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Using the Critical Path Method to Find Time of Constriction for Helicopters Airport Project in the Oil Fields

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Abstract

This research is considered one of the important researches in Maysan Governorate, as it focuses on the construction of helicopter airport project in the oil fields of the Maysan Oil Company, where the oil general companies in Maysan Governorate suffer from the cost of transporting the foreign engineering experts and the governing equipment of sustaining oil industry from Iraq's international airports to oil fields and vice versa. Private international transport companies transport foreign engineering from the oil fields to Iraqi airports and vice versa, and other international security companies take action to provide protection for foreign engineering experts during transportation. Hence, this process is very costly.

The objective of this research is to construct helicopters airport in the oil fields of the Maysan Oil Company, which can be reduced the required time for the arrival of foreign engineering experts and required equipment to the oil fields of the company by using the Critical Path Method (CPM). This may assist finding the time and cost of completing the project and drawing charts the project in light of the existence of non-traditional relationships between some activities in the project network, depending on the computer engineering software such as Primavera V6. 478 days were required to complete the project . Finally, a number of conclusions and recommendations are drawn up, and a number of future studies are suggested.

Paper type: Research Paper

Keywords: The Critical Path Method, Primavera V6, cost of project, untraditional activities, time to complete the project, an airport project for helicopters in the oil fields.

1. Introduction

The project is the outcome of the economic, technical, and social priorities in the institution. It is a temporary administrative system that allows structuring the foundations upon which the design, development, manufacturing, and marketing of a new product is based. It is requiring the participation of individuals coming from different professions organized within the framework of a goal that they work to achieve it. Each project mechanisms for setting goals is along with a culture of its own. Hence, the idea of projects begins. This project is one of the human needs that seeks to satisfy through a project and since the operations of transporting workers in the oil sector and the equipment used in transporting the sustainability of oil production are basic needs. Moreover, it is necessary to establish projects to achieve these needs, and here the idea of constructing an airport for helicopters in the oil fields within the Bazrgan oil field was flow up to the Maysan Oil Company, which considers one of the general companies of the Iraqi Oil Ministry. The research includes the use of modern scientific methods in project planning such as CPM in order to find the completion period and cost, ,. This topic contains a presentation of the research methodology starting from the research problem, the research objective, the importance of the research, the research assumptions, the methods used in the research, the research community and sample, and the sources and methods of data collection.

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The researchers relied on the case study method for the following reasons:

- The researchers' desire is to shed light on one of the most important projects that are being implemented in the oil fields of Maysan Oil Company.
- Use the CPM to find time and the completion cost of the project

research statement is that the majority of oil companies in Iraq in general and in Maysan Governorate in particular suffer from the high cost of transporting foreign engineering experts from Basrah Airport to the oil fields in Maysan Governorate and vice versa, where private transport companies transfer these staff from the fields to Iraqi airports and vice versa. In addition, other security companies undertake to secure protection for foreign staff during transportation. Hence, this process is very costly, as the oil sector companies should find solutions for this problem, and after studies and discussions, the company has found that the establishment of an airport for helicopters could reduce the required time to transfer foreign experts from the oil fields to Iraqi airports and vice versa, and reduce the costs of transporting foreign experts by transport companies. The protection of the project also works to reduce the security concern of international companies operating in the Iraqi oil fields, which helps to encourage an investment in the oil sector, which generates and increase financial returns in the country. The importance of the study is embodied in the fact that it addresses a basic problem affecting the Iraqi economy, as it is a rentier economy that mainly depends on the oil industry. Therefore, the study may solve the problem of transporting foreign staff and necessary equipment in the oil industry, where the establishment of the airport for helicopters in the oil fields (the study sample) was in confronting the high prices of transporting foreign staff and the necessary continuous equipment, as the study sample is aimed to reduce transportation costs through finding time achievement project using CPM, comparing the results with the obtained results using Primavera v6, and finally finding a cost achievement the project.

Literature Review

There are many studies under this subject illustrated ad bellow:

A study by Algazaria (2008) used project scheduling methods, PERT and CPM in the comparison between time and cost to complete projects. It found that the use of each of the methods PERT - CPM has achieved tremendous fame among experts in the field of planning, and the benefits of these methods have increased more and beyond what we imagine through the use of computer systems for the achievement, analysis and control of the network of projects. Another study by Shaaban (2009) ssuggested the applicability of CPM at Najaf International

