organisation's strategy
5.a	GP98		Manage the end to end processes, including processed that extend beyond the boundaries of the organisation
5.a	GP99		Ensure process owners understand their role and responsibility in developing, maintaining and improving the processes
5.a	GP100		Develop a meaningful mix of process performance indicators and related outcome measures, enabling the review of the efficiency and effectiveness of the key processes and their contributions towards the strategic goals
5.a	GP101		Use data on the current performance and capabilities of their processes, as well as appropriate benchmarks, to drive improvements, creativity and innovation

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
5.b	GP102	Products and Services are developed to create optimum value for customers.	Strive to innovate and create value for their customers, involving them and other stakeholders, where appropriate, in the development of new and innovative services, support and experiences.
5.b	GP103		Use market research, customer surveys and other forms of feedback to anticipate and identify improvements aimed at enhancing the product and service portfolio.
5.b	GP104		Develop their portfolio in line with the changing needs of existing and potential customer groups.
5.b	GP105		Design their product and service portfolio and actively manage the full product life cycle in a responsible way.
5.c	GP106	Products and Services are effectively promoted and marketed.	Know who their different customers groups are, both existing and potential, and anticipate their different needs and expectations.
5.c	GP107		Transform needs, expectations and potential requirements into attractive and sustainable value propositions for both existing and potential customers.
5.c	GP108		Implement the business model by defining their value proposition "unique selling points", and positioning, target customers groups and distribution channels
5.c	GP109		Develop marketing strategies to promote their services to target customers and user groups
5.d	GP110	Products and Services are produced delivered and managed.	Produce and deliver products and services to meet, or exceed, customer needs and expectations, in line with the offered value proposition
5.d	GP111		Develop effective and efficient key processes and value chains to ensure they can consistently deliver on their promised value proposition.
5.d	GP112		Ensure people have the necessary resources, competencies and empowerment to maximise the customer experience.
5.d	GP113		manage products and services throughout their lifecycles, including reusing and recycling whether appropriate, considering any impact on public health, safety and the environment
5.d	GP114		Compare their performance with relevant benchmarks and learn from their strengths and opportunities for improvement in order to maximise the value generated for customers.
5.e	GP115	Customer relationships are managed and enhanced.	Segment customers, in line with the organisation’s strategy, and adopt appropriate policies and processes for effectively managing the relationship.
5.e	GP116		Determine and meet customers’ day-to-day and long-term contact requirements.
5.e	GP117		Build and maintain a dialogue with customers, based on openness and transparency.

Old Criteria	GP Ref	EFQM 2012 Criteria	Guidance Points of EFQM 2012
5.e	GP118		Continually monitor and review the experiences and perceptions of their customers and ensure processes are aligned to respond appropriately to any feedback.
5.e	GP119		Ensure customers are clear on their responsibilities with regards to the use of the products and services
6.a	GP120		Customer Perceptions
6.b	GP121		Customer Performance Indicators
7.a	GP122		People Perceptions
7.b	GP123		People Performance Indicators
8.a	GP124		Society Perceptions
8.b	GP125		Society Performance Indicators
9.a	GP126		Business Outcomes
9.b	GP127		Business Performance Indicators

APPENDIX A2: CII-EXIM BANK BUSINESS EXCELLENCE PARTICIPATING ORGANIZATIONS

Sl No	**Organization**	**Year (Award category)**
1	Ace Designers Limited	2007(1), 2008(1), 2013(1), 2014(1)
2	Aditya Auto Products & Engineering (I) Pvt. Ltd	2008(2)
3	Alexandria Carbon Black	2002(1), 2003(1), 2004 (2)
4	Alumina Refinery, National Aluminium Company Limited, Damanjodi	2018(1), 2020(2)
5	Angelique International Ltd.	2012(1)
6	Apollo Hospitals, Chennai	2013(1)
7	ASE Structure Design Pvt Ltd.	2015(1)
8	Ashok Leyland	2009(1)
9	AT & S	2000(2)
10	AUDCO India Ltd.	2009(1), 2010(1), 2011(1)
11	B M Birla Heart Research Centre	2011(1)
12	Balasore Alloys Ltd.	2008(1)
13	Bharat Electronics Limited, Chennai Unit,	2011(1), 2018(2)
14	Bharat Electronics Limited, Ghaziabad Unit,	2018(2)
15	Bharat Electronics Ltd., Bangalore	2012(2), 2018(4)
16	Bharat Electronics Ltd., Components	2008(1), 2009(1), 2010(1)
17	Bharat Electronics Ltd., Export Mfg SBU	2010(1)
18	Bharat Electronics Ltd., Ghaziabad	2006(1), 2007(1), 2009(1), 2011(1), 2012(1), 2013(1), 2014(1), 2019(2)
19	Bharat Electronics Ltd., Hyderabad	2012 (1), 2013(1)
20	Bharat Electronics Ltd., Kotdwara	2003(1), 2004(1), 2005(1), 2008(1) 2011(1), 2010(2)
21	Bharat Electronics Ltd., Machilipatnam	2005(1), 2012(1), 2013 (1), 2018(2)
22	Bharat Electronics Ltd., Navi Mumbai	2013(1)
23	Bharat Electronics Ltd., NS	2005(1), 2008(1)
24	Bharat Electronics Ltd., Panchkula	2004(1), 2005(1), 2009(1), 2010(1), 2011(1), 2012(1)
25	Bharat Electronics Ltd., Pune	2008(1)
26	Bharat Electronics Ltd., Telecom & Broadcast Systems (T&BS)	2007(1)
27	Bharat Electronics Ltd.,Military Communications	2007(1), 2009(2)
28	Bharat Heavy Electricals Ltd., Bhopal	2003(1), 2004(2), 2006(2), 2007(2) 2009(2)
29	Bharat Heavy Electricals Ltd., Boiler Auxiliaries Plant, Ranipet	2009(1), 2010(1), 2011(1)
30	Bharat Heavy Electricals Ltd., Electronics Division, Bangalore	2006(1), 2009(1), 2010(1), 2011(1) 2012(2)
31	Bharat Heavy Electricals Ltd., Hardwar	2003(1), 2004(2), 2005(2), 2006(3)
32	Bharat Heavy Electricals Ltd., Heavy Power Equipment Plant (HPEP), Hyderabad	2004(1), 2005(1), 2006(2), 2007(2), 2010(2), 2011(2), 2012(2)
33	Bharat Heavy Electricals Ltd., Jhansi	2007(1), 2008(1)
34	Bharat Heavy Electricals Ltd., PSER	2005(1), 2008(1), 2009 (2), 2011(2)
35	Bharat Heavy Electricals Ltd., PSNR	2003(1), 2004(1), 2005(1), 2008(2)
36	Bharat Heavy Electricals Ltd., PSSR	2009(1)

37	Bharat Heavy Electricals Ltd., Trichy	2000(2), 2001(2), 2002(2), 2003(2), 2004(2), 2005(2), 2006(2), 2007(2), 2009(2), 2010(1), 2013(2)
38	Bharat Petroleum Corporation Ltd	2011(1)
39	Bharti Tele Ventures	2005(1)
40	Birla Cellulosic	2002(1), 2003(1), 2004(1)
41	Blue Star Ltd., Air-Conditioning & Refrigeration Service Division	2017(1), 2018(1)
42	Bosch Ltd., Diesel Systems business – Bangalore	2008(2), 2009(4)
43	Bosch Ltd., Diesel Systems business – Jaipur	2008(1), 2012(2), 2013(3), 2014(3) 2016(3)
44	Bosch Ltd., Diesel Systems business – Nashik	2010(2), 2011(2), 2012(3), 2013(4)
45	Brigade Group	2011(1)
46	BSI Group India Pvt Ltd	2018(2), 2019(2)
47	Bunts Tools Company	2008(1)
48	Canon India Private Ltd.	2006(1), 2010(1)
49	Carborundum Universal Ltd (CUMI)	2003(1), 2005(1)
50	CESC Limited	2014(2), 2015(2), 2016(2), 2017(2) 2019(2)
51	CFL Ennore	2008(1)
52	CFL Kakinada	2008(1), 2009(1)
53	CFL Vizag	2008(1), 2009(1)
54	Coinnessuer	2008(1)
55	Connoisseur Infotech Pvt Ltd	2008(1)
56	Coromandel International Limited, Fertilisers SBU	2011(2), 2012(2), 2019(2)
57	Crompton Greaves Ltd.	2006(1), 2009(2), 2010(3)
58	Eastman Cast and Forge Ltd.	2008(1)
59	Eastman Industries Ltd.	2008(1)
60	Exide Industries	2006(1), 2007(1), 2008(2)
61	Finacle, Infosys	2008(1)
62	GAIL	2005(1)
63	GAIL Pata	2008(1)
64	Godrej & Boyce Mfg Co Ltd., Godrej Construction Division	2010(1), 2011(1), 2012(2), 2013(2), 2014(2), 2016(2)
65	Godrej & Boyce Mfg Co Ltd., Godrej Prima Div	2012(1), 2013(1), 2014(1), 2015(1)
66	Godrej & Boyce Mfg Co. Ltd., Appliance Division	2011(1), 2012(1), 2012(2), 2013(2), 2014(2), 2015(2), 2017(3), 2018(3) 2019(4)
67	Godrej & Boyce Mfg Co. Ltd., Godrej Electricals & Electronics	2011(1), 2012(1), 2013(1)
68	Godrej & Boyce Mfg Co. Ltd., Godrej Precision Engineering Division	2012(1), 2013(1), 2014(2), 2015(2), 2016(2), 2019(2)
69	Godrej & Boyce Mfg Co. Ltd., Interio Division	2010(2), 2011(2), 2012(2), 2013(2), 2014(2), 2015(2), 2016(3), 2014(4)
70	Godrej & Boyce Mfg Co. Ltd., Lawkim Motors Group	2011(1), 2013(1), 2015(2)
71	Godrej & Boyce Mfg Co. Ltd., Material Handling Division	2011(1), 2012(1), 2013(1), 2014(1)

72	Godrej & Boyce Mfg Co. Ltd., Security Solutions Division	2010(1), 2011(1), 2012(1), 2013(2), 2014(2), 2015(2), 2016(2)
73	Godrej & Boyce Mfg Co. Ltd., Tooling Division	2011(1), 2012(1), 2013(1)
74	Godrej & Boyce Mfg Co. Ltd.,Godrej Storage Solutions Division	2016(1)
75	Godrej & Boyce Mfg. Co. Ltd., Godrej Locking Solutions and Systems	2006(1), 2007(1), 2008(2), 2009(2), 2010(1), 2011(2), 2012(2), 2013(3), 2014(4)
76	Godrej Consumer Products	2006(1), 2007(1), 2008(1)
77	Grasim Industries Ltd.	2005(1), 2006(1)
78	Grasim Industries Ltd., Chemical Division	2013(1)
79	Grasim Industries Ltd., White Cement Division	2007(1)
80	Grindwell Norton Ltd., CAD	2007(1)
81	Grundfos Pumps India Pvt Ltd	2011(1)
82	Harita Grammer	2000(2)
83	HCC AmmeNPur	2005(1)
84	HCC-BP	2005(1)
85	Hewlett Packard India Ltd	1996(2), 1997(4)
86	Hindalco Industries Ltd.	1999(2), 2002(1), 2011(1)
87	Hindalco Industries Ltd., Alupuram Works	2016(1)
88	Hindalco Industries Ltd., Taloja Unit	2014(1)
89	Hindustan Latex Ltd.	2009(1)
90	Honeywell	2005(1)
91	Housing Development Finance Corporation	2000(2)
92	Humming Bird Corporate Travel and Stay Private Ltd	2011(1)
93	Humming Bird Digital Pvt. Ltd.	2016(1)
94	Imerys Steelcasting India Pvt. Ltd.	2017(1), 2018(1), 2019(1)
95	INDAL Hirakud	2003(1), 2004(1)
96	Indelox Services Pvt Ltd	2009(1), 2010(2), 2013(4),
97	Infosys BPO Ltd.	2007(1)
98	Infosys Technologies Ltd.	2001(2), 2002(4)
99	Infotech Enterprises Ltd.	2011(1)
100	Inteliment Technologies (India) Pvt. Ltd.	2012(1)
101	IOCL Panipat	2004(1)
102	IP Rings Ltd.	2008(2)
103	Ispat Industries	2008(1)
104	J K Fenner (India) Limited, Patancheru Plant,	2019(1)
105	J K Fenner (India) Ltd.	2011(1), 2013 (1)
106	J K Tyres Ltd.	2001(2)
107	J. K. Fenner (India) Limited, Madurai Plant,	2018(1)
108	Jay Bharat Maruti Ltd.	2003 (1), 2004(2), 2005(2), 2006(2) 2007(2)
109	JCB India Ltd.	2009 (1), 2011(2)
110	JSW Steel Coated Products Ltd.	2017(1)
111	JSW Steel Limited, Dolvi Works	2017(2), 2018(2), 2019 (2)
112	JSW Steel Ltd., Salem	2015(1)

113	JSW Steel Ltd., Vijayanagar Works	2003(1), 2004(1), 2005(2), 2006(2), 2007(2), 2009(2), 2010(2), 2011(2), 2012(2), 2013(2), 2014(2), 2015(2)
114	Kalpataru Ltd.	2012(1), 2013(1), 2014(1)
115	Kalyani Plant, Phoenix Conveyor Belt India (P) Limited	2018(1)
116	Kirloskar Brothers Ltd, Industrial Pumps Division SBG1	2007(1), 2009(1),2010(1), 2011(1) 2013(2)
117	Kirloskar Brothers Ltd., Small Pumps Division	2014(2)
118	Kirloskar Cope land	2005(1), 2006(1)
119	Kirloskar Ferrous Industries Limited	2009(2), 2010(1) ,2011(1),2013(1) 2014(1), 2015(2), 2016(2), 2017(2) 2018(2)
120	Kirloskar Oil Engines Limited	2006(1), 2009(1),2010(1), 2011(1), 2013(2), 2014(2),2015(2), 2019(3)
121	Kirloskar Pneumatic Company Ltd	2009(3), 2010(3), 2011(3), 2013(2), 2014(2)
122	Lakshmi Precision Screws Ltd.	2008(1)
123	Larsen & Toubro Limited, Rubber Processing Machinery Business Unit,	2019(1)
124	Larsen & Toubro Ltd – Komatsu Ltd.	2000(2), 2007(1), 2008(1), 2009(1), 2011(1), 2010(2)
125	Larsen & Toubro Ltd Hazira	2003(1)
126	Larsen & Toubro Ltd., Power	2016(1)
127	Larsen & Toubro, Ltd L&T, ECC Division	2000(2), 2003(1), 2005(2),
128	Ma Foi Management Consultants Ltd.	2007(1)
129	Madura Fashion & Life Style (A Division of ABNL)	2011(2), 2014(1)
130	Magdalla Cement Works	2014(2)
131	Maruti Suzuki India Ltd.	2013(2)
132	Maruti Udyog Ltd	1996 (2), 1998(4)
133	Mathura Refinery, Indian Oil Corporation Limited	2019(1)
134	Max New York Life Insurance Company Ltd.	2008(1), 2009(1), 2010(1)
135	MICO, Bangalore	2007(2)
136	Moolchand Medcity	2010(1)
137	Moonlight Engineering Co.	2010(2), 2011(2), 2012(2)
138	National Aluminium Company Limited	2019(2)
139	National Stock Exchange of India Ltd.	2011(1), 2012(1), 2014 (2), 2016(3)
140	NCR Corporation India Pvt Ltd.	2010(1)
141	NDPL	2005(1)
142	NEG Micon	2006(1)
143	NICCO Parks & Resorts Ltd.	2010(1), 2012(2)
144	NTPC Anta	2006(1), 2010(1)
145	NTPC Badarpur	2008(1)
146	NTPC Dadri	2003(1), 2005(2), 2010(2)
147	NTPC Farakka	2007(1)
148	NTPC Faridabad	2005(1)
149	NTPC Feroze Gandhi Unchahar Thermal Power	2007(1)

