JPB REVIEW
INTERNATIONAL JOURNAL OF PROFESSIONAL BUSINESS REVIEW
ISSN: 2525-3654
OPEN ACCESS

CRITICAL SUCCESS FACTORS FOR APPLYING SIX SIGMA IN TRANSFORMATIVE INDUSTRIES IN IRAQ

Ameera Sh Weli Albayatey [A]

ARTICLE INFO

Article history:

Received 24 March 2023

Accepted 20 June 2023

Keywords:

Transformative Industries;
Improvement Projects;
Six Sigma.

ABSTRACT

Purpose: the article aims to measuring Critical Success Factors (CSFs) for Applying Six Sigma (SS) in Iraq Transformative Industries (TI).

Theoretical framework: The theoretical framework included a conceptual presentation of organizational success factors according to the Six Sigma tool in a sample of Iraqi companies.

Design/methodology/approach: To ensure six sigma is successful, twenty-two CSFs have been found in the literature. These include managerial involvement and commitment, alignment with institutional strategy; communication; and team member selection. Surveys of Iraqi TI verified the instrument, resulting in (97) results. Only experienced project managers were asked to take the test. Exploratory factor analysis were performed on the collected data using the SPSS software package.

Findings: TI can use the proposed instrument to evaluate how Six Sigma's important success characteristics are controlled throughout the construction of improvement projects (IPs), according to our findings.

Research, Practical & Social implications: the survey can help industries discover areas for development when adopting the six-sigma technique and fit models to evaluate how key success factors combine to achieve the desired results of improvement projects.

Originality/value: A project's success is dependent on the achievement of its crucial success criteria. Based on these findings, a six-sigma critical success element implementation assessment instrument will be developed and tested.

Doi: https://doi.org/10.26668/businessreview/2023.v8i6.1917

FATORES CRÍTICOS DE SUCESSO PARA A APLICAÇÃO DO SIX SIGMA EM INDÚSTRIAS TRANSFORMADORAS NO IRAQUE

RESUMO

Objetivo: o artigo tem como objetivo medir os Fatores Críticos de Sucesso (FCSs) para a aplicação do Seis Sigma (SS) nas Indústrias Transformadoras (IT) do Iraque.

Estrutura teórica: A estrutura teórica incluiu uma apresentação conceitual dos fatores de sucesso organizacional de acordo com a ferramenta Seis Sigma em uma amostra de empresas iraquianas.

Projeto/metodologia/abordagem: Para garantir o sucesso do Seis Sigma, foram encontrados 22 CSFs na literatura. Entre elas estão o envolvimento e o comprometimento da gerência, o alinhamento com a estratégia institucional, a comunicação e a seleção dos membros da equipe. As pesquisas da TI iraquiana verificaram o instrumento, resultando em (97) resultados. Somente gerentes de projeto experientes foram convidados a fazer o teste. A análise fatorial exploratória foi realizada nos dados coletados usando o pacote de software SPSS.

Conclusões: A TI pode usar o instrumento proposto para avaliar como as características importantes de sucesso do Seis Sigma são controladas durante a construção de projetos de melhoria (PIs), de acordo com nossos resultados.

[A] *Lecturer at Management Department. College of Administration and Economics/Business Administration, University of Baghdad. Iraq. E-mail: Ameeraalbayatey@coadec.uobaghdad.edu.iq*
Orcid: https://orcid.org/0000-0001-6703-967X

Implicações sociais, práticas e de pesquisa: a pesquisa pode ajudar as indústrias a descobrir áreas de desenvolvimento ao adotar a técnica Seis Sigma e ajustar modelos para avaliar como os principais fatores de sucesso se combinam para alcançar os resultados desejados dos projetos de melhoria.
Originalidade/valor: O sucesso de um projeto depende da realização de seus critérios cruciais de sucesso. Com base nessas descobertas, será desenvolvido e testado um instrumento de avaliação da implementação de elementos críticos de sucesso do Six-Sigma.

Palavras-chave: Indústrias Transformadoras, Projetos de Melhoria, Seis Sigma.

