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USING FAILURE MODE AND EFFECT ANALYSIS TOOL TO DETERMINE RISKS OF DEALING WITH CUSTOMER COMPLAINTS AT BAGHDAD OIL TRAINING INSTITUTE - CASE STUDY

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Original research

A B S T R A C T

This research aims to identify potential risks that prevent customer complaints from being addressed in accordance with the Baghdad Oil Training Institute's processes for providing educational and training services using Failure Mode and Effect Analysis tool, as the institute suffers from a weak complaints handling system, which is reflected in the quality of its services. To identify modes of failure and effect analysis, a questionnaire was used, Personal interviews and brainstorming sessions to collect data and information. The results showed that there were three types of failure: minor risks at 20%, moderate risks at 53%, and major risks at 27%. The institute must develop a plan that includes strategies for dealing with failure modes (risks) to reduce their effects on the quality of its services.

1. INTRODUCTION

The existence of any organization in a competitive market depends on the extent of customer satisfaction with the services or products offered. Both customer expectations and perceptions are considered illogical, which makes it difficult to satisfy them if the organization does not comprehensively consider the various vital factors. Customer satisfaction includes achieving the customer's expectations, desires, requirements or his happiness with a product or service (Rashed & Abdulkareem, 2023). With the rapid changes taking place in technologies, interest has increased among service organizations, as well as other businesses, in developing relationships with customers. It is considered the need of organizations to strengthen relationships with customers satisfaction is seen as a strategic step for business growth and competitiveness (Ahmed & Al Ameri, 2023). The (Koc et al., 2023) study, which was conducted to explore the use of ChatGPT-4 in generating management responses to customer reviews or complaints posted on Trip advisor, indicated that the ChatGPT-4 generated management response satisfies the requirements of an efficient and effective management response. The quality of ChatGPT-4 generated management responses tends to be extremely high and they may be generated within seconds and with little effort. While the study (Maduhu, 2023) conducted at

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Arusha City Council indicated as a case study to examine the effectiveness of complaints resolution approaches on customer satisfaction revealed that the council promptly addresses and resolves customer complaints and effectively communicates with customers during the complaints resolution process to a moderate extent, have significantly Improved customer satisfaction, influencing how customers perceive the quality of services provided. Also, indicated that there lack of effective communication, struggle to take ownership and responsibility, lack of attentiveness and unresponsive and slowness are the complaints resolution challenges facing the council. While the (Autio, 2024) study conducted in The case company for waterjet and laser cutting in Finland, to learn how a company's complaint management process can be improved with the help of an ERP system. It reached to the company's complaints management process is highly customer-oriented, and customer problems are resolved quickly. Weaknesses in the process included poor implementation of the process, lack of knowledge regarding roles and responsibilities, and the fact that the process does not produce sufficient information for managerial decision-making.

The FMEA tool is also used to evaluate potential failures in the complaints handling process and prioritize improvement actions based on their severity, occurrence, and detectability, and then prioritize areas that need immediate and effective improvement. Through their planning processes, organizations must identify, evaluate and manage the consequences of relevant risks and potential opportunities (Fadel & Abdel Karim, 2022). Failure mode and effect analysis is an approach used to identify potential failure modes that could affect process efficiency, product quality, or customer satisfaction and that helps an organization implement process changes, redesign workflows, introduce controls, or develop training programs to improve process performance and reduce errors or inefficiencies. The study by Cahyono and Nurcahyanie (2023) conducted on the Logistics Department at PT XZY identified 19 operational risks, and according to the RPN value that was calculated, the top 3 risks in operations that can hinder business activities are limited product storage, inappropriate placement of spare parts, and input errors into the system. To reduce disruption, PT XZY can do several things, Including Firstly, in the inventory placement section of the room should PT XZY staff have an organized inventory placement plan to facilitate the process of counting goods or returning and picking up goods for use. Secondly, limited storage space can be used to arrange items efficiently and effectively. Third, the competence of the company's employees must always be developed to obtain superior services. While the study (Pajic et al., 2023) that applied the FMEA-QFD approach to assess risks in the distribution process, focusing on storage and transportation operations, which are usually associated with user dissatisfaction and loss of customers, concluded that for the storage process, a long reception time, Additional costs and lack of experience have the highest priority. In the transportation process, loss of time, generation of additional costs, and longer retention time are the three highest priority effects of failure. The Kök and Yıldız (2023) study, which was applied in the automobile spare parts industry, identified the risks of the painting process, and the processes that were initially carried out manually by the operators were automated. With this improvement, the risk decreased by 69.8%.