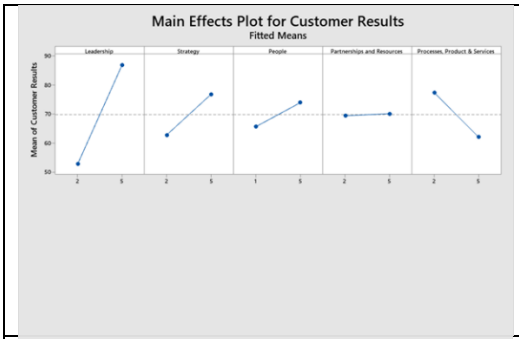
150	NTPC Jhanor	2006(1)
151	NTPC Kawas	2005(1)
152	NTPC Kawas Gas Power Project	2007(1)
153	NTPC Kayamkulam	2009(1)
154	NTPC Korba	2004(1), 2007(1), 2010(1)
155	NTPC Ramagundam	2005(1), 2008(2)
156	NTPC Rihand	2005(1), 2009(1)
157	NTPC Simhadri	2005(1), 2007(2)
158	NTPC Singrauli	2006(1)
159	NTPC Talcher	2007(1), 2009(1)
160	NTPC Tanda	2005(1)
161	NTPC Vindyachal	2005(1), 2008(1)
162	NTTF	2009(1)
163	NTTF Industries Pvt Ltd	2009(1)
164	Nuclear Power Corporation of India Ltd.	1999(2)
165	Optical Fiber Unit, Aurangabad, Sterlite Technologies Ltd.	2018(1)
166	Overseas Infrastructure Alliance (India) Pvt Ltd.	2011(1)
167	Philips Software	2004(1), 2005(1)
168	Pravin Masalewala	2008(1)
169	PSG Institute of Management	2008(2), 2011(2), 2017(2),
170	PT Indo Liberty	2004(1), 2005(1)
171	PT Sunrise	2005(1)
172	Pushpak Products India Pvt Ltd	2011(1)
173	Rallis India Ltd.	2008(2), 2012(3), 2015(3)
174	Rashtriya Ispat Nigam Ltd., Visakhapatnam Steel Plant	2006(1), 2007, 2013, 2014
175	Raychem RPG (P) Ltd.	2001(2), 2003(1)
176	Reliance	2005(1), 2006(2)
177	Reliance Hazira	2007(2)
178	Robert Bosch Engineering and Business Solutions Pvt. Ltd.	2015(1)
179	Satish Injecto-Plast Pvt Ltd	2011(1), 2012(1)
180	Shreekripa Enterprises	2011(1)
181	Snam Alloys	2009(1)
182	SSA Business Solutions (P) Ltd	2012(1)
183	Steel Authority of India Ltd Rourkela Steel Plant	2013(1)
184	Steel Authority of India Ltd., Bhilai Steel Plant	2009(1), 2011(2), 2012(2),2013(2), 2014(2), 2015(3), 2016(3)
185	Steel Authority of India Ltd., Bokaro Steel Plant	2013(1), 2015(1), 2016(2)
186	Steel Authority of India Ltd., Durgapur Steel Plant	2011(1), 2012(1), 2012(1), 2014(2) 2015(2)
187	Steel Authority of India Ltd., Rourkela Steel Plant	2008(1), 2011(1), 2012(1), 2014(1), 2015(2), 2016(1),
188	Sterlite Industries	2008(1)
189	Subros Ltd.	2013(1)
190	Susira Industries Ltd.	2008 (1)

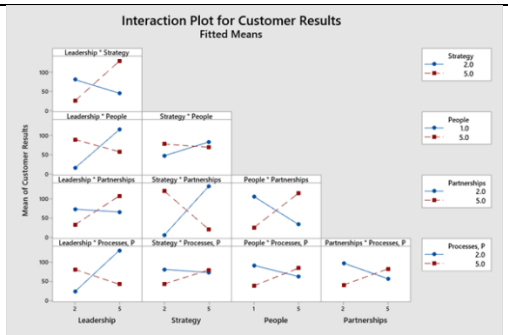
191	TATA Chemicals	2003(1), 2004(1)
192	TATA Honeywell	2004(1)
193	Tata Housing Development Company Ltd.	2014(2)
194	Tata Iron & Steel Company Ltd	1996(2), 1997(2), 1998(2), 2000(4)
195	Tata Johnson	2004(1), 2005(1)
196	Tata Liebert Ltd.	1999(2)
197	Tata Metaliks	2003(1), 2004(1), 2008(1)
198	Tata Motors	2003(1), 2004(2), 2005(4)
199	Tata Power	2003(1), 2005(1)
200	Tata Ryerson	2003(1), 2004(1), 2006(1)
201	Tata Steel Bearings Ltd., Kharagpur	2007(1)
202	TCS	2004(1), 2006(4)
203	Thai Carbon Black	2002(1),
204	The Aditya Birla Group, Domestic Textiles Business	2014(1)
205	The Tinplate Company of India Ltd.	2003(1), 2004(1), 2005(1), 2006(2), 2007(2), 2009(3), 2010(3)
206	Thinksoft Global Services Ltd	2009(1), 2010(1)
207	TI Cycles	2003(1), 2005(1)
208	TI Diamond	2005(1)
209	TIDC India Ltd.	1999(1)
210	TIDC, Chennai	2004(1)
211	TITAN, Hosur	2004(2), 2006(1)
212	Tractors and Farm Equipment Ltd., Tractor Div	2007(1), 2009(2), 2012(2)
213	Triveni Engineering & Industries Ltd., Gear Business Group	2013(1), 2014(1), 2016(2)
214	Triveni Turbine Ltd.	2008(1), 2009(1), 2010(1), 2011(2), 2012(2), 2013(2), 2014(2), 2015(2)
215	TTK Healthcare TPA Pvt. Ltd.	2008(1)
216	TV Super Filters Industries	2008(1),
217	UCAL Fuel Systems Ltd.	2007(1), 2008(1)
218	Venture Infotek Global Private Ltd.	2009(1)
219	Vestas	2007(1)
220	Village Financial Services Pvt Ltd	2008(1)
221	Vir Electro Engg. Pvt. Ltd.	2008(1)
222	Weir Minerals India Pvt Ltd	2008(1), 2010(1)
223	Wendt (India) Ltd.	2011(1), 2015 (1), 2012(2)
224	Yashoda Super Speciality Hospital, Kaushambi	2018(2), 2019(2)
225	Yes Bank Ltd.	2013(1)

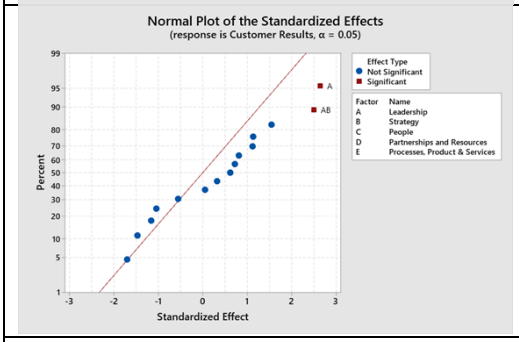
Note : 1 indicates SCE category, 2 indicates SA category, 3 indicates prize winning, 4 indicates award winning organization. For Example, Yes Bank Ltd – 2013(1) presents, Yes Bank Ltd got an CII SCE category award in 2013.

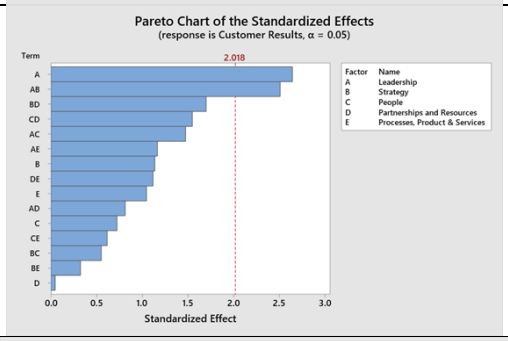
APPENDIX A-3: Minitab Results for Criteria Level Factorial Analysis Results -Iteration-2;

Iteration- 2: Factorial DOE Analysis for Customer Results









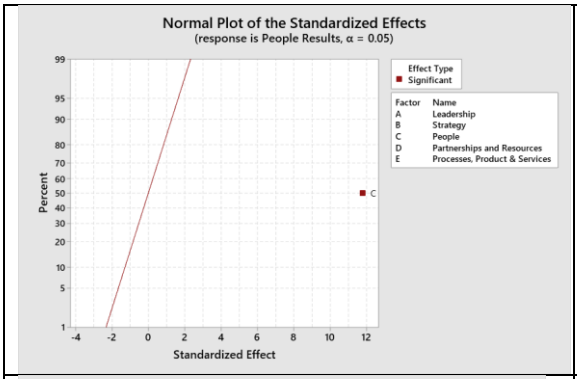
Factorial Regression: Customer Results

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		69.83	2.31	30.21	0.000	
Leadership	34.06	17.03	6.44	2.64	0.011	16.11
Strategy	13.99	6.99	6.15	1.14	0.262	13.58
People	8.29	4.15	5.73	0.72	0.473	6.28
Partnerships and Resources	0.70	0.35	7.29	0.05	0.962	14.68
Processes, Product & Services	-15.34	-7.67	7.33	-1.05	0.302	13.27
Leadership*Strategy	68.9	34.4	13.7	2.51	0.016	31.06
Leadership*People	-66.1	-33.1	22.4	-1.48	0.148	50.69
Leadership*Partnerships and Resources	41.2	20.6	25.3	0.81	0.421	80.63
Leadership*Processes, Product & Services	-72.4	-36.2	31.1	-1.17	0.250	109.78
Strategy*People	-22.3	-11.1	20.2	-0.55	0.584	37.71
Strategy*Partnerships and Resources	-114.5	-57.3	33.7	-1.70	0.097	153.57
Strategy*Processes, Product & Services	22.0	11.0	34.0	0.32	0.748	137.22
People*Partnerships and Resources	81.4	40.7	26.3	1.55	0.129	54.31
People*Processes, Product & Services	37.2	18.6	30.2	0.62	0.541	78.05
Partnerships and Resources*Processes, Product & Services	41.1	20.5	18.4	1.12	0.270	34.88

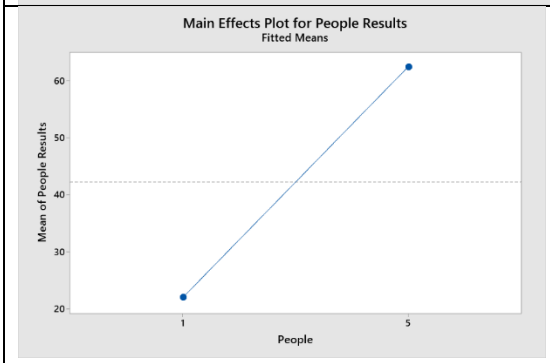
Model Summary

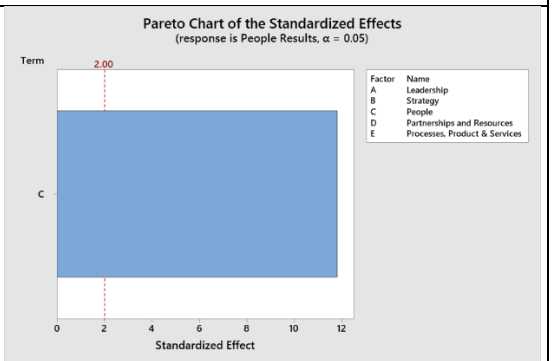
S	R-sq	R-sq(adj)	R-sq(pred)
7.86781	81.87%	75.40%	*

Iteration- 2: Factorial DOE Analysis for People Results



* NOTE * There are no valid interactions to plot.