Airport. The researcher found that the application of the network analysis method, especially CPM, has a great importance in project management by compressing the time factor, the crash time of the implemented project activities, to the least possible time in order to take advantage of these surplus times. After using the program (QM Pro.) related to the network analysis in the electronic calculator shows that there are surplus times in the project activities that can be used in the development of the airport without resorting to extending the completion period for a longer period. Castro, et al (2009) used construction project scheduling with time, cost, and physical constraints using math models and the critical path method. The study found that the use of mathematical models reduces costs by including time and cost in the schedule analysis process. Additionally, assuming that the maximum possible cost for a simple project is $30,000, and it takes 43 days to complete it without restrictions. The following results were obtained from the analysis. When the critical path is not considered, the increase in project completion time by 20% from 43 to 52 days. This leads to an increased cost 73% to $51,800. This increase in time and cost was due to activities that were not critical becoming critical. Another investigation of Saleh (2011) applied in the Ministry of Construction and Housing studied the impact of time management on the completion of construction projects, and reached a positive trend towards time management and the application of the practice of time management dimensions of engineers and the arrangement of the practice of those dimensions according to the degree of importance for planning, setting goals and priorities, avoiding time wasters, and enhancing the skill of time management. It considers it the basic nucleus in the behaviour of workers in the completion of projects because time is a scarce, precious and important resources for both organizations' and individuals' life. A study of Khalaf (2012) used project scheduling management by using acceleration in critical path networks to complete the project on limited time and the lowest cost. Scientific methods in identifying critical paths, determining the project life span, determining the beginnings and ends of project activities, and using the time-cost exchange method, which helps project management to complete the project in the least time and cost. Al-Badiri (2015) Suggested the use of the network analysis method to reduce the project completion time and found that adopting CPM as a scientific method leads to complete the project as quickly and cheaply as possible. In addition to the possibility of making great use of non-critical activities in transferring equipment and manpower to critical activities that are lagging behind. Munjih (2018) studied the importance of network analysis in the trade-off among time, cost, and quality of completing the project. The framework of its three constraints (time, cost, and quality), as network analysis is a scientific method used in preparing and scheduling projects and monitoring their implementation by following a set of successive stages and using a combination of traditional and modern methods. Hassan (2018) used planning and scheduling the implementation of government projects and found that scientific methods in setting a schedule for the implementation of works at the level of each of the construction activities did not use, based on the standard concepts referred to in the resident engineer's guide for parts one and two. Furthermore a schedule for the progress of work based on realistic foundations by relying on the work progress curriculum within feasibility studies and bidding through a comparison of the bid execution periods with the periods that should be sufficient to complete the work did not set. Likewise, there were the lack of coordination among the project executing authorities, the planning authorities, and the legal authorities for each contractor. This might constitute a weakness in the process of supervision and follow-up and determining the rights and obligations of both the employer and the contractor represented by the executing companies. Samaher (2019) used CPM and PERT methods in planning the stages of manufacturing and producing wooden doors. It concluded that the failure to use operations research methods in the implementation of projects inside the factory can reflect its negative effects on the implementation of the first project, as the time period for implementation was 365 days, while the planned period did not exceed 206 days, and by adopting the two methods (CPM and PERT), determined the time period was 206days, found a clear difference between the actual implementation and the scientific planning, as it amounted to 159 days. Whereas, relying on the accumulated personal experience without determining the best correct scientific methods in the completion of the projects of manufacturing wooden doors in Al-Mustafa Factory. Andiyan, et al, (2021) Suggested the evaluation of construction projects using (CPM and PERT) and exchanging cost with time to reduce project delay. The study concluded that the use both methods reduces the probability of delay in completing critical chain projects by 55%.

2. Materials and Methods

2.1 Data Collection Sources

In order to cover the theoretical side of study, we depend on Arabic and foreign sources that focused in their studies on CPM, as well as the data has been obtained from the services of the global information network. In regard to the practical side of the study, it was completed by obtaining data from field visits to the project site in the Bazargan Oil Field in Maysan and collect qualitative data obtained by the researchers during interviews with the project engineers and supervisors.

2.2.1 Project Management Concept:

Project management is the provision of the structure that helps in define each project objective. The means by which those objectives are achieved by the monitoring of performance (Turner, 2016:10). Project management provides organizations with an effective force to improve the capabilities to plan projects; organize, implement and control various activities; as well as help making an optimal use of the capabilities and resources of the organization (Awali et al, 2017: 28). Projects are often characterized by uncertainty, which makes managing them more difficult. Therefore, they require projects with a special management method. Project management can be described as the events and activities that work with each other from planning, organizing, directing, and controlling the purpose of optimal use of the capabilities of the project. This can efficiently and effectively achieve goals within the criteria of time, cost, and quality; management should take g into account the various environmental factors and variables surrounding the project (Dudin, 2012 :26; Stevenson, 2015: 731).

2.2.2 Importance of the Project Management:

There are a number of reasons that show the importance of project management to help organizations achieving their strategic goals, which are: (Kerzner ,2009:3; Alotaibi, 2016:98)

- defining job responsibilities to ensure that all necessary activities are accounted for and remove activities and unnecessary tasks;
- reducing the need for reporting;
- determining the duration of the activity;
- defining a methodology for trade-off analysis between standards and objectives;
- measuring the planned completion of the project;
- helping in early identification of problems for corrective action; and
- helping create broader awareness of the business environment;

2.2.3 Goals of the Project Management:

Project management aims to achieve a set of objectives, which are as follows:

- The period specified for the completion of the project, meeting the needs of customers is the most important component of the main objective of the project (John, 2003:43).
- The technical performance of the project, which expresses the project's response to technical conditions and its direct impact on customers' reactions (Al-Rikabi,2019:57).
- Cost, because it expresses a financial constraint as the project manager seeks to reduce the cost of the project, taking into account each goal during the completion period and responding to the appropriate technical and quality specifications (Verzuh, 2005: 3).

