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Enhancing the competitiveness of real estate development companies using the critical path model: an applied study in Al-Faw General Engineering Company

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Abstract
This study aims to demonstrate the possible financial and economic gains through developing the capabilities of human resources to contribute to diagnosing and evaluating proposals to accelerate completion of construction projects implemented by real estate development companies. The College of Law building project at the University of Baghdad, which was implemented by Al-Faw General Engineering Company, was chosen as applied case, where data was identified describing the relationship between pressure on project completion time within the technically feasible range and its high costs using the critical path method with the help of the WINQSB program, and the data was used to determine the net present value of the proposal to accelerate building completion as a basic criterion according to which the decision to implement the proposal or not is made, and it included The hypothesis of the study is the possibility of using the method used in the applied case referred to above in developing the financial and economic performance of companies implementing construction projects and institutions benefiting from their services. The study reached conclusions, including the possibility of employing the results of using the critical path method in calculating the net present value to proposals of accelerate the completion construction projects. The study's recommendations included the need for decision-makers in real estate development companies and institutions benefiting from their services to pay attention to using the method used in the applied study in all construction projects to develop their Financial and economic performance, and strengthening the components of a knowledge society and economy.

Keywords: financial and economic feasibility, critical path method, net present value, construction projects, human resources development.

1. Introduction
Achieving outstanding financial and economic performance of business sectors requires the availability of an encouraging investment climate that includes the availability of the components of a knowledge society and economy, in which the business community thrives in generating and exchanging appropriate data to rationalize economic and administrative decision-making, and in which the skills of human resources are developed in institutions to use scientific methods using specialized programs to formulate models describing the activities of institutions and analysis of their results to contributes to diagnosing and evaluating possible opportunities to contribute to decision-making enhancing the competitiveness of enterprises, and accelerating the pace of knowledge-based economic development.

The problem of the study is that there are opportunities to develop the financial and economic performance of construction and real estate development companies and institutions benefiting from their services can be achieved by diagnosing proposals to accelerate the completion of projects and estimate their net present values for approve as a feasible proposals if that achieve a positive net present value, as construction companies and institutions benefiting from their services suffer from the loss of these opportunities due to the weak interest of decision makers in construction companies of using the Critical Path

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Method, and the weakness their efforts to develop the work environment and staff skills in communicating with their counterparts in institutions benefiting from the services of construction companies to diagnose and Share possible financial and economic gains from accelerate Completion of projects.

The premise of the study provides for the possibility of developing the financial and economic performance of construction and real estate development companies and institutions benefiting from their services by developing the capabilities of employees in the field of using the Critical Path Method and using its outputs in estimating the net present value as the main criterion in feasibility studies for proposals of accelerate the completion of projects using available commercial software packages, in conjunction with the development of communication and negotiation skills to diagnose financially and economically feasible proposals to agree to share their gains, and promote knowledge-based economic development.

The study aims to clarify the method of using the critical path method for construction projects, and to use the results of the trade-off between the time and cost of completion in estimating the net present value of options to accelerate the completion of projects to enhance the financial and economic performance of construction companies executing projects and the beneficiaries for whom projects are implemented.

For the purpose of achieving the objectives of the study, the deductive method based on logical inference was adopted in its analysis of the results, and the descriptive analytical method was used to clarify the study determinants, where the FAO company was visited and select the work progress schedule for the Faculty of Law building project at the University of Baghdad for the period 2012-2013, in addition to conducting interviews with engineers to estimate the fastest completion time for activities that can be accelerated and its costs, so that the college building project is a model for using the critical path method and determining the possible trade-off results between the project completion time and its costs, and stating How to employ it in calculating the net present value as a main criterion for diagnosing possible opportunities for improving performance financial and the accompanying desirable economic results.

Literature review: the researchers reviewed a number of previous studies related to our study, including: -
Safa Mohammed Hadi al-Jazairi's study in 2008 entitled "The use of project scheduling methods, Bert and the critical path in differentiating between time and cost to complete projects applied study at the Technical Institute in Basra", the study adopted the activities of completing the construction of the Computer Center at the Technical Institute in Basra as an application case, and the problem of the study showed that neglecting the relationship between the construction time and the cost of construction keeps the project away from achieving rational exploitation of resources. The study aimed to use Bert and critical path methods to rationalize the use of resources by achieving the required goals with the least time and cost, and the study found that there was a delay in the completion date of construction for 41 days because the executing company adopted the experience and recommendations included the need to use Bert and critical path methods to determine the stages of implementation and follow up on their timing.

- Behzad Montazeri Study, 2017, tagged:
"Comparing Critical Chain Project Management with Critical Path Method: A Case Study"
The study stressed the importance of early completion of projects to raise the efficiency of using financial and human resources, and showed that using the critical chain project management method CCPM made the project duration shorter and improved the efficiency of resource use compared to using the critical path method CPM, because project planning using CCPM addressed the problem of overestimating the time of each activity individually in order to provide backup time to compensate for the potential delay of the activity due to lack of resources in the required timing, which is usually followed when using CPM, while using CCPM, reserve time is excluded for each activity individually and replaced with reserve time in the form of buffers at a project level_. The study found that many operations research textbooks do not address CCPM, as well as the lack of ready-made commercial programs to facilitate their use in Applied Research, and that including them in ready-made programs with the possibility of comparing them with CPM will provide better opportunities to analyze their results.

- Nidal & Can Study, 2018, tagged:
"Development of Construction Planning Strategies for Coastal Project using Monte Carlo Simulation"
The study aimed to prepare a plan for the completion of a port project in Turkey within specific timings and costs in a way that takes into account the risks of implementing critical activities that were diagnosed by applying the critical path method, as Monte Carlo simulation was used to generate random values using the normal distribution of the cost and time of completion of critical activities, where the normal distribution was statistically formulated from similar projects, presented the results of the analysis and outlined the available strategies for Risk Management in order to choose the best.

-Samaher Tarek Ibrahim study, 2019, tagged "the use of the Critical Path Method and the Bert method in planning the stages of manufacturing and production of wooden doors is an applied study in the Mustafa Laboratory in Duhok Governorate", the study adopted the activities of completing the doors of one of the projects as an applied case, the problem included the failure of the laboratory management to use scientific methods in the follow-up this led to an increase in the implementation period by 159 days, and the study recommended developing the capabilities of laboratory staff to use methods Operations Research in the planning and follow-up of the completion of projects.

-Kheniwa Mohammed Al-Amin study, 2023, tagged " the effectiveness of using network analysis in the management of financial resources for construction projects, the case study of the construction project of 1500 housing units in Jijel state," the study explained the possibility of using the Critical Path Method to reduce the project completion time for a period of 2.8 months in conjunction with an increase in direct costs by up to 9%, the study also identified financial savings and the way they are distributed according to the priority completion of project activities.