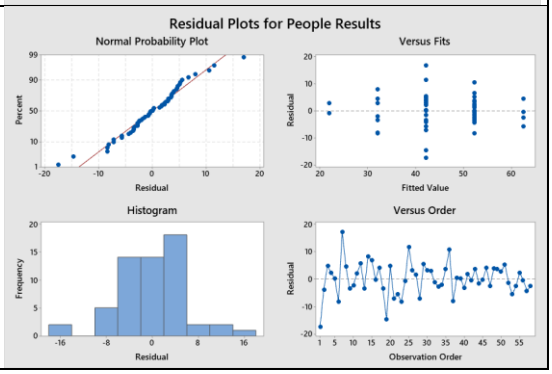


Factorial Regression: People Results

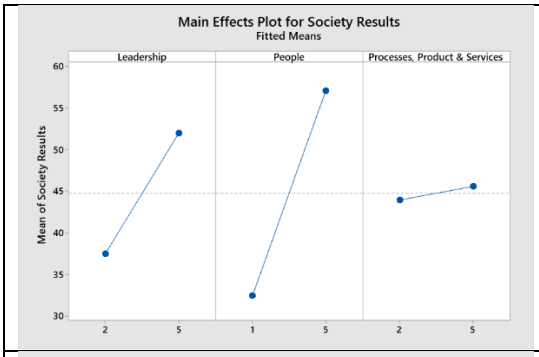
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		42.227	0.836	50.52	0.000	
People	40.51	20.26	1.72	11.80	0.000	1.00

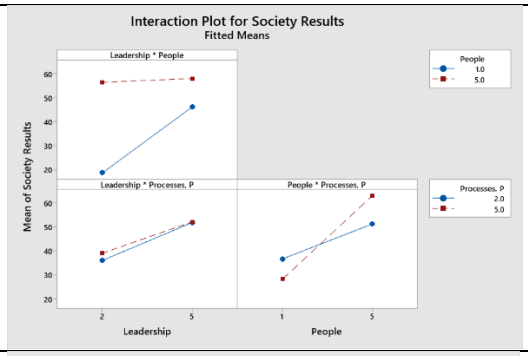
Model Summary

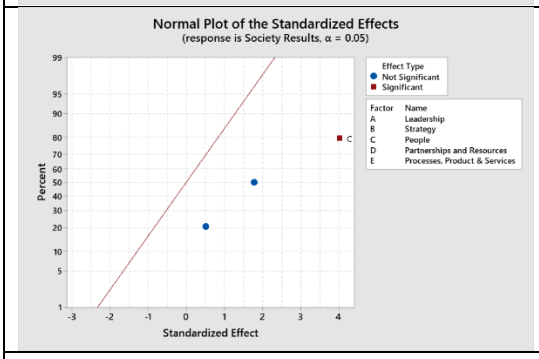
S	R-sq	R-sq(adj)	R-sq(pred)
5.90929	71.32%	70.80%	69.62%

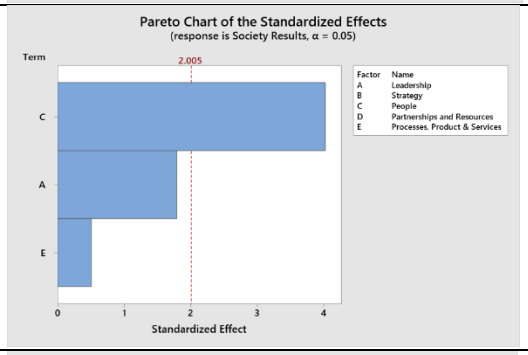


Iteration- 2: Factorial DOE Analysis for Society Results









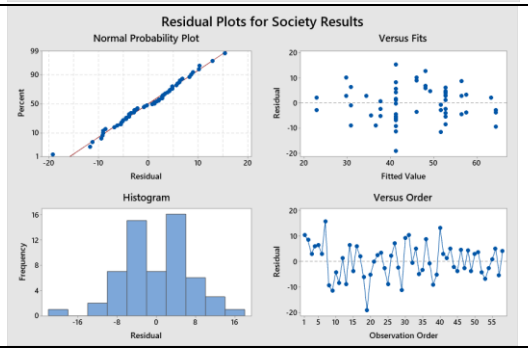
Factorial Regression: Society Results

Coded Coefficients

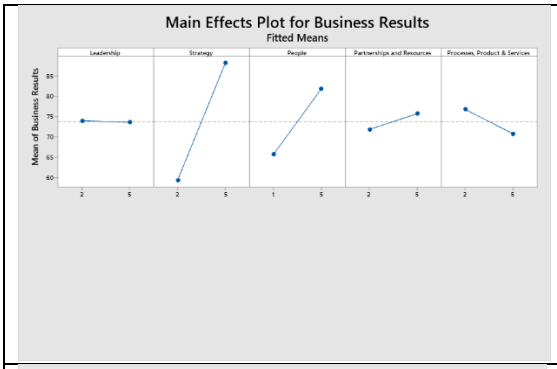
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		43.63	1.17	37.35	0.000	
Leadership	10.76	5.38	3.01	1.79	0.079	4.49
People	27.39	13.70	3.41	4.02	0.000	2.84
Processes, Product & Services	3.41	1.71	3.36	0.51	0.613	3.55

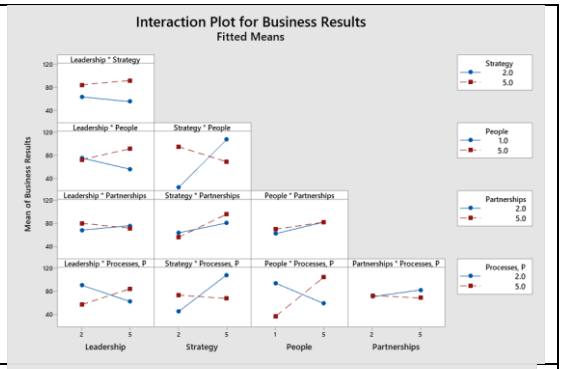
Model Summary

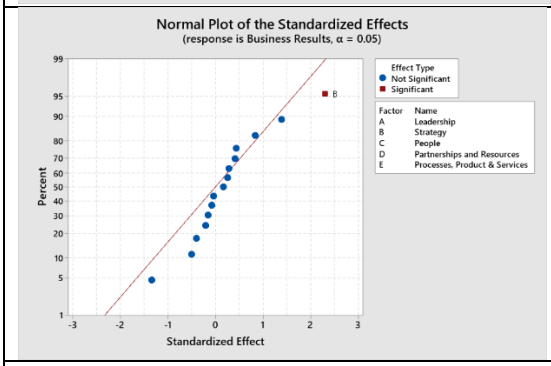
S	R-sq	R-sq(adj)	R-sq(pred)
6.95745	68.56%	66.82%	64.37%

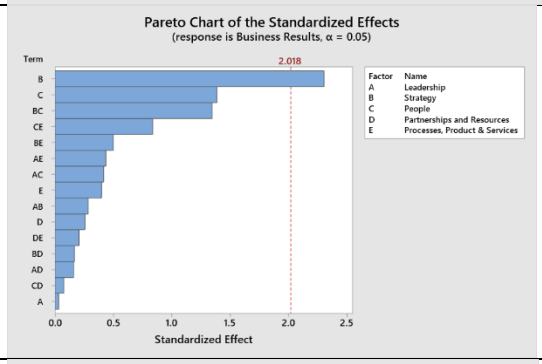


Iteration- 2: Factorial DOE Analysis for Business Results









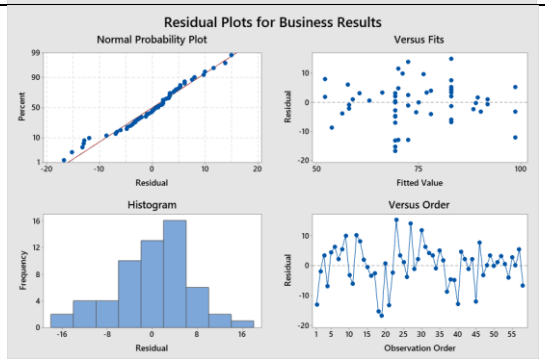
Factorial Regression: Business Results

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF	P-Value
Constant		73.81	2.35	31.44	0.000		0.000
Leadership	-0.43	-0.22	6.54	-0.03	0.974	16.11	0.974
Strategy	28.76	14.38	6.24	2.30	0.026	13.58	0.026
People	16.15	8.07	5.82	1.39	0.173	6.28	0.173
Partnerships and Resources	3.83	1.91	7.40	0.26	0.797	14.68	0.797
Processes, Product & Services	-5.96	-2.98	7.45	-0.40	0.691	13.27	0.691
Leadership*Strategy	7.9	4.0	13.9	0.28	0.777	31.06	0.777
Leadership*People	19.0	9.5	22.8	0.42	0.678	50.69	0.678
Leadership*Partnerships and Resources	-8.2	-4.1	25.7	-0.16	0.874	80.63	0.874
Leadership*Processes, Product & Services	27.5	13.8	31.5	0.44	0.665	109.78	0.665
Strategy*People	-55.2	-27.6	20.5	-1.35	0.186	37.71	0.186
Strategy*Partnerships and Resources	11.5	5.8	34.2	0.17	0.867	153.57	0.867
Strategy*Processes, Product & Services	-34.7	-17.3	34.6	-0.50	0.619	137.22	0.619
People*Partnerships and Resources	-4.1	-2.1	26.7	-0.08	0.939	54.31	0.939
People*Processes, Product & Services	51.4	25.7	30.6	0.84	0.406	78.05	0.406
Partnerships and Resources*Processes, Product & Services	-7.7	-3.9	18.6	-0.21	0.837	34.88	0.837

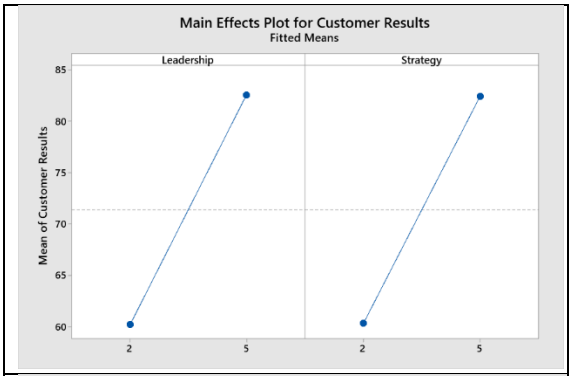
Model Summary

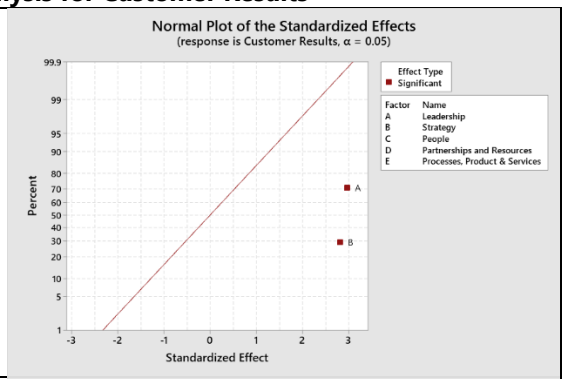
S	R-sq	R-sq(adj)	R-sq(pred)
7.99016	74.90%	65.93%	*

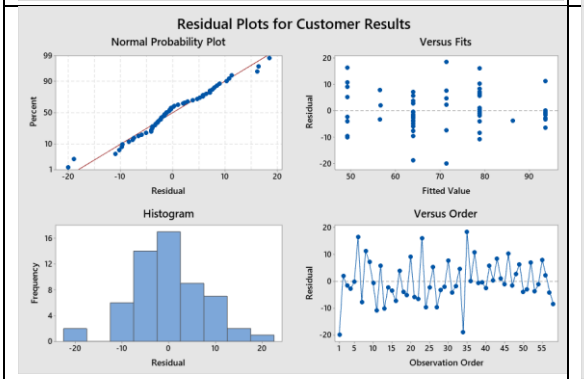


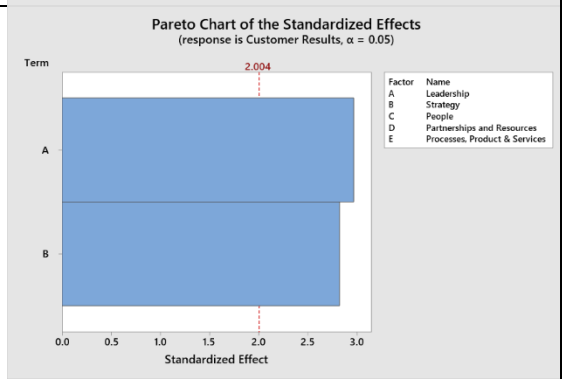
APPENDIX A-4: Minitab Results for Criteria Level Factorial Analysis Results -Iteration-3;

Iteration- 3: Factorial DOE Analysis for Customer Results









Factorial Regression: Customer Results versus Leadership, Strategy

Coded Coefficients

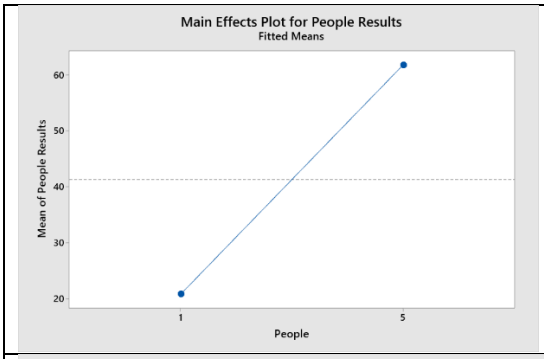
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		71.40	1.04	68.68	0.000	
Leadership	22.39	11.20	3.77	2.97	0.004	5.51
Strategy	22.14	11.07	3.92	2.82	0.007	5.51

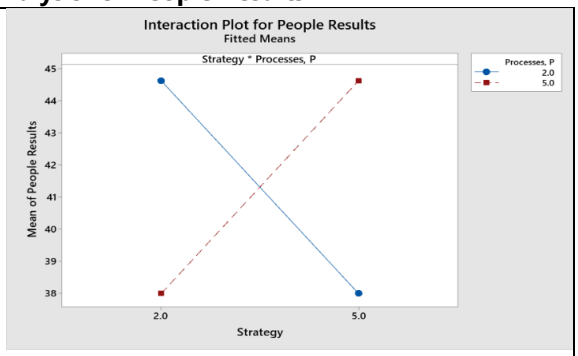
Model Summary

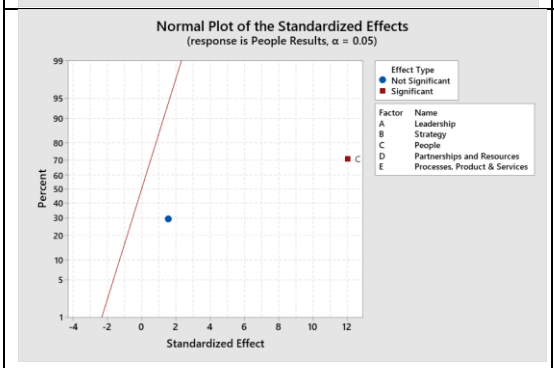
S	R-sq	R-sq(adj)	R-sq(pred)
7.88241	76.17%	75.30%	72.86%

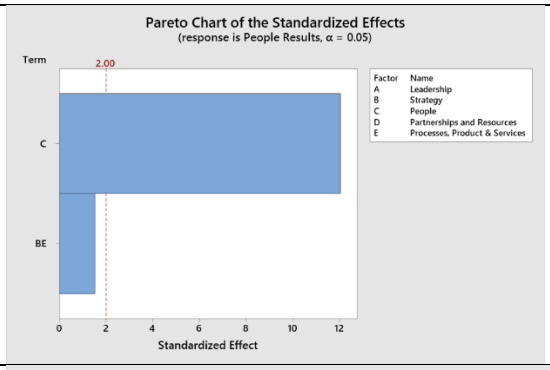
* NOTE * There are no valid interactions to plot.

