The impact of re-engineering maintenance operations through time for a tower and a heater (A case study of Tobruk petroleum refinery Libya)

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Abstract— **A Petroleum Refinery is a basic industrial facility that has a wide product range of products used as fuels and chemicals. Maintenance activities with a Petroleum Refinery affect very much its productivity.**

The maintenance program time is very critical and essential for these types of industries. Business Process Reengineering is an effective approach which can be used to reduce time through many techniques and tools like: flowcharting, creative process redesign, process visualization, and process Benchmarking and simulation. In this research, the maintenance program in the Tobruk petroleum refinery has been studied and analyzed. Reengineering of the maintenance program is done using process mapping and Business Process Reengineering tools like flowcharting, and creative process redesign. The flowcharts of the maintenance activities of the Towers and heater in Tobruk petroleum refinery have shown that there are some activities done in series while the maintenance process could be redesigned by doing the activities in a parallel way and some of the activities are combined together. Consequently, the maintenance program time has been decreased from 29 days to 27 days, which leads to an increase in the productivity of approximately (US $3,200,000 every 2 years) to the Tobruk petroleum refinery.

Index Terms—ALHARIQA, iGrafx process software, re-engineering maintenance, Tobruk petroleum refinery

I. INTRODUCTION

In 1980, the Arabian Gulf Company started building Tobruk Petroleum Refinery in the northeastern part of Libya to cover a part of the country's needs for petroleum products. The production of the refinery started in 1986 with a capacity of

20,000 barrels/day. And the refinery provides several products such as LNG, light Naphtha, heavy Naphtha, home keroseAirplanesanes kerosene, diesel, and, heavy oil. The source of the crude oil is the "ALSARIR" field, and the refinery lies the near "ALHARIQA" Petroleum port from which the products of "The ALSARIR field are exported. The refinery employed by the number of workers of about 600 workers. The company cares about maintenance, which is a factor in the progress of production and maintaining the required production rates at the required level.

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The company uses all possible methods to secure production and reduce sudden stops.

The basic strategies within the Tobruk Petroleum Refinery are to divide the maintenance team into some groups to perform maintenance activities over a certain period of time. Fig "1"shows the schedule for maintenance groups, as they need about 29 days to complete their tasks.

In this study, heaters, and towers, which take longer to maintain, were chosen. It can be concluded that the critical path duration is 29 days, and try to reduce this duration by using re-engineering software

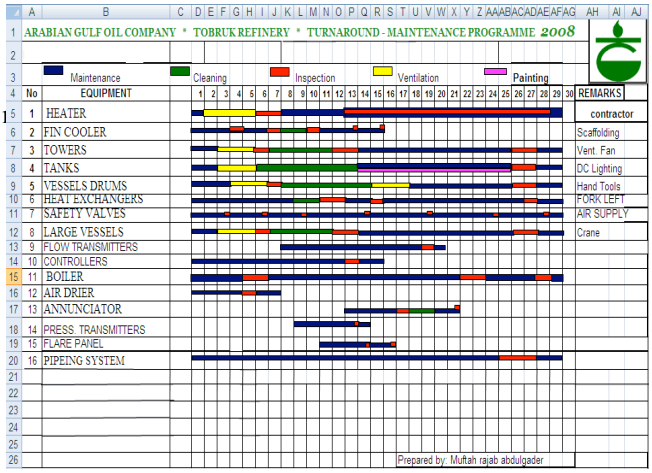

Fig "1": Illustration of The Scheduled Maintenance for The Nine Major Equipment in Tobruk Petroleum Refinery

II. RESEARCH PROBLEM

The maintenance time in petroleum refinery industries has a great impact on productivity. For this reason, the availability of the equipment is a major concern for this type of industry. The maintenance activities' time length needs to be decreased and consequently the uptime increases and the equipment's availability increases.

III.RESEARCH OBJECTIVES

The objectives of the present work are:

Reviewing and analyzing the maintenance program in Crude oil refineries. And applying so as to Business Process Reengineering tools and process mapping techniques to reduce maintenance time and increase equipment availability.

IV. PROBLEM STATEMENT AND DESCRIPTIONS

table "1" summarizes the obtained results using (the iGrafx process), The time duration is found as 29 days which is similar to that obtained by the maintenance department in Tobruk Refinery. We can conclude that the Towers and heater in need 29 days to be maintained.