Baghdad Oil Training Institute is one of the institutions affiliated with the Iraqi Ministry of Oil and works to qualify staff in the fields of refinery, drilling, electricity, mechanics, and oil to be ready to work in oil companies. There are many customer complaints that reach the Baghdad Oil Training Institute and are not addressed most of the time because there are no processes for handling complaints. The aim of this research was to apply the Failure Mode and Effect Analysis (FMEA) tool, for the purpose of identifying and evaluating unwanted failures that negatively affect the quality of handling customer complaints at the institute with regard to educational and training services and in accordance with the processes that have been identified as main processes customer complaints relate to them, which are (the educational process, training, recruitment, marketing and promotion, employees, the effectiveness of the institute's website, internal and external communication).

2. LITERATURE REVIEW

2.1 Origin of the FMEA tool

The use of Failure Mode and Effect Analysis (FMEA) dates back to the mid-20th century when it was first developed as a reliable tool in the manufacturing industry (Burhanuddin & Sutopo, 2022), The chronological stages of the FMEA tool indicate that in the nineties of the last century, FMEA was recognized as a tool for risk assessment and non-conformity prevention in quality management systems, and it was integrated into international standards such as ISO 9001 (Shoults 2016). In the second millennium, FMEA advanced with the introduction of software tools for data analysis and automation, and new forms of it were developed, such as Design FMEA (DFMEA) and Process FMEA (PFMEA), to meet specific stages of product development and manufacturing processes (Gattig 2020). Currently, FMEA has continued to evolve with advances in technology, risk management practices, and industry requirements, and has been integrated into various sectors including manufacturing, healthcare, aerospace, defense, and electronics, as a standard practice for proactive risk identification and mitigation (Soltanali & Ramezani, 2023).

2.2 Concept of (FMEA) tool

Organizations seek to provide high-quality products and services while reducing risks and ensuring customer satisfaction, and one of the valuable tools that can contribute significantly to achieving these goals is the Failure Mode and Effect Analysis (FMEA) tool (Kang,

2011). It is a systematic and proactive approach that helps organizations identify, evaluate and mitigate potential failure modes and their effects. The FMEA tool provides a comprehensive framework for identifying and addressing failure risks during the various stages of product development, manufacturing processes, or system implementation (Mhenni, 2014). FMEA can be defined as an approach that helps the organization understand and meet customer expectations by identifying potential failure modes and their effects on product performance, reliability, or usability. It helps in designing mitigation strategies and emphasizes the importance of aligning the organization's activities with the customer's needs and preferences to provide the products or services that are needed meets or exceeds his expectations. Kholil (2023) defined it as a technique used to identify, find, and eliminate known failures, errors, and problems of systems, designs, processes, or services before they reach the consumer. Its purpose is to determine the risk level of each type of failure so that a decision can be made about whether action should be taken.or not. The researchers define the Failure Mode and Effect Analysis Tool as a reliability management tool designed to evaluate and eliminate potential failures to improve system performance, prioritize actions, and implement preventive measures.

2.3 Objectives of (FMEA) tool

The objectives of Failure Mode and Effects Analysis (FMEA) tool can be summarized as follows:

- Improving the design of the product or process: It facilitates the identification of weak points in the design or that may lead to failure, and by addressing them at an early stage of the design stage, the organization can enhance the reliability, performance, and overall quality of its products or processes (Bureau Veritas, 2020).
- Reducing costs: The FMEA tool aims to identify potential failure modes and their associated costs by proactively addressing these failure modes, costs associated with rework, warranty claims, product recalls, or customer complaints are reduced, and it also helps allocate resources efficiently, and focus on areas that have the highest potential for cost savings (Alinezhad et al., 2015).
- Enhancing risk management: It is a valuable tool for managing the risks associated with failure, as it helps organizations understand and mitigate risks by proactively identifying and addressing potential failure modes before they occur, this allows for reducing the probability and effect of failure, and reducing the risks associated with them (Bureau Veritas, 2020).
- Enhancing customer satisfaction: By understanding, identifying, and addressing failure modes, product quality, reliability, and performance can be improved, leading to increased customer satisfaction, and aligning product or process design with his or her expectations and preferences (Alinezhad et al., 2015).
- Supporting continuous improvement: The FMEA tool supports a culture of continuous improvement by providing insights into failure modes and driving corrective and preventive actions, and encourages organizations to learn from previous failures and implement improvements to prevent similar failures from recurring (Bureau Veritas, 2020).
- Enhancing organizational learning: This tool contributes to organizational learning and knowledge management, The organization gains insights into problems and modes through systematic analysis of failure modes and their causes, This information can be used to update design guidelines, improve manufacturing processes, develop training programs, and share best practices within the organization.

Through the above objectives, it can be said, from the researchers' point of view, that the organization is effectively applying the FMEA tool as a proactive risk management tool, which ensures the reliability, safety and quality of its products, services, operations and systems while reducing costs and enhancing customer satisfaction. The objectives revolve around identifying, evaluating and mitigating potential failure modes to enhance reliability, quality, safety, customer satisfaction and overall risk management in the organization. By achieving these objectives, the organization can improve its products, processes and systems, leading to increased performance, efficiency and customer confidence.

2.4 Components of (FMEA) tool

The Failure Mode and Effects Analysis (FMEA) tool consists of several key components that facilitate systematic analysis and mitigation of potential failures. These components include:

- Description of the system or process: Provides an overview of the system or process being analyzed, and includes information about the purpose, functions, inputs, outputs, and interfaces with other systems or processes.
- Failure modes: involves identifying and documenting all possible ways in which a system or process may fail to perform its intended function. This includes both functional failure (failure to perform the desired function) and potential failure related to safety, reliability, or other critical aspects (Gattig 2020).
- Causes of failure: This component focuses on identifying the underlying causes or factors that can lead to each failure mode, and includes analysis of potential failure mechanisms, design flaws, process weaknesses, human errors, environmental factors, or other relevant aspects that contribute to the occurrence of failure modes.
- Effects of Failure: The effects component explores the consequences of each failure mode on the system, process, or end users, and includes

assessing the severity and effect of failures in terms of safety, reliability, customer satisfaction, financial impacts, or other important criteria (Mhenni, 2014).

- Risk assessment: that is, an assessment of the risks associated with each failure mode, and usually takes into account two dimensions: probability (likelihood of occurrence) and severity (consequences or impact), By assessing probability and severity, a risk priority or importance rating is assigned to prioritize actions to mitigate the risks (Dobra & Jósvai, 2021).
- Existing Controls: Focuses on identifying and documenting current controls or preventive measures in place to mitigate identified failure modes, and includes analysis of design features, process controls, quality assurance procedures, inspections, test protocols, or other preventive measures that help reduce the occurrence or impact of failure (Balaraju et al., 2019).
- Detection and prevention controls: addresses the effectiveness of current detection and prevention controls, and includes evaluating the ability to detect failures before they reach the customer or cause harm, as well as the effectiveness of preventive measures in eliminating or reducing failures (Sutrisno et al., 2015).
- Recommended Actions: Identifies specific actions or recommendations to mitigate identified failures, and includes proposing design changes, process improvements, additional controls, training programs, testing protocols, or other measures intended to reduce the risk of failure (Bocut et al., 2022).
- Documentation and Reporting: The FMEA tool requires comprehensive documentation of the analysis process, results, and recommended actions, and this component emphasizes the importance of clear and accurate documentation to ensure traceability, knowledge transfer, and effective communication among stakeholders (Bellinello et al., 2023).

Follow-up and monitoring: that is, establishing a process to monitor the effectiveness of recommended procedures and verifying their successful implementation, This includes defining metrics, tracking progress, conducting periodic reviews, and updating the tool as needed to ensure continuous improvement and risk management (Gattig,2020).