FACTORES CRÍTICOS DE ÉXITO PARA LA APLICACIÓN DE SEIS SIGMA EN LAS INDUSTRIAS MANUFACTURERAS DE IRAK

RESUMEN
Objetivo: El objetivo de este trabajo es medir los Factores Críticos de Éxito (FCE) para la aplicación de Seis Sigma (SS) en las Industrias Manufactureras (IF) de Iraq.
Marco teórico: el marco teórico incluía una presentación conceptual de los factores de éxito organizativo según la herramienta Seis Sigma en una muestra de empresas iraquíes.
Diseño/metodología/enfoque: para garantizar el éxito de Seis Sigma, se encontraron 22 CSF en la bibliografía. Entre ellos figuran la implicación y el compromiso de la dirección, la alineación con la estrategia institucional, la comunicación y la selección de los miembros del equipo. La investigación iraquí sobre TI verificó el instrumento, dando lugar a (97) resultados. Sólo se invitó a realizar la prueba a directores de proyecto con experiencia. Se realizó un análisis factorial exploratorio de los datos recogidos mediante el paquete informático SPSS.
Conclusiones: la TI puede utilizar el instrumento propuesto para evaluar cómo se controlan las características importantes del éxito de Seis Sigma durante la construcción de proyectos de mejora (PI), según nuestros resultados. Implicaciones sociales, prácticas y de investigación: la investigación puede ayudar a las industrias a descubrir áreas de desarrollo al adoptar la técnica Seis Sigma y ajustar los modelos para evaluar cómo se combinan los factores clave del éxito para lograr los resultados deseados de los proyectos de mejora.
Originalidad/valor: el éxito de un proyecto depende de la consecución de sus criterios cruciales de éxito. A partir de estas conclusiones, se elaborará y pondrá a prueba un instrumento para evaluar la aplicación de los elementos cruciales de éxito de Six-Sigma.

Palabras clave: Industrias Manufactureras, Proyectos de Mejora, Seis Sigma.

INTRODUCTION

There are several elements that affect the success of SS implementation in the workplace. One of the essential elements of a SS project's performance in an industry is a vital success component (Coronado & Antony, 2002; Albderi et al., 2023). The adoption of Six-Sigma will struggle if an essential component is not reached; this is because there are a range of potential success elements that must be met for every project (Rungasamy et al., 2002). To effectively execute SS, leading business mgt should have a thorough understanding of the quality management principles that underpin SS methodology; throughout furthermore towards this knowledge, senior executives should be actively involved in every stage of SS so that the goal of the initiative is not lost though since senior leadership considers and gets involved in the execution of Six-Sigma (Pande et al., 2000; Albayatey et al., 2021). By demonstrating time and time again that practical application of SS technologies will have a positive effect on business effectiveness (Snee and Rodebaugh, 2002; Ali et al., 2023). There are numerous

elements that influence the success of Six-Sigma implementation. Since SS now has applications in numerous different fields, The purpose of this study is to examine a thorough list of the factors that contribute to the success of SS. First, a comprehensive literature analysis identifies academic contributions relevant to Six-Sigma success factors (Talab & Flayyih, 2023). Then, Incorporating the multiple CSFs that resulted from the previous studies is a difficult task. A survey of SS professionals in manufacturing businesses is then utilized to identify critical variables (Mawlood et al., 2022). which are subsequently analyzed using factor analysis. Finally, these parameters have been proposed for the investigated ITIs based on the extracted CSFs. According to (Siddiqui et al., 2016), CSFs have earned their reputation thanks to (Rockart 1979). Specifically, a company's CSFs are a collection of elements necessary for any improvement efforts to be successful. The concept methodically shows the essential areas that management must carefully evaluate to achieve its performance objectives. An organization can successfully identify the obstacles that have a crucial impact on the process by knowing the CSFs for system implementation, reducing or preventing any issues contributing to its failure. (Alkarney & Albraithen, 2018). The advantages of CSFs are currently more apparent in the manufacturing industry due to the introduction of techniques such as TQM, ISO 9001, SS, Kaizen, lean thinking, and the 5Ss, to name but a few (Albayatey et al., 2023). Thankfully, these quality improvement principles and tactics are now being tested in the service sector (Pandi et al., 2016). In other industries, such as electronic manufacturing services, a questionnaire has been used to analyze CSFs (Jeyaraman & Teo, 2010; Al-taee & Flayyih, 2023). Another comparable study was undertaken by (Kumar, 2007) in small and medium manufacturing enterprises, and an instrument was devised to capture the respondent's perspective on CSFs and the difficulties experienced in SS implementation. In contrast (Laureani & Antoni, 2012) describe an LSS study concentrating on the CSFs found in the literature through a survey of both manufacturing and service organizations. Successful organizations in the current era have begun to deal in one way or another with the management style of business organizations in terms of the working mechanism and profit-making methodology according to the concepts of efficiency and effectiveness, even if these organizations do not provide business or activities that require them to invest their money, products or services (Kumar, 2007). Then there are many from aspects witnessed by institutions of all kinds in terms of the existence of radical changes in the management methodology and application methods in the competition for excellence in work and innovation and in adopting TQM in order to reach high levels of customer satisfaction or beneficiaries (Ceschin, 2013).