After reviewing the previous studies, it is clear that what distinguishes this study is that it used the Critical Path Method to determine the nature of the trade-off between the time and cost of completing the Faculty of Law Building

Project at the University of Baghdad, which was commissioned by FAO to implement, where its results were used to determine the financial, economic and social feasibility of the proposal of accelerate the completion of the project by estimating its net present value as the main criterion for deciding whether to implement the proposal or not.

2-theoretical framework: basic concepts of study variables, criteria and models

Developing the skills of employees of business companies and service institutions to discover possible alternatives for the implementation of their production activities and diagnosing the expected gains from them is a key pillar for developing the performance of business sectors in the knowledge economy. In this paragraph, we will present the basic theoretical contents related to the development of human resources skills in the knowledge society and economy, diagnose opportunities to accelerate completion times for real estate development companies using the Critical Path Method, and evaluate financial and economic opportunities to rationalize decision-making.

2.1-the development of human resources is part of the components of the knowledge society and economy

The knowledge economy is based on building the components of the knowledge society and developing capabilities to actively contribute to the generation and exchange of data that leads to the identification of new options and opportunities that may contribute to the development of economic performance of enterprises, which necessarily requires the development of their human resources. The knowledge economy is defined as "the economy based mainly on the production, dissemination and use of knowledge as a basic engine for development and the acquisition of wealth and employment across all economic sectors" (Shtateh, 2022, P:)

As defined by the United Nations Development Program (UNDP) in 2003, "the knowledge economy is the dissemination, production and adequate use of knowledge in all areas of social activity, the economy, civil society, politics and private life to entertain people's lives, that is, the establishment of human development. This requires the building of possible human capabilities and the successful distribution of human capabilities". (UNDP: united naons Development programme, 2003.

Oecd (Organization for Economic Cooperation and development)". Organization for Economic Cooperation and development, knowledge-based economy, Organization for Economic Cooperation and development documents, general regulation 102 of the organization for Economic Cooperation and development, 1996, pp. 9-11.)

To develop human resources management skills in discovering investment opportunities, some steps can be done, including:

Promote and understand market processes and economic trends.

And also develop, strengthen and improve the ability to analyze data and use the appropriate analytical tools for the process.

Significant expansion of professional networks to obtain up-to-date accurate information to create new opportunities at work.

Good training in techniques in negotiation and effective communication of interaction with interested parties at work.

High interest in investing in the development of leadership and motivation skills to achieve organizational and individual effectiveness together.

Access to modern literature and sources in the sciences of Human Resources Management and investment.

Using such strategies, we can enhance the capabilities in exploring investment opportunities and effectively employing professional human resources to achieve investment goals, as the development of skills enhances the elements of strength within the enterprise environment that enable it to invest the available opportunities efficiently compared to its competitors (Skair and Halawi, 2023, 67).

Human resources workers in organizations and companies can be motivated by providing a positive and healthy work environment, providing incentives and financial and in-kind incentive rewards, enhancing teamwork in the spirit of one team in addition to providing opportunities for professional development and training through continuous training programs in the organization, enhancing opportunities for participation in decision-making and listening to their opinions, supporting periodic evaluation systems, achieving the organization's goals, supporting leadership and Professional Responsibility programs inside and outside the organization, and finally creating an environment that balances the life of human resources working in the organization with their working life.

2.2. basic concepts in financial and economic feasibility studies

It is necessary to prepare a feasibility study for each investment project idea that is discovered by the business community from within the beneficiary organization or from outside, as the feasibility study goes through many stages, starting with the discovery of possible investment opportunities, followed by a preliminary study of its feasibility, which may recommend, if the proposed investment opportunity is valid for further study, a detailed feasibility study that includes a marketing and technical feasibility study, then a financial feasibility study that requires the preparation of some financial statements that include the cash flow list, followed using some evaluation criteria that are divided into two parts, the first includes criteria that do not care about the time value for money, while the second includes criteria Take into account the time value of money, especially the net present value criterion, in addition to the study of economic and social feasibility, the use of some appropriate methods to take into account the risk situations and uncertainties generated by the inaccuracy of data on the evaluation results, and finally make a recommendation on whether to implement the investment proposal (kadawi, 2007, 27-154).

The net present Value NPV is one of the most prominent criteria used in assessing the financial feasibility of projects.it expresses the current value of the net cash flows realized from a proposed investment project. the project is accepted if the net present value is greater than zero (NPV > 0) if the necessary funding is available for its implementation and rejected if the net present value is less than zero (NPV < 0). the positive value of NPV indicates an increase in the wealth of the project owners in the event of its implementation, as wealth maximization is a fundamental goal in private projects. The NPV is calculated according to the following formula (Brealey and Others, 2017, 25):-

$$NPV = C_0 + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

C_0: A negative value is usually because it represents an outflow of cash that expresses the cost of investment in zero time.

C_t: Cash flow in year T.

r: Favorable discount rate.

T: the last year of the estimated life of the project.

Suitable working guides are available for the preparation of economic and social feasibility studies to be followed in the evaluation of public government projects, for example, education projects (Pedro Belli and Others, 2001, P:83-98). The cost-benefit method is one of the methods used to measure the profitability of investment for public projects in the field of education by comparing the costs of proposed education projects with the benefits achieved, especially the change in additional income over the life of learners as a direct benefits resulting from developing their skills after providing better buildings and learning supplies, as a project is accepted whose benefit-to-cost ratio is greater than one if the necessary funding is available to complete the project, however, this analysis is difficult to use in determining non-economic benefits of education such as developing students ' skills and absorptive abilities, other techniques can be used such as cost-effectiveness method, which includes achieving a certain goal, such as achieving an ambitious and targeted success rate for students of at least 90%, and choosing the project that achieves the goal at the lowest cost compared to other proposed projects, as this method determines a monetary value for the costs, but it is enough to identify and measure the benefits without specifying a monetary value for them (Maureen Woodhall, 2004, 23-28) .

The financial feasibility study differs from the economic and social feasibility study in the following respects (Abdul Hamid, 2006, 373-376):-

A-the objective of the financial feasibility study is to determine private profitability, while the objective of the economic and social feasibility study is to determine social profitability in light of the strategic objectives of national development plans.

B-in the financial feasibility study, the direct monetary effects that the project earns are exclusively adopted regardless of the indirect effects of other projects associated with it, while the direct and indirect effects are sponsored in economic and social feasibility studies.

C-market prices are used in determining returns and costs in the financial feasibility study, but in the economic feasibility study, shadow prices are used expressing the real value of resources allocated for use in a particular project only.

D. for the purpose of taking into account the time preference of utility and cost flows, the interest rate or the weighted rate of the cost of capital is adopted as an appropriate discount rate in financial feasibility studies, while the social discount rate, expressed as the cost of financial resources from the point of view of society, is adopted in economic and social feasibility studies.

E-taxes and fees are included as cash outflows and government support as cash inflows in the financial feasibility study, while they are excluded from the cash flows in the economic and social feasibility study because they are transformational expenses that remain within the national economy.