2.2 Critical Path Method (CPM)

2.3.1 The Concept of the Critical Path Method

The critical path method was introduced in the year of 1957 by DuPont Company () in Louisville/USA. The purpose of this method was to address a problem in times when production operations were stopped as maintenance and then restarted in chemical plants. This method achieves many advantages, as its use in a factory reduced the maintenance time due to breakdowns from 125 to 78 hours (Badis et al., 2010:24-25). It is a series of activities in the project network that represents the least possible time to complete the project, as its CPM provides the planned schedule to assist the project team and forms the basis for examining project schedule performance by comparing actual performance with planned task progress. The critical path is a way of evaluating how long each task will take before one can finish the entire project (Hebert , 2011:24).

Where CPM is one of the most important methods in planning and controlling large and complex projects.In addition, it is considered one of the most important methods in implementing projects in the shortest time, with high efficiency, and at the lowest cost. CPM refers to the shortest possible time to complete the project within the imposed restrictions and conditions that lead to the completion of the entire project (Dawwod et al., 2012: 200).

2.3.2 Finding the Critical Path of the Project

The networks assume an estimate of the times of the activities, and the time of the activity that is certain determines the typical time for the implementation of the activity, and knowing the times of the activities depends on the experience and ability of the project management or those responsible for its implementation and the previous experiences of similar activities, and the time of the activity is often fixed on the arrow that represents the activity in networks (AOA) and on the node in (AON) networks (PERT) and CPM for calculating early and late times include two types of calculations (Khalaf,2022: 92).

i. Forward Computation:

These calculations usually start from the first event in the network, and are sequenced until the last event in the network. This type of calculation is important to know the early start and end times for all project activities, to determine the earliest time needed to start the project, and then the activities are sequenced until we get to know the early final time for the project. The early start time of the first activity is the start date of that project. In order to determine the time required to complete the project activities, it is necessary to calculate the early and late times, which are as follows:
(Stevenson: 2007:775; Hillier et al, 2010:477)

▪ early start time ES: This time for the first activity is zero, and for the following activities it is the earliest possible time to start the activity.

$ES=0$ (1)

▪ early completion time EF: It is the early start time of the activity plus the duration of that activity.

$EF_j = ES_i + t_{ij}$ (2)

t_{ij}: time required to complete the activity.

In the event that there is more than one activity, the event is entered *j* We take the highest activity or the activity whose summation of its early start with the time of its completion is the highest among the activities that enter the event *j* And as in the following mathematical equation,

$EFj=max[ESi+tij]$ (3)

ii. Backward Computation

These calculations are implemented for the purpose of knowing the delayed times, as they start from where the forward calculations end, in other words, from the last event in the network and fall back sequentially to the first event. Through this method, the late start and late finish times are determined for each activity, and the late start time for any activity is the maximum time an activity can start without causing that project to be delayed from its end date (Schwalbe:2007:236)

▪ delayed start time LS: starts by identifying the subsequent activities for each activity in the network, after which the delayed start time is calculated and is equal to the delayed finish time minus the time it takes for the activity.

$LS_i = LF_j - t_{ij}$ (4)

▪ Late completion time LF: It is the delayed start time of the activity plus the duration of that activity.

$LF_j=LS_i+t_{ij}$ (5)

As the late completion time for the last activity in the project is equal to the early completion time for the same activity.

$LF_j=EF_j$ (6)

In the case of more than one subsequent activity, the delayed end of the activity that ends with the event$j$ (LF_j) the time required to complete the activity(t_{ij}) is equal to or less than the value of(LS_i), that is, we take the least activity or the activity whose completion time subtraction from its late end is the least among the activities that come out of the event$i$As in the following mathematical equation:

$LSi=\min[LF_j-t_{ij}]$ (7)

iii. Total Slack

Represents the maximum time that completion of an activity can be delayed without causing a delay in the completion time of the project as a whole, and is the difference between the time of early and late start or late start and late finish (Nigel: 2002:141).

if value (TS) for a specific activity is equal to zero, then this activity is called a critical activity and is located on the critical path, and by delaying it, the subsequent activity is delayed, then the project as a whole is delayed (Al-Dairi: 30: 2011).

It can be calculated by one of equation (8,9) (Lewis: 2011:524)

$TS_i = LS_i - ES_i$ (8)

$TS_i = LF_i - EF_i$ (9)

3. Discussion of Results

3.1 An Introduction to the Project of Helicopters Airport

Project establishment of an Airport for Helicopters is one of the important projects in the oil field , where the urgent need for it has emerged in recent periods due to the increase in oil extraction activity by foreign companies operating in the oil fields in Iraq. This may lead to an increase in foreign staff working in those fields, and in the cost of transporting those fields foreign staff from the Iraqi international airports (Baghdad, Basra, and Erbil Airports) to the oil fields and vice versa. Hence the idea of establishing an airport for helicopters in the oil fields is to reduce the cost of transporting these individuals as well as reduce the time required to transfer them from the oil fields to the airports and vice versa. Figure 1 shows a scheme the project.

