Evaluation of Maintenance Management System in Iraqi Oil Refineries - Najaf Oil Refinery as a case study

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Abstract:-

This study included a field analysis of the maintenance management system currently used in Iraqi oil refineries by studying the maintenance management system which is already used in Najaf Oil Refinery (NOR) as a case study through the main functions of maintenance management (planning, organization, directing, and control). The field survey included site coexistence, frequent field visits, conducting direct interviews with the senior maintenance staff in NOR and outside, and then preparing closed questionnaire based on previous theoretical studies and expert opinions. Then the researchers discussed the results of the questionnaire for main functions of maintenance management based on the results of the practical analysis and identified the shortcomings of the current maintenance management system in NOR and then developed effective solutions for each trouble. In fact, the necessary solutions to the problems of the current system have been reached, including the development of maintenance management of the Najaf oil refinery and the preparation of an appropriate mechanism to ensure that the system works functionality. The researchers also reached a set of conclusions and recommendations to improve the current maintenance management system for NOR and other Iraqi Oil refineries.

Keywords: - Maintenance Management System, Construction Management, Corrective maintenance, Preventive maintenance.

1. Introduction

Industry began to develop largely and fast. Complicated and high-cost machinery and equipment appeared, particularly in the field of oil facilities. Therefore, the need urged to develop maintenance systems to maintain the machines and equipment for as long as possible. However, despite the importance of the maintenance management of oil refineries and the economic and social importance they represent to people's lives, studies and research

in the maintenance of refineries are still limited, at least in Iraq.

This study will discuss theoretical frameworks of maintenance management in oil facilities and the four maintenance functions in the oil refineries (planning, organization, direction, and control), then, evaluate the reality of maintenance through the distribution of closed questionnaires and then develop useful solutions to the problems that will appear in the current system.

2. Research Methodology:-

A) Conducting a theoretical study by studying some of the previous systems and studies in the field of maintenance of international oil refineries as well as theories and methods that are concerned with maintenance management.

B) Conducting a field study through conducting interviews with the managers and heads of maintenance departments and engineers in the refinery under study and investigating their views on the current system through many questionnaires then, analysis of private information and data in the current system of NOR statistically and defining the current system defects of maintenance of the refinery under study based on field survey and available data , finally developing proposed management system to manage the maintenance of Iraqi oil refineries, prepared in the light of the recent theoretical studies and field survey which treats all the downsides in the current system and supports the upsides in it.

3. Maintenance definition and types:-

Maintenance is usually defined as it's combination of all technical and administrative actions, including supervisory actions, intended to retain an item in, or restore it to, a state in which it can perform a required function **[1].**

There are many classifications for maintenance in books, papers and various studies. One of these ranking which is classified maintenance into two main types which one of this types is named preventive and two is named corrective as shown below in **Fig. 1** :-

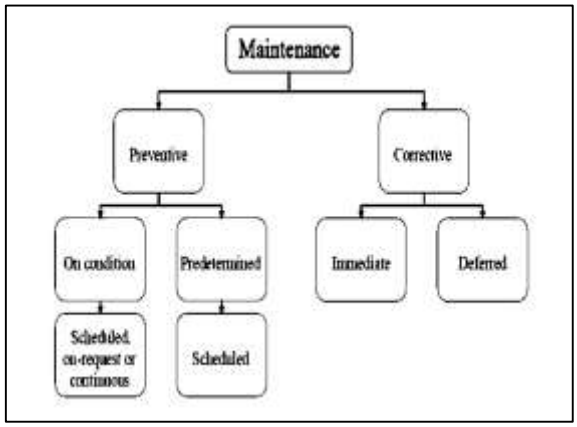

Fig. 1 Types of maintenance (EN 13306, 2001)

3.1 Preventive Maintenance

Preventive maintenance is defined as maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of the equipment. Preventive maintenance can be predetermined or condition based **[2]:**

3.1.1 Predetermined maintenance: Preventive maintenance carried out in accordance with established intervals of time or number of units of use (i.e. scheduled maintenance) but without previous item condition investigation **[2] ;**

3.1.2 Condition based maintenance:

Preventive maintenance based on performance and/or parameter monitoring and the subsequent actions**.[2]** .

3.2 Corrective Maintenance

Corrective maintenance also called breakdown maintenance, is the oldest strategy in the industry **[4]** is maintenance carried out after fault recognition and intended to put the equipment into a state in which it can perform a required function. Corrective maintenance can be immediate or deferred

3.2.1 Immediate maintenance: Maintenance which is carried out without delay after a fault has been detected to avoid unacceptable consequences **[2];**

3.2.2 Deferred maintenance: Corrective maintenance which is not immediately carried out after fault detection but is delayed according to given maintenance rules. **[2]**

4. Importance of maintenance management (Gupta, 2009)

1. To ensure continuity in production.
2. To ensure efficiency in production.
3. To ensure productivity.
4. To deliver goods on the right time.
5. To ensure good housekeeping

5. Iraqi Oil Refineries

The refining industry in Iraq began very early, when Haditha Oil refinery was established in 1949 followed by Dora refinery in 1953. The process continued to grow and flourish in certain eras and decline in others, depending on political and economic factors such as wars, embargoes and so on.