Economic and social evaluation of public projects often faces many challenges, for example, it is difficult to estimate the monetary values of each benefits and harms of the project from the point of view of the beneficiaries and those affected by its implementation, while the values of revenues and costs are clearly defined in private sector projects, and it is difficult to determine the social discount rate for deducting cash flows for public projects due to the complexity of procedures for determining the appropriate cost of capital, while the discount rate in private projects is determined in clear ways relatively take Taking into account the weighted average cost of capital as well as opportunity costs, therefore it takes longer to make a decision to invest in public projects compared to the private sector . (Donald G. Newnan and Others, 2012, P:557)

2.3. use the results of the critical path method of proposes accelerating projects in determining their net present value

The What-if analysis that can be provided by many ready-made software for solving operations research models, such as WINQSB, provides one of the possible means to discover many opportunities for investment project proposals and implementation options, and provide the necessary data for their evaluation and Exchange within the knowledge community, which contributes to supporting decision makers to enhance the financial and economic benefits of their organizations ' activities.

CPM Critical Path Method or CPN Critical Path Network is one of the models of operations research that is recommended to be used in planning and following up the completion of projects using one of the ready-made programs for the purpose of using its outputs in the preparation of feasibility studies and project evaluation, especially at the stage of Project Construction, whose activities are carried out in many interrelated stages. (Behrens, 1991, P:244)

The use of the CPM model in the planning and follow-up of a proposed project requires determining the nature of the project and each activity in it, the usual time for its implementation and the fastest time for its implementation in the event that the implementation process can be accelerated from a technical point of view and with the same level of quality of the standards required for the outputs of the activity, in addition to determining the expected cost of each activity according to the two methods of implementation in the usual time and in the fastest time, after which the model can be formulated and reach the optimal solution according to which the normal time for implementing the project is determined, or the shortest possible time for its implementation, or any target time for its implementation, and its total costs and critical and non-critical activities, whether by adopting the normal or accelerated implementation times, since The delay in the implementation time of the critical activity results in a delay in the duration of the completion of the project as a whole, other than non-critical activities that can be delayed within a specific time period without delaying the duration of the project completion, as critical activities fall on at least one critical path, according to which the duration of the project as a whole is determined. CPM models can be

formulated and solved in the form of tables and / or a grid diagram.

CPM models can be used in the planning and follow-up of construction and Real Estate Development Companies ' projects to verify the implementation of their critical activities on time and avoid the consequences of delaying the completion of any project beyond the date specified in the contract between the company and the beneficiary for which the project is being implemented, as the contract often includes compensatory fines to be borne by the company in case of delayed completion and delivery of the project, as well as losses associated with the company's reputation and classification within the sector to which it belongs. The CPM model can also be used to speed up the duration of completion of an activity (if there is a possibility of acceleration) compared to its normal duration through the use of additional labor and production resources at higher costs, thereby providing opportunities to compare the cost of implementation within the normal time of the activity and the higher cost of accelerated implementation time, which can be used to diagnose potential financial, economic and social gains for both the project implementer and the beneficiary for whom the project is being implemented, as the completion of some activities can be accelerated within a specified range between the normal implementation time and the fastest implementation time (Crash time) or any acceleration level along the cost-time trade-off relationship shown in Figure (1). The same method of trade-off between time and cost can be carried out for all other activities and therefore for the project manager to determine the activities to be accelerated, where the project can be completed within the usual time and cost, or completed within the shortest possible time and at high costs, or choose any level between them according to a target period specified by decision makers and at the lowest possible cost. (Frederick S., and Gerald J., 2010, 403-406)
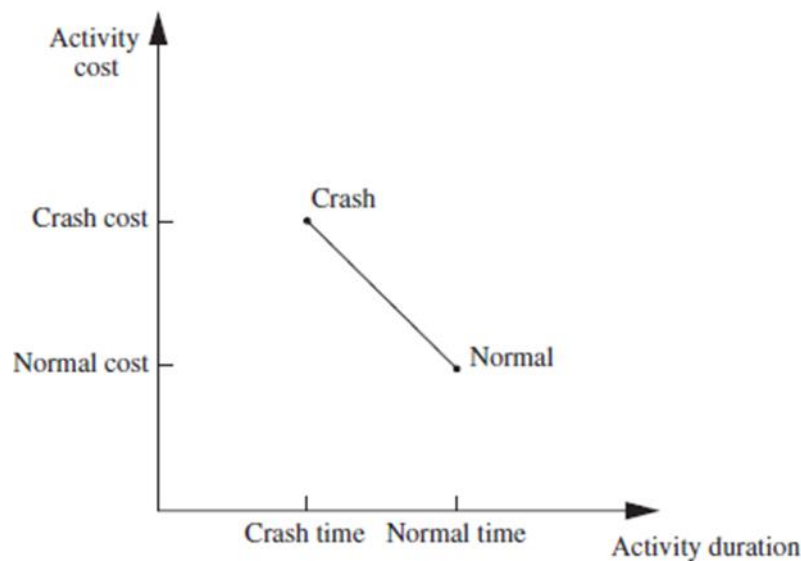

Figure 1 the traditional relationship between the time and cost of completing an activity.

Source: Frederick S. Hillier, And Gerald J. Lieberman, 2010, Introduction to Operations Research, Mcgraw-Hill, Ninth Edition, P:404.

Speeding up the completion time of critical activities entails speeding up the completion of the project and changing the values of annual cash inflows (Revenue R) and timings achieved and the values of annual cash outflows (Cost C) and timings achieved, thus determining the expected cash flow from the idea of accelerating the implementation of the project and its net present value achieved, as the proposal will be feasible according to the financial study if NPV >0, and financial gains will be realized from its implementation, and additional gains will be automatically achieved according to the economic and social feasibility study represented by accelerating the benefits of the proposal from the point of view of society and the national economy.

The following observations should be taken into account when estimating the expected cash flow from any proposed investment project as a previous step to assess its financial feasibility and calculate its net present value (Mansfield, 1999, 566) :-

A-the need to carry out an analysis based on the increased value, which refers to the assessment of the cash surplus of any project as equal to the difference between its value in the event of the implementation of the project and its value in the event of non-implementation.

B- The adoption of the value of the cash flow after tax for the purpose of studying the financial feasibility.

C - Attention should be paid to estimating the level of effects resulting from the project on the expected cash flow. For example, the proposal of a new product for an existing company may result in an increase in profits achieved from it simultaneously with a decrease in sales of its other products and, consequently, a decrease in its contribution to achieving profits.

The expected cash flow from the proposed project is estimated at the end of each year, and it is equal to the increased value realized from the project for the after-tax cash flow $\Delta\pi$, which expresses the change in net income realized after tax if the project is implemented, in addition to the change in depreciation ΔD , i.e. that:-

$$F = \Delta\pi + \Delta D \qquad \text{..................................1}$$

$$\Delta\pi = \Delta B(1-t) \qquad \text{.................................2}$$

Since ΔB represents the change in income before tax, and t represents the tax rate on profits, thus the: -

$$F = \Delta B(1-t) + \Delta D \qquad \text{............................3}$$

$$F = (\Delta R - \Delta C - \Delta D)(1-t) + \Delta D \qquad \text{............4}$$

ΔR and ΔC represent the change in revenue and the change in operating costs, respectively.