Iteration- 3: Factorial DOE Analysis for People Results









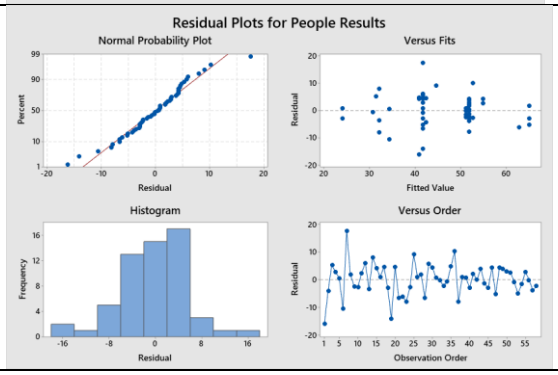
Factorial Regression: People Results

Coded Coefficients

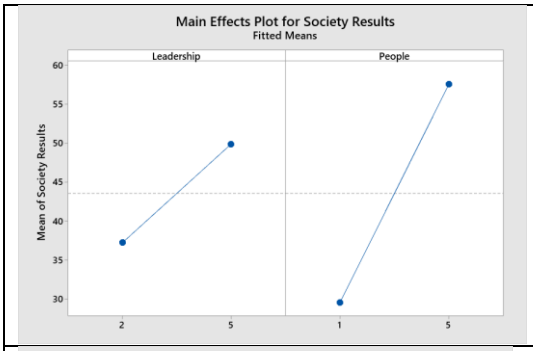
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		41.30	1.02	40.35	0.000	
People	41.04	20.52	1.71	12.03	0.000	1.01
Strategy*Processes, Product & Services	6.64	3.32	2.17	1.53	0.131	1.01

Model Summary

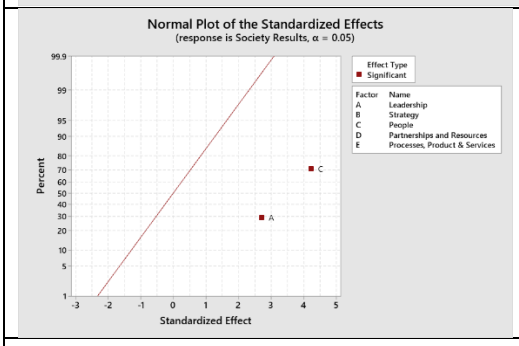
S	R-sq	R-sq(adj)	R-sq(pred)
5.83956	72.49%	71.49%	69.71%

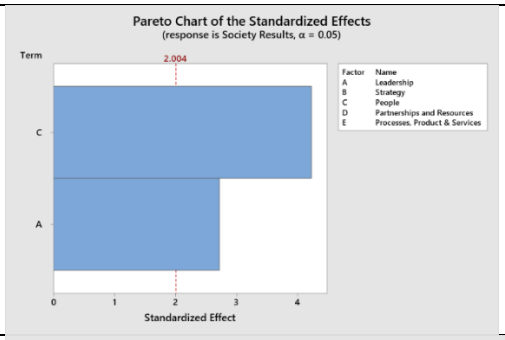


Iteration- 3: Factorial DOE Analysis for Society Results



* NOTE * There are no valid interactions to plot.





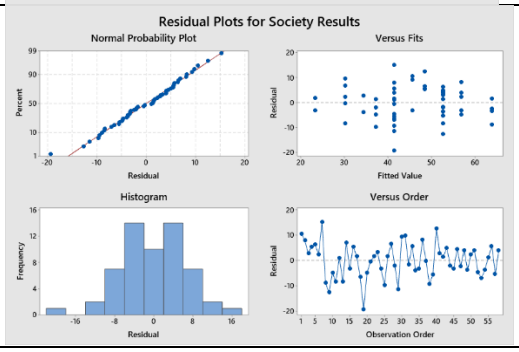
Factorial Regression: Society Results

Coded Coefficients

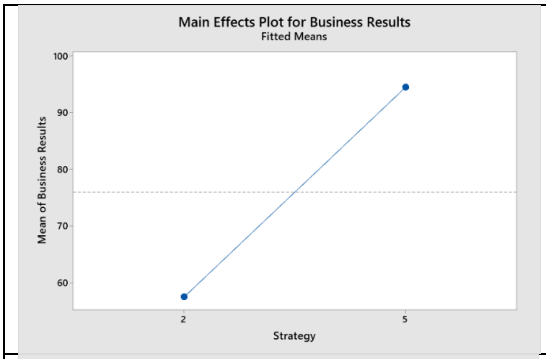
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		43.56	1.15	37.77	0.000	
Leadership	12.67	6.34	2.33	2.72	0.009	2.73
People	28.07	14.03	3.32	4.23	0.000	2.73

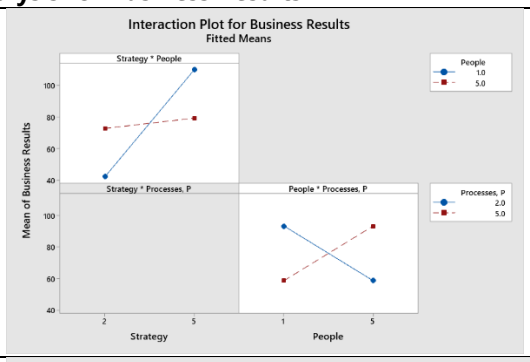
Model Summary

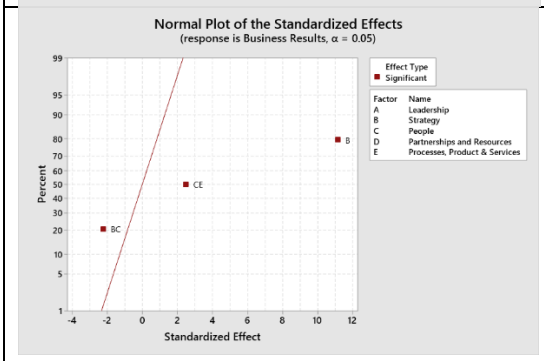
S	R-sq	R-sq(adj)	R-sq(pred)
6.91040	68.41%	67.26%	65.45%

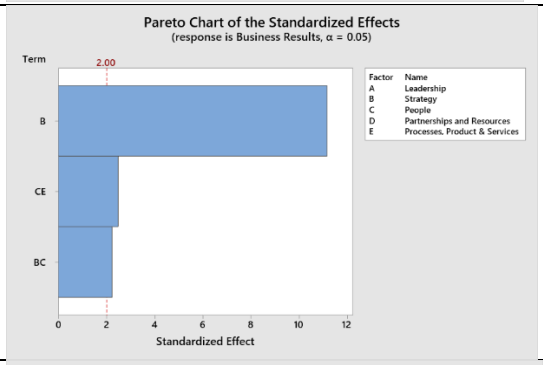


Iteration- 3: Factorial DOE Analysis for Business Results









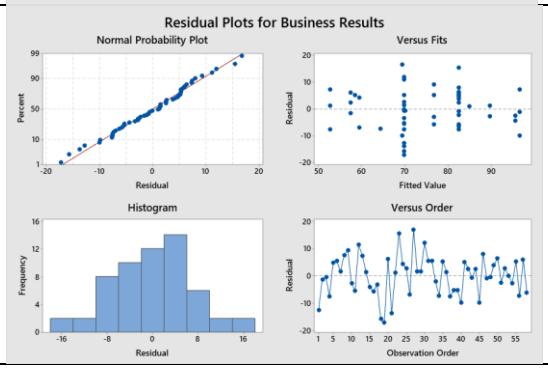
Factorial Regression: Business Results

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		75.97	1.29	58.92	0.000	
Strategy	37.07	18.53	1.66	11.16	0.000	1.10
Strategy*People	-30.55	-15.27	6.85	-2.23	0.030	4.81
People*Processes, Product & Services	34.67	17.33	6.98	2.48	0.016	4.63

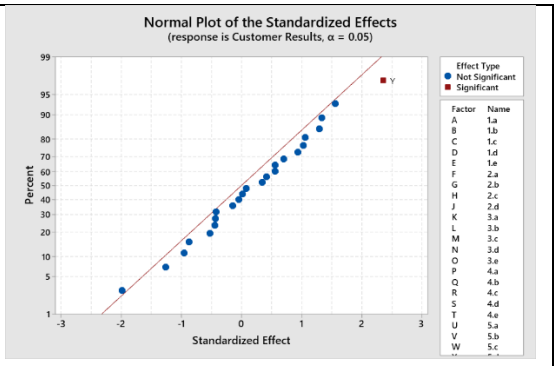
Model Summary

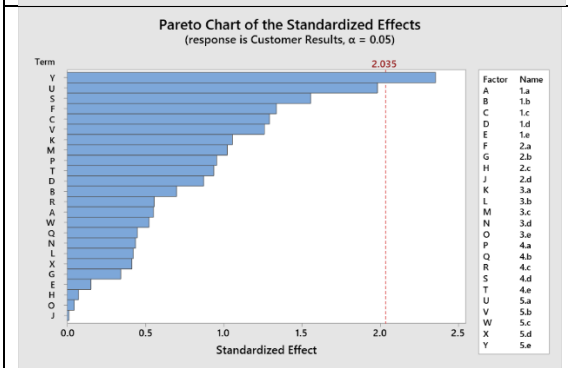
S	R-sq	R-sq(adj)	R-sq(pred)
7.47115	71.78%	70.21%	68.17%



APPENDIX A-5: Minitab Results for Sub-criteria Level Factorial Analysis Results -Iteration-4;

Factorial DOE Analysis for Customer Results





Factorial Regression: Customer Results

Coded Coefficients

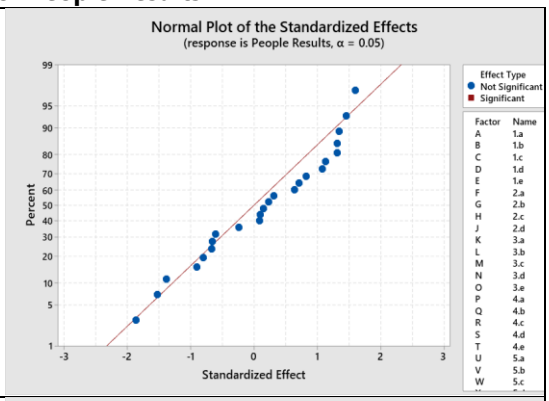
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		70.82	2.89	24.53	0.000	
1.a	5.87	2.93	5.31	0.55	0.584	12.66
1.b	6.67	3.34	4.76	0.70	0.489	11.43
1.c	13.09	6.54	5.06	1.29	0.205	11.26
1.d	-10.23	-5.12	5.86	-0.87	0.389	10.89
1.e	-1.40	-0.70	4.61	-0.15	0.880	10.28
2.a	16.05	8.03	6.00	1.34	0.190	10.75
2.b	3.28	1.64	4.79	0.34	0.734	10.65
2.c	1.10	0.55	7.54	0.07	0.942	14.21
2.d	0.13	0.06	5.66	0.01	0.991	7.36
3.a	13.47	6.73	6.38	1.06	0.299	9.11
3.b	-5.38	-2.69	6.35	-0.42	0.675	11.62
3.c	10.89	5.45	5.32	1.02	0.313	6.50
3.d	-4.76	-2.38	5.45	-0.44	0.665	6.77
3.e	-0.58	-0.29	6.17	-0.05	0.963	7.41
4.a	-7.22	-3.61	3.78	-0.96	0.346	4.96
4.b	-4.23	-2.11	4.72	-0.45	0.657	8.59
4.c	4.78	2.39	4.29	0.56	0.581	6.71
4.d	14.88	7.44	4.78	1.56	0.129	7.96
4.e	9.47	4.74	5.05	0.94	0.355	5.80
5.a	-17.02	-8.51	4.29	-1.98	0.056	4.66
5.b	-12.24	-6.12	4.85	-1.26	0.216	8.13
5.c	-4.49	-2.25	4.28	-0.52	0.603	3.92
5.d	3.17	1.58	3.83	0.41	0.682	5.15
5.e	19.41	9.71	4.12	2.36	0.025	5.83

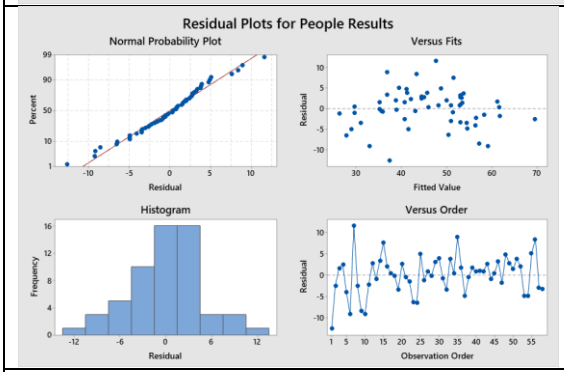
Model Summary

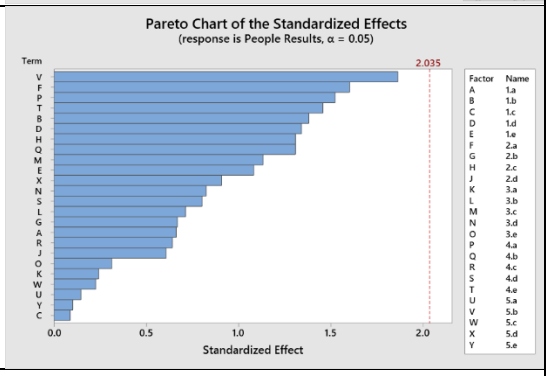
S	R-sq	R-sq(adj)	R-sq(pred)
7.18292	88.13%	79.49%	46.98%

* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis for People Results







Factorial Regression: People Results

Coded Coefficients

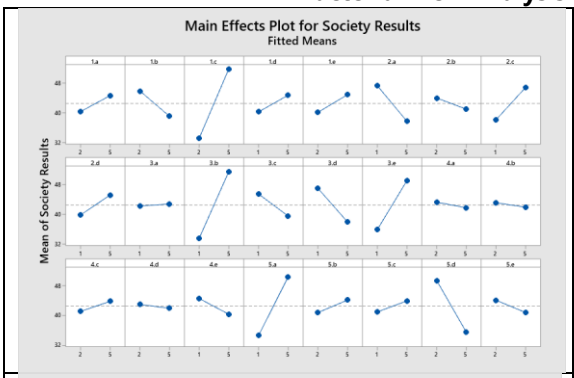
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		38.50	2.42	15.88	0.000	
1.a	-5.91	-2.96	4.46	-0.66	0.512	12.66
1.b	-11.05	-5.53	4.00	-1.38	0.176	11.43
1.c	0.75	0.37	4.25	0.09	0.930	11.26
1.d	13.21	6.60	4.92	1.34	0.189	10.89
1.e	8.38	4.19	3.87	1.08	0.287	10.28
2.a	16.15	8.07	5.04	1.60	0.119	10.75
2.b	-5.39	-2.69	4.02	-0.67	0.508	10.65
2.c	16.57	8.29	6.33	1.31	0.200	14.21
2.d	-5.78	-2.89	4.75	-0.61	0.548	7.36
3.a	-2.60	-1.30	5.35	-0.24	0.810	9.11
3.b	7.61	3.80	5.34	0.71	0.481	11.62
3.c	10.13	5.06	4.47	1.13	0.265	6.50
3.d	7.54	3.77	4.57	0.82	0.416	6.77
3.e	3.23	1.62	5.18	0.31	0.757	7.41
4.a	-9.67	-4.84	3.17	-1.52	0.137	4.96
4.b	10.37	5.19	3.96	1.31	0.200	8.59
4.c	4.62	2.31	3.60	0.64	0.526	6.71
4.d	-6.45	-3.22	4.01	-0.80	0.427	7.96
4.e	12.37	6.18	4.24	1.46	0.155	5.80
5.a	1.05	0.53	3.60	0.15	0.885	4.66
5.b	-15.19	-7.59	4.08	-1.86	0.071	8.13
5.c	1.62	0.81	3.60	0.23	0.823	3.92
5.d	-5.84	-2.92	3.22	-0.91	0.371	5.15
5.e	0.70	0.35	3.46	0.10	0.920	5.83