The nineteen state petrol refineries are distributed in all governorates of

Iraq and are administratively administered by three public companies affiliated to the Federal Oil Ministry, these are (Researchers)[1]:

- **North Refineries Company:** The largest oil company affiliated to the Ministry of Oil. It is capable of refining (410000) barrels per day and is associated with the refineries (North, Saladin, Kirkuk, al-Kisk, Saynia, Qayara.

- **Midland Refineries Company:** one of the most important oil companies affiliated to the Federal Oil Ministry. It is capable of refining (220000) barrels per day. It is associated with Dora, Najaf, Samawah, Diwaniyah and Karbala refineries

- **South Refineries Company**: one of the largest oil companies affiliated to the Federal Oil Ministry, established in 1969. It is capable of refining (270000) barrels per day. The company consists of three refineries, Basra; Dhiqar and Maysan.

Table .1 lists the names of the government refineries in Iraq, their affiliation, their establishment dates, their production capacities, and their status of work after the invasion of Islamic State of Iraq and the Levant (ISIL) to several provinces on 10/6/2014 and the destruction, burning, and sabotaging of vital facilities, most importantly oil refineries.

Table. 1 Iraqi Oil Refineries (Researchers)[1]

No	Location	Dependency	Comm. Date	Capacity	production stance
1	North Oil Refinery	North Refineries Company	1983	170000 BPD	Stopped
2	Salahuldin 1 Oil Refinery	North Refineries Company	1982	70000 BPD	Stopped
3	Salahuldin 2 Oil Refinery	North Refineries Company	1984	70000 BPD	Stopped
4	Lube Oil Refinery	North Refineries Company	-	250000 TPY	Stopped
5	Kirkuk Oil Refinery	North Refineries Company	1973	30000 BPD	Unstopped
6	Kasek Oil Refinery	North Refineries Company	1982	10000 BPD	Stopped
7	Seneyah Oil Refinery	North Refineries Company	1978	30000 BPD	Stopped
8	Qayyarah Oil Refinery	North Refineries Company	1956	14000 BPD	Stopped
9	Hadetha Oil Refinery	North Refineries Company	1949	16000 BPD	Unstopped
10	Durra Oil Refinery	Midland Refineries Company	1955	140000 BPD	Unstopped
11	Lube Oil Refinery	Midland Refineries Company	-	120000 TPY	Unstopped
12	Najaf Oil Refinery	Midland Refineries Company	2006	30000 BPD	Unstopped
13	Samawah Oil Refinery	Midland Refineries Company	1978	30000 BPD	Unstopped
14	Diwaniya Oil Refinery	Midland Refineries Company	2008	20000 BPD	Unstopped
15	Karbala Oil Refinery	Midland Refineries Company	Under construction	140000 BPD	-

[1] Researchers were obtained this data when they visited the Federal Ministry of Oil – Technical Department and the Department of Studies, Planning and Following to prepare a study on the oil refineries.

16	Basra Oil Refinery	South Refineries Company	1974	210000 BPD	Unstopped
17	Lube Oil Refinery	South Refineries Company	1996	100000 TPY	Unstopped
18	Thiqar Oil Refinery	South Refineries Company	1981	30000 BPD	Unstopped
19	Missan Oil Refinery	South Refineries Company	2000	30000 BPD	Unstopped

6. Case Study

Najaf oil refinery (NOR), affiliated to the external refineries commission of the Central Refineries Company, is a medium capacity refinery with a production capacity of 30,000 barrels per day in three units in a capacity of (10000) barrels per day for each unit. Each single unit produces a range of (20-22%) of naphtha, (14%) of kerosene, (22%) of gasoil, and (51%) of diesel.

The foundation stone of NOR was laid on 3/10/2003 after identifying the suitable land with an area of (326) acres. The actual operation of NOR started by installing the first productive unit of the refinery on 10/2/2006 to witness on 7/10, the opening of NOR with a production capacity of (10000) barrels per day. After about (17) months, exactly on 15/3/2008, the second unit was opened with the same specifications of the first refining unit in terms of production capacity as (20000) barrels per day. The Central Refineries Company continued working hard to have the refinery reach in its designing capacity to (30000) barrels per day by setting up the third refinery unit, opened on 15/8/2009. In addition to the construction of refining units, a large number of tanks with fixed and mobile ceilings and different sizes and capacities have been constructed to increase the capacity of the reservoir. This will give it greater flexibility in the production process and emergency situations. Twenty two reservoirs and a storage card of 87 million liters were implemented as well as the new reservoir of Najaf of 125 million liters, bringing the total capacity of the reservoir up to (212) million liters, and this capacity of the reservoir provides the capability to increase the capacity of the refinery. NOR employs a very large number of engineers, technicians, administrators and others. The number of permanent staff is (798), 400 of whom are Najaf residents, 198 are Babylonians, 200 are Karbala residents, (221) engineers, (414) technicians, and (163) administrators & guards in addition to (24) other workers are temporary employees (Researchers)[2].