3-application and results: using the outputs of the CPM model in calculating the NPV for the proposal to accelerate the completion of the Faculty of Law Building

The University of Baghdad includes a number of colleges, some of which are located inside the campus in the jadiriyah area, while others are located outside the jadiriyah complex, including the College of law, which is located in the waziriyah area, where the site area is 19,107 square meters and includes a number of buildings according to the site plan shown in Appendix 1. The University of Baghdad has contracted with al-Faw general engineering company, one of the formations of the Ministry of construction, housing and public municipalities, to establish a building for the faculty of law inside the university campus. Appendix 2 explains the project activities and the time required to complete each activity and its cost according to the usual and fastest implementation time.

Bearing the costs of completing the building of the Faculty of law and the transition of its community of teachers, students and employees from their building in the waziriyah area to the new building within the campus of the University of Baghdad entails achieving economic and social gains represented by improving the quality of education by providing a model building for the college and enabling the college community to benefit from educational and research services, recreational and sports facilities at the university, such as the Central Library, its parks, clubs, squares, halls dedicated to sports activities and conference halls, in addition to facilitating the requirements of completing multidisciplinary research projects within attendance sessions in cooperation with the communities of other colleges at the university, as the above results in developing the productivity of the University and the skills of its community in a way that reflects positively on the present values of their expected future incomes, where it is assumed to take into account the benefits mentioned above and compare them with the costs when preparing the economic and social feasibility study of the building project. An economic and social feasibility study has been prepared and, according to its recommendations, the college building has been included in the University's investment plan. FAW has been contracted to carry out construction works according to the usual costs and duration of completion.

The provision of an appropriate working environment and effective management of human resources in Faw company, in addition to appropriate incentives that arouse the determination of engineers and employees and motivate them to perform the work assigned to them, and the development of their skills related to the use of the CPM model in discovering available options to accelerate the completion of any project that the company has committed to implement within the specified time according to the contract concluded and the resulting increase in the costs borne by the company, in conjunction with the development of effective communication and negotiation skills with their counterparts in the institutions and organizations for which projects are implemented for the purpose of cooperation in the field of successful marketing of these options by contributing to estimating the financial implications on the wealth of institutions and organizations Through the NPV account for the available options and the conclusion of new contracts that guarantee joint gains from the acceleration projects in which it is NPV>0 .

Based on the above, the Applied side of this study will focus on using the NPV net present value index to study the financial feasibility of the proposal to accelerate the completion of the Faculty of Law Building from the point of view of the University of Baghdad as an entity that may be a beneficiary of the proposed project to be an appropriate model that can be used to develop the financial performance of any public or private institution for which an investment project can be completed, including the construction of buildings implemented by one of the construction and real estate development companies in order to achieve the interests of the beneficiary and the executing entity of the project. Additional gains will automatically be achieved according to the criteria of economic and social feasibility in the event of speeding up the completion of the building, which is to accelerate the college community's access to the desired benefits of the project.

The CPM critical path model has been formulated for the implementation of the Faculty of Law Building shown in Table 1

Table 1 formulation of the critical path model for the Faculty of law building project commissioned by FAW

Activity Number	Activity Name	Immediate Predecessor (list number/name, separated by ',')	Normal Time	Crash Time	Normal Cost	Crash Cost
1	A		15	10	35	40
2	B	1	15	7	20	23
3	C	2	24	24	40	40
4	D	3	38	38	120	120
5	E	4	15	15	8	8
6	F	5	15	15	56	56
7	G	6	67	37	782	900
8	H	7	25	20	55	60
9	I	8	17	10	4.62	5.5
10	J	9	9	9	4.62	4.62
11	K	10	20	20	49.5	49.5
12	L	11	44	44	287.08	287.08
13	M	12	51	51	728.72	728.72
14	N	13	61	61	400	400
15	O	14	15	15	90	90
16	P	11	22	22	15	15
17	Q	14	35	35	42.5	42.5
18	R	13	25	13	140	150
19	S	18	25	25	10	10
20	T	8	15	15	42	42
21	U	15	35	35	205.2	205.2
22	V	15	25	10	9.7	10.5
23	W	22	95	80	404.4	450
24	X	23	70	50	41.7	48
25	Y	24	20	20	15	15
26	Z	24	30	30	67.5	67.5
27	Activity27	24	75	50	240	270
28	Activity28	27	60	45	64	70
29	Activity29	27	45	35	260	270
30	Activity30	23	25	20	44	46
31	Activity31	29	22	12	36	37
32	Activity32	15	40	40	168	168
33	Activity33	15	40	40	18	18
34	Activity34	32	30	15	3.75	4
35	Activity35	24	25	25	6.5	6.5
36	Activity36	24	20	10	1.75	2
37		23	55	35	12	15
38		23	93	80	135	145
39		23	70	70	16	16
40		26	22	22	6.25	6.25
41		29	23	23	52.5	52.5
42		41	35	35	12	12
43		23	44	30	5.5	6.5
44		23	42	30	19.2	21
45		23	44	35	137.5	141
46		23	60	45	116.125	119
47		24	15	7	1.8	2
48		47	12	7	2.25	3
49		48	21	9	1.54	2
50		49	34	20	5.6	6
51		50	25	10	3.5	4
52		14	89	45	313.402	330
53		52	55	35	470.104	500
54		7	80	60	67.444	70
55		54	79	45	101.166	120
56		14	98	75	1879.827	1890

Source: prepared by researchers using the WINQSB program and based on the data of Appendix 2.

The optimal solution of the model was achieved by adopting the normal execution time of the college building shown in Table 2 .

Table 2 report the results of solving the critical path model for the Faculty of law building using the normal execution time.