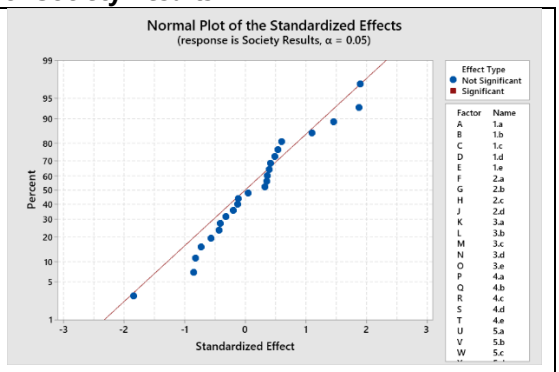
Model Summary

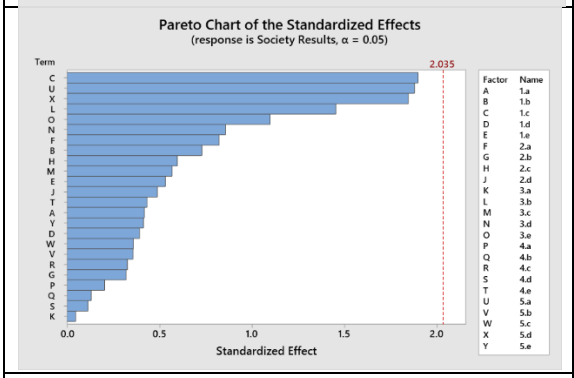
S	R-sq	R-sq(adj)	R-sq(pred)
6.03201	82.39%	69.58%	6.27%

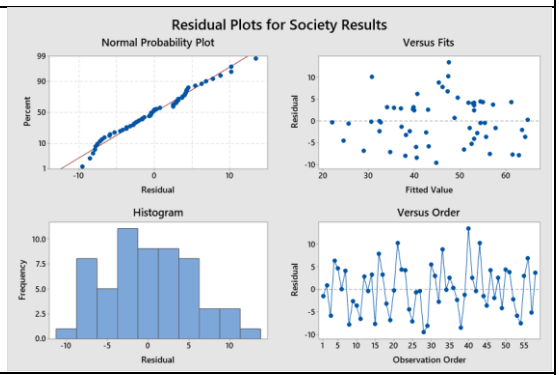
* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis for Society Results









Factorial Regression: Society Results

Coded Coefficients

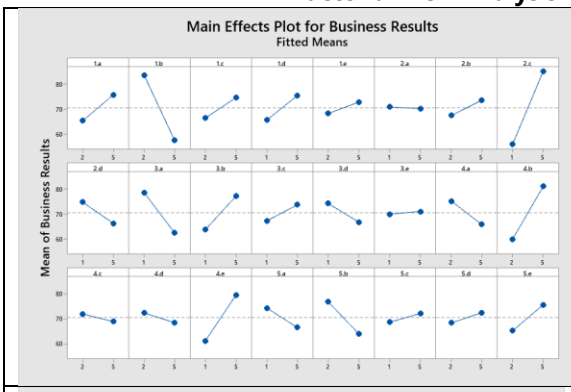
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		42.51	2.81	15.13	0.000	
1.a	4.32	2.16	5.17	0.42	0.679	12.66
1.b	-6.76	-3.38	4.63	-0.73	0.471	11.43
1.c	18.69	9.34	4.92	1.90	0.066	11.26
1.d	4.47	2.23	5.70	0.39	0.698	10.89
1.e	4.77	2.39	4.48	0.53	0.598	10.28
2.a	-9.60	-4.80	5.84	-0.82	0.417	10.75
2.b	-2.97	-1.49	4.66	-0.32	0.752	10.65
2.c	8.74	4.37	7.33	0.60	0.555	14.21
2.d	5.37	2.69	5.51	0.49	0.629	7.36
3.a	0.57	0.28	6.20	0.05	0.964	9.11
3.b	17.99	8.99	6.18	1.45	0.155	11.62
3.c	-5.88	-2.94	5.17	-0.57	0.574	6.50
3.d	-9.08	-4.54	5.30	-0.86	0.398	6.77
3.e	13.19	6.59	6.00	1.10	0.280	7.41
4.a	-1.49	-0.75	3.68	-0.20	0.841	4.96
4.b	-1.20	-0.60	4.59	-0.13	0.897	8.59
4.c	2.72	1.36	4.17	0.33	0.747	6.71
4.d	-1.05	-0.52	4.65	-0.11	0.911	7.96
4.e	-4.26	-2.13	4.92	-0.43	0.668	5.80
5.a	15.68	7.84	4.17	1.88	0.069	4.66
5.b	3.37	1.69	4.72	0.36	0.723	8.13
5.c	2.99	1.50	4.17	0.36	0.722	3.92
5.d	-13.76	-6.88	3.73	-1.85	0.074	5.15
5.e	-3.31	-1.66	4.01	-0.41	0.682	5.83

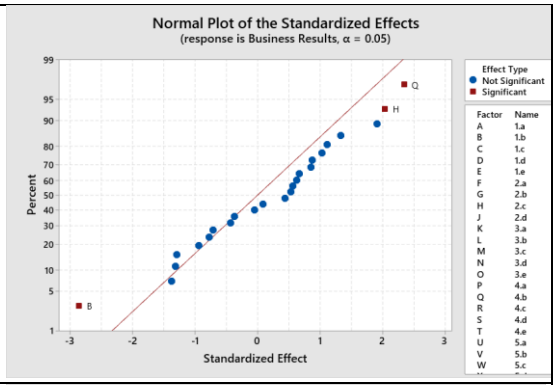
Model Summary

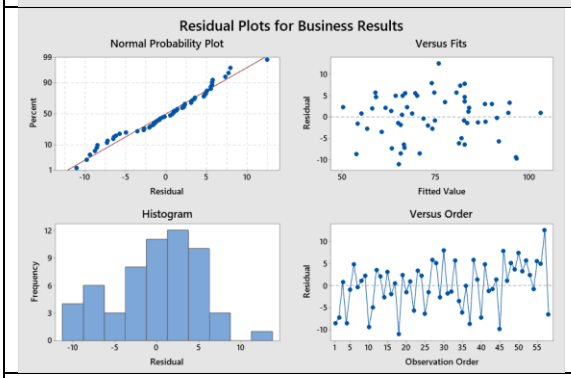
S	R-sq	R-sq(adj)	R-sq(pred)
6.98750	80.62%	66.53%	22.47%

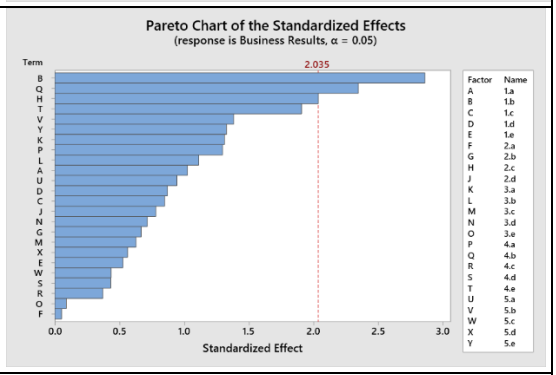
* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis for Business Results









Factorial Regression: Business Results

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		70.58	2.77	25.52	0.000	
1.a	10.44	5.22	5.09	1.03	0.312	12.66
1.b	-26.11	-13.05	4.56	-2.86	0.007	11.43
1.c	8.23	4.12	4.84	0.85	0.402	11.26
1.d	9.79	4.89	5.62	0.87	0.390	10.89
1.e	4.66	2.33	4.41	0.53	0.601	10.28
2.a	-0.61	-0.31	5.75	-0.05	0.958	10.75
2.b	6.14	3.07	4.59	0.67	0.508	10.65
2.c	29.40	14.70	7.22	2.04	0.050	14.21
2.d	-8.47	-4.24	5.42	-0.78	0.440	7.36
3.a	-16.01	-8.01	6.11	-1.31	0.199	9.11
3.b	13.55	6.78	6.09	1.11	0.274	11.62
3.c	6.40	3.20	5.09	0.63	0.534	6.50
3.d	-7.47	-3.73	5.22	-0.72	0.479	6.77
3.e	1.06	0.53	5.91	0.09	0.929	7.41
4.a	-9.38	-4.69	3.62	-1.30	0.204	4.96
4.b	21.21	10.60	4.52	2.35	0.025	8.59
4.c	-3.05	-1.53	4.11	-0.37	0.712	6.71
4.d	-3.96	-1.98	4.58	-0.43	0.668	7.96
4.e	18.47	9.23	4.84	1.91	0.065	5.80
5.a	-7.76	-3.88	4.11	-0.94	0.352	4.66
5.b	-12.86	-6.43	4.65	-1.38	0.176	8.13
5.c	3.56	1.78	4.10	0.43	0.667	3.92
5.d	4.14	2.07	3.67	0.56	0.576	5.15
5.e	10.47	5.24	3.95	1.33	0.194	5.83

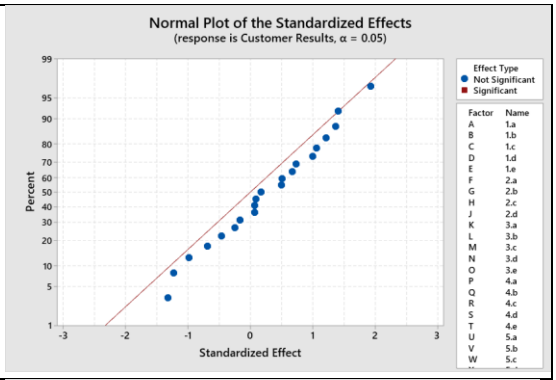
Model Summary

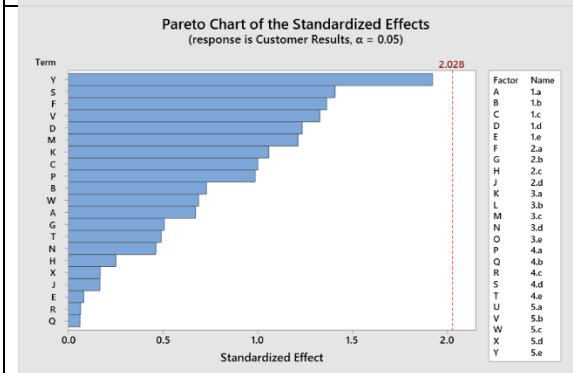
S	R-sq	R-sq(adj)	R-sq(pred)
6.88109	85.37%	74.73%	43.93%

* NOTE * There are no valid interactions to plot.

APPENDIX A-6: Minitab Results for Sub-criteria Level Factorial Analysis Results -Iteration-5;

Factorial DOE Analysis for Customer Results





Factorial Regression: Customer Results versus 1.a, 1.b, 1.c, 1.d, 1.e, 2.a, 2.b, 2.c, 2.d, 3.a, 3.c, 3.d, 4.a, 4.b, 4.c, 4.d, 4.e, 5.b, 5.c, 5.d, 5.e

Coded Coefficients

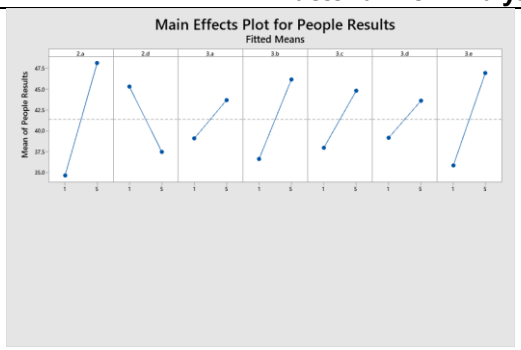
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		69.40	2.68	25.85	0.000	
1.a	7.02	3.51	5.23	0.67	0.506	11.85
1.b	7.05	3.52	4.82	0.73	0.470	11.33
1.c	9.89	4.94	4.94	1.00	0.324	10.39
1.d	-14.43	-7.22	5.84	-1.23	0.225	10.46
1.e	0.76	0.38	4.59	0.08	0.935	9.88
2.a	16.26	8.13	5.96	1.36	0.181	10.25
2.b	4.83	2.42	4.76	0.51	0.615	10.15
2.c	-3.66	-1.83	7.27	-0.25	0.803	12.79
2.d	-1.89	-0.95	5.65	-0.17	0.868	7.10
3.a	12.56	6.28	5.93	1.06	0.297	7.62
3.c	11.59	5.80	4.78	1.21	0.233	5.07
3.d	-4.80	-2.40	5.19	-0.46	0.647	5.95
4.a	-7.54	-3.77	3.82	-0.99	0.330	4.90
4.b	0.56	0.28	4.54	0.06	0.951	7.68
4.c	0.56	0.28	4.19	0.07	0.947	6.20
4.d	13.30	6.65	4.72	1.41	0.167	7.51
4.e	4.84	2.42	4.93	0.49	0.626	5.34
5.b	-12.36	-6.18	4.65	-1.33	0.192	7.22
5.c	-5.88	-2.94	4.27	-0.69	0.495	3.77
5.d	1.29	0.64	3.80	0.17	0.867	4.91
5.e	15.52	7.76	4.03	1.92	0.062	5.40