2- Researchers were obtained this data when they visited the Federal Ministry of Oil – Midland Refineries Company- Najaf oil refineries – Management.

7. Field Analysis of the Current Maintenance Management System in Najaf Oil Refinery

The aim of studying the current maintenance system in Najaf Refinery is to identify the reality of maintenance management, which is directly reflected on the results of the maintenance work in the refinery and to show the positive aspects and scrutinizing the negative aspects in order to set treatment and appropriate alternatives. The method of data collection by the open & closed questionnaires and they are one of the important methods to obtain adequate information. It has been used by the researchers to inquire about the reality of maintenance in the refinery under study.

7.1 Closed Questionnaire Configuration

After reviewing a large number literature of studies on maintenance management in oil refineries and consulting many maintenance engineers in the Middle Refineries Company through a visit to the Dora Oil Refinery and directly reviewing the maintenance administrators as well as chain of direct interviews with the maintenance engineers of the refinery under study, and asking a number of direct questions and obtaining the appropriate answers that enrich the research and help the researchers, the current questionnaire form was prepared according to the Five Likert Scale.

7.2 Designing the Questionnaire Form

Based on the previous facts, a closed questionnaire form was divided by researchers into two sections as follows:

7.2.1 The first section: included questions about the personal information of the sample questionnaire, which included engineering specialization, academic qualifications, job position in addition to the number of years of experience in the field of maintenance.

7.2.2 The second section: It was divided into four parts according to the elements of the maintenance management system represented by (planning, organizing, directing and controlling). Each part included a number of questions according to the nature of each element as follows:

7.2.2.1 Planning: This part includes questions about how to conduct the periodic examination and the nature of the specialty of the committees

that perform the periodic examination. The impact of the time it takes to verify it and the times for proper maintenance. And how to refer maintenance work either centrally or decentralized in addition to the accuracy in determining the cost of maintenance and consistency between the amounts allocated and disbursements.

7.2.2.2 Organizing: It includes the questions related to the preparation of the organizational structure and its compatibility with the maintenance and operation requirements in the project, and the availability of training programs for developing the technical staff and specialization in work allocation between departments and the determining efficiency.

7.2.2.3 Directing: It includes questions about the clarity and compatibility of powers with responsibilities for maintenance work, in addition to the availability and provision of a specialized supervision level commensurate with the nature of the importance of the project and its facilities and maintenance works and the extent of coordination in directions giving between the supervisory and management staffs in the project.

7.2.2.4 Controlling: This part includes questions about the possibility of providing specialized personnel in the implementation of control and follow-up work for the maintenance and preservation of documents and records of maintenance work and the possibility of providing a coding system in the enterprise and works in the project for the purpose of control and follow-up.

7.3 Distributing the Questionnaire Form

The final questionnaire form was distributed to a group of management and technical staffs working in maintenance in NOR, where (60) questionnaires were distributed to the research sample and (46) forms were received with a response rate of (76.6%).

7.4 Mathematical and Statistical Approaches Used in Questionnaire Form Analysis

In order to identify the results of the closed questionnaire, it was necessary to analyze the responses of using the statistical methods and SPSS V. 22 .To adopt and follow these results, the validity and reliability of the questions in each of the survey parts had to be tested. The weights of the five answers used in the questionnaire had to be

calculated to find the arithmetic mean to arrange the answers in the questionnaire forms collected for each of the four sections of the questionnaire (planning, organizing, directing, and controlling).

7.5 Validity and Reliability Test

Validity has large wide of definitions to reflect the questionnaire content required measuring it according to relative weights for making sure from the validity of the tool **[5]** . Mathematically, it is equal to the square root of the coefficient of reliability **[5].**

Reliability of the questionnaire, usually means giving the questionnaire the same results when re-applying several times on the same sample under the same conditions, in other words, the reliability of the questionnaire means stability in its results that do and not change significantly as a result re-distributed several times in the sample during the time periods certain **[7].**

The reliability of the study tool (Likert scale) was checked using the program of statistical package for social sciences (SPSS V. 22) for finding the rate of reliability for the causative factors of evaluating of the reality of maintenance in oil refineries. Frequently used the coefficient of alpha to measure the reliability of scales that measure the trends as a scale of Likert, coefficient of alpha gives the minimum limit for value estimated of the reliability coefficient, If the value of alpha is high (close to one), this already indicates the reliability of the questionnaire. **Table. 2** illustrates the reliability & validity coefficients.