10-03-2023 09:01:15	Activity Name	On Critical Path	Activity Time	Earliest Start	Earliest Finish	Latest Start	Latest Finish	Slack (LS-ES)
1	A	Yes	15	0	15	0	15	0
2	B	Yes	15	15	30	15	30	0
3	C	Yes	24	30	54	30	54	0
4	D	Yes	38	54	92	54	92	0
5	E	Yes	15	92	107	92	107	0
6	F	Yes	15	107	122	107	122	0
7	G	Yes	67	122	189	122	189	0
8	H	Yes	25	189	214	189	214	0
9	I	Yes	17	214	231	214	231	0
10	J	Yes	9	231	240	231	240	0
11	K	Yes	20	240	260	240	260	0
12	L	Yes	44	260	304	260	304	0
13	M	Yes	51	304	355	304	355	0
14	N	Yes	61	355	416	355	416	0
15	O	Yes	15	416	431	416	431	0
16	P	no	22	260	282	777	799	517
17	Q	no	35	416	451	764	799	348
18	R	no	25	355	380	749	774	394
19	S	no	25	380	405	774	799	394
20	T	no	15	214	229	784	799	570
21	U	no	35	431	466	764	799	333
22	V	Yes	25	431	456	431	456	0
23	W	Yes	95	456	551	456	551	0
24	X	Yes	70	551	621	551	621	0
25	Y	no	20	621	641	779	799	158
26	Z	no	30	621	651	747	777	126
27	Activity27	Yes	75	621	696	621	696	0
28	Activity28	no	60	696	756	739	799	43
29	Activity29	Yes	45	696	741	696	741	0
30	Activity30	no	25	551	576	774	799	223
31	Activity31	no	22	741	763	777	799	36
32	Activity32	no	40	431	471	729	769	298
33	Activity33	no	40	431	471	759	799	328
34	Activity34	no	30	471	501	769	799	298
35	Activity35	no	25	621	646	774	799	153
36	Activity36	no	20	621	641	779	799	158
37	Activity37	no	55	551	606	744	799	193
38	Activity38	no	93	551	644	706	799	155
39	Activity39	no	70	551	621	729	799	178
40	Activity40	no	22	651	673	777	799	126
41	Activity41	Yes	23	741	764	741	764	0
42	Activity42	Yes	35	764	799	764	799	0
43	Activity43	no	44	551	595	755	799	204
44	Activity44	no	42	551	593	757	799	206
45	Activity45	no	44	551	595	755	799	204
46	Activity46	no	60	551	611	739	799	188
47	Activity47	no	15	621	636	692	707	71
48	Activity48	no	12	636	648	707	719	71
49	Activity49	no	21	648	669	719	740	71
50	Activity50	no	34	669	703	740	774	71
51	Activity51	no	25	703	728	774	799	71
52	Activity52	no	89	416	505	655	744	239
53	Activity53	no	55	505	560	744	799	239
54	Activity54	no	80	189	269	640	720	451
55	Activity55	no	79	269	348	720	799	451
56	Activity56	no	98	416	514	701	799	285
	Project	Completion	Time	=	799	days		
	Total	Cost of	Project	=	$7,874.25	[Cost on	CP =	$3,700.84]
	Number of	Critical	Path(s)	=	1			

Source: prepared by researchers using the WINQSB program.

Table 2 shows the report of the results of solving the model according to the method of implementing the building in normal time, as the completion time reached 799 days at a cost of 7874.25 million dinars. The WINQSB program provides options for displaying the results of the trade-off between the execution time and its cost shown in Table 3

and Figure 2, as any target acceleration level for the completion of the building and the corresponding cost can be selected to calculate the change in annual revenue and costs compared to the method of execution in normal time and evaluate the target acceleration proposal using the NPV standard.

Table 3 the trade-off between time and cost for the project to accelerate the completion of the Faculty of Law Building.

Time T) day (	Cost (million dinar)
799	7874.25
760	7881
730	7904
700	7947
670	8055
659	8098.83

Source: from the work of researchers based on the results of the acceleration analysis (Crashing analysis) of the CPM model available within the WINQSB program.
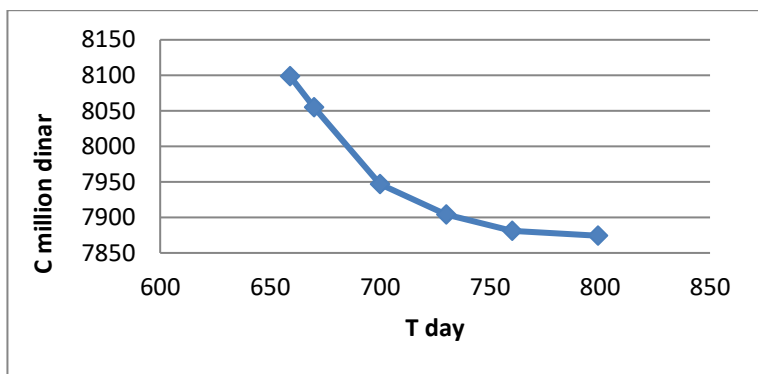

Fig. 2: the trade-off between time and cost for a project to accelerate the completion of the Faculty of Law Building
Source: from the work of researchers using the EXCEL program and based on the data of Table 3.

According to the data of Table 3, the delivery time of the college building can be approximated by a maximum of 140 days so that the fastest completion time is 659 days instead of the usual completion time of 799 days, and this will require an increase in costs by 224.58 million dinars so that the fastest completion costs are 8098.83 million dinars instead of the usual completion costs of 7874.25 million dinars. Here, the management of the FAO company can offer the University of Baghdad the opportunity to accelerate the delivery of the building by 140 days in exchange for the university to bear the increased costs by at least 224.58 million dinars according to the results of negotiations between the parties.

Accelerating the receipt of the college building entails opportunities to achieve possible financial and economic profits for the University of Baghdad, where financial profits can be achieved from accelerating the start of operation of any proposed investment for the waziriyah site for a specific period of time, which will result in accelerating the University's access to income flows from investment, as the above will be reflected positively on the current value of the change in revenues, if it exceeds the current value of the change in costs, the proposal to accelerate the completion of the building will be financially feasible because the net present value will be positive (NPV > 0), and other economic and social gains will be achieved by accelerating the access of the Faculty of law community to educational requirements the best.

Table 4 shows the method of calculating the NPV that the University of Baghdad will achieve from the proposal to

accelerate the completion of the new college building by 140 days instead of adopting the duration of its completion at the usual time, which required diagnosing the annual change in revenue values, costs and deprecation to determine the cash flow F and NPV as follows: -

A-calculation of the change in costs ΔC: - because the university owns the land where the new law school building will be erected, so the university will bear the construction costs only. For the purpose of calculating ΔC, the cash outflows (Cost C) of the two construction execution cases were estimated according to the time taken as follows: -

The first case is the implementation of construction in the usual time: the implementation in the usual time takes approximately 2.189 years (799/365 = 2.189), the construction costs of the project amount to 7874.25 million dinars, and the costs of C1 will amount to 3597.19 million dinars at the beginning of both the first and second years (7874.25/2.189 =3597.19), while the beginning of the third year carries costs of approximately 679.87 million dinars (3597.19*0.189= 679.87)**.**

The second case is the implementation of construction in the fastest time: the implementation in the fastest time takes approximately 1.805 years (659/365 = 1.805), the costs when accelerating the completion of the project will amount to 8098.83 million dinars, and the costs C2 will amount to 4486.886 million dinars at the beginning of the first year (8098.83/1.805 =4486.886), while the beginning of the second year carries costs of approximately 3611.943 million dinars (4486.886*0.805=3611.943).

