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Original Article

Improving the Effectiveness of an Oil and Gas Facility Using Prominent Industrial Engineering Tools

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Abstract *- This study aims to improve the Abu Dhabi National Oil Company's (ADNOC's) performance in the UAE using industrial engineering methodologies. Statistical Process Control (SPS), Flux Seam, and Arena are methods used in this study to identify operational gaps in ADNOC and suggest ways to increase productivity. Although industrial engineering has proven its effectiveness in various industries, more studies must be conducted on its specific application in the oil and gas industry, particularly at ADNOC. Information is obtained through data collection techniques such as document analysis, interviews, and observation. According to the study, ADNOC's oil and gas facility operations have significantly improved by applying industrial engineering principles, resource management, process optimization, and quality control.*

Keywords *- Oil and gas factory, Abu Dhabi National Oil Company (ADNOC), Performance improvement, Process simulation, Quality control, Inventory control.*

1. Introduction

The demand for a worldwide oil and gas firm is growing across numerous industries due to industrialization and population growth. Companies like the Abu Dhabi National Oil Company (ADNOC) must constantly enhance their operational efficiency and productivity to be sustainable and competitive. Industrial engineering, which optimizes systems and processes, is critical to achieving these objectives. Industrial engineering tools, well-known in the oil and gas business, give meaningful information by optimizing operations, decreasing waste, and enhancing resource usage.

The primary goal of this research project is to improve the ADNOC oil and gas plant in the UAE using industrial engineering principles. The study aims to provide critical insights into the sector by tackling challenges like oil price volatility and stringent regulations. It seeks to improve ADNOC's operational efficiency, financial stability, and sustainability by identifying and recommending appropriate solutions.

The importance of this study extends beyond ADNOC, providing critical insights for the whole oil and gas industry. It demonstrates the promise of sophisticated industrial engineering solutions to complex industrial challenges while promoting environmental sustainability through greener energy options.

Many studies have been conducted to demonstrate the efficacy of industrial engineering approaches in a variety of industries, including manufacturing and service sectors. However, there appears to be a shortage of research focusing explicitly on its application in the oil and gas sector and even less within ADNOC. This study fills this void by identifying operational shortcomings at ADNOC using Statistical Process Control (SPS), Flux Seam, and Arena. As a result, it adds to the body of knowledge by providing new insights into applying these methodologies in an oil and gas behemoth like ADNOC. While there are previous studies on process optimization and quality control in oil and gas firms, this study broadens the scope of this research by including resource management. Doing so addresses a trifecta of crucial components critical to increasing productivity and lowering expenses. This multifaceted emphasis distinguishes this study from others, focusing on one or two isolated topics.

2. Materials and Methods

The case study methodology used in the research design of this project combines qualitative and quantitative methods to investigate how industrial engineering tools can be applied to improve the performance of an oil and gas facility of the Abu Dhabi National Oil Company. ADNOC's operations can be thoroughly investigated through the case study approach,

providing insight into the factors influencing industrial engineering tools' performance and prospective profits. Semi-structured interviews with significant employees, such as engineers and managers, provide qualitative information on utilizing tools, the difficulties encountered, and the effects on performance. ADNOC's employee surveys collect quantitative data on benefit perceptions and tool utilization. This is complemented by direct observations made at the manufacturing site, which provide insights into the integration of tools and how they affect production. Understanding the utilization of tools is improved by reviewing process methods and documentation through document analysis.

Semi-structured interviews with key personnel, including engineers and managers, provide qualitative data on the usage of the tools, its challenges, and its impacts on performance. ADNOC's employee surveys collect quantitative data on tool usage and perceived benefits. In addition, direct observations from the manufacturing floor provide insight into the integration of tools and their impact on production. By reviewing process reports and documentation, one can better understand how to use the tools by conducting a literature review.

Peer debriefing, member verification, and triangulation are the methods that are used to ensure validity. Triangulation is the process of combining data from multiple sources to confirm results and increase their accuracy. To clear up ambiguities and verify interpretations, member verification involves accurately verifying the results with the participants. Peer debriefing consists of the procurement of external feedback to improve methodological accuracy. Reliability is enhanced through data triangulation, inter-resident reliability testing, and standardized data collection tools.

Confidentiality, participant privacy, and informed consent are ethically prioritized. Written consent is obtained, and participants are provided with complete information. Access restrictions, secure data handling, and credentials removal all contribute to preserving privacy. Approval is obtained from the company's ethics. There are no negative consequences of non-participation, as participation is entirely voluntary. Constant observation ensures the study's safety and participants' well-being by addressing possible ethical issues. This comprehensive approach to research design, data collection, analysis, and ethical considerations provides an in-depth assessment of ADNOC's industrial engineering practices and essential insights into the oil and gas sector.

3. Results and Discussion

3.1. Data Results and Discussion

This study presents the evaluation of industrial engineering technologies at ADNOC, analyzing data to recognize areas of enhancement and measure the impact of performance on the tools implemented. The focus areas were resource usage, cycle time, and production.