Table. 2 shows reliability & validity coefficients

No	Section	Reliability	Validity
1	Planning	0.730	0.854
2	Organizing	0.700	0.836
3	Directing	0.725	0.851
4	Controlling	0.829	0.910
Total questionnaire		0.877	0.936

7.6 Calculating the Arithmetic Mean

To quantify data analysis and calculate the arithmetic mean it is require to identifying a hypothetical weight value (WV), for each answer of the five-scale likert and by using SPSS as illustrated in **Table .3.**

Table. 3 weight value of descriptive frequencies

Descriptive Frequency	Intervals	WV
Never	0-< 1	0.5
Rarely	1-< 2	1.0
Occasionally	2-< 3	1.5
Frequently	3-< 4	2.0
Always	4-5	2.5

8. Discussion of the Questionnaire Results

Part One: Personal Information

By analyzing the answers to the questions of the personal data (which were explained in the relative circles method)

i. Engineering Specialization:

The sample of the study included the **Fig. 2**, which explains the frequency distribution of the engineering specialties of the studied sample.

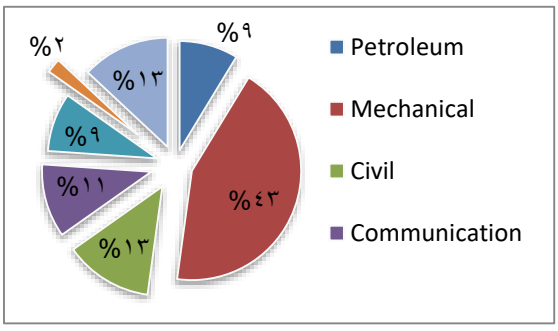

Fig. 2 the engineering specialization in elected sample

ii. Educational achievement:

The study sample which are illustrated in **Fig. 3**, explaining the frequency distribution of the academic achievement of the sample members.

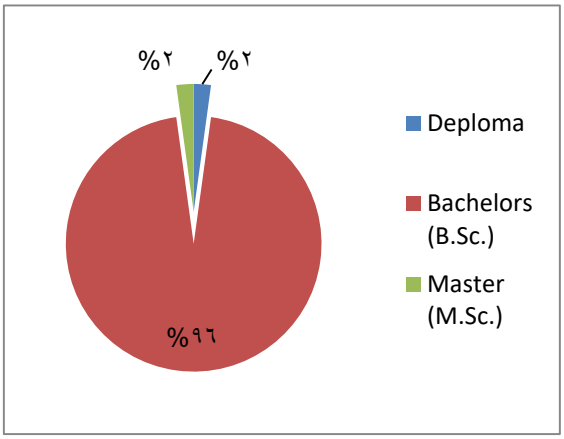

Fig. 3 the educational achievement in elected sample

iii. Work situation in the refinery:

The sample of the study included in **Fig. 4**, explaining the frequency distribution of the individuals of the research sample and the nature of the work inside the refinery.

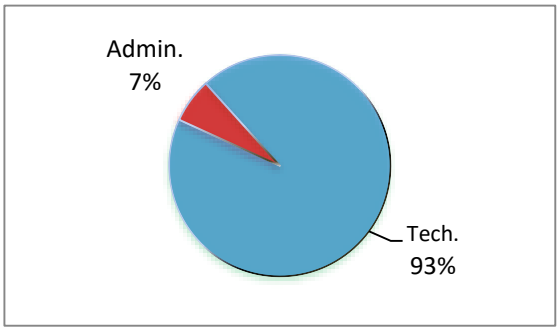

Fig. 4 the work situation of elected sample in the refinery

iv. Experience in the field of maintenance:

The study sample which are illustrated in **Fig. 5** showing the frequency distribution of experience years for the sample individuals in maintenance.

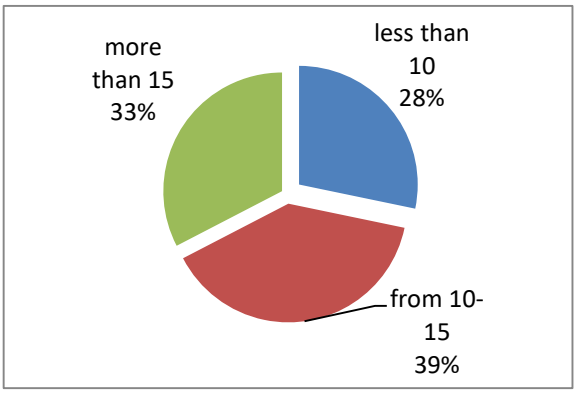

Fig. 5 the experience in the field of maintenance in elected sample

Part 2: Analysis of maintenance status in NOR and its conclusions

The second part of the questionnaire includes four sections, which included some of sub-sections for each, and to process the data obtained from the questionnaire forms and convert this qualitative data into quantitative data on which to compare and analyze, and as follows:

1. Planning

In planning there are many positives in Najaf Oil Refinery and there are some negatives in the current administrative system in the refinery under study. One of the advantages that can be reinforced in the current system is that the routine inspection of the monitoring devices is done regularly and periodically inside the refinery, and there is classification and identification of the types of maintenance in the refinery and that all maintenance work is carried out by self-cadres maintenance and mechanics division relying on the skill and competence in the selection of cadres in charge of maintenance. Also, the time it takes to prepare lists of maintenance to be approved by the higher authorities do not cause malfunctions in maintenance times & dates according to the response of sample.