B-calculation of the change in revenue ΔR :- It will be possible for the Faculty of law community to move to the new site, which will provide the opportunity to lease the old Waziriyah site, which has an area of 19107 square meters, for a period equal to the life span of the new building of 50 years, as the annual rent allowance paid at the beginning of each year is estimated at 400 million dinars, which will represent an internal cash flow (Revenue R) for all years of revenue except the first and last years of operation (rent), where the first part of the annual rental income is realized and the remaining part is completed in the last year, and there will be no residual value for the building. For the purpose of calculating ΔR, the revenue for the two cases of construction execution was estimated according to the time It takes as follows: -

The first case is the implementation of the construction at the normal time: the revenue flow begins R1 during the third year after the expiration of 0.189 years of it, so the duration of the revenue flow during the third year is approximately 0.811 years, and the value of the revenue during the third year is 324.4 million dinars (0.811*400=324.4), so the revenue of the last year is 75.6 million dinars (400-324.4=75.6).

The second case is the implementation of construction in the fastest time: the revenue flow begins R2 during the second year after the expiration of 0.805 years of it, and the duration of the revenue flow during the second year is approximately 0.195 years, and the value of the revenue flow during the second year is 78 million dinars (0.195*400=78), thus the revenue of the last year is 322 million dinars (400-78=322).

C-calculation of the change in the depreciation premium ΔD for the two cases of construction execution according to the time taken to complete the building and using the fixed depreciation premium method and at a rate of 2% approved for buildings as follows: -

The first case is the extinction premium according to the costs of implementing the building in the normal time D1: the construction costs in the normal time are 7874.25 million dinars, so the annual extinction premium is 157.485 million dinars (7874.25*0.02=157.485).

The second case is the extinction premium according to the construction costs in the fastest time D2: the construction costs in the fastest time are 8089.83 million dinars, so the annual extinction premium is 161.976 million dinars (8098.83*0.02=161.976).

Table 4: calculation of the net present value NPV that the University of Baghdad will achieve from the proposal to accelerate the completion of the faculty of law building by 140 days.

F	ΔD			ΔC			ΔR			
F=(ΔR-ΔC-ΔD)(1-t)+ΔD	ΔD	D2	D1	ΔC	C2	C1	ΔR	R2	R1	/years
-889.686	0	0	0	889.686	4486.886	3597.2	0	0	0	0
-14.743	0	0	0	14.743	3611.943	3597.2	0	0	0	1
757.87	0	0	0	-679.87	0	679.87	78	78	0	2
75.6	161.976	161.976	0	0	0	0	75.6	400	324.4	3
0	4.491	161.976	157.485	0	0	0	0	400	400	4
0	4.491	161.976	157.485	0	0	0	0	400	400	5
0	4.491	161.976	157.485	0	0	0	0	400	400	6
0	4.491	161.976	157.485	0	0	0	0	400	400	7
0	4.491	161.976	157.485	0	0	0	0	400	400	8
0	4.491	161.976	157.485	0	0	0	0	400	400	9
0	4.491	161.976	157.485	0	0	0	0	400	400	10
0	4.491	161.976	157.485	0	0	0	0	400	400	11
0	4.491	161.976	157.485	0	0	0	0	400	400	12
0	4.491	161.976	157.485	0	0	0	0	400	400	13
0	4.491	161.976	157.485	0	0	0	0	400	400	14
0	4.491	161.976	157.485	0	0	0	0	400	400	15
0	4.491	161.976	157.485	0	0	0	0	400	400	16
0	4.491	161.976	157.485	0	0	0	0	400	400	17
0	4.491	161.976	157.485	0	0	0	0	400	400	18
0	4.491	161.976	157.485	0	0	0	0	400	400	19
0	4.491	161.976	157.485	0	0	0	0	400	400	20
0	4.491	161.976	157.485	0	0	0	0	400	400	21
0	4.491	161.976	157.485	0	0	0	0	400	400	22
0	4.491	161.976	157.485	0	0	0	0	400	400	23
0	4.491	161.976	157.485	0	0	0	0	400	400	24
0	4.491	161.976	157.485	0	0	0	0	400	400	25
0	4.491	161.976	157.485	0	0	0	0	400	400	26
0	4.491	161.976	157.485	0	0	0	0	400	400	27
0	4.491	161.976	157.485	0	0	0	0	400	400	28
0	4.491	161.976	157.485	0	0	0	0	400	400	29
0	4.491	161.976	157.485	0	0	0	0	400	400	30
0	4.491	161.976	157.485	0	0	0	0	400	400	31
0	4.491	161.976	157.485	0	0	0	0	400	400	32

0	4.491	161.976	157.485	0	0	0	0	400	400	33
0	4.491	161.976	157.485	0	0	0	0	400	400	34
0	4.491	161.976	157.485	0	0	0	0	400	400	35
0	4.491	161.976	157.485	0	0	0	0	400	400	36
0	4.491	161.976	157.485	0	0	0	0	400	400	37
0	4.491	161.976	157.485	0	0	0	0	400	400	38
0	4.491	161.976	157.485	0	0	0	0	400	400	39
0	4.491	161.976	157.485	0	0	0	0	400	400	40
0	4.491	161.976	157.485	0	0	0	0	400	400	41
0	4.491	161.976	157.485	0	0	0	0	400	400	42
0	4.491	161.976	157.485	0	0	0	0	400	400	43
0	4.491	161.976	157.485	0	0	0	0	400	400	44
0	4.491	161.976	157.485	0	0	0	0	400	400	45
0	4.491	161.976	157.485	0	0	0	0	400	400	46
0	4.491	161.976	157.485	0	0	0	0	400	400	47
0	4.491	161.976	157.485	0	0	0	0	400	400	48
0	4.491	161.976	157.485	0	0	0	0	400	400	49
0	4.491	161.976	157.485	0	0	0	0	400	400	50
0	4.491	161.976	157.485	0	0	0	0	400	400	51
-78	4.491	161.976	157.485	0	0	0	-78	322	400	52
-75.6	-157.485	0	157.485	0	0	0	-75.6	0	75.6	53
($220.98)	$154.11	$1,327.24	$1,173.13	$341.21	$7,770.47	$7,429.26	$120.23	$3,341.54	$3,221.31	Current values

Source: prepared by researchers, where the present values were calculated using the NPV function available in the Microsoft Excel program under the list of Formulas.

Notes:

- R1 and R2 represent revenues according to the methods of execution of the building in the normal time and the fastest time, respectively.
- C1 and C2 represent the costs according to the methods of execution of the building in the normal time and the fastest time, respectively.
- D1 and D2 represent the deprecation premiums according to the methods of execution of the building in the normal time and the fastest time, respectively.
- Do not deduct taxes on the revenues of the University of Baghdad because it is a government institution, so the tax rate t is equal to zero%.
- The lease term of the waziriyah site was estimated to be equal to the life span of the new college building of 50 years, as the extinction premiums after fifty years recover the cost of construction.
- Estimate the appropriate discount rate at 10%.

The results of Table 4 show that the project to accelerate the completion of the building resulted in the following: -

A-the current value of the change in revenues ΔR was recorded at 120.23 million dinars, which is equal to the subtraction of the current value of R1 of 3221.31 million dinars from its counterpart to R2 of 3341.54 million dinars, as the above was achieved as a natural result of accelerating the revenue flow began during the second year instead of the third year due to speeding up the completion of the building by 140 days.