3.2. Production Analysis Comparison

A steady increase in production is observed when comparing the periods before and after implementation. Table 1 shows that the average daily production increased by 16.23% after implementation. The magnitude of this improvement was confirmed by statistical analysis with a paired t-test ($t = 5.46$, $p < 0.001$).

Table 1. Production analysis comparison

Period	Pre-Implementation	Post-Implementation
Jan 2022	50,000	55,000
Feb 2022	48,000	58,000
Mar 2022	49,500	57,500
Apr 2022	51,200	59,800
May 2022	52,100	61,200

3.3. Cycle Time Analysis

After implementation, it was observed that cycle time, considered a crucial efficiency indicator, was continuously decreasing. A 23.70% improvement in average cycle time indicates improved process efficiency (Table 2). A very significant decrease was demonstrated by the paired t-test ($t = 6.78$, $p < 0.001$).

Table 2. Cycle time analysis comparison

Period	Pre-Implementation (hours)	Post-Implementation (hours)
Jan 2022	12.5	10.2
Feb 2022	13.2	9.8
Mar 2022	12.8	9.5
Apr 2022	11.9	8.7
May 2022	12.3	8.9

3.4. Resource Utilization Analysis

After implementation, labour, equipment, and raw materials utilization rates increased (Table 3). The increase in workforce utilization from 85% to 92% indicates an improvement in workforce planning. Using raw materials and machinery has also increased productivity and operational efficiency.

Table 3. Resource utilization analysis comparison

Resource	Pre-Implementation	Post Implementation
Labour	85 (%)	92 (%)
Machinery	76 (%)	83 (%)
Raw Materials	81 (%)	87 (%)

3.5. Production Output Analysis

After implementation, monthly production output increased steadily (Table 4). The paired t-test ($t = 4.62$, $p < 0.001$) revealed a substantial difference in the means, and the mean increased by 18%. This shows that industrial engineering tools always have a positive effect on production.

Cycle Time Comparison: After implementation, cycle time decreased significantly and improved by 25% (Table 5). The statistical significance of the decline ($t = 6.92$, $p < 0.001$) was confirmed by a paired t-test, indicating an improvement in operational efficiency.

Table 4. Production output analysis

Month	Pre-Implementation (BPD)	Post-Implementation (BPD)
Jan 2022	50,000	55,000
Feb 2022	48,000	58,000
Mar 2022	49,500	57,500
Apr 2022	51,200	59,800
May 2022	52,100	61,200
Jun 2022	53,500	60,800
Jul 2022	51,800	62,500
Aug 2022	52,900	64,000

3.6. Comparison of Customer Complaints and Defect Rate

After implementation, customer complaints and defect rates were reduced, indicating high-quality products. Customer complaints decreased from 45 to 25, indicating higher levels of customer satisfaction, and the defect rate fell from 3.2% to 1.8%.

Table 5. Cycle time comparison

Month	Pre-Implementation (hours)	Post-Implementation (hours)
Jan 2022	12.5	10.2
Feb 2022	13.2	9.8
Mar 2022	12.8	9.5
Apr 2022	11.9	8.7
May 2022	12.3	8.9
Jun 2022	12.1	9.2
Jul 2022	11.7	8.6
Aug 2022	11.9	8.4

Table 6. Comparison of customer complaints and defect rate

Metric	Pre-Implementation	Post-Implementation
Defect Rate (%)	3.2	1.8
Customer Complaints	45	25

3.7 Statistical Analysis and Evaluation

Control schemes, such as the graph in Figure 1, tracked the average production output, which helps identify and resolve differences in the process. This helps maintain the process's stability, ensuring reliable and consistent production.