The results of the analysis of the state of maintenance in the refinery under study, as in **Table .4** it is shown that the contingency plans are often prepared for this purpose, and the maintenance information and data are often updated periodically, and total money required for maintenance are assigned by senior management in Baghdad and that the examination work and inspection of facilities and equipment are periodically drained and programmed by specialized committees for that purpose.

It should be noted that contingency plans should be prepared

permanently as alternative plans that may occur in the facilities or equipment of the refinery. Updating information and maintenance data in the records should be periodic, continuous and permanent, as well as conducting inspection and examination of the refinery facilities and equipment to avoid problems.

One of the most important disadvantages in the refinery case study (NOR) according to the response of sample is the maintenance operations are not conducted according to a scientific manner authorized to determine the priority depending on the situation importance and its impact on production after damage analysis and diagnosis of causes .The priority must be determined according to a clear scientific method, depending on the seriousness of the situation and its impact on production.

Another negative aspect I the refinery under study highlighted by the questionnaire regarding planning is the lack of accuracy in determining the maintenance costs by the concerned department. There is also a discrepancy between the estimated costs (planned) and the costs implemented by the designated department and the determination of the financial allocations for the maintenance work which is not based on the annual financial statements organized by the specialized department, but randomly assigned by the senior management since the refinery is not financially and administratively independent from auditing by the administrators; and it does not have an independent accounting unit to prepare the financial statements and certify and disburse on demand. The most effective solution to these problems is to make NOR an independent administrative and financial institution directly linked to the Midland Refineries Company

The following **Table** .4 shows the frequency of the participants' responses on the axes of planning and percentages for each and classification of answers after calculating the mean and stranded deviation by the (SPSS).

Table. 4 the results of the questionnaire in the planning axis

No.	Planning	Never	Rarely	Occasionally	Frequently	Always	Mean	Std. Deviation
		No. %	No. %	No. %	No. %	No. %		
1	Are skilled specialized maintenance workers available in the refinery؟	0 0	3 6.8	1 2.3	23 52.3	17 38.6	4.23	0.803
2	Are the routine visual examinations and surveillance devices monitoring performed regularly and periodically?	0 0	3 6.8	5 11.4	18 40.9	18 40.9	4.16	0.888
3	Is there any classification and identification for maintenance in the refinery?	1 2.2	2 4.4	7 15.6	15 33.3	20 44.4	4.13	0.991
4	In the case of self-maintenance, is there any concentration on skill and specialization factors in the selection of staff in assuming the maintenance	0 0	3 6.7	7 15.6	24 53.3	11 24.4	3.96	0.824
5	Is the damages analysis and diagnosis of reasons conducted first and then the optimal method of maintenance determined?	1 2.2	2 4.4	12 26.7	18 40	12 26.7	3.84	0.952
6	In the case foreign staffs assistance in maintenance is there any concentration on the specialization and skill factors in the selection of maintenance specialized contractors	0 0	4 9.5	13 31	17 40.5	8 19	3.69	0.897
7	Is there a plan B emergency maintenance for the unusual situations?	1 2.2	9 20	10 22.2	16 35.6	9 20	3.51	1.1
8	Is there a periodical update of the maintenance information and data in the records?	4 9.1	7 15.9	8 18.2	16 36.4	9 20.5	3.43	1.246
9	Are all the sums required for maintenance allocated by the senior administration?	8 21.6	1 2.7	7 18.9	11 29.7	10 27	3.38	1.479
10	Is the examination and inspection of the facilities and equipment of the refiner periodically carried out and programmed by specialized committees?	6 13	6 13	9 19.6	16 34.8	9 19.6	3.35	1.303
11	Are there any obstacles and difficulties facing the maintenance planning process in the refinery?	1 2.2	7 15.6	32 71.1	4 8.9	1 2.2	2.93	0.654
12	Is there accuracy in determining the cost by the relevant department and is there a discrepancy between the estimated costs (planned) and the costs executed?	8 21.1	3 7.9	19 50	6 15.8	2 5.3	2.76	1.125