B - the current value of the change in costs ΔC was recorded at 341.21 million dinars, which is equal to the subtraction of the current value of C1 of 7,429.26 million dinars from its counterpart to C2 of 7,770.47 million dinars, as the above was achieved as a natural result of the high costs of accelerating the completion of the project on the one hand and shortening the duration of its implementation on the other hand, as the flow of costs was limited according to the implementation program at the fastest time during the first year and part of the second year, which is less period than costs flow into it during the first, second and part of the third year.

C-the current value of the change in the extinction premium ΔD was recorded at 154.11 million dinars, which is equal to the subtraction of the current value of D1 of 1173.13 million dinars from its counterpart of D2 of 1327.24 million dinars, as the above was achieved as a natural result of the high costs of accelerating the completion of the project, in addition to the start of deducting deprecation premiums a year faster. Although the change in the depreciation premiums ΔD did not contribute to determining the values of the cash surplus F and the net present value NPV because the tax rate t is equal to zero because there are no taxes imposed on the revenues of public government institutions, however, the inclusion of their calculations in Table 4 is useful in clarifying the method of applying the mathematical formula 4 in calculating the values of F, as it clarifies the role of ΔD values in determining the values of profits after Tax and F and NPV in the event that AL-FAO company deals with private institutions subject to the tax rate t when they are $(1 > t > 0)$.

D- a negative present value of cash flow F (Net Present Value NPV) was recorded at -220.98 million dinars as a natural result of an increase in the present value of the change in costs ΔC of 341.21 million dinars over its counterpart to the change in revenues ΔR of 120.23 million dinars, as the difference between them is equal to the value of NPV because the tax rate is equal to zero.

The data and results of this study show that it is not possible to conclude an agreement between FAW General company and the University of Baghdad to accelerate the completion of the faculty of law building by 140 days due to its lack of financial feasibility because NPV < 0 and the revenue achieved from it are less than its costs.

It is also clear that the NPV values of any proposed investment project that includes speeding up the completion period of the investment can improve and

negative values may become positive if the current value of ΔR is recorded greater than its counterpart of ΔC and lead to the implementation of the project if its funding sources are available, as other variables remain constant, the value of NPV improves in projects to speed up the completion period of the investment, especially the college building project implemented by AL-FAO company. As a result of what follows: -

A- Rise expected annual returns from the implementation of the investment, regardless of the speed of its completion, such as an increase in the annual rent allowance for the waziriyah site to a level greater than 400 million dinars and/or continued to be achieved for a longer period.

B-the increase in the values of revenues in the first years of their flows, for example, if the lease contract of the site of the waziriyah site includes the delivery of rent allowance for two or more years in the first year.

C-Reducing the required increase in the costs of accelerating the implementation, which is technically possible, if FAW engineers have come up with innovative methods that allow reducing the costs of accelerating some critical activities of the college building project implementation plan.

D-A low appropriate discount rate, due to a decrease in the opportunity cost of capital in the sector or to other factors that reduce the cost of financing economic activities in general.

E-Recording a greater level of decrease for the accelerated completion period of the project, especially for some large projects whose completion period can be reduced by more than one year, as the above leads to an early start to achieve positive net cash flows for the years of their flow and thus an increase in their current values.

The NPV value can also become positive for the project of accelerating the completion of the college building by choosing an accelerated completion period greater than 659 days and less than the normal execution time period from the alternatives available in Table 3, and/ or achieve some reasons that improve the NPV value mentioned above.

In general, all proposals to accelerate the completion of projects implemented by construction and real estate development companies should be studied in accordance with the methodology applied to the proposal to accelerate the building of the faculty of law for the possibility of achieving financial and economic gains for the executing entity and the beneficiary of accelerating the completion of investment projects whose net current values are positive.

The importance of using CPM models increases with the increasing details of the activities and size of the projects, as the completion of the Faculty of law building project is very small compared to other projects, for example, the completion of a port project, and the risks associated with the delay in the completion of critical activities and/ or their high costs resulting from inaccuracies in estimating the duration and cost of the project, or due to the inability to provide some material or human resources on time, or due to climatic or security conditions and their effects on the workflow, where many options can be used to include risks for consideration within feasibility studies, most notably the use of Monte Carlo simulators.

First: conclusions: -

A-the study of accelerating the completion of the Faculty of law building for a period of 140 days showed the possibility of using the outputs of CPM models containing data on the relationship between the time of completion of the project and its cost in calculating NPV, although the overall assumptions of the study resulted in a negative value of NPV, but any logically acceptable change to these assumptions may make the value of NPV positive and the proposal becomes financially and economically feasible. The same method used in the study can be applied to proposals to accelerate the completion of other projects, where financial and economic gains are achieved from their implementation if the NPV > 0 and their funding sources are available.

B-the method used in the study can be developed to take into account the risks of inaccuracy of the data adopted in the NPV calculation of the proposals to accelerate the completion of projects to provide financial and economic decision makers with an appropriate perception of the nature of the risks associated with the use of CPM results in the NPV calculation, where the Monte Carlo simulation method can be used to estimate the results of the use of CPM and its impact on the NPV results.

C-The Behzad Montazeri study clarified the importance of the literature on the critical chain project management method CCPM and the provision of commercial programs that facilitate its application as a methodology for scheduling construction projects and facilitate the analysis of its results and comparison with CPM analogues in order to use time and resources in the best possible way, however, the study did not address the impact of using CCPM or CPM on the cash flows of the entity implementing the project and on NPV as the main financial criterion for evaluation.

D-the financial and economic performance of construction and real estate development companies as executors of some investment assets can be improved by developing the skills of their cadres to contribute to the generation and analysis of appropriate data to make decisions related to accelerating the completion of investment assets using CPM and using their outputs in the NPV account.

E-the development of communication and cooperation skills between the employees of the companies executing the investment and the institutions for whose benefit the investment is carried out is an essential step that allows discovering proposals to accelerate the completion of projects and evaluating them in order to make decisions that enhance financial and economic performance and achieve joint gains for their institutions resulting from their contribution to enhancing the components of the knowledge society and economy.

Second: recommendations: -

A-encourage the use of CPM in real estate development companies to plan the activities of their projects and analyze the relationship between the time and cost of their completion, and use the results of the analysis in the financial evaluation of proposals to accelerate projects through the NPV account and approve them if NPV > 0.

B-providing the necessary requirements to develop the skills of employees in construction and real estate development companies to use CPM using ready-made programs in planning project activities and providing appropriate data to discover opportunities to accelerate some projects.

C-developing communication and cooperation skills between the employees of real estate development companies and the employees of the institutions benefiting

from their services for the purpose of presenting opportunities to accelerate the completion of projects, evaluating them financially and contributing to making decisions that enhance the financial and economic performance of their institutions.