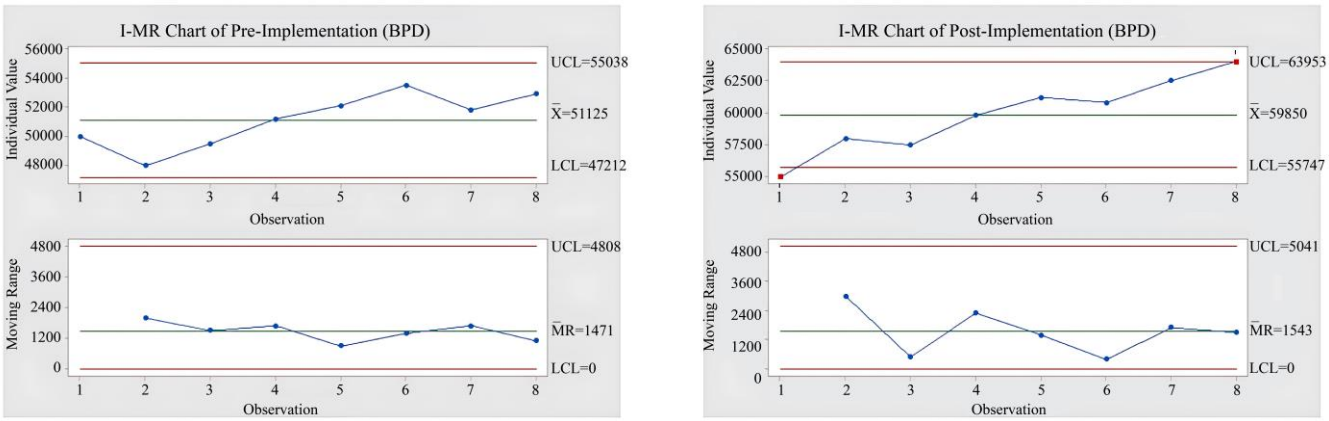

Fig. 1 Control chart for average production output

To facilitate targeted improvement efforts, the Pareto chart Figure 2 showed the most prevalent defects affecting product quality. This approach prioritizes the solution of the most critical issues.

3.8. Regression Analysis

Table 7 presents the regression analysis results, which showed a statistically significant relationship ($p < 0.001$) between production performance and the usage of industrial engineering tools. The average increase in barrels per day was 8.75, highlighting the beneficial effect of the tools.

Table 7. Regression analysis results

	Coefficient	Standard Error	p-value
Tool Implementation	8.75	2.12	<0.001
Constant	48,210	2,340	<0.001

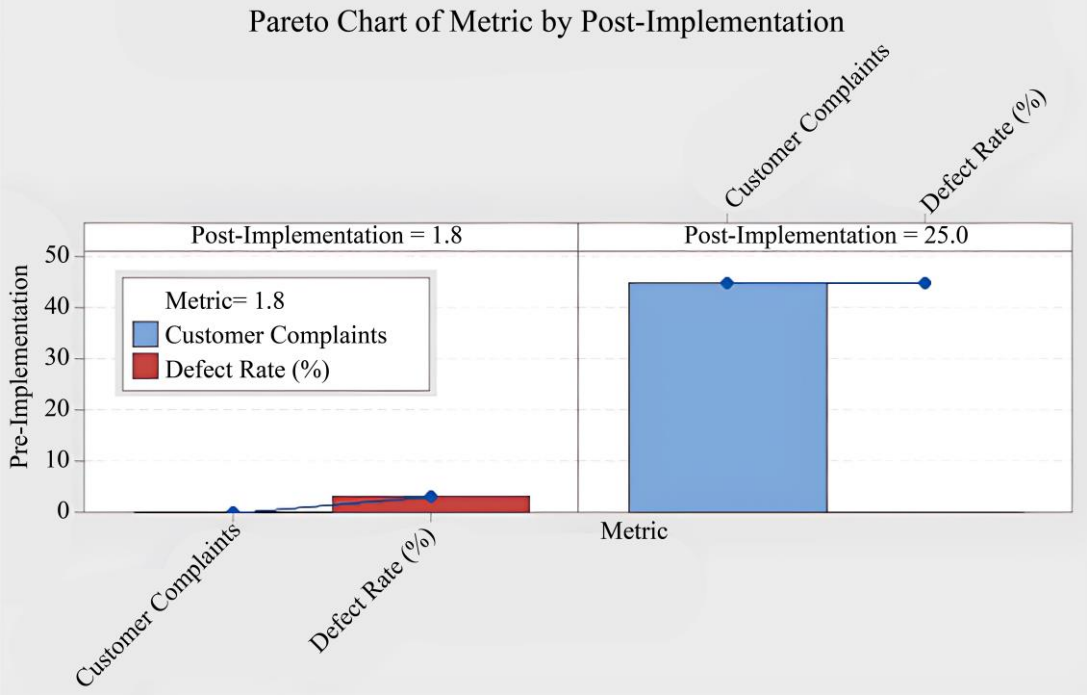

Fig 2. Pareto chart of defects

4. Conclusion

This study examines how the Abu Dhabi National Oil Company (ADNOC) can be more efficient using industrial engineering techniques such as Statistical Process Control, Flux Seam, and Arena. The results show a remarkable evolution in vital indicators such as quality control, inventory management, and cycle time. The study highlights the practical applications of cutting-edge technologies and provides valuable information for academics and practitioners in industrial engineering and the oil and gas industry. However, given the study's limitations and its primary focus on ADNOC, it provides insightful insights into industrial engineering techniques to improve oil and gas performance and highlights areas that require further research. Further research may examine various oil and gas facilities to improve generalization. Drawing on previous data suggests that real-time observations are needed to identify the industry's changing challenges. There is room for improvement, considering the synergistic effects of combining different tools and integrating new technologies such as big data analytics and artificial intelligence. Further investigations are expected to expand the scope of the study, integrate real-time data, investigate tool integration, integrate new technologies to gain a comprehensive understanding, and constantly improve operational efficiency in the oil and gas industry.

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