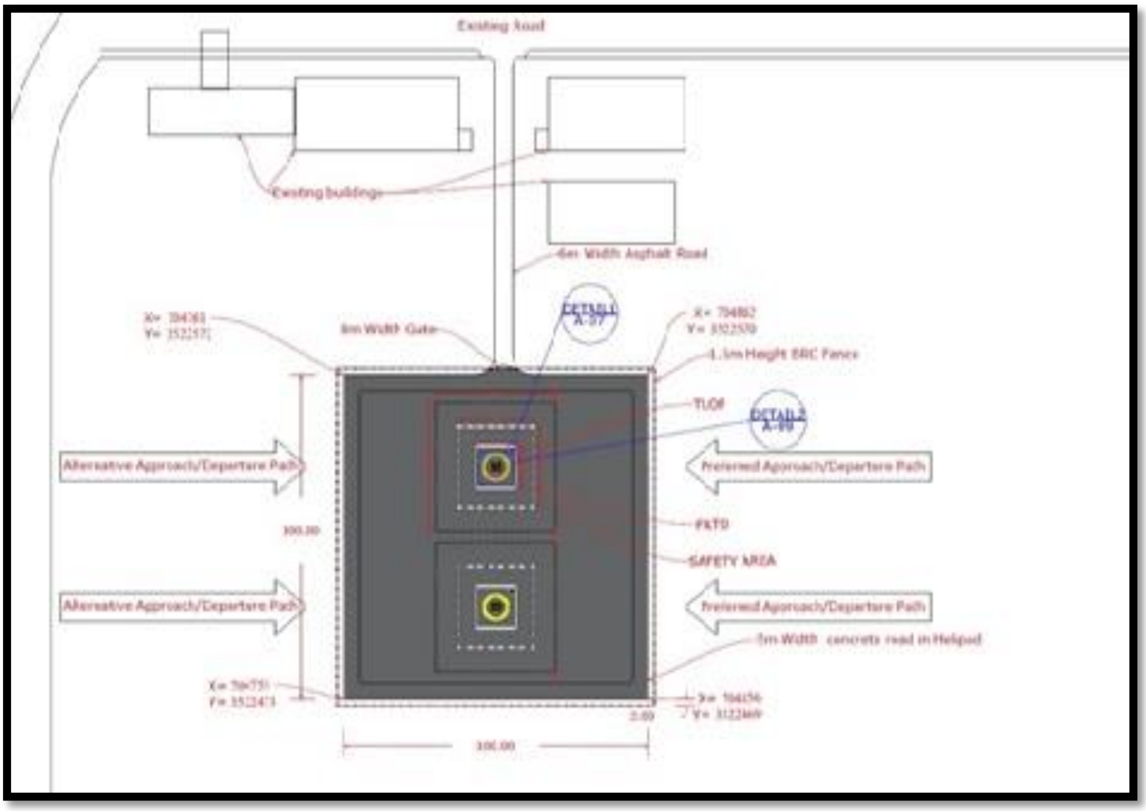

Figure 1: Scheme of the airport project for helicopters in Maysan Oil Company fields The source from project plans).

3.2 Data of Airport Project for Helicopters in the Oil Fields

Include establishment of an airport for helicopters in the Maysan fields operation authority with in Maysan Oil Company (one of the public companies of the Iraqi Ministry of oil) where it includes many of costs and activities and the relationship between those activities and this data listed in Table 1.

1.**Table 1: Data of Project Activities**

No	Activities	Time in days	Activity Icon	Previous Activity	Relationship Between Activities	Cost of Activities in Dollars ($)
1	Planning approval and related parties	15	A1000	---	----	500
2	Soil sampling	5	A1010	A1000	**FS**	15,000
3	Preparation of examination sand issuance of the report.	14	A1020	A1010	FS	4500
4	direct design counter	20	A1030	A1020	FS	20,000
5	Reviewing designs, making amendments to them, and approving them	10	A1040	A1030	FS	1000
6	Issuance of final blueprints	7	A1050	A1040	FS	1500
7	Equipping technical personnel	7	A1060	A1050	FS	3000

8	Equipping and configure hard ware necessary	7	A1070	A1060	SS	4000
9	Survey work	10	A1080	A1070	FS	3000
10	Skimming and soil cleaning works	5	A1090	A1080	FS	10,000
11	cutting works soil according to the plans	14	A1100	A1080	FS	14,000
12	Test of soil density	7	A1110	A1100	FS	1100
13	Boulder processing according to the required sizes	7	A1120	A1100	FS	40,000
14	Lay and compact works	14	A1130	A1120	FS	22,000
15	Provide and the first layer of soil with thickness 25 cm	5	A1140	A1130	FS	20,000
16	Compact of the first layer of soil	5	A1150	A1140	FS	8000
17	Test of the first layer after compact (site density)	5	A1160	A1150	FS	1000
18	Provide the second layer of soil with thickness 25 cm	5	A1170	A1160	FS	20,000
19	Lay and compact works	5	A1180	A1170	FS	8000
20	Test of the second layer after compact (site density)	5	A1190	A1180	FS	1000
21	Provide the third layer of soil with thickness 25 cm	5	A1200	A1190	FS	20,000
22	Lay and compact works	5	A1210	A1200	FS	8000
23	Test of the third layer after compact (site density).	5	A1220	A1210	FS	1000
24	Provide the fourth layer of soil with thickness 25 cm	5	A1230	A1220	FS	20,000
25	Lay and compact works	5	A1240	A1230	FS	8000
26	Test the fourth layer after compact (site density)	5	A1250	A1240	FS	1000
27	Provide the fifth layer of soil with thickness 25 cm	5	A1260	A1250	FS	20,000
28	Lay and compact works	5	A1270	A1260	FS	8000
29	Test the fifth layer after compact (site density)	5	A1280	A1270	FS	1000
30	Provide the sixth layer of soil with thickness 25 cm	5	A1290	A1280	FS	20,000
31	Lay and compact works	5	A1300	A1290	FS	8000
32	Test the sixth layer after compact (site density)	5	A1310	A1300	FS	1000
33	Provide the seventh layer of soil with thickness 25 cm	5	A1320	A1310	FS	20,000
34	Lay and compact works	5	A1330	A1320	FS	8000