13	Is there a scientific method to determine the priority of maintenance depending on the seriousness of the situation and its impact on production?	7 16.3	12 27.9	12 27.9	9 20.9	3 7	2.74	1.177
14	Are the financial allocations for maintenance determined basing on annual financial statements organized by the concerned department?	9 23.7	6 15.8	12 31.6	9 23.7	2 5.3	2.71	1.228
15	Does the time taken by the maintenance reports for the purpose of being approved by the higher authorities make malfunction in maintenance times and dates?	12 29.3	17 41.5	8 19.5	3 7.3	1 2.4	2.12	1.005

2. **Organizing**

In organization there are also many pros and cons by surveying the sample of the study in NOR, one of the pros that can be consolidated in the current system is the presence of maintenance staff with sufficient experience consistent with the size of maintenance work in the refinery in spite the absence of a regular administrative building within the oil refinery. In addition, there are many programs and training courses necessary for the technical staff working in the refinery and the equipment required to carry out maintenance operations are adequate and suitable for maintenance operations. Moreover, the organizational structure is consistent with the nature of maintenance and operation in the refinery under study.

From the results of the analysis of the current situation in the refinery under study which listed in **Table. 5**, it shows there is specialization in the type of work for each maintenance department, and continuous availability of the occupational safety measures for maintenance staff, (one of the positive aspects not noticed by the researcher in his frequent visits to the oil refinery). Also the cadre dedicated to maintenance work in number is consistent with the size of work assigned to them. On the other side, the refinery lacks adequate service facilities from laboratories and so on to the inspection, monitoring and maintenance personnel in the refinery and the absence of incentives system approved for maintenance workers to help improve the productivity of workers in the refinery.

The effective solution for these problems is to build a regular administrative building with modern laboratories and infrastructure to increase productivity and improve production quality as well as a

meaningful incentive system must be used. The following **Table. 5** shows the results of the questionnaire in the organizing axis.

Table .5 the results of the questionnaire in the organizing axis

No.	Organizing	Never	Rarely	Occasionally	Frequently	Always	Mean	Standard Deviation
		No. %	No. %	No. %	No. %	No. %		
1	Is there a maintenance staff with sufficient experience consistent with the size of maintenance liabilities in the refinery?	1 2.2	0 0	2 4.4	15 33.3	27 60	4.49	0.787
2	Are there crucial programs and training courses for the technical staff?	1 2.2	1 2.2	10 21.7	12 26.1	22 47.8	4.15	0.988
3	Is the equipment required for maintenance operations available?	0 0	1 2.2	7 15.2	23 50	15 32.6	4.13	0.749
4	Is there an organogram consistent with the nature of maintenance and operation in the refinery?	0 0	3 6.7	4 8.9	23 51.1	15 33.3	4.11	0.832
5	Is there a specialization in the nature of each division and determining competence level?	2 4.3	0 0	10 21.7	17 37	17 37	4.02	1
6	Are the occupational safety measures always available to maintenance personnel?	0 0	1 2.2	11 23.9	22 47.8	12 26.1	3.98	0.774
7	Is the staff number allocated for maintenance work consistent with the size of work?	4 8.7	0 0	14 30.4	16 34.8	12 26.1	3.7	1.133
8	Are service facilities such as labs and the like, available for the inspection, monitoring and maintenance personnel in the refinery?	3 6.5	1 2.2	18 39.1	10 21.7	14 30.4	3.67	1.136
9	Is there an approved incentive system for maintenance workers?	11 23.9	10 21.7	3 6.5	4 8.7	18 39.1	3.17	1.691
10	Is there a regular administrative building to manage maintenance in the refinery?	3 6.8	16 36.4	12 27.3	5 11.4	8 18.2	2.98	1.229

3. Directing

Regarding the answers of the sample responses in relation to direction, there are many advantages, including full coordination between the maintenance team and the other parties in the refinery, and the issuing the directive to start maintenance work is conducted after the size of the problem is recognized and the necessary inspection is performed. The maintenance team is

obliged to carry out the maintenance work on the implementation period predetermined, especially with the presence of adequate clarity for all the powers and responsibilities between the labor force towards the maintenance and availability of specialist supervision issued issuing orders to the cadres working in coordination with senior management, according to the opinions of the questionnaire participants.

Of current administrative system traits is also the coordination between the maintenance management in the refinery with the maintenance departments in the other oil refineries, providing the necessary integration to carry out the maintenance in well and the personal disagreements between the staff and the teams supervising the maintenance work does not pose noticeable impact according to the category in questionnaire which is listed in **Table. 6** In addition the refinery follows the central maintenance system meaning that there is a specialized department maintenance work operating in all departments, sections and units, having a series of features including the use of all maintenance elements effectively and in accordance with the requirements of maintenance activities as well as organizing and documenting maintenance information and increasing workers experience, and assisting in business continuity and good performance. The central maintenance system followed in NOR also helps reduce the cost because of the optimal use of resources.