D-presenting CCPM as well as CPM within the curricula specialized in scheduling projects, seeking to provide ready-made programs to facilitate their use, and encouraging the completion of further studies to compare the effects of their application on cash flows and NPV values as a key criterion for evaluating financial results from the point of view of the entity implementing the projects.

E-developing the current study to take into account the risks of inaccuracy of time and cost estimates for critical activities and their reflection on the NPV standard through the use of Monte Carlo simulation to employ its results in choosing the appropriate strategy to deal with these risks.

Appendix 1 : general outline of the faculty of law.
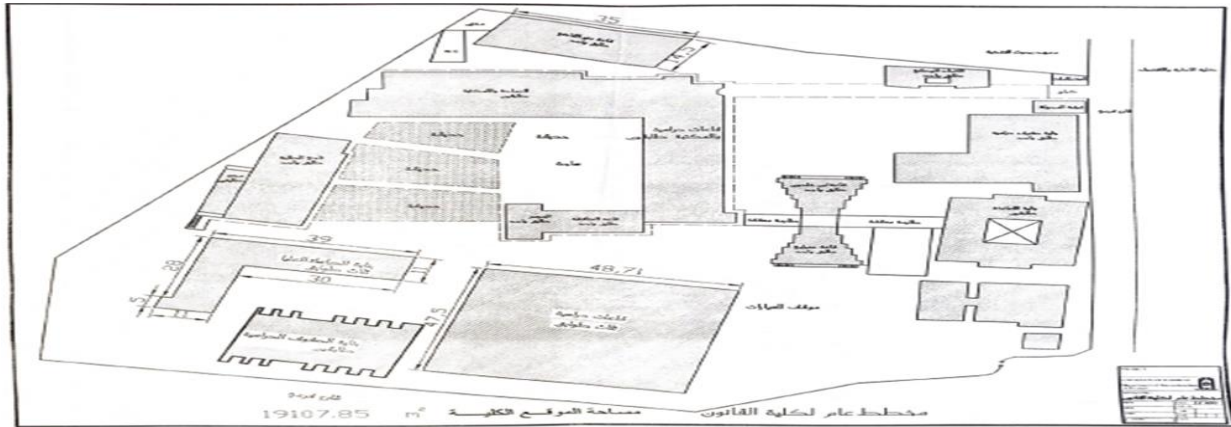
Source: University of Baghdad / Department of construction and projects.

Appendix 2 data of the stages, timing and cost of implementing the activities of the faculty of law building that was commissioned by FAO to accomplish (million dinars).

Activity number	Name of activity	Activity description	Previous activity number	Normal activity time (day)	The fastest activity time (day)	usual cost	cost of the fastest time
1	A	location preparation works, processing of materials and equipment, making a fence around it	...	15	10	35	40
2	B	Settlement and location planning	1	15	7	20	23
3	C	Earth excavation works and water withdrawal, if any	2	24	--	40	--
4	D	Burial with gravel 50 cm thick with humus	3	38	--	120	--
5	E	Spraying a layer of chlordine	4	15	--	8	--
6	F	Pouring concrete under the foundation with a thickness of 10 cm using resistant cement	5	15	--	56	--
7	G	Reinforced concrete casting works for strip foundations with lime coating	6	67	37	782	900
8	H	Works of pouring column bases over foundations using resistant cement	7	25	20	55	60
9	I	Gravel works with dirt below the T.B	8	17	10	4.62	5.5
10	J	Pour weak concrete under the T.B	9	9	--	4.62	--
11	K	Pouring the foundation bond using resistant cement with lime coating	10	20	--	49.5	--
12	L	Casting of columns and work of bracketing with polished facets	11	44	--	287.08	--
13	M	Reinforced concrete pouring works for bridges with smooth faces	12	51	--	728.72	--
14	N	Pouring reinforced concrete for ceilings	13	61	--	400	--
15	O	Pouring reinforced concrete for curtains	14	15	--	90	--

16	P	Reinforced concrete pouring works for the foundations of drawers	11	22	--	15	--
17	Q	Reinforced concrete pouring works for drawers and drawer plates	14	35	--	42.5	--
18	R	Reinforced concrete casting works with B.R.C) for the basis	13	25	13	140	150
19	S	Reinforced concrete pouring for the foundations of the internal sectors	18	25	--	10	--
20	T	Reinforced concrete pouring works for the foundation of sun umbrellas	8	15	--	42	--
21	U	molding precast concrete	15	35	--	205.2	--
22	V	D.P,C concrete	15	25	10	9.7	10.5
23	W	Bick work 12,24 cm	22	95	80	404.4	450
24	X	Cement plastering	23	70	50	41.7	48
25	Y	Cement plastering	24	20	--	15	--
26	Z	Sheathing of facades with stone	24	30	--	67.5	--
27	Activity27	Juss plastering	24	75	50	240	270
28	Activity28	Painting work	27	60	45	64	70
29	Activity29	Mozaiec tilling	27	45	35	260	270
30	Activity30	Ceramic tiling	23	25	20	44	46
31	Activity31	Skirting with marbele 8cm	29	22	12	36	37
32	Activity32	Topping the roof with conc. Tiles	15	40	--	168	--
33	Activity33	Cover of parapets work	15	40	--	18	--
34	Activity34	Rain water pine	32	30	15	3.75	4
35	Activity35	plastering for pumping rooms 5 cm	24	25	--	6.5	--
36	Activity36	Topping path floors	24	20	10	1.75	2
37	Activity37	Metal false ceiling	23	55	35	12	15
38	Activity38	Accostic tiles false ceiling	23	93	80	135	145
39	Activity39	Haierib false ceiling	23	70	--	16	--
40	Activity40	Filling expansion joints with poly slephate under rubber role	26	22	--	6.25	--
41	Activity41	Tilling the staircase with mozaiec steps and riser	29	23	--	52.5	--
42	Activity42	Hand rale for staircase	41	35	--	12	--
43	Activity43	Steel doors	23	44	30	5.5	6.5
44	Activity44	Steel doors – glazed partition	23	42	30	19.2	21
45	Activity45	Steel windows	23	44	35	137.5	141
46	Activity46	Wood doors	23	60	45	116.125	119
47	Activity47	Walkways excavation	24	15	7	1.8	2
48	Activity48	Broken brick under walkway	47	12	7	2.25	3
49	Activity49	Casting walkways	48	21	9	1.54	2
50	Activity50	Brick work for walk ways	49	34	20	5.6	6
51	Activity51	Casting walkways	50	25	10	3.5	4
52	Activity52	Electrical work	14	89	45	313.402	330
53	Activity53	Fitting electric work	52	55	35	470.104	500
54	Activity54	plumping work	7	80	60	67.444	70
55	Activity55	Fitting plumping work	54	79	45	101.166	120
56	Activity56	mechanical works	14	98	75	1879.827	1890

Source: FAW general engineering company, planning and follow-up section, planning division.

Note: the time and cost of the fastest implementation was estimated by the head of Engineers Akram Kazim Mohammed/ planning and follow – up department, and (-) indicates the inability to speed up the activity.

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