2.5 Steps to implement (FMEA) tool

Number of authors (Zúñiga et al., 2020; Omidvari et al., 2020; Cabanes et al., 2021) agreed That the steps for implementing the Failure Mode and Effect Analysis (FMEA) tool are as follows:

- Defining the scope: including the system, process, or component to be analyzed, and defining the purpose and objectives of the analysis.
- Establish a cross-functional team: made up of individuals with diverse experience and knowledge relevant to the system or process being analyzed, and including representatives from different departments or functions involved in the design, production, and maintenance of the product or process.
- Identify failure modes: Identify and document all possible failure modes that can occur within a system or process, A failure mode is a specific way in which a system or process can fail to meet its intended function or performance requirements.
- Determine causes and effects: Identify the causes or factors that could lead to each failure mode, through root cause analysis, including design deficiencies, process variations, human errors, environmental factors, or any other factors that could contribute to the occurrence, failure modes, and identify the effects or consequences of each failure mode on the system, process, or stakeholders.
- Severity Rating: Assess the severity of the impact of each failure mode by assigning a rating or score to indicate the potential impact of the failure mode on safety, quality, reliability, customer satisfaction, or other relevant criteria.
- Occurrence Evaluation: Estimating the probability or likelihood of each failure mode occurring by taking into account historical data, expert opinions, industry standards, and any other relevant information to evaluate the frequency or occurrence of the failure mode.
- Detection Assessment: Evaluating the detectability or likelihood of detecting each failure mode before it reaches the customer or causes significant harm, taking into account the effectiveness of detection methods, controls, inspections, or tests in place to determine the failure mode.
- Calculating Risk Priority Number (RPN): Each failure mode is calculated by multiplying the Severity, Occurrence, and Detection ratings, and helps prioritize failure modes based on their potential risk.
- Develop Mitigation Actions: Based on analysis of failure modes, cause and effect networks (RPNs), specific actions can be developed to mitigate or eliminate identified failure modes, assign responsibility, set target completion dates, and determine implementation of the actions.
- Implement and monitor actions: that is, implementing recommended actions and monitoring their effectiveness in mitigating identified failure modes, tracking progress, measuring the impact of actions, and making any necessary adjustments.
- Documentation and Communication: Document the entire process, including identified failure modes, causes, effects, risk assessments, and mitigation actions, as well as communicating findings and recommendations to relevant stakeholders, ensuring clear and effective communication of findings.

- Periodic review and update: Regularly review and update the tool as new information, designs or processes become available, or lessons are learned from actual failures, and continually improve the process based on suggestions and lessons learned.

3. RESULTS

3.1 Define processes and define the scope of FMEA

Defining processes is the important and necessary step when applying the FMEA tool because it defines the scope of work. For the purpose of conducting the definition phase, the following processes were defined at the Baghdad Oil Training Institute:

- Educational process.
- Training.
- Employment.
- Marketing. and promotion
- Staffing.
- Website effectiveness.
- Internal communication.
- External communication.

3.2 Probability of failure Occurrence (O)

It is considered necessary and important because it gives an idea of possible deviations that negatively affect the handling of complaints. For the purpose of determining the possibility of expected deviations occurring, The following scale shown in Table 1 was relied upon:

Table 1. Occurrence scale (Pazireh et al., 2017)

Failure	Range
Extremely high	**10**
Very high failure	**9**
Frequent failure	**8**
Failure is high	**7**
Failure is moderately high	**6**
Moderate failure	**5**
Failure is relatively low	**4**
Low	**3**
Remote	**2**
Nearly impossible	**1**

A form was used to determine the probability of failure occurring, as shown in Table (2), after presenting it to the experts at the institute to determine the degree of classification.