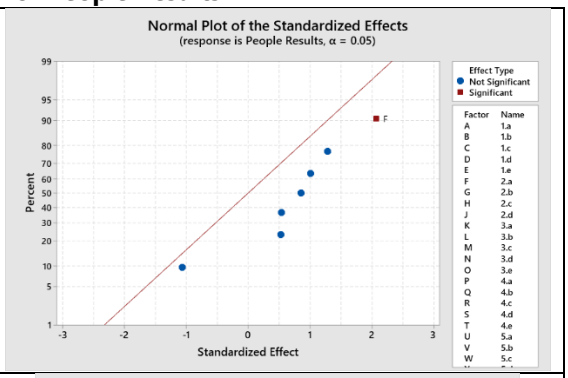
Model Summary

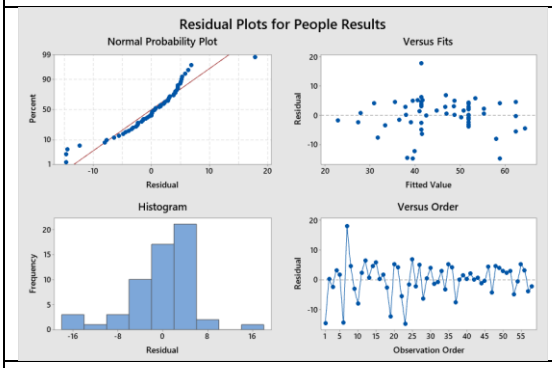
S	R-sq	R-sq(adj)	R-sq(pred)
7.30530	86.60%	78.79%	54.41%

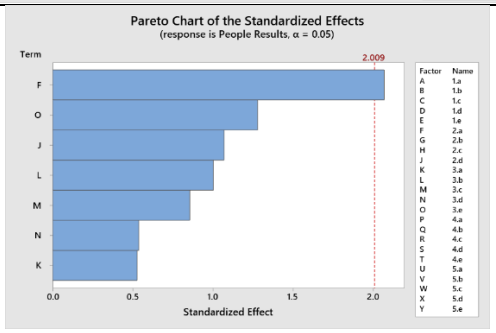
* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis for People Results









Factorial Regression: People Results

Coded Coefficients

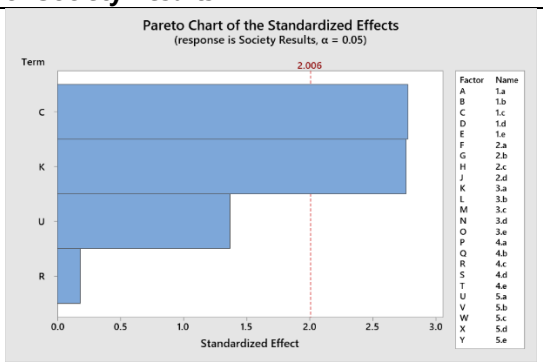
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		41.39	1.08	38.25	0.000	
2.a	13.42	6.71	3.24	2.07	0.044	4.34
2.d	-7.80	-3.90	3.65	-1.07	0.290	4.22
3.a	4.61	2.30	4.37	0.53	0.601	5.91
3.b	9.53	4.76	4.75	1.00	0.320	8.95
3.c	6.81	3.41	3.98	0.86	0.396	5.02
3.d	4.45	2.22	4.13	0.54	0.593	5.39
3.e	11.09	5.54	4.33	1.28	0.207	5.06

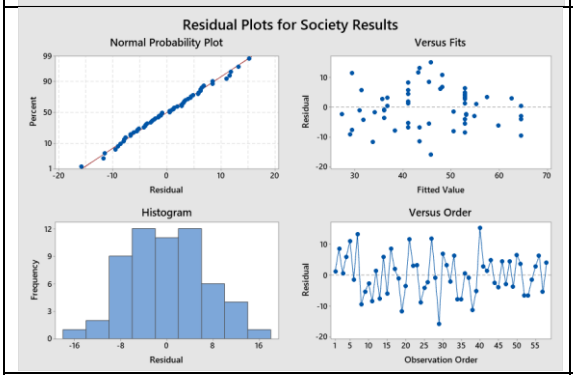
Model Summary

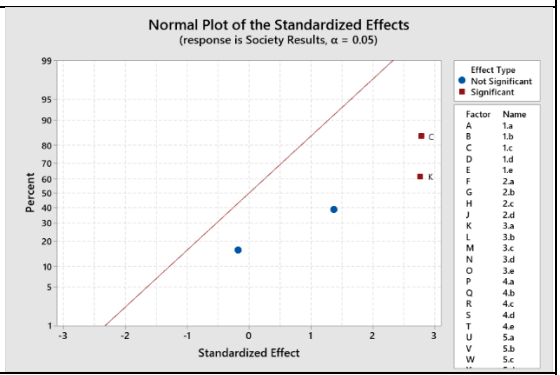
S	R-sq	R-sq(adj)	R-sq(pred)
6.11199	72.60%	68.77%	54.53%

* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis for Society Results







Factorial Regression: Society Results

Coded Coefficients

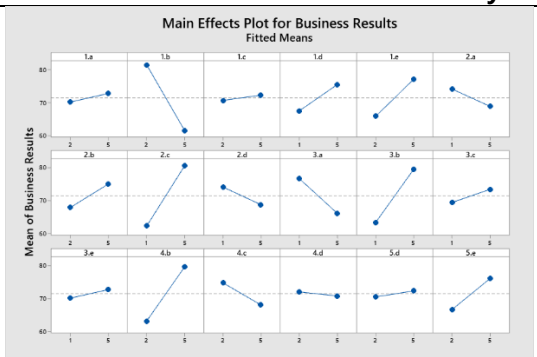
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		43.44	1.52	28.54	0.000	
1.c	15.03	7.51	2.70	2.78	0.008	3.38
3.a	18.88	9.44	3.41	2.76	0.008	2.74
4.c	-1.05	-0.53	2.88	-0.18	0.856	3.19
5.a	9.42	4.71	3.44	1.37	0.177	3.16

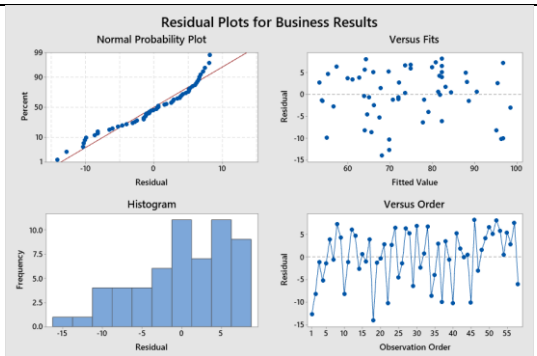
Model Summary

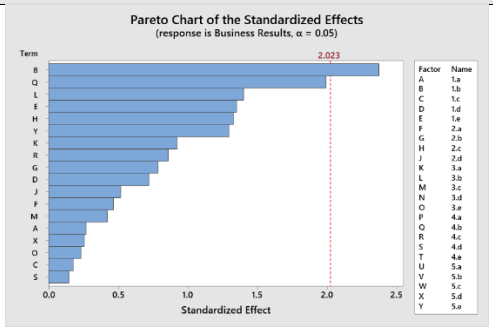
S	R-sq	R-sq(adj)	R-sq(pred)
7.00676	68.71%	66.34%	62.46%

* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis for Business Results







Factorial Regression: Business Results

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		71.51	2.45	29.22	0.000	
1.a	2.62	1.31	4.88	0.27	0.789	11.12
1.b	-20.04	-10.02	4.22	-2.37	0.023	9.37
1.c	1.60	0.80	4.54	0.18	0.861	9.45
1.d	8.03	4.01	5.57	0.72	0.476	10.25
1.e	11.29	5.65	4.18	1.35	0.185	8.83
2.a	-5.27	-2.64	5.68	-0.46	0.645	10.03
2.b	7.15	3.58	4.55	0.79	0.437	10.03
2.c	18.40	9.20	6.93	1.33	0.192	12.52
2.d	-5.35	-2.68	5.16	-0.52	0.607	6.38
3.a	-10.58	-5.29	5.74	-0.92	0.362	7.68
3.b	16.18	8.09	5.78	1.40	0.169	10.01
3.c	4.00	2.00	4.76	0.42	0.677	5.43
3.e	2.62	1.31	5.62	0.23	0.817	6.42
4.b	16.54	8.27	4.15	1.99	0.053	6.93
4.c	-6.71	-3.35	3.90	-0.86	0.396	5.81
4.d	-1.23	-0.61	4.20	-0.15	0.885	6.43
5.d	1.84	0.92	3.60	0.26	0.800	4.74
5.e	9.46	4.73	3.65	1.29	0.203	4.78

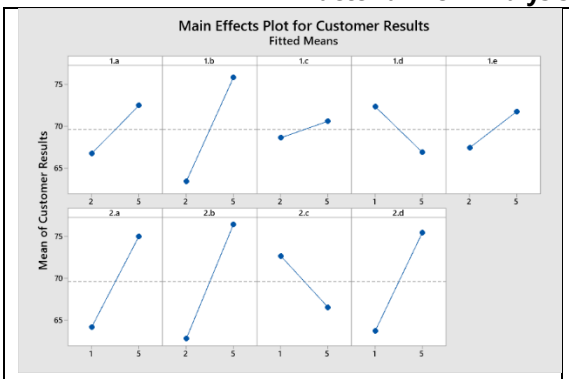
Model Summary

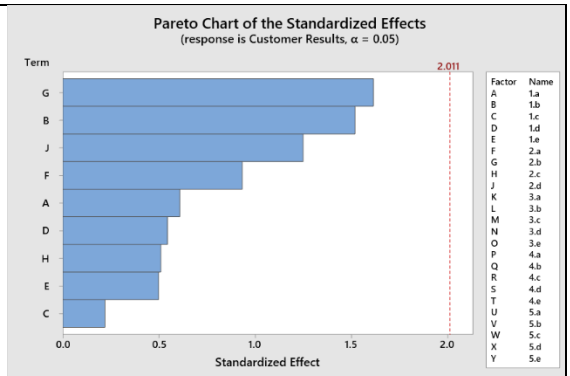
S	R-sq	R-sq(adj)	R-sq(pred)
7.03595	81.92%	73.58%	54.67%

* NOTE * There are no valid interactions to plot.

APPENDIX A-7: Minitab Results for Sub-criteria Level Factorial Analysis Results -Iteration-6;

Factorial DOE Analysis: Customer Results





Factorial Regression: Customer Results

Coded Coefficients

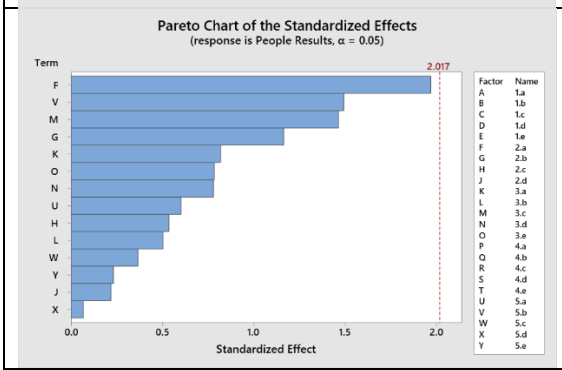
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		69.61	2.28	30.48	0.000	
1.a	5.74	2.87	4.71	0.61	0.545	8.74
1.b	12.45	6.22	4.10	1.52	0.135	7.43
1.c	1.99	0.99	4.54	0.22	0.827	7.95
1.d	-5.47	-2.74	5.02	-0.55	0.588	7.01
1.e	4.35	2.17	4.36	0.50	0.620	8.07
2.a	10.85	5.42	5.81	0.93	0.355	8.86
2.b	13.69	6.84	4.24	1.61	0.113	7.32
2.c	-6.13	-3.07	6.01	-0.51	0.612	7.93
2.d	11.78	5.89	4.71	1.25	0.217	4.48

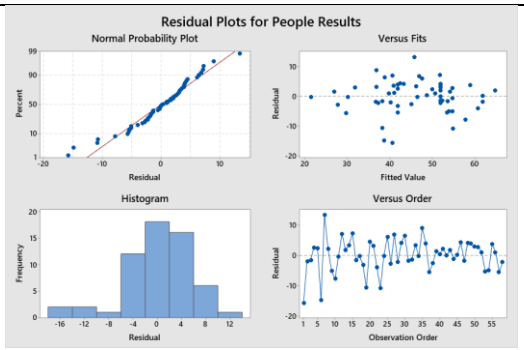
Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
7.66583	80.33%	76.64%	70.93%

* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis: People Results





Factorial Regression: People Results

Coded Coefficients

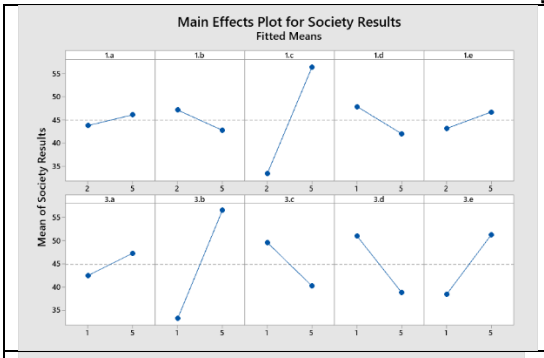
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		38.41	1.90	20.25	0.000	
2.a	18.67	9.33	4.74	1.97	0.055	8.95
2.b	-8.60	-4.30	3.69	-1.16	0.251	8.44
2.c	4.98	2.49	4.65	0.54	0.595	7.20
2.d	-1.83	-0.91	4.18	-0.22	0.828	5.33
3.a	7.62	3.81	4.65	0.82	0.418	6.46
3.b	5.13	2.57	5.10	0.50	0.617	9.97
3.c	12.70	6.35	4.34	1.46	0.151	5.76
3.d	6.77	3.39	4.34	0.78	0.440	5.74
3.e	7.64	3.82	4.87	0.78	0.437	6.16
5.a	3.99	2.00	3.31	0.60	0.550	3.71
5.b	-10.51	-5.25	3.52	-1.49	0.143	5.70
5.c	2.23	1.12	3.05	0.37	0.716	2.64
5.d	-0.40	-0.20	2.93	-0.07	0.946	4.01
5.e	-1.35	-0.68	2.92	-0.23	0.818	3.90

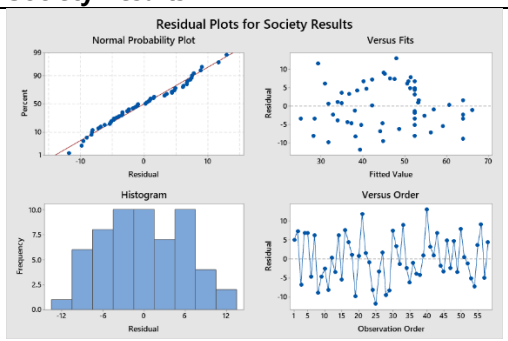
Model Summary

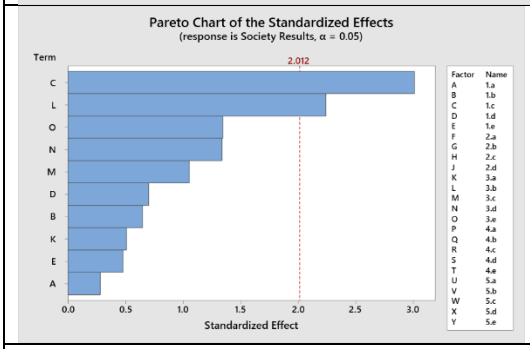
S	R-sq	R-sq(adj)	R-sq(pred)
6.22266	75.58%	67.62%	34.45%