The SS was developed by engineer Bill Smith of Motorola in (1987). Original SS depended on various methodical and rigorous procedures used in current SS programs todays (Raisinghani et al., 2005). According to (Reosekar & Pohekar 2014), In order to eradicate errors and flaws, SS employs a process improvement technique known as variation reduction (Maseer et al., 2022). A vital component of this strategy is the DMAIC methodology (design, measure, analyze, improve, and control), which uses a collection of tools and processes in a sequential order to carry out projects and generate long-term results (Al-Janabi et al., 2023). The DMAIC project technique is used to apply SS in enterprises, and it is a well-structured method. When implementing SS, it is critical to choose initiatives that will have the most significant financial impact on a firm (Anthony and Banuelas, 2002). Another distinguishing feature of SS is its constant focus on data, measurement and precision. It is essential to have a reliable measurement assurance system to ensure that process performance is maintained consistently and accurately. Operational performance can be quantified using SS metrics and numerical performance measures (Sharma & Chetiya, 2012). Data-driven implementation of social science initiatives can be achieved using the DMAIC (Define, Measure and Analyze, Improve and Control) methodology (Oakland and Oakland, 2019). Using DMAIC, it is easier to identify the root of a problem by focusing on the context in which it is occurring. (Montgomery & Woodall, 2008). The DMAIC is not just about tools and procedures; it is also about the people who use them. In order to have a successful learning experience, team members must stay involved and communicate effectively (Talankar et al., 2015). Additionally, project management and cooperation qualities are essential, as development comes through the implementation of initiatives. It is vital to identify the critical components to allocate personnel and resources and sustain focus (Coronado & Antony, 2002; Resen et al., 2023). Objective of the work or research problem. This study assumes that industrial performance can be used to determine whether SS was implemented successfully. Therefore, consider the following intriguing questions:

1- What CSFs contribute to the success of SS adoption in ITIs?

2- Is widespread adoption of SS beneficial to ITI achievement?

3- Should the high executive's commitment and involvement as the primary pillar of CSFs in TI's widespread adoption of SS influence other CSFs?

LITERATURE REVIEW

Six Sigma has received widespread acceptance in various businesses. Till the 1980s, whenever Motorola presented it as a way to reduce volatility within their functional areas, Six-Sigma was used as a methodology of TQM (Oakland, 2014). Six-Sigma is a method that comprises the application of statistical techniques throughout a predetermined framework in order to gather the necessary competence to dramatically increase the effectiveness of production technologies (Siddiqui et al., 2016). The adoption of SS requires the establishment of both a defined and similar hierarchy comprised of a team of experts, a systematic approach for a place from time to time (i.e., DMAIC), and client performance measures to accomplish business strategies (Ali et al., 2023). While SS began in the manufacturing sector, it has since moved to various areas, particularly medicine, finance, and postsecondary learning (Chakrabarty & Chuan Tan, 2007). Another anecdotal belief is that SS is only applicable to large enterprises, which is not valid, as proven by the research demonstrating successful deployments of Six-Sigma in enterprises (Pandi et al., 2016; Hadi et al., 2023). As a result, SS has grown in popularity as a technique for improving the quality of products and services, business agility, and, most crucially, business sustainability (Jeyaraman & Teo, 2010). The Numerous books and articles have been written about Six-Sigma since it has become increasingly popular in the business world today. Identifying CSFs for Six-Sigma implementation is a well-accepted practice in the SS literature (Shankar, 2009). Unsurprisingly, CSF research has remained popular in various domains, such as brand extension, TQM, process optimization, and sustainable product-service systems, owing to its practical applicability and innate attractiveness to researchers (Ceschin, 2013) (Mendes et al., 2016). Numerous scholarly articles have focused on CSFs in Six-Sigma implementation (Kumar, 2007). Six-Sigma implementation should be guided by critical components that contribute to the organization's effective generation of value (Flayyih & Khiari, 2022). Likewise, (Alkarney & Albraithen 2018) CSFs, according to (Sharma & Chetiya, 2012), assure the successful implementation, operation, and long-term viability of a Six-Sigma system. The researchers classify CSF: as enabling factors, such as organizational support, operational factors and sustainability considerations. Numerous research accord on the critical nature of particular SS CSFs. For example, management engagement and commitment are frequently identified as essential variables. CSFs connected to the soft aspects of SS implementation include investments in education and training, cultural transformation, and open communication techniques. Numerous CSFs link successful SS implementation and business strategy, customer and