Some experiments will be done using Business Process Reengineering tool and process mapping in order to increase the performance of the model.

No.	Equipment Name	Elapsed Time(days)
1	Heater	29
2	Towers	29

Table"1": the tower and heater in Tobruk Petroleum Refinery

Based on the data obtained from the refinery it can be applying this flow chart by using (iGrafx process) software. The results of the software are shown in table "2".

Figure "2" displays the results obtained in table "2" and plots them as bar diagrams.

It's clear that the total period of time needed to complete the Heater maintenance is approximately (29days).

Table "2": Expected Time for Heater Maintenance

Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
1	29.000	9.667	19.333	0.000

Table "3": Expected Time for Heater Maintenance Activity

	Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
Start	1	0.000	0.000	0.000	0.000
Isolate inlet & outlet connections	1	0.375	0.333	0.042	0.000
Remove front &rear covers	1	2.000	0.667	1.333	0.000
Ventilation	1	3.000	1.000	2.000	0.000
Remove burners	1	7.000	2.333	4.667	0.000
tube Inspection	1	3.000	1.000	2.000	0.000
Repair or replace tube if required	1	1.000	0.333	0.667	0.000
Tube hydro test	1	0.625	0.000	0.625	0.000
Insulation check & repair if required	1	0.375	0.333	0.042	0.000
Repair or replace	1	2.375	1.000	1.375	0.000
Connect soot blowers & burners	1	3.000	1.000	2.000	0.000
Replace the covers & man way	1	2.000	0.667	1.333	0.000
Reconnect in let &out let piping	1	2.000	0.667	1.333	0.000
handle to portion	1	1.000	0.333	0.667	0.000
Soot blowers check	1	0.625	0.000	0.625	0.000
End	1	0.625	0.000	0.625	0.000

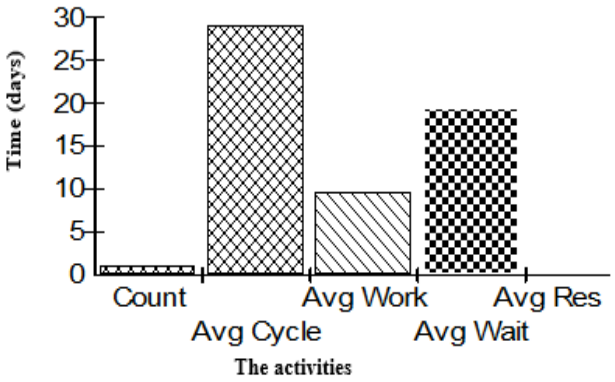

Fig."2": iGrafx Expected Time of Current Maintenance Activities for Heater

Fig"3": displays the results obtained in Table "4" and plots them as bar diagrams.

It's clear that the total period of time needed to complete the Tower's maintenance is approximately (29days)

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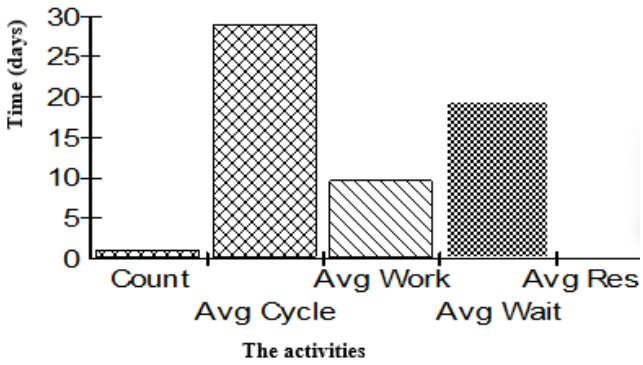
Table"4": Expected Time for Towers Maintenance

Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
1	29.000	9.667	19.333	0.000