35	Test the seventh layer after compact (site density)	5	A1340	A1330	FS	1000
36	Provide sub base Type B	14	A1350	A1340	FS	65,000
37	Lay and compact the first layer with thickness 25cm	10	A1360	A1350	FS	25,000
38	Test the first layer after of sub base compact (site density)	7	A1370	A1360	FS	1500
39	Lay and compact the second layer with thickness 25cm	10	A1390	A1370	FS	25,000
40	Test the second layer after of sub base compact (site density)	7	A1400	A1390	FS	1500
41	Provide iron for concrete	10	A1410	A1400	FS	80,000
42	Wood work for the first part of concrete	5	A1420	A1410	FS	9500
43	Blacks mithing and arming works for the first part of concrete	7	A1430	A1420	FS	19,000
44	First concrete casting works	2	A1440	A1430	FS	55,000
45	concrete treatment (Curing)	7	A1450	A1440	FS	950
46	Compression test of concrete	7	A1460	A1450	FS	1000
47	Wood work for the second part of concrete	5	A1480	A1420	FS	9500
48	Blacks mithing and arming works for the second part of concrete	7	A1490	A1480	SS	19,000
49	second part concrete casting works	2	A1500	A1490	FS	55,000
50	concrete treatment (Curing)	7	A1510	A1500	FS	950
51	Compression test of concrete of the second part	7	A1520	A1510	FS	1000
52	Wood work for the third part of concrete	5	A1540	A1480	FS	9500
53	Blacks mithing and arming works for the third part of concrete	7	A1550	A1540	SS	19,000
54	third part concrete casting works	2	A1560	A1550	FS	55,000
55	concrete treatment (Curing)	7	A1570	A1560	FS	950
56	Compression Test of concrete for the third part	7	A1580	A1570	FS	1000
57	Wood work for the fourth part of concrete	5	A1600	A1540	FS	9500
58	Blacks mithing and arming works for the fourth part	7	A1610	A1600	SS	19,000
59	Concrete pouring works for the fourth part fourth of concrete	2	A1620	A1610	FS	55,000

60	concrete treatment Curing	7	A1630	A1620	FS	950
61	Compression Test of concrete for the fourth part	7	A1640	A1630	FS	1000
62	Install wall boundaries and gates	7	A1650	A1640	FS	800
63	Fence materials provide processing works BRC	7	A1660	A1650	FS	28,000
64	Fence foundation digging BRC	5	A1670	A1660	FS	5000
65	Install columns (BRC with ordinary concrete casting	6	A1680	A1670	FS	12,000
66	Buckle install BRC	5	A1690	A1680	FS	4500
67	Barbed wire installation	6	A1700	A1690	FS	3500
68	Install gates	5	A1710	A1700	FS	1000
69	Electrical transformer supply works 250KVand other electrical materials	40	A1720	A1710	FS	80,000
70	Electrical transformer installation works	5	A1730	A1720	FS	9000
71	Cable extension works	21	A1740	A1730	FS	12,000
72	Connecting work HV and incisors	14	A1750	A1740	FS	2000
73	Install and install lighting poles and other accessories	10	A1760	A1750	FS	6500
74	Experimental examination	7	A1770	A1760	FS	3000
75	The work of preparing the necessary materials for the runway layout	14	A1780	A1770	FS	4500
76	Layout of the runway with thermochromic dyes	7	A1790	A1780	FS	3500
77	Adding photocells to the approaches	5	A1800	A1790	FS	2800
78	Business layer brushesmyspacefish25cm with a hump to Airport Street	5	A1810	A1720	SS	4500
79	Mold and reinforcement work	10	A1820	A1810	FS	8000
80	Street concrete casting works	4	A1830	A1820	FS	30,000
81	concrete treatment curing	7	A1840	A1830	FS	1000
82	Compression tests	7	A1850	A1840	FS	1000
83	The work of forming the first receiving committee	7	A1860	A1800	FS	500
84	to equip file the project final	7	A1870	A1860	FS	400
85	Signing the receipt report	7	A1880	A1870	FS	300
				Total Cost of the Project	1,106,200$	

The source: Documents of Maysan Oil Company.

3.3 Finding the Completion Time of the Airport Project for Helicopters Using the Critical Path Method

After the type of relationship between all project activities has been determined, the project completion time must be calculated, as the researcher used mathematical equations to calculate the project completion time by using front-end accounts. **(Forward Computation**) and accounts the background (**Backwards Computation**).