However, there are some drawbacks in the central system, including the difficulty of communication between maintenance and departments and individuals responsible for maintenance which may lead to delays in decisions and thus wasting time and it may also lead to a contradiction between the views of stakeholders, creating difficulties in the implementation of maintenance work as well as administrative routine and its delays that could lead to heavy losses, and these things should not take place in sensitive facilities as oil refineries. The efficient solution lies in adoption of central and non-central maintenance system within the maintenance departments in NOR, can be relied on the central system when conducting complex maintenance to optimal use of resources and experience and non-central when performing simple maintenance and emergency to avoid possible delays and additional costs. The following

Table .6 shows the results of the questionnaire in the directing axis.

Table. 6 the results of the questionnaire in the directing axis

No.	Directing	Never	Rarely	Occasionally	Frequently	Always	Mean	Standard Deviation
		No. %	No. %	No. %	No. %	No. %		
1.	Does the maintenance team coordinate with the other parties in the refinery?	0 0	3 6.5	4 8.7	20 43.5	19 41.3	4.2	0.859
2.	Are all maintenance types implemented by the specialized department of maintenance (central maintenance)?	1 2.2	1 2.2	7 15.2	17 37	20 43.5	4.17	0.926
3.	Is checking the size of the problem and the necessary inspection conducted before starting maintenance work?	1 2.2	1 2.2	5 10.9	22 47.8	17 37	4.15	0.868
4.	Is the date of carrying out the maintenance work and the completing work within the deadline taken into account?	1 2.2	2 4.3	6 13	18 39.1	19 41.3	4.13	0.957
5.	Is there clarity for all authorizations and responsibilities among the workforce towards maintenance work?	0 0	2 4.3	8 17.4	19 41.3	17 37	4.11	0.849
6.	Is there a maintenance specialized advising team that directs the working staff in coordination with the senior administration?	1 2.2	4 8.7	4 8.7	22 47.8	15 32.6	4	0.989
7.	Is there coordination between the maintenance department in the refinery and the maintenance departments in the other oil refineries?	0 0	4 8.7	14 30.4	16 34.8	12 26.1	3.78	0.941
8.	Are inspections and monitoring carried out under the direction of the maintenance manager or directly by the responsible unit in accordance with a pre-programmed schedule?	4 8.7	7 15.2	14 30.4	16 34.8	5 10.9	3.24	1.119
9.	Are there maintenance units in each department that carry out maintenance (decentralized maintenance)?	16 34.8	5 10.9	14 30.4	7 15.2	4 8.7	2.52	1.346
10.	Does personal disagreement affect staff and teams supervising the maintenance work?	11 23.9	14 30.4	14 30.4	6 13	1 2.2	2.39	1.064

4. Monitoring and control

One of the most important characteristics of the current administrative system in the refinery under study is that the supervision of maintenance officials on the staff working in the field of maintenance is carried out permanently, while documentation is not systematic with no permanent use of computers with the existence of a competent authority to save documents and records for maintenance work, according to the opinions of questionnaire participants which is listed in **Table 7**, and are often supported by the work completion certificate on site without sufficient support of work achievement. Also evaluation and review of maintenance work whether carried out self-cadres or using third-party is often performed, according to the sample selected to the questionnaire.

The refinery under study lacks the scientific method of quality control of maintenance operations. Moreover, one of the main disadvantages of the current system in the monitoring and control center is the failure of the maintenance department to implement international standards in the maintenance of oil facilities according to scheduled plans according to the surveyed members' views and the lack of the current system for tracking system to control the maintenance work at the refinery. In fact the most highlighted disadvantage recorded on the current system of maintenance management is not working on modern computer systems as a system of e-government and the like to facilitate the work and simplify and reduce administrative red tape measures and waste of public money and time extensively. The alternative solutions to the Problems that emerged during the questionnaire are the international standards should be applied during the maintenance of NOR according to scheduled plans, as well as the coding system must be used to enhance control of the maintenance work in the refinery. The work should be started on the modern computer systems such as electronic governance system to facilitate the work procedures and simplify them and reduce administrative routine. The following **Table .7** shows the results of the questionnaire in the controlling axis.