supplier relationships, and incentive programs. Several CSFs emphasize developing a robust organizational infrastructure/belt system and project management procedures. Finally, another commonly mentioned CSF is the connection of SS programs to financial returns or accountability. Nonetheless, there is widespread opposition to CSFs (Naslund, 2013). These studies employ various research methods, target groups, and firm sizes, making comparisons and conclusions challenging. The SS projects serve as the foundation for future SS efforts. According to Snee (2001), an SS project is a problem with metrics that can be used to set project objectives and measure the effort's progress. This method is aimed at gaining an understanding and eliminating the root causes of process variability in these projects (Oakland, 2014). The detection of CSF has been the primary focus of empirical research in Six-Sigma adoption for the past two decades. An infrastructure for managing and distributing information and communication, as well as process mapping and re-engineering, are other essential success elements that have been discussed in the literature (Oakland et al., 2021). Research by Choi et al. (2012) found that SS management activities have a positive impact on process innovation. Finally, the authors identified 22 CSFs based on a literature review. This is what you will find in the following paragraphs: Picking the Right Project to Work On; selecting an executive for a project; employee intensively educated and trained; measurement assurance systems that are properly calibrated; a novel way to tackle problems; The use of the right equipment combination; creating multi-disciplinary teams; establishing lengthy supplier partnerships that are linked to SS goals; the evaluation and enhancement process of the capabilities of the suppliers; identification of the procedures and attributes that are key to achieving high quality; management commitment degree; quality of leadership on the project; development of the ideal work environment; the management of information and communication as it moves through various stages of the work cycle; being able to recognize and develop the right metrics and deliverables is needed; Incorporation of SS into a company’s overall strategy and goals; The company's capability to handle innovation and design; mapping and re-engineering of processes; Infrastructure and resources availability; enhancing employee motivation; the linkage between SS and customer service; and the linkage between SS and employees.

METHODOLOGY

Compilation of Data

A pilot survey of (28) TI was done using the following criteria in order to analyze and extract significant elements discovered via literature research objectively: organizations with

a minimum of three years of SS implementation experience; organizations with a minimum of three sigma and a desire to improve further; organizations having at least Green Belt and Black Belt-trained leaders; Foreign technical involvement with the organization was essential; Quality management systems (QMS) like ISO 9000 should have been implemented sooner rather than later; and There should have been much SS education and planning in the organization. The Businesses were categorized into three groups based on the type of business they were engaged in: The oil industry, electrics industry and Batteries industry. Three companies were selected, two of which have been using SS for around ten years, and a third is only a few years old. More than three years of expertise and successful projects ranging from 25 to 40 are the hallmarks of eight oil component manufacturers. Also included in this sample is an electrics manufacturing company with more than five years of SS expertise. Additionally, all firms have put in place quality management systems and quality initiatives. There was a whole of 97 people that responded to the survey; all were senior executives from the selected firms and had completed several successful SS projects and received some SS training. This means that the people who took the survey have a good understanding of the SS methodology.

RESULTS AND DISCUSSION

According to the literature review, the questionnaire contained 22 questions or variables about CSFs. For each statement, respondents were asked to rank its importance on a five-point Likert scale, from 1 to 5, where 1 - not important, 2 - least important, 3 - important, 4 - very important, 5 - highly importance. An estimated Kaiser-Meyer-Olkin Measure of Sampling Adequacy (0.862) This result shows the sufficiency of the sample size. As for Bartlett's Test of Sphericity, it achieved a score of (1551.402); The results are listed in Table 1.

Table (1) KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.862**
Bartlett's Test of Sphericity	Approx. Chi-Square	1551.402
	df	231
	Sig.	0.000

Source: prepper by author. (2023)

Factor Analysis on CSFs

The responses gathered from these variables were subjected to factor analysis in SPSS (V. 26). One-factor item representation was determined by considering only items with factor loadings greater than (0.50). Community types are listed in Table 2 (see below). According to Table (3), the eigenvalues, loading sums, and rotation sums that were previously explained are

shown. One example is presented in Figure (1): the scree plot with the x-axis components along with their respective eigenvalues on the y-axis five components. The component matrix illustrating the relationships between variables and factors is shown in Table (4) (rotated component matrix). To remove any low correlations considered negligible, factor loadings of 0.50 have not been examined.