In order to find the critical path, the early and late times of the project activities must be calculated using the forward calculations method (**Forward Computation**) which starts with the first time point (the first event or activity) in the network diagram of the project and goes to the last time point (the last event or activity). Note that all calculations will be in days, where (d) means day.

And to calculate the time to complete the activityA1000 (Planning approvals and relevant authorities) by applying Equation (1).

$ES_{A1000}=0$

To calculate the time for completing the following activities through the application of Equation (2), an example of applying this equation is calculating the time for completing the activityA1030(direct numbers of designs).

$EF_{A1030}=ES_{A1020}+t_{A1030}$ $\quad ,t_{A1030}=20d$

$EF_{A1030}= 34 + 20 \Longrightarrow EF_{A1030}= 54d$

By applying equation (2) to the project activities, we find the completion time of the activities as shown in Table 2, and the application of equations (3,4, and 5) related to the background calculations used to find the late start time and the late completion time for the project activities. An example of applying the equations is calculated the time for the late start of the activityA1830(Business Concrete casting to the entrance street).

$LS_{A1830}=LS_{A1840}-t_{A1830,}t_{A1830}=4d$

$LS_{A1830}=450-4 \Longrightarrow LS_{A1830}=446d$

To calculate the total spare time for project activities, we apply equations (6, and7) an example of their application. Where the excess time for the activityA1060(class check the first soil after humping (local density)) The early and late start times for this activity were found through forward and backward calculations

$LS_{A1060}=85$ $,ES_{A1060}=71$

$TS_{A1060} = LS_{A1060} - ES_{A1060}$

$TS_{A1060} = 85 – 71 \Longrightarrow TS_{A1050} = 14$ d

To find Anthers Calculation can find it on the web:
https://www.researchgate.net/publication/369023231_Using_the_Critical_Path_Method_to_find_time_of_constriction_for_Helicopters_airport_project_in_the_oil_fields
the results are as shown in Table 2.

Table 2: Early, late and excess time for project activities

Activities	Time Activity	Early start ES	Early Finish EF	Late Start LS	Late Finish LF	Slack LS-ES
A1000	15	0	15	0	15	0
A1010	5	15	20	15	20	0
A1020	14	20	34	20	34	0
A1030	20	34	54	54	34	0
A1040	10	54	64	64	54	0
A1050	7	64	71	71	64	0
A1060	7	71	78	85	64	14
A1070	7	71	78	71	78	0
A1080	7	78	85	78	85	0
A1090	8	85	93	100	78	15
A1100	14	85	99	104	118	19
A1110	7	93	100	106	80	13
A1120	7	99	106	99	106	0
A1130	14	106	120	106	120	0
A1140	5	120	125	120	125	0
A1150	5	125	130	125	130	0
A1160	5	130	135	130	135	0
A1170	5	135	140	135	140	0
A1180	5	140	145	140	145	0
A1190	5	145	150	145	150	0
A1200	5	150	155	150	155	0
A1210	5	155	160	155	160	0
A1220	5	160	165	160	165	0
A1230	5	165	170	165	170	0
A1240	5	170	175	170	175	0
A1250	5	175	180	175	180	0
A1260	5	180	185	180	185	0
A1270	5	185	190	185	190	0
A1280	5	190	195	190	195	0
A1290	5	195	200	195	200	0
A1300	5	200	205	200	205	0
A1310	5	205	210	205	210	0
A1320	5	210	215	210	215	0
A1330	5	215	220	215	220	0
A1340	5	220	225	220	225	0
A1350	14	225	239	225	239	0
A1360	10	239	249	239	249	0
A1370	7	249	256	249	256	0
A1390	10	256	266	256	266	0
A1400	7	266	273	266	273	0
A1410	10	273	283	273	283	0
A1420	5	283	288	283	288	0
A1430	7	288	295	293	300	5
A1440	2	295	297	300	302	5
A1450	7	297	304	302	309	5
A1460	7	304	311	309	316	5
A1480	**5**	**288**	**293**	288	293	0

A1490	7	293	300	298	305	5
A1500	2	300	302	305	307	5
A1510	7	302	309	307	314	5
A1520	7	309	316	314	321	5
A1540	**5**	**293**	**298**	293	298	0
A1550	7	298	305	303	310	5
A1560	2	305	307	310	312	5
A1570	7	307	314	312	319	5
A1580	7	314	321	319	326	5
A1600	**5**	**298**	**303**	298	303	0
A1610	7	303	310	303	310	0
A1620	2	310	312	310	312	0
A1630	7	312	319	445	452	133
A1640	7	319	326	452	459	133
A1650	**7**	**312**	**319**	312	319	0
A1660	7	319	326	319	326	0
A1670	5	326	331	326	331	0
A1680	6	331	337	331	337	0
A1690	5	337	342	337	342	0
A1700	6	342	348	342	348	0
A1710	5	348	353	348	353	0
A1720	21	353	374	353	374	0
A1730	5	374	379	374	379	0
A1740	21	379	400	379	400	0
A1750	14	400	414	400	414	0
A1760	10	414	424	414	424	0
A1770	7	424	431	424	431	0
A1780	14	431	445	431	445	0
A1790	7	445	452	445	452	0
A1800	5	452	457	452	457	0
A1810	**5**	**353**	**358**	**353**	**358**	0
A1820	10	358	368	358	368	0
A1830	4	368	372	368	372	0
A1840	7	372	379	372	379	0
A1850	7	379	386	379	386	0
A1860	7	457	464	457	464	0
A1870	7	464	471	464	471	0
A1880	7	471	478	471	478	0