Table 2. Probability of failure occurrence

failure	O
Weakness of the electronic complaints system	**8**
Absence of the competent (essential) employee	**4**
Many tasks and duties (for the bodies concerned with handling complaints)	**8**
Lack of understanding and recognition of complaints received	**4**
Indifference from those concerned with handling complaints	**6**
Poor performance in devices and equipment	**4**
Inability to classify complaints	**8**
Overlapping of powers (sometimes inadvertently or intentionally)	**9**
Poor follow-up	**10**
Lack of employee mental/psychological presence	**7**
Inaccurate transmission of complaints (for complaints recorded orally)	**8**
The employee moves from a recipient of complaints to a negotiator with the complainant	**4**
Excessive disclosure (relying on conclusions rather than available information)	**3**
Slow response to complaints	**7**
Unconvincing handling of complaints	**6**

3.3 Severity of failure (S)

After determining the probability of failure occurring, it is necessary to determine the severity of the failure's effect on the degree of quality of complaint handling. For the purpose of determining the degree of severity of the failure's impact, the following scale was relied upon in Table (3):

Table 3. Severity Scale (Pazireh et al., 2017)

Severity of failure	Range
Dangerous (maximum effect and occurs without warning)	**10**
Severe (maximum effect with prior warning)	**9**
Very high (not working)	**8**
High (very poor performance)	**7**
Moderate (poor performance)	**6**
Low (poor performance causes inconvenience)	**5**
Very low (performance that leaves high deviations on completion)	**4**
Small (performance leaves moderate deviations)	**3**
Small (performance leaves minor deviations upon completion)	**2**
Nothing (no effect)	**1**

The severity of effect of the failure was determined according to Table (4) after presenting it to the experts at the institute to determine the classification:

Table 4. Severity of failure

Failure	S
Weakness of the electronic complaints system	**9**
Absence of the competent (essential) employee	**8**
Many tasks and duties (for the bodies concerned with handling complaints)	**6**
Lack of understanding and recognition of complaints received	**7**
Indifference from those concerned with handling complaints	**5**
Poor performance in devices and equipment	**9**
Inability to classify complaints	**7**
Overlapping of powers (sometimes inadvertently or intentionally)	**3**
Poor follow-up	**6**
Lack of employee mental/psychological presence	**5**

Inaccurate transmission of complaints (for complaints recorded orally)	**6**
The employee moves from a recipient of complaints to a negotiator with the complainant	**8**
Excessive disclosure (relying on conclusions rather than available information)	**8**
Slow response to complaints	**4**
Unconvincing handling of complaints	**9**

3.4 Detectability of failure (D)

Failure detection is important in determining the level of Baghdad Oil Training Institute's handling of complaints with high quality and in a way that achieves customer satisfaction and the parties benefiting from the services provided by the Institute. Failure detection means the extent of the ability of workers in the complaints handling process to discover failures in the process, which contributes to taking the necessary measures for the purpose of correcting The path ensures the quality of treatment, and to determine the degree of detection, we rely on the scale shown in Table (5):

Table 5. Detection Scale (Pazireh et al., 2017)

Degree of detection	Range
Absolute uncertainty (unproven, unreliable failure detection)	**10**
Too far (too far to detect failure)	**9**
Remote (remote failure detection)	**8**
Very low (too low to detect failure)	**7**
Low (Low failure detection)	**6**
Moderate (moderate failure detection)	**5**
Moderately high (probability of failure detection)	**4**
High (high probability of failure detection)	**3**
Very high (very high probability of failure detection)	**2**
Almost Certain (Almost Certain for Failure Detection)	**1**

The level of detection of deviations was determined according to Table (6) by experts at the researched institute to estimate the degree of classification.

Table 6. Detection of Failure

Failure	D
Weakness of the electronic complaints system	**2**
Absence of the competent (essential) employee	**1**
Many tasks and duties (for the bodies concerned with handling complaints)	**5**
Lack of understanding and recognition of complaints received	**2**
Indifference from those concerned with handling complaints	**3**
Poor performance in devices and equipment	**2**
Inability to classify complaints	**3**
Overlapping of powers (sometimes inadvertently or intentionally)	**5**
Poor follow-up	**8**
Lack of employee mental/psychological presence	**1**
Inaccurate transmission of complaints (for complaints recorded orally)	**7**
The employee moves from a recipient of complaints to a negotiator with the complainant	**8**
Excessive disclosure (relying on conclusions rather than available information)	**7**
Slow response to complaints	**5**
Unconvincing handling of complaints	**4**

3.5 Risk Priority Number Matrix (RPN)

A risk prioritization matrix (RPN) was built based on dimensional assessments (probability of occurrence, severity of effect, and detection of failure) by multiplying the values of these dimensions together (Occurrence x Severity x Detection) and classifying risks into three levels:

- ✓ The first level: represented by the red color, which indicates the presence of a significant and unacceptable risk and action must be taken to avoid it.