Table (2) CSFs communalities

Communalities	Initial	Extraction
1- Picking the Right Project to Work On.	1.000	0.677
2- employee intensively educated and trained.	1.000	0.645
3- a novel way to tackling problems.	1.000	0.654
4- measurement assurance systems that are properly calibrated.	1.000	0.777
5- selecting an executive for a project.	1.000	0.624
6- The use of the right equipment combination.	1.000	0.676
7- creating multi-disciplinary teams.	1.000	0.725
8- creating long-term supplier relationship associated with SS aims.	1.000	0.733
9- the evaluation and enhancement process of the capabilities of the suppliers.	1.000	0.825
10- Identify the procedures and attributes that are key to achieving high quality.	1.000	0.813
11- management commitment degree.	1.000	0.735
12- the quality of leadership on the project.	1.000	0.546
13- development of the ideal work environment.	1.000	0.782
14- the management of information and communication as it moves through various stages of the work cycle.	1.000	0.860
15- Recognizing and developing the right metrics and deliverables is needed.	1.000	0.715
16- Incorporation of SS into a company's overall strategy and goals.	1.000	0.782
17- The company's capability to handle innovation and design.	1.000	0.782
18- mapping and re-engineering of processes.	1.000	0.814
19- Infrastructure and resources availability.	1.000	0.840
20- enhancing employee motivation.	1.000	0.694
21- linkage between SS and customer service.	1.000	0.797
22- - linkage between SS and employee.	1.000	0.573

Source: prepper by author. (2023).

Extraction Method: Principal Component Analysis.

Table (3) Total Variance Explained

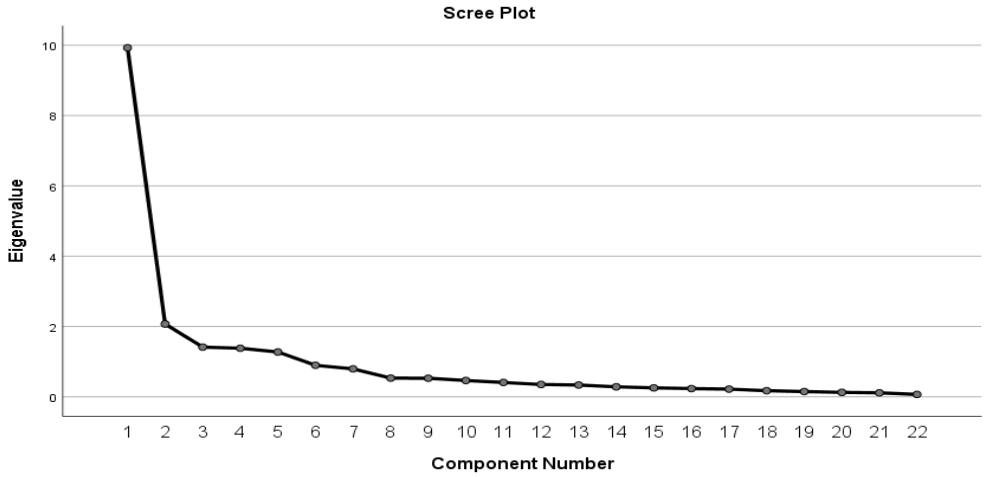
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.928	45.125	45.125	9.928	45.125	45.125	3.921	17.821	17.821
2	2.072	9.417	54.542	2.072	9.417	54.542	3.881	17.641	35.462
3	1.414	6.428	60.971	1.414	6.428	60.971	3.323	15.105	50.567
4	1.381	6.278	67.248	1.381	6.278	67.248	2.488	11.311	61.878
5	1.275	5.794	73.042	1.275	5.794	73.042	2.456	11.164	73.042
6	.896	4.073	77.115						

7	.794	3.611	80.725						
8	.532	2.420	83.145						
9	.528	2.400	85.546						
10	.464	2.107	87.652						
11	.408	1.853	89.506						
12	.350	1.593	91.099						
13	.336	1.525	92.624						
14	.284	1.292	93.916						
15	.254	1.155	95.071						
16	.234	1.065	96.136						
17	.219	.996	97.132						
18	.174	.792	97.924						
19	.149	.677	98.601						
20	.126	.574	99.175						
21	.114	.516	99.692						
22	.068	.308	100.000						

Source: prepper by author. (2023).

Extraction method: a principal component analysis.

Figure **(1)** CSFs Scree plot



Source: prepper by author. (2023).

Table (4) Rotated component matrix[a]

Component	1	2	3	4	5
21- linkage between SS and customers service.	.808				
20- enhancing employee motivation.	.785				
16- Incorporation of SS into a company's overall strategy and goals.	.742				

04- measurement assurance systems that are correctly calibrated.	.649				
05- Select an executive for a project.	.555				
07- creating multi-disciplinary teams.		.816			
06- The use of the right equipment combination.		.637			
22- linkage between SS and employee.		.633			
18- mapping and re-engineering of processes.		.607			
08- Establish lengthy supplier partnerships that are linked to SS goals.		.598			
19- Infrastructure and resources availability.		.595			
09- the evaluation and enhancement process of the capabilities of the suppliers.			.824		
10- Identify the procedures and attributes that are key to achieving high quality.			.810		
11- management commitment degree.					.579
02- employee intensively educated and trained.			.536		
14- the management of information and communication as it moves through various stages of the work cycle.				.897	
13- development of the ideal work environment.				.579	
15- Recognizing and developing the right metrics and deliverables is needed.				.566	
03- a novel way to tackle problems.				.561	
01- Picking the Right Project to Work On.					.740
17- The company's capability to handle innovation and design.					.611
12- the quality of leadership on the project.					.592
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 13 iterations.					