3.4 Finding a time to complete the airport project for helicopters using Primavera V6

After completing the project completion time calculations using CPM, where the front and back calculation methods were used, it was necessary to use another method to calculate the project completion time for comparison, as the researcher used the engineering program for project management Primavera to find the project completion time. This program is one of the scientific programs with high accuracy, easy to use, and characterized by the speed of obtaining the final results. in addition, it has an ability to absorb the changes that arise in the project, including times and costs, where the data of the project activities were entered, which included the time required for each activity, the time sequence, and the relationship between the activities. The researchers found the results of the program, where the time required to complete the project appeared to be 478 days, which is completely identical to the front and back calculations. They also found the critical path as shown in Figure 2.

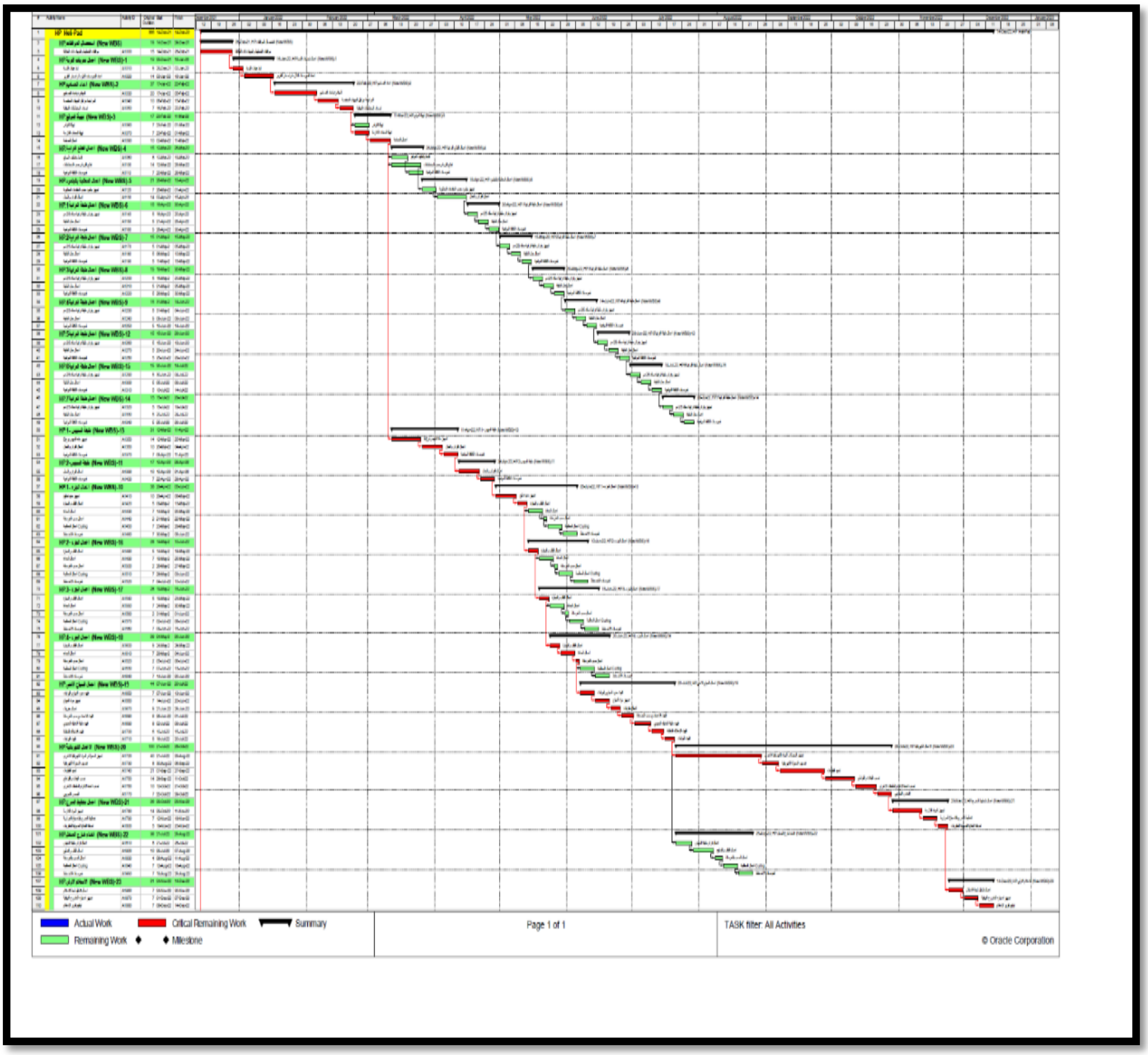

Figure 2: Critical Path of the Project Using Primavera Program

4. Conclusions

According to the results obtained in this research, we conclude that completing the results of the forward and backward calculations, using the Primavera program, and finding the slack time for all project activities, the researchers found the following points:

- through the forward calculations, the researchers found that the time required to complete the project is 478 days, which was found through calculating the critical path of the project.
- The researchers found that there are some non-critical activities that have great flexibility and have an importance that gives the project management permission to direct financial and technical resources towards the implementation of other activities.
- the researchers found that the importance of flexibility for some non-critical activities, where the project management is granted by directing the funds allocated for their implementation towards using them in the implementation of other more important activities.