Table. 7 shows the results of the questionnaire in the controlling axis

No.	Controlling	Never	Rarely	Occasionally	Frequently	Always	Mean	Standard Deviation
		No. %	No. %	No. %	No. %	No. %		
1	Is there supervision by the maintenance officials on the maintenance personnel?	0 0	1 2.2	5 11.1	22 48.9	17 37.8	4.22	0.735
2	Are maintenance works documented and organized by computers?	1 2.2	5 11.1	10 22.2	16 35.6	13 28.9	3.78	1.064
3	Is a specific entity assigned to documenting and recording the maintenance works?	6 13	2 4.3	10 21.7	16 34.8	12 26.1	3.57	1.294
4	Are the site's business reports prepared in an organized and documented manner, and not only by the completion of work certificate?	1 2.2	8 17.8	15 33.3	12 26.7	9 20	3.44	1.078
5	Is there an assessment and review of the maintenance work whether carried out by self-employed or by outsourcing?	3 6.5	12 26.1	11 23.9	14 30.4	6 13	3.17	1.161
6	Is there a specialized staff that performs the control and follow-up work of maintenance?	8 17.4	7 15.2	11 23.9	10 21.7	10 21.7	3.15	1.398
7	Is there a followed method of quality control over maintenance work?	7 16.7	8 19	11 26.2	11 26.2	5 11.9	2.98	1.278
8	Does the maintenance administration apply the international standards of oil facilities maintenance according to a scheduled plan?	5 10.9	10 21.7	18 39.1	9 19.6	4 8.7	2.93	1.104
9	Is there a coding system for monitoring and controlling the maintenance works in the refinery?	12 28.6	9 21.4	10 23.8	5 11.9	6 14.3	2.62	1.396
10	Does maintenance department work on modern computer systems such as e-governance, for example?	23 51.1	15 33.3	4 8.9	2 4.4	1 2.2	1.73	0.963

8. Conclusions: -

After studying the status of maintenance in Najaf oil refinery, the researcher concluded the following:

1. The lack of accuracy in determining the maintenance costs by the concerned department.
2. There is a discrepancy between the estimated costs (planned) and the costs implemented by the

designated department and the determination of the financial allocations for the maintenance work which is not based on the annual financial statements organized by the specialized department, but randomly assigned by the senior management.

3. The refinery is not financially and administratively independent from auditing by the administrators; and it does not have an independent accounting unit to prepare the financial statements and certify and disburse on demand
4. The refinery lacks adequate service facilities from laboratories and so on to the inspection, monitoring and maintenance personnel in the refinery.
5. The absence of incentives system approved for maintenance workers to help improve the productivity of workers in the refinery.
6. The central maintenance system was adopted without taking into consideration the issue of its disadvantages.
7. The failure of the maintenance department to implement international standards in the maintenance of oil facilities according to scheduled plans according to the surveyed members' views.
8. The lack of the current system for tracking system to control the maintenance work at the refinery.
9. In fact the most highlighted disadvantage recorded on the current system of maintenance management is not working on modern computer systems as a system of e-government and other.

9. Recommendation

After examining the maintenance situation in Najaf Oil Refinery (NOR), the researchers recommend the following:

1. Be Accurate in determining annually maintenance costs by the concerned management.
2. Adoption of Independence financial & administrative in Najaf Oil Refinery and linked it directly to the Midland Refineries Company which is based in Baghdad
3. Provide sufficient work infrastructure, such as laboratories and others.
4. Adoption of incentives system for maintenance workers to help improve the productivity of workers in the refinery.
5. Adoption of the central maintenance system and

addressing some of its disadvantages consistent with its application, such as the existence of a contradiction between the views of the stakeholders, which leads to difficulties in implementation of maintenance work, in addition to the problems of administrative routine significant delays that may lead to heavy losses.

6. Adoption of international standards in maintenance of oil installations.
7. Adoption of tracking system to control the maintenance work at the refinery.
8. Working on modern computer systems as a system of e-government and other.

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تقييم نظام إدارة الصيانة في مصافي النفط العراقية / مصفى النجف النفطي كحالة دراسية

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تضمنت هذه الدراسة تحليلا ميدانيا لنظام إدارة الصيانة المتبع حاليا في مصافي النفط العراقية من خلال دراسة النظام الاداري المتبع لادارة الصيانة في مصفى النجف النفطي كحالة دراسية ، استناداً الى الوظائف الرئيسية الاربعة لإدارة الصيانة (التخطيط، التنظيم، التوجيه، المتابعة والسيطرة) . تضمنت عملية المسح الميداني والتي شملت المعايشة الموقعية والزيارات الميدانية المتكررة لموقع العمل وإجراء اللقاءات المباشرة مع المختصين باعمال الصيانة في المصفى وخارجة ، ومن ثم إعداد استمارة الاستبيان المغلق بالاعتماد على الدراسات النظرية السابقة واراء الخبراء في هذا الشأن وبعدها تم إجراء التحليل الإحصائي لمحاور نظام إدارة الصيانة ثم مناقشة نتائج الاستبيان لهذه المحاور اعتماداً على نتائج التحليل العملي و تحديد عيوب النظام الحالي لإدارة صيانة المصفى حالة الدراسة ، واقعياً فقد تم التوصل ألى معالجة ضرورية لمشاكل النظام الحالي تتضمن تطوير ادارة صيانة مصفى النجف النفطي ومن ثم إعداد الية مناسبة لعمل هذا النظام. كما توصل الباحثون إلى مجموعة من الاستنتاجات والتوصيات الخاصة بتحسين نظام أدارة الصيانة الحالي وتنفيذ جميع فقراته للاستفادة منهو مستقبلاً في جميع المصافي النفطية الأخرى في العراق.