Source: prepper by author. (2023).

Based on these relationships, the (22) components have been pared down to only five.

- **Factor 1:** Customers and SS are linked, boosting employee morale, SS integration into corporate strategy and goals, project leader, process mapping and re-engineering – 17.821% of the data variation can be attributed to this single factor.
- **Factor 2:** multi-functional teams, right tool mix, employees and SS, mapping and re-engineering, long-term supplier partnerships, infrastructure and resources - 17.641% of the total variation is attributed to this factor.
- **Factor 3:** strengthening of supplier's capabilities, Identifying the quality-enhancing techniques, employees well-trained - This factor is responsible for 15.105% of the total data variance.
- **Factor 4:** management of information and communication throughout the work cycle, creating a dream workplace, right metrics, and problem-solving ingenuity - A further 11.311% of the data's variance is attributed to this factor.
- **Factor 5:** management dedication, choosing a project, Innovativeness and design, and Proper project direction - This variable is responsible for 11.164% of the variance in the data. Each component of the six-sigma CSFs is summarized in Table (5),

along with the percentage variance and factor loading value. The five factors account for (55.221%) of the variance in the data when taken together.

Table (5) Summary of factors analysis on Six-Sigma CSFs

Fact	% of variance	Scale items	Factor loading loading
Factor 1	17.821%	21- linkage between SS and customers service.	.808
		20- enhancing employee motivation.	.785
		16- Incorporation of SS into a company's overall strategy and goals.	.742
		04- measurement assurance systems that are correctly calibrated.	.649
		05- selecting an executive for a project.	.555
Factor 2	17.641%	07- creating multi-disciplinary teams.	.816
		06- The use of the right equipment combination.	.637
		22- linkage between SS and employee.	.633
		18- mapping and re-engineering of processes.	.607
		08- Establish lengthy supplier partnerships that are linked to SS goals.	.598
		19- Infrastructure and resources availability.	.595
Facto	15.105%	09- the evaluation and enhancement process of the capabilities of the suppliers.	.824
		10- Identify the procedures and attributes that are key to achieving high quality.	.810
		02- employee intensively educated and trained.	.536
Factor 4	11.311%	14- the management of information and communication as it moves through various stages of the work cycle.	.897
		13- development of the ideal work environment.	.579
		15- Recognizing and developing the right metrics and deliverables is needed.	.566
		03- a novel way to tackle problems.	.561
Factor 5	11.164%	11- management commitment degree.	.579
		01- Picking the Right Project to Work On.	.740
		17- The company's capability to handle innovation and design.	.611
		12- the quality of leadership on the project.	.592

Source: prepper by author. (2023).

According to the extracted results, the author suggests that the studied companies should adhere to the five main success factors that have been diagnosed if they want to achieve high results, sustainable quality and financial returns, as well as adopting the DMAIC SS methodology roadmap that will provide them with the framework that will help them achieve those results.

CONCLUSION

This method has been well researched, and most pioneering research found that organizational commitment was CSFs. Nonetheless, the examination of the 28 Iraqi companies' CSFs shows that the critical factor is a combination of the project teams' competence to apply the appropriate technologies, innovative and creative management in issue solving and long-term supplier collaboration of the companies. Essentially Many people mistakenly believe that SS's success is only dependent on the management's commitment, which is a misunderstanding

of how the methodology works. Although Management's role and participation are critical, this is not meant to diminish their significance. However, as the results of the factor analysis show, other elements are just as crucial in making the program a success. A project-based approach to SS calls for the proper application of tools and an inventive approach to problem-solving. The SS methodology's enhancement tools aid in evaluating the project's success. Additionally, in companies where adopting SS standards and goals is a requirement for supplier acceptance, assessing and monitoring supplier performance using SS standards results in a win-win situation. Finally, the study suggests that work and organizational environment play a critical role. For future research, we propose the application of SS in determining success factors in service institutions that provide public benefit services to citizens.