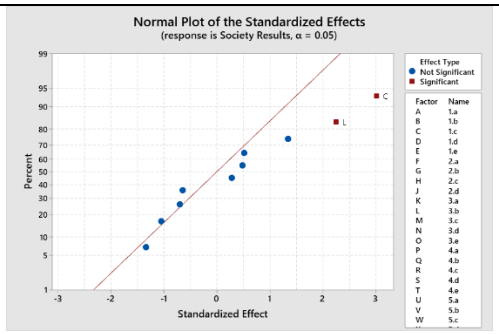
* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis: Society Results









Factorial Regression: Society Results

Coded Coefficients

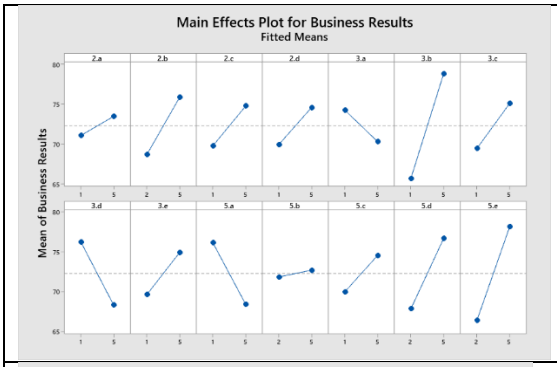
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		44.91	1.44	31.29	0.000	
1.a	2.32	1.16	4.12	0.28	0.779	8.99
1.b	-4.35	-2.18	3.35	-0.65	0.518	6.67
1.c	23.00	11.50	3.82	3.01	0.004	7.60
1.d	-5.86	-2.93	4.18	-0.70	0.486	6.54
1.e	3.55	1.78	3.70	0.48	0.634	7.86
3.a	4.85	2.42	4.75	0.51	0.612	5.99
3.b	23.36	11.68	5.21	2.24	0.030	9.23
3.c	-9.40	-4.70	4.45	-1.06	0.296	5.38
3.d	-12.21	-6.10	4.56	-1.34	0.187	5.60
3.e	12.89	6.44	4.79	1.35	0.185	5.29

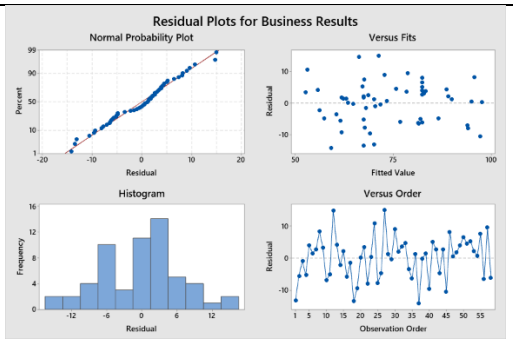
Model Summary

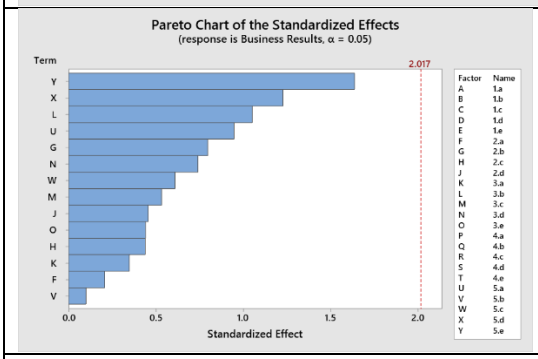
S	R-sq	R-sq(adj)	R-sq(pred)
6.60381	75.35%	70.10%	57.31%

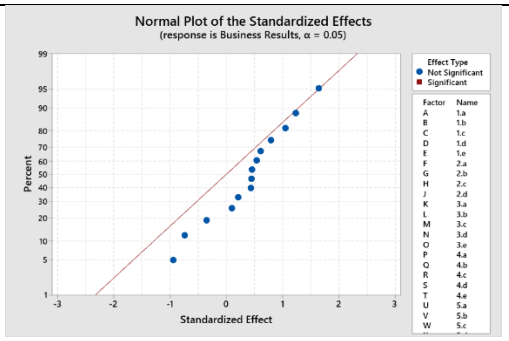
* NOTE * There are no valid interactions to plot.

Factorial Plots for Business Results









Factorial Regression: Business Results

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		72.28	2.33	31.01	0.000	
2.a	2.41	1.20	5.83	0.21	0.837	8.95
2.b	7.23	3.61	4.54	0.80	0.430	8.44
2.c	5.01	2.50	5.71	0.44	0.663	7.20
2.d	4.68	2.34	5.13	0.46	0.651	5.33
3.a	-3.98	-1.99	5.72	-0.35	0.730	6.46
3.b	13.19	6.60	6.27	1.05	0.298	9.97
3.c	5.68	2.84	5.33	0.53	0.597	5.76
3.d	-7.90	-3.95	5.34	-0.74	0.463	5.74
3.e	5.27	2.64	5.98	0.44	0.662	6.16
5.a	-7.71	-3.86	4.07	-0.95	0.349	3.71
5.b	0.86	0.43	4.32	0.10	0.921	5.70
5.c	4.56	2.28	3.75	0.61	0.546	2.64
5.d	8.83	4.41	3.59	1.23	0.226	4.01
5.e	11.75	5.88	3.59	1.64	0.109	3.90

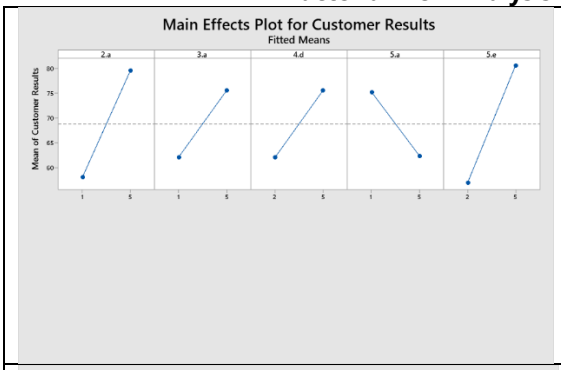
Model Summary

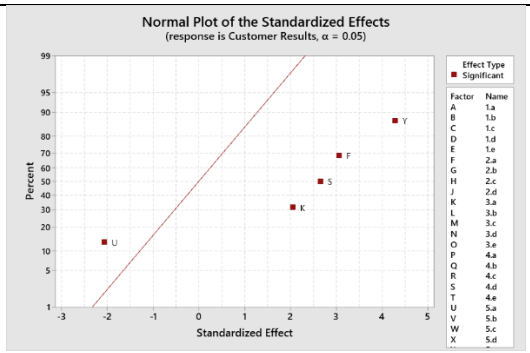
S	R-sq	R-sq(adj)	R-sq(pred)
7.64561	76.47%	68.81%	49.22%

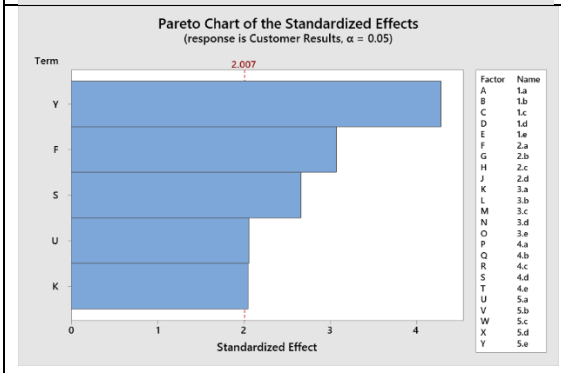
* NOTE * There are no valid interactions to plot.

APPENDIX A-8: Minitab Results for Sub-criteria Level Factorial Analysis Results -Iteration-7;

Factorial DOE Analysis for Customer Results







Factorial Plots for Customer Results

* NOTE * There are no valid interactions to plot.

Factorial Regression: Customer Results versus 2.a, 3.a, 4.d, 5.a, 5.e

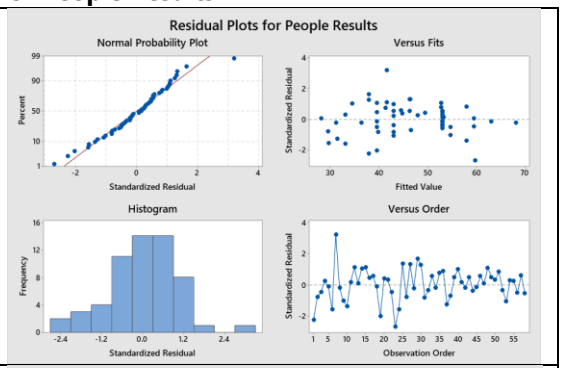
Coded Coefficients

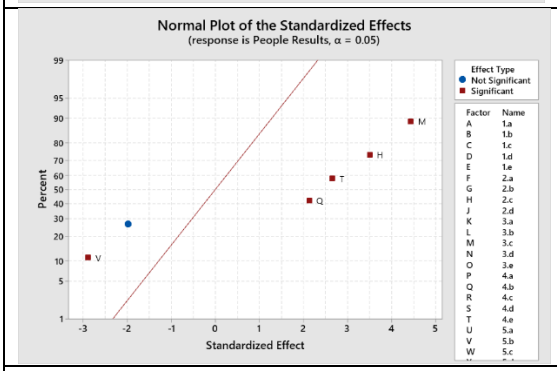
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		68.81	1.24	55.60	0.000	
2.a	21.41	10.70	3.48	3.07	0.003	4.47
3.a	13.39	6.70	3.27	2.05	0.045	2.95
4.d	13.53	6.77	2.54	2.66	0.010	2.78
5.a	-12.82	-6.41	3.11	-2.06	0.044	3.03
5.e	23.56	11.78	2.75	4.28	0.000	3.21

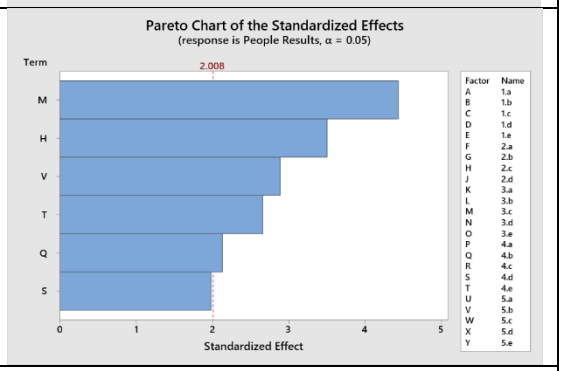
Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
6.46567	84.84%	83.38%	80.19%

Factorial DOE Analysis for People Results







Factorial Regression: People Results versus 2.c, 3.c, 4.b, 4.d, 4.e, 5.b

Coded Coefficients

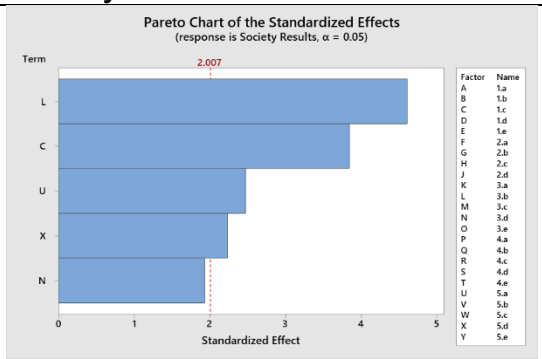
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		39.75	1.11	35.83	0.000	
2.c	21.94	10.97	3.13	3.50	0.001	3.62
3.c	23.49	11.74	2.65	4.44	0.000	2.37
4.b	12.28	6.14	2.88	2.13	0.038	4.72
4.d	-11.76	-5.88	2.97	-1.98	0.053	4.53
4.e	16.42	8.21	3.09	2.66	0.010	3.20
5.b	-18.15	-9.07	3.14	-2.89	0.006	5.02

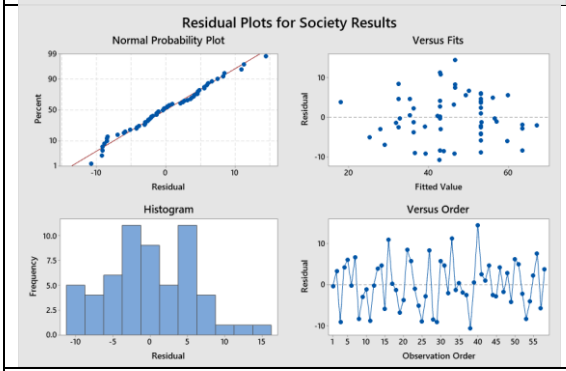
Model Summary

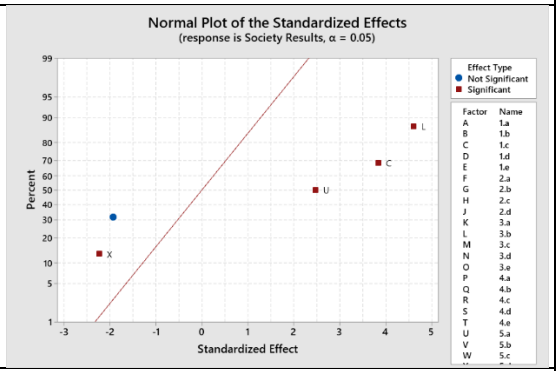
S	R-sq	R-sq(adj)	R-sq(pred)
5.91420	73.83%	70.75%	63.36%

* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis of Society Results







Factorial Regression: Society Results

Coded Coefficients

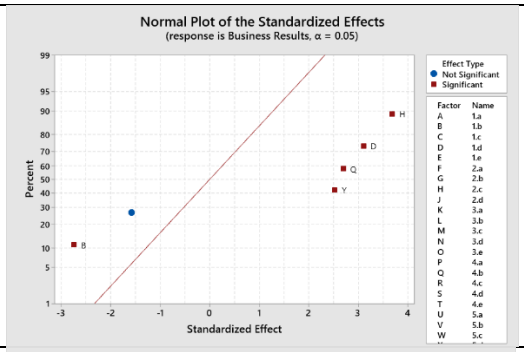
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		44.32	1.24	35.80	0.000	
1.c	19.52	9.76	2.54	3.84	0.000	3.94
3.b	29.81	14.91	3.23	4.61	0.000	4.18
3.d	-14.67	-7.33	3.80	-1.93	0.059	4.57
5.a	14.36	7.18	2.90	2.47	0.017	2.97
5.d	-10.67	-5.33	2.39	-2.23	0.030	2.78

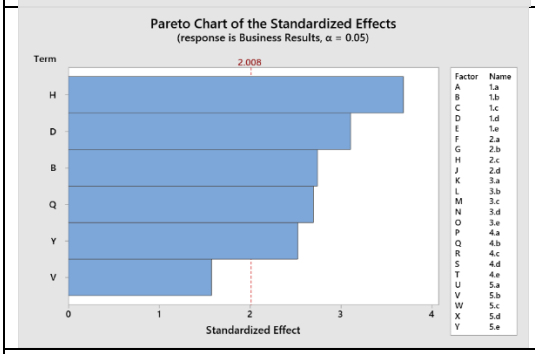
Model Summary

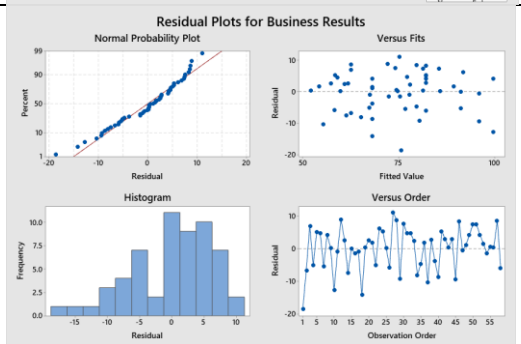
S	R-sq	R-sq(adj)	R-sq(pred)
6.09775	76.75%	74.51%	70.32%

* NOTE * There are no valid interactions to plot.