Table 7. Risk Priority Number Matrix

	S	O										D
		1	2	3	4	5	6	7	8	9	10	
	10	100	200	300	400	500	600	700	800	900	1000	10
	9	81	162	243	324	405	486	567	648	729	810	9
	8	64	128	192	256	320	384	448	512	576	640	8
	7	49	98	147	196	245	294	343	392	441	490	7
	6	36	72	108	144	180	216	252	288	324	360	6
	5	25	50	75	100	125	150	175	200	225	250	5
	4	16	32	48	64	80	96	112	128	144	160	4
	3	9	18	27	36	45	54	63	72	81	90	3
	2	4	8	12	16	20	24	28	32	36	40	2
	1	1	2	3	4	5	6	7	8	9	10	1
	Risk / Major Failure / (321 -1000)											
	Moderate risk/ Moderate failure/(64-320)											
	Minor risk / Minor failure (1-63)											

3.6 Extract results

- ✓ The second level: represented by the color yellow, indicating the presence of a moderate and somewhat unacceptable risk, and measures must be taken to avoid it.
- ✓ The third level: green, meaning there is a slight and somewhat acceptable risk.

After determining the estimated values of (probability of failure, effect of failure, possibility of detection), the Risk Priority Number (RPN) is extracted as shown in Table 8:

RPN= O * S * D

Table (7) shows the matrix for assessing risk priorities and types at the Baghdad Oil Training Institute.

Table 8. Risk Priority Number

Failure	O	S	D	RPN	
Weakness of the electronic complaints system	**8**	**9**	**2**	**144**	
Absence of the competent (essential) employee	**4**	**8**	**1**	**32**	
Many tasks and duties (for the bodies concerned with handling complaints)	**8**	**6**	**5**	**240**	
Lack of understanding and recognition of complaints received	**4**	**7**	**2**	**56**	
Indifference from those concerned with handling complaints	**6**	**5**	**3**	**90**	
Poor performance in devices and equipment	**4**	**9**	**2**	**72**	
Inability to classify complaints	**8**	**7**	**3**	**168**	
Overlapping of powers (sometimes inadvertently or intentionally)	**9**	**3**	**5**	**135**	
Poor follow-up	**10**	**6**	**8**	**480**	
Lack of employee mental/psychological presence	**7**	**5**	**1**	**35**	
Inaccurate transmission of complaints (for complaints recorded orally)	**8**	**6**	**7**	**336**	
The employee moves from a recipient of complaints to a negotiator with the complainant	**4**	**8**	**8**	**256**	
Excessive disclosure (relying on conclusions rather than available information)	**3**	**8**	**7**	**168**	
Slow response to complaints	**7**	**4**	**5**	**140**	
Unconvincing handling of complaints	**6**	**9**	**4**	**216**	

4. CONCLUSIONS

The research results revealed there are three types of failure classified as minor risks, It was represented by (the absence of the competent (primary) employee, Lack of understanding and recognition of complaints received, The employee's mental/psychological absence) which is equivalent to (20%), Therefore, the Baghdad Oil Training Institute should develop an appropriate strategy for this. While the moderate risk rate was (53%), It was represented by (the weakness of the electronic complaints system, Many tasks and duties (entities concerned with handling complaints), Lack of interest on the part of those concerned with handling complaints, Poor performance of devices and equipment, Inability to classify complaints, Overlapping powers, The employee moves from a recipient of complaints to a negotiator with the complainant, Excessive disclosure. While the percentage of high risks reached (27%) represented by (poor follow-up,
Inaccurate transmission of complaints, slow response to complaints, Unconvincing handling of complaints). These results demonstrate the failure that may occur in the process of handling complaints, which requires the Baghdad Oil Training Institute to take a set of actions such as conduct an analysis of the expected failure by identifying the root causes, relying on analysis tools like fishbone tool, Follow one of the strategies for failure (Failure reduction strategy, Failure conversion strategy, Failure avoidance strategy, Failure retention strategy).

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