REFERENCES

Albayatey, A. S. W., Mawlood, S. J., & Abbood, H. Q. (2023). Analysis of the Impact of Six Sigma and Risk Management on Iraq's Energy Sector Metrology. *International Journal of Professional Business Review*, *8*(4), e01037. https://doi.org/10.26668/businessreview/2023.v8i4.1037

Albayatey, A. S., Makttoof, H. S., & Mawlood, S. J. (2021). Quality of Transition to E-Learning under Corona pandemic: An Application Study in College of Administration and Economics, Baghdad University. *Review of International Geographical Education Online*, *11*(5). https://doi.org/10.48047/rigeo.11.05.338

Albderi et al., 2023

Albderi, A. J. T., Hasan , M. F., & Flayyih, H. H. (2023). Measuring the level of banking performance according to the requirements of comprehensive quality management: an application study. *Ishtar Journal of Economics and Business Studies*, *4*(1), 1–18. https://doi.org/10.55270/ijebs.v4i1.15

Ali, M. A., Hussin, N., Flayyih, H. H., Haddad, H., Al-Ramahi, N. M., Almubaydeen, T. H., ... & Hasan Abunaila, A. S. (2023). A Multidimensional View of Intellectual Capital and Dynamic Innovative Performance. *Journal of Risk and Financial Management*, *16*(3), 139. https://doi.org/10.3390/jrfm16030139

Ali, S. I., Al-taie, B. F. K., Flayyih, H. H. (2023). The Effects of Negative Audit and Audit Environment on The Internal Auditor Performance: Mediating Role of Auditing Process Independence. International Journal of Economics and Finance Studies, 15 (01), 64-79. doi: https://doi.org/10.34111/ijefs.2022315104

Al-Janabi, A. S. H., Mhaibes, H. A., & Hussein, S. A. (2023). The role of learning organizations in crisis management strategy: A case study. Corporate & Business Strategy Review, 4(1), 8–21. https://doi.org/10.22495/cbsrv4i1art1

Alkarney, W. and Albraithen, M., (2018), ``Are critical success factors always valid for any case? A contextual perspective," IEEE Access, Vol. 6, pp. (63496-63512).

Al-taee, S. H. H., & Flayyih, H. H. (2023). Impact of the Electronic Internal Auditing Based on IT Governance to Reduce Auditing Risk. *Corporate Governance and Organizational Behavior Review*. 7(1), 94–100. https://doi.org/10.22495/cgobrv7i1p9

Antony, J., & Banuelas, R. (2002). Key ingredients for the effective implementation of Six Sigma program. *Measuring business excellence*. https://doi.org/10.1108/13683040210451679

Ceschin, F. (2013). Critical factors for implementing and diffusing sustainable product-Service systems: insights from innovation studies and companies' experiences. *Journal of Cleaner Production*, *45*, 74-88. https://doi.org/10.1016/j.jclepro.2012.05.034

Chakrabarty, A., & Chuan Tan, K. (2007). The current state of six sigma application in services. *Managing service quality: An international journal*, *17*(2), 194-208. https://doi.org/10.1108/09604520710735191

Choi, B., Kim, J., Leem, B. H., Lee, C. Y., & Hong, H. K. (2012). Empirical analysis of the relationship between Six Sigma management activities and corporate competitiveness: Focusing on Samsung Group in Korea. *International Journal of Operations & Production Management*. https://doi.org/10.1108/01443571211226489

Flayyih, H.H., khiari, W. (2022). A COMPARATIVE STUDY TO REVEAL EARNINGS MANAGEMENT IN EMERGING MARKETS : EVIDENCE FROM TUNISIA AND IRAQ. *International Journal of Professional Business Review*, 7(5), 1–18. https://doi.org/https://doi.org/10.26668/businessreview/2022.v7i5.815

Hadi, A. H., Ali, M. N., Al-shiblawi, G. A. K., Flayyih, H. H., Talab, H. R. (2023). The Effects of Information Technology Adoption on the Financial Reporting: Moderating Role of Audit Risk. International Journal of Economics and Finance Studies, 15 (01), 47-63. doi: https://doi.org/10.34111/ijefs.2022315104

Jeyaraman, K., & Kee Teo, L. (2010). A conceptual framework for critical success factors of lean Six Sigma: Implementation on the performance of electronic manufacturing service industry. *International Journal of Lean Six Sigma*, *1*(3), 191-215. https://doi.org/10.1108/20401461011075008

Kumar, M. (2007). Critical success factors and hurdles to Six Sigma implementation: the case of a UK manufacturing SME. *International Journal of Six Sigma and Competitive Advantage*, *3*(4), 333-351. https://doi.org/10.1504/IJSSCA.2007.017176

Laureani, A., & Antony, J. (2012). Critical success factors for the effective implementation of Lean Sigma: Results from an empirical study and agenda for future research. *International Journal of Lean Six Sigma*, *3*(4), 274-283. https://doi.org/10.1108/20401461211284743