Table""5: Expected Time for Towers Maintenance Activity

	Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
Start	1	0.000	0.000	0.000	0.000
Isolate vessel& discommend piping	1	3.375	1.333	2.042	0.000
Open man way for ventilation	1	1.000	0.333	0.667	0.000
Ventilation period	1	3.000	1.000	2.000	0.000
Gas test	1	0.625	0.000	0.625	0.000
More Ventilation Time	1	1.375	0.667	0.708	0.000
Clean	1	12.000	4.000	8.000	0.000
Repair or replace	1	1.375	0.667	0.708	0.000
Close man way& handle to operation	1	5.000	1.667	3.333	0.000
End	1	0.625	0.000	0.625	0.000
Inspection	1	0.625	0.000	0.625	0.000



Fig"3": I Grafx Expected Time of Current Maintenance Activities for Towers

Analyzed the current maintenance schedule for the Tobruk refinery and closed the following comments: Maintenance durations were determined using (iGrafx software) and compared with Tobruk Refinery's maintenance department. The maintenance program lacks a schedule. Some jobs can be done quickly. Despite the ability to multitask for a device simultaneously, no group of people took advantage of this. Observation shows that there is a lack of heavy machinery facilities such as cranes, forklifts, trucks, etc. This results in high proactive maintenance time values.

We will explain how to use business process reengineering tools to solve these problems

V. DISCUSSION AND RESULTS

Time gain cones from performing the 2 tasks [isolate in let& outlet connections]and [remove front& rear covers], and the inspection as steps are merged into one step [hydro test] and in addition the 2 steps [reconnect in let& outlet piping] and [replace the covers &man way]. in parallel instead of in series.

It is clear that the total period of time needed to complete the maintenance is approximately [27days]. Table"6" summarizes the major activities which are shown in Fig "4",

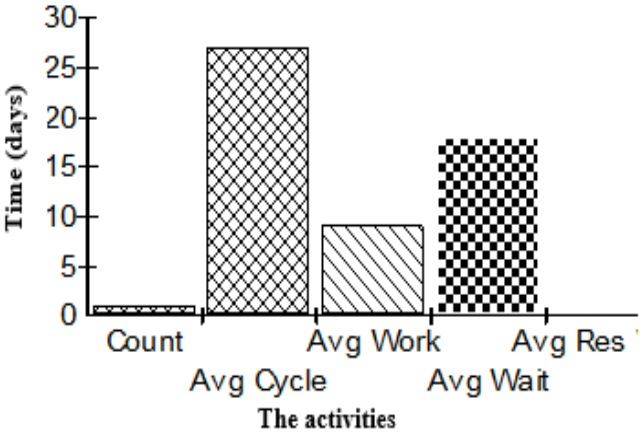
where the average cycle duration is 27 days which means the total time has been decreased by two days when we attempted to do some activities together. While Table "7" shows in elaboration the main tasks
which build the flow chart, all the statistics indicate the time duration in days. In addition, the above collecting data existing in Tables "6" and "7" can be illustrated in Fig "4"

Table"6": Expected Time for Heater Maintenance

Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
1	27.000	9.000	18.000	0.000

Table"7": Expected Time for Heater Maintenance

Activity	Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
Start	1	0.000	0.000	0.000	0.000
Isolate inlet & outlet connections Remove front &rear covers	1	1.333	0.667	0.667	0.000
Ventilation	1	2.000	0.667	1.333	0.000
Remove burners	1	2.958	1.000	1.958	0.000
Remove tube	1	4.875	1.667	3.208	0.000
replace tube	1	5.000	1.667	3.333	0.000
Tube hydro test	1	1.208	0.333	0.875	0.000
Insulation	1	3.875	1.333	2.542	0.000
Connect soot blowers & burners	1	2.083	0.667	1.417	0.000
Replace the covers & man way Reconnect in let &out let piping	1	2.000	0.667	1.333	0.000
handle to portion	1	1.042	0.333	0.708	0.000
Soot Inspectionblowers check	1	<0.001	<0.001	0.000	0.000
End	1	0.625	0.000	0.625	0.000



Fig"4": iGrafx Expected Time of Modified Maintenance Activities for Heater

Time gain cones from performing the 2 tasks [isolate vessel& dis-commend piping] and [open man way for ventilation], and the inspection as steps are merged into one step [hydro test] in parallel instead of in series.

Some results can be obtained as summarized in Table"8" where the average duration is 25 days. and by analyzing these results with iGrafx software we can find out them in detail in Table"9".