- the critical path includes the following activities (A1000 - A1010 - A1020 - A1030 A1040 - A1050 - A1070 - A1080 - A1100 - A1120 - A1130 - A1140- A1150 - A1160 - A1170 - A1180 - A1190 - A1200 - A1210 - A1220 - A1230 - A1240 - A1250 - A1260 - A1270 - A1280 - A1290 - A1300 - A1310 - A1320 - A1330 - A1340 - A1350 - A1360 - A1370 - A1390 - A1400 - A1410 - A1480 - A1540 - A1600 - A1610 - A1620 - A1650 - A1660 - A1670 - A1680 - A1690 - A1700 - A1710 - A1720 - A1730 - A1740 - A1750 - A1760 - A1770 - A1780 - A1790 - A1800 - A1810 - A1820 - A1830 - A1840 - A1850 - A1860 - A1870 -A1880
- through the results, the researchers found that most of the project activities are located on the critical path, due to the nature of the sequential project activities.
- the researchers concluded that there are some relationships between the activities of the type (SS) whereas

activity relationshipA1070 with activity A1060 is a relationship (SS).
Activity relationshipA1430with activityA1420is a relationship (SS)
Activity relationshipA1490with activityA1480is a relationship (SS)
Activity relationshipA1550with activityA1540is a relationship (SS)
Activity relationshipA16100with activityA1600is a relationship (SS)
Activity relationshipA1810with activityA1720is a relationship (SS).

5. Future Works

In the light of the research findings, the researchers suggest conducting future studies and research, such as the folowing:

- Studying the use of the critical path method in another project that does not contain a security aspect.
- Studying the exchange of time for cost in the non-critical activities of the project and knowing the extent of its impact in reducing the project completion time and increasing its cost.
- A comparison study between alternative materials used to reduce project duration and their impact on cost.
- Study the analysis of administrative costs and their percentage of the total cost of the project.
- Studying the adoption of the smart management method and its impact on the progress of the project.
- Studying the impact of employing skilled personnel on costs and project schedule.
- Increasing focus in future research on conducting similar studies in the same industrial sector and comparing their results with this study.
- A comparative study using quantity others in project planning to find out how much optimization critical path method in planning the Like for projects.
- An in-depth study using checklists (Check list) to find out the other dimensions of operational risks for civil and military airport projects.

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استخدام الاسلوب المسار الحرج في ايجاد وقت أنجاز مشروع مطار لطائرات الهلكوبتر في الحقول النفطية

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مستخلص البحث

يٌعتبر هذا البحث أحد البحوث المهمة في محافظة ميسان من خلال تركيزه على مشروع انشاء مطار لطائرات الهلكوبتر في الحقول النفطية التابعة لشركة نفط ميسان، إذ تعاني شركات القطاع النفطي في محافظة ميسان من كلفة نقل الكوادر الهندسية الاجنبية والخبراء والمعدات الحاكمة في ديمومة الصناعة النفطية من مطارات العراق الدولية الى الحقول النفطية والعكس صحيح حيث تتولى شركات نقل عالمية خاصة نقل تلك الكوادر من الحقول الى المطارات العراقية والعكس صحيح وتتولى شركات أمنية عالمية اخرى تأمين الحماية للكوادر الاجنبية اثناء النقل وهذه العملية مكلفة جدا.

ان هدف البحث هو ان انشاء مطار لطائرات الهلكوبتر في الحقول النفطية التابعة لشركة نفط ميسان والذي سيعمل على تقليل الوقت اللازم لوصول الكوادر الاجنبية والمعدات الحاكمة الى الحقول النفطية في الشركة من خلال استخدام اسلوب المسار الحرج (CPM). هذا يمكن ان يساعد أيجاد وقت وكلفة انجاز المشروع ورسم المخططات الخاصة بالمشروع في ظل وجود علاقات غير تقليدية بين بعض الانشطة في شبكة المشروع إعتماداً على الحاسوب والبرامجيات الجاهزة كبرنامج (Primavera V6.) حيث بلغ الوقت اللازم لإنجاز المشروع 478 يوم ، وأخيراً تم وضع عدد الاستنتاجات والتوصيات و التطرق الى مقترحات لعدد من الدراسات المستقبلية.

نوع البحث: ورقة بحثية

المصطلحات الرئيسة للبحث: اسلوب المسار الحرج ، Primavera V6 ، كلفة المشروع ، أنشطة غير تقليدية ، وقت أنجاز المشروع ،مشروع مطار لطائرات الهلكوبتر في الحقول النفطية .

***البحث مستل من رسالة ماجستير**