Maseer, R. W., Zghair, N. G., Flayyih, H. H. (2022). RELATIONSHIP BETWEEN COST REDUCTION AND REEVALUATING CUSTOMERS' DESIRES: THE MEDIATING ROLE OF SUSTAINABLE DEVELOPMENT. *International Journal of Economics and Financial Studies*. Vol. 14 No. 4. 330-344. doi: https://doi.org/10.34111/ijefs.20220116

Mawlood, S. J., Albayatey, A. S. W., & Jassem, A. A. (2022). Investigating the use of lean manufacturing techniques in liquid batteries production: A field research in Babylon plants. *Materials Today: Proceedings*, *60*, 1851-1856. https://doi.org/10.1016/j.matpr.2021.12.523

Montgomery, D. C., & Woodall, W. H. (2008). An overview of six sigma. *International Statistical Review/Revue Internationale de Statistique*, 329-346. https://www.jstor.org/stable/27919650

Näslund, D. (2013). Lean and six sigma–critical success factors revisited. *International Journal of Quality and Service Sciences*. https://doi.org/10.1108/17566691311316266

Oakland, John S and Oakland, Robert James, (2019), Statistical process control, 7th Edition, Routledge, London.

Oakland, John S, (2014), Total Quality Management and Operational Excellence: Text with Cases, 4th Edition, Routledge, London.

Oakland, John S, Oakland, Robert J, and Turner , Michael A. (2021), Total Quality Management and Operational Excellence: Text with Cases, 5th Edition, Routledge, London.

Pande, Peter S.; Neuman, Robert P.; Cavanagh, Roland R., (2000), The six-sigma way: How GE, Motorola, and other top companies are honing their performance, McGraw-Hill, New York.

Pandi, A. P.; Sethupathi, P. R. and Jeyathilagar, D., (2016), `Quality sustainability in engineering educational institutions: A theoretical model," International Journal of Productivity and Quality Management, Vol. 18, No. 2-3, pp (364-384).

Raisinghani, M.S., Ette, H., Pierce, R., Cannon, G. and Daripaly, P. (2005), "Six Sigma: concepts, tools, And applications", Industrial Management & Data Systems, Vol. 105 No. 4, pp. (491-505).

Reosekar, R. S. and Pohekar, S. D., (2014), ``Six Sigma methodology: A structured review," Lean Six Sigma Journal, Vol. 5, No. 4, pp. (392-422).

Resen, E. J., AbdulRazzaq, M. S., & Abbood, H. Q. (2023). Environmental Impact Assessment for Industrial Organizations using Rapid Impact Assessment Matrix. *Ecological Engineering & Environmental Technology*, *24*(2), 94-108. https://doi.org/10.12912/27197050/156964

Ricardo, B. C., & Jiju, A. (2002). Critical success factors for the successful implementation of six sigma projects in organisations. *The TQM Magazine*, *14*(2), 92-99. https://doi.org/10.1108/09544780210416702

Rockart, J. F., (1979),``Chief executives define their own data needs.," Harvard Business Review, Vol. 57, No. 2, pp. (81-93).

Rungasamy, S., Antony, J. and Ghosh, S. (2002), "Critical success factors for SPC implementation in UK small and medium enterprises: some key findings from a survey", The TQM Magazine, Vol. 14, No. 4, pp. (217-224).

Shankar, R., (2009), Process Improvement Using Six Sigma: A Dmaic Guide. Milwaukee, WI, ASQ Quality Press, USA.

Siddiqui, S. Q., Ullah, F., Thaheem, M. J., & Gabriel, H. F. (2016). Six Sigma in construction: a review of critical success factors. *International Journal of Lean Six Sigma*, *7*(2), 171-186. https://doi.org/10.1108/IJLSS-11-2015-0045

Snee, R. D. (2001). Dealing with the Achilles heel of Six Sigma initiatives. *Quality progress*, *34*(3), 66-72.

Snee, R.D. and Rodebaugh, W.F., JR., (2002), The project selection process, Quality Progress, pp. (78-80).

Talab, H. R., & Flayyih, H. H. (2023). An Empirical Study to Measure the Impact of Information Technology Governance Under the Control Objectives for Information and Related Technologies on Financial Performance. *International Journal of Professional Business Review*, *8*(4), e01382. https://doi.org/10.26668/businessreview/2023.v8i4.1382

Talankar, A., Verma, P., & Seth, N. (2015). Modelling the clusters of critical success factors of Six Sigma for non-formal service sectors using interpretive structural modelling. *International Journal of Six Sigma and Competitive Advantage*, *9*(2-4), 222-240. https://doi.org/10.1504/IJSSCA.2015.074965