Fig"5"presents the above data obtained in Table"8", So the saving time is 4 days as compared to the current situation of the maintenance program.

It is concluded that the total period of time needed to complete the maintenance is approximately [25 days].

Table"8": Expected Time for Towers Maintenance

Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
1	25.000	6.000	19.000	0.000

Table"9": Expected Time for Towers Maintenance Activity

	Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait
Start	1	0.000	0.000	0.000	0.000
Isolate vessel& discommend piping&Open man way for ventilation	1	1.375	0.667	0.708	0.000
Ventilation period	1	0.625	<0.001	0.625	0.000
Gas test	1	1.375	0.333	1.041	0.000
More Ventilation Time	1	4.000	0.667	3.333	0.000
Clean	1	8.000	2.000	6.000	0.000
Inspection	1	2.000	0.667	1.333	0.000
replace	1	5.000	1.000	4.000	0.000
Hydro test if required	1	2.000	0.667	1.333	0.000
Close man way& handle to operation	1	0.625	<0.001	0.625	0.000
End	1	0.000	0.000	0.000	0.000

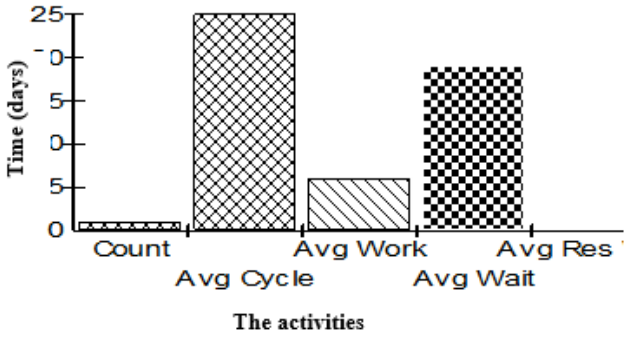


Fig "5": iGrafx Expected Time of Maintenance Activities for Towers

the current program of maintenance in Tobruk Petroleum Refinery has been tested by using reengineering software called iGrafx. After some experiments had been done, we reached the best conditions where less time was needed to complete the maintenance activities for each piece of equipment.

Overall, it can be stated that the iGrafx software has the ability to analyze the model roughout the flow chart and to test the model under several conditions including the number of shifts daily and the number of workers. The time duration can be touched clearly in Table"10"

Table "10": Compares the Two Situations of the maintenance programs (Current and Modified)

No	Equipment	Current	New(modified)
		Time(days)	Time(days)
1	Heater	29	27
2	Towers	29	25

Eventually, Business Process Reengineering and to study the maintenance programs and achieves some modifications

that can improve the performance of the organization, as well as Business Process Reengineering has the ability to these programs under various conditions. The Business process reengineering has been done to the maintenance program Although, the time of maintenance activities in so equipment has dropped down to a satisfactory level, the time of the maintenance activities of the heart and the safety valves has dropped down only by two days from 29 days to 27 days. became the maintenance program of the equipment is simultaneously at the same time.

The financial analysis can be achieved via the following calculations:

Daily producer for Refinery 20000 crud oil

Time reduced 2days = 2 *20000 =40000 barrel

Average barrel price of crud oil [80$]

40000 *80 = 3200000$

This will be added to the total amount of money gained annually =(Us$3,200,000)

VI. CONCLUSIONS

The reengineering processes are one of the operations needed in every organization and especially for the process that has not been changed for a long period like Tobruk Petroleum Refinery. These are some points that need to be underlined:

1) The maintenance program data in Tobruk Petroleum Refinery has been reviewed and analyzed and the weak points have been discovered.

2) The maintenance program time, is reduced by reengineering some maintenance tasks through perform some tasks in parallel instead of in series.

3) The laborers do not perform the technical steps in a perfect manner which leads to the re-working of some maintenance tasks.

4) Reengineering the maintenance program of the Towers and heater in Tobruk Petroleum Refinery is done using Business Process Reengineering and process mapping.

5) The maintenance program time has decreased from 29 days to 27 days for the Towers.

6) The reduced time from the maintenance program has incised the Tobruk Petroleum Refinery availability by 0.54% from 92.1% to 92.6%

7) The Financial benefit from reduced maintenance time and increasing production = (Us$3,2 00,000)

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