Factorial DOE Analysis for Business Results







Factorial Regression: Business Results

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		68.38	1.62	42.11	0.000	
1.b	-18.96	-9.48	3.46	-2.74	0.008	6.72
1.d	22.39	11.19	3.60	3.11	0.003	4.59
2.c	31.82	15.91	4.31	3.69	0.001	5.20
4.b	16.60	8.30	3.08	2.70	0.009	4.07
5.b	-11.09	-5.54	3.52	-1.58	0.121	4.76
5.e	14.63	7.32	2.90	2.53	0.015	3.21

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
6.80183	77.91%	75.31%	70.42%

* NOTE * There are no valid interactions to plot.

APPENDIX A-9: SUVERY REQUEST MESSAGE

Dear Sir/Madam,

I am currently pursuing my PhD through BITS Pilani. My broad research area is evolution and benefits of the business excellence models to the Industry. I would like to seek your opinion on the model through a survey. Your expertise and observation of the business excellence model would help me to carry out my research. The survey has 63 questions and should not take more than 25 minutes to answer. I request you to respond to the survey. I will keep the information confidential and use it only for research purposes.

If you are interested in the outcome of this study, please let me know. I shall be pleased to share my research findings with you as and when they are published. Kindly access this link to respond to the survey and do the needful. If you are not sure of the response to a certain question, you can skip answering such questions. If you need any clarification, please do not hesitate to call me.

I welcome your suggestions. It will be my pleasure to receive your response to this survey.

Appreciate your support and timely help on the same.

https://www.surveymonkey.com/r/3MLKRGT

--
Regards

Murthy

98451-94037

APPENDIX A-10: SURVEY QUESTIONNAIRE MAPPING TO BLOCKS

Respondent Profile Questions:

Q1 Name of the respondent
Q2 If you wish to provide the name of your current organisation
Q3 Size of your current organisation (in terms of no. of people in the current organisation)
Q4 The profession of the respondent
Q5 Total Professional Experience of the respondent
Q6 Proficiency of Business Excellence Model (EFQM, MBNQA, SQA, DQA, AQA, etc.,)
Q7 Total no. of years of familiarity with Business Excellence models
Q8 Region of Respondent

Respondent Subject Questions:

Q no	Survey Question	Respondent Options ##	Block	Classification	Criteria
Q09	Defining and communicating a vision of the organizations by its leaders sets the tone of the organizational behaviour		block-2	Promoter	1.a
Q10	Leadership has a strong influence on process management practices in an organization		block-2	L-P	1.a to 1.e
Q11	Leadership has a strong influence on strategy in an organization		block-2	L-S	1.a to 1.e
Q12	Leader defining the performance expectations of the organization helps to realize the business goals		block-1	BR	1.b
Q13	Proper management systems improve strategic and operational performance in the organization		block-2	Defender	1.b
Q14	Close engagement of leadership with external stakeholders helps in understanding and prioritizing the stakeholder expectations while formulating the strategies		block-2	Promoter	1.c
Q15	Leader's active involvement in community activities and environment protection enhances society's perception of the organization		block-1	SR	1.c
Q16	Leaders reinforcing the culture of excellence in the organization influences the business results of the organization		block-1	BR	1.d
Q17	Reinforcing the culture of excellence by leaders influences the continuous improvements in the organization		block-2	Promoter	1.d
Q18	Leaders pre-empt changes needed in the organization and initiate necessary actions		block-2	Proponent	1.e
Q19	Strategies are based on internal and external stakeholders' inputs are the key ingredient for the success of the Organization		block-2	Proponent	2.a
Q20	Periodic reviewing of strategy and deployment effectiveness is essential to stay focused on the business goals		block-1	BR	2.c

Q no	Survey Question	Respondent Options ##	Block	Classification	Criteria
Q21	Periodic reviewing of strategy and deployment create positive vibes among employees of the organization		block-1	PR	2.c
Q22	Periodic reviewing of strategies and deployment effectiveness is essential for coordinated action among all departments to achieve the performance goals		block-2	Promoter	2.c
Q23	Periodic communication of strategy and progress helps the organization to succeed in achieving its goals		block-2	Defender	2.d
Q24	The strategy has a significant influence on the partnership (suppliers, technology partnership, distributors, educational bodies, customers, etc.,)		block-2	S-P&R	2.a to 2.d
Q25	Over-Relying on the current capabilities (infrastructure, tools, technologies) would not help in improving the business results		block-2	Proponent	2.b
Q26	Proper resource planning and allocation to support the organizational strategy impacts the customer results		block-1	CR	3.a
Q27	Over-relying on the current human resources and people policies impacts the future plans of the organization		block-2	Detractor	3.a
Q28	Improved employee technical knowledge and capabilities create positive vibes in the Organizations		block-2	Proponent	3.b
Q29	Improved employee technical knowledge and capabilities create a positive perception of the organization in the society		block-1	SR	3.b
Q30	Employee satisfaction is influenced by better coordination, involvement and empowerment of employees in the organization		block-1	PR	3.c
Q31	Aligned, involved and empowered employees help the organization to achieve business excellence		block-2	Promoter	3.c
Q32	The two-way communication between employee and management helps the Organization to Excel		block-2	Detractor	3.d
Q33	Consistent communication among the people of the organization creates a positive image of the organization among the employees		block-1	SR	3.d
Q34	Employee rewards and recognitions help in building an excellent organization		block-2	Proponent	3.e
Q35	Over-focus on partnership and supplier management does not guarantee the excellence of business		block-2	Detractor	4.a
Q36	Proper financial management positively influences the business results		block-1	BR	4.b
Q37	Proper financial management creates a positive perception among people		block-1	PR	4.b
Q38	Managing the resources (building, equipment, materials, and natural		block-2	Promoter	4.c

Q no	Survey Question	Respondent Options ##	Block	Classification	Criteria
	resources) effectively help the organization to excel				
Q39	Appropriate technology adoption in the organization influences the customer perception of the organization		block-1	CR	4.d
Q40	Appropriate technology adoption creates position positive perception among people		block-1	PR	4.d
Q41	Adoption of appropriate technology helps the Organization to accelerate the realisation of the vision		block-2	Promoter	4.d
Q42	Proper management of data, information and knowledge influences the people management practices		block-1	PR	4.e
Q43	Effective management of data, information and systems are essential for improving the decision-making capabilities of the organization		block-2	Promoter	4.e
Q44	Overstressing optimised product development impacts the customer perception of the organization		block-1	CR	5.b
Q45	Over optimised product creates a poor perception of the organization		block-1	SR	5.a
Q46	Overemphasizing on simplification of the product design and development processes impact the customer perception		block-1	CR	5.a
Q47	Products and services are developed based on the current skills and capabilities of the organization		block-2	Detractor	5.b
Q48	Processes are designed and managed to optimise the stakeholder values in the organization		block-2	Defender	5.a
Q49	Simplified processes, products and services create a positive atmosphere among the employees		block-1	PR	5.b
Q50	Promoting and marketing of products by itself does not lead to business excellence		block-2	Proponent	5.c
Q51	Effective management of product delivery and services guarantees positive business results		block-1	BR	5.d
Q52	Effective management of product delivery and services create a good society perception about the organization		block-1	SR	5.d
Q53	Products and services are produced and delivered based on the skills and capabilities of the organization		block-2	Detractor	5.d
Q54	Product design, development and delivery management of an organization is strongly influenced by its partnership (with suppliers, technology partnership, distributors, educational bodies, customers, etc.,)		block-2	Promoter	4.d
Q55	Periodic interactions with the customers help in improving the business results		block-1	BR	5.e
Q56	Customer results are influenced by structured customer relationship management		block-1	CR	5.e

Q no	Survey Question	Respondent Options ##	Block	Classification	Criteria
Q57	Existing relationships with customers are analysed and regular attempts are made to improve customer satisfaction		block-2	Proponent	5.e
Q58	Business results are directly related to customer perception about the organization		block-3	BR	6.b
Q59	Customer's perception is directly related to people's satisfaction in the organization		block-3	CR	6.b
Q60	Better customer perception of the organization leads to better society perception of the organization		block-3	SR	6.b
Q61	Business results influence the positive perception among the people of the organization		block-3	PR	9.b
Q62	Society's perception directly connects to people's perception of the organization		block-3	SR	6.b
Q63	Better operational performance leads to business excellence in the organization Any suggestions or feedback		block-3	BR	9.b

Respondent options are Strongly Agree, Agree, Neither Agree or disagree, Disagree or Strongly disagree.

These columns are masked to respondent, it is for author reference

APPENDIX – B

List of Publications

PEER-REVIEWED INTERNATIONAL JOURNAL PUBLICATIONS (Published, In Press, or Accepted)

1. Murthy, N., Sangwan, K. and Narahari, N., (2021), Empirical Classification of EFQM model Enabler's Sub-criterion using a Quadrant Matrix, International Journal of Quality & Reliability Management (accepted) DOI 10.1108/IJQRM-10-2020-0351

2. Narasimha Murthy, Kuldip Singh Sangwan, N.S. Narahari. Demystifying the Relationship between Enablers and Results at Sub-criteria level: An Empirical Study on EFQM model. International Journal of Business Excellence (IJBEX). DOI: 10.1504/IJBEX.2020.10034481

3. Narasimha Murthy M.A., Sangwan K.S., Narahari N.S. (2021) Progression of EFQM and Deep-Dive into EFQM 2020. In: Agrawal R., Jain J.K., Yadav V.S., Manupati V.K., Varela L. (eds) Recent Advances in Smart Manufacturing and Materials. Lecture Notes in Mechanical Engineering. Springer, Singapore. https://doi.org/10.1007/978-981-16-3033-0_26 (SCOPUS)

4. Narasimha Murthy, Kuldip Singh Sangwan, N.S. Narahari. Evolution of EFQM & Deep-Dive into EFQM 2020. *Total Quality Management & Business Excellence*. Conditionally accepted. Reference manuscript ID is CTQM-2020-0499.R3

UNDER PEER-REVIEW

1. Narasimha Murthy, Kuldip Singh Sangwan, N.S. Narahari. Identification of key influencers for achieving high maturity of business excellence in EFQM model using an empirical study. Total Quality Management & Business Excellence. Reference CTQM- manuscript ID is 2021-0144

PAPERS UNDER PREPARATION

1. Developing and Mapping Industry 4.0 and EFQM Business Excellence Model Key Performance Indicators

ABSTRACT ACCEPTED FOR UPCOMING INTERNATIONAL CONFERENCE PAPER

1. Narasimha Murthy, Kuldip Singh Sangwan, N.S. Narahari, December 10-12, 2020, Empirical Study of Inter-relationship of the Result Sub Criteria of EFQM. International Conference on Business Analytics and Intelligence (ICBAI) – 2021, December 20-22, 2021

APPENDIX – C

Biography

About the candidate (Mr. M A Narasimha Murthy)

M.A. Narasimha Murthy is a PhD scholar from BITS Pilani. He has more than 30 years of professional experience in the area of QM, Process Mgt, IE, and Manufacturing. He is a certified Business Excellence Senior Assessor, a certified Competent Assessor of Automotive SPICE and lead auditor of various ISO standards. He has been working as Senior Director of Quality Management at Infineon Technologies and in the past, he has worked with Motorola, HP, Compaq, TVS Electronics, Tech Mahindra and Symphony Services. He is the past chairman, president, and national council member of Indian Institute of Industrial Engineering, and Vice-chairman and life member of Quality Circle Forum of India. He has awarded with Fellowship, HK Firodia and SR Gollapudi Award from IIIE and member of Board of studies in several engineering institutes.

About the supervisor (Prof. Kuldip Singh Sangwan)

Dr. Kuldip Singh Sangwan is a Senior Professor of Mechanical Engineering at Birla Institute of Technology and Science Pilani (BITS Pilani), Pilani campus. He is the recipient of prestigious Shri B. K. Birla and Shrimati Sarala Birla Chair Professorship. He has been a visiting researcher to TU Braunschweig, Germany. He has supervised 11 PhDs, edited four books and authored more than 160 research papers. Currently one post-doc and eight PhD scholars are working under his supervision/co-supervision. He has collaborative projects worth more than 7.6 crore INR with international agencies, industry and Indian Government agencies. Professor Sangwan found a place in the 'top 2% world scientists' list by Stanford University researchers in the area of Industrial Engineering and Automation published in 2020. He is a fellow of the institution of Engineers (India), and a life member of Indian Institute of Industrial Engineering, and Society of Operations Management.

About the co-supervisor (Prof. N S Narahari)

N.S. Narahari is currently is a Professor in the Department of Industrial Engineering and Management at RV College of Engineering. He has over 33 years of teaching experience. His research interests are in the field of quality, reliability, industrial engineering. He has over 120 research publications in national and international conferences and international Journals. He has guided more than 100 undergraduate and post graduate projects. He is an active member of ISTE, IIIE, QCFI, IET (UK). He has been awarded Fellowship, S.R. Gollapudi Award and H.K. Firodia Award from IIIE. He has been recognized as 'Best Teacher Award' by the ISTE RVCE and 'Distinguished Alumni Award' from MSRIT Alumni association