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THE FEASIBILITY OF A PROJECT TO ESTABLISH MAINTENANCE AND REHABILITATION WORKSHOPS FOR GAS AND STEAM TURBINES IN IRAQ TO ACHIEVE SAVINGS AND STOP FINANCIAL WASTE

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Abstract

The current study focused on providing a preliminary view regarding the establishment of a project for turbine maintenance workshops for electricity in Baghdad. Moreover, it also focused on efficient maintenance methods and measuring the generated energy. Nonetheless, the results were all positive after estimating the project revenues and operating costs, conducting field surveys, and making all predictions based on the market study. Therefore, we can depend on these results to establish a turbine maintenance workshop project in Baghdad to serve energy projects for the whole electrical system in Iraq. Based on the results of the market study conducted, cash flows, and income statement, the study recommended granting an investment opportunity to establish gas turbine maintenance workshops in Baghdad because all the results were positive for establishing such a project.

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Keywords: economic feasibility, electric energy, business enterprises

Introduction

One of the most fundamental engines is a gas turbine, which uses different kinds of fuel to generate mechanical and electrical energies. These turbines require periodic preventive and spot maintenance, where the cost of spare parts and maintenance is quite high, just like at any other station. An initiative to construct facilities for repairing and rehabilitating gas and steam turbines inside the boundaries of Baghdad is supposed to cover 25,000 square meters. The services provided by the project include the rehabilitation of steam and gas turbines and the construction of a hot path for gas and steam production plants. It also includes the establishment of a specialized workshop to rehabilitate gas and steam turbines for all types of electrical stations and turbine engines. Furthermore, the project includes rehabilitating and developing the machines and specialized equipment belonging to the generating unit repair factory workshop and transferring advanced rehabilitation and maintenance technology to the country. The proposed time period for the project to provide the service according to the work progress schedule is three actual work years.

Methodology

The research importance

The significance of energy in Iraq is emphasized by the research, particularly in light of the suffering from war for decades, exceptional security issues, and challenges of financial and administrative corruption. These challenges were reflected in the final services provided for the Iraqi citizen, the state of satisfaction that was lost, the state of dissatisfaction prevailing, and the large waste of money spent on the maintenance of electricity plants to no avail. In addition, the investment sector was affected by the lack of electricity, and the health services were damaged and the environment was polluted due to increased reliance on private electricity generators.

The research objective

The research aims at measuring the feasibility of a project to establish an exceptional central maintenance workshop at the level of Iraq and the region by determining the necessary investment costs for the project in addition to the operational costs and measuring the feasibility of the project after determining the

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expected revenues and extracting financial ratios. The investing company is truly interested in putting an end to financial waste and reactivating a large portion of the electrical production capacity within the investment frameworks. To do this, they plan to successfully complete the task by using resources, particularly technical and administrative competence. This may lead to an indispensable goal, which is the high quality of service outputs and ensuring the preservation of the investor's reputation. As a final result, the project makes revenue for the company, ensures its continuity and work, in addition to enhancing its financial position to provide new services.

The research problem

Is the project to establish maintenance and rehabilitation workshops for gas and steam turbines inside Iraq economically feasible, achieve savings, and stop financial waste?

The research hypotheses

As for the hypothesis of the study: Is it possible to establish an investment project for gas and steam turbines inside Iraq? Will it certainly be economically feasible?.

Methodology

The study employed a quantitative approach by providing facts, information, and statistics pertaining to the subject matter. This strategy relies on examining the phenomenon as it occurs in real-world settings to address the research problem.

Theoretical framework: Energy field in Iraq

The Iraqi people heavily depend on electric energy for their daily life activities. The Iraqi Ministry of Electricity states that in order to keep up with the increasing need for electricity, the energy industry must grow quickly. However, Iraq consumes more than 28 gigawatts of electricity in the summer alone, whereas it only produces around 18 gigawatts at present. Providing reliable, low-cost energy not only impacts the lives of Iraqi citizens, but is also a starting point for confronting and alleviating social and economic challenges. GE has the latest turbines and technologies that help provide more electricity to the Iraqi people. Preserving the ability to generate electricity is one strategy to safeguard the investment in any power plant, as equipment needs to be upgraded and repairs and maintenance must be performed on a regular basis. If you want to increase the

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output and efficiency of your current gas turbine equipment, you must plan ahead. Thus, it could be time to upgrade any stations that have been in use for a long period of time.

The technical teams of the Ministry of Electricity are in charge of maintaining the stations; they have been continuously working since the start of the year to make sure that the required maintenance is completed on schedule and that the units are prepared for the spike in summertime electricity demand in Iraq. This is considered part of the Ministry's strategy, which focuses on a set of priorities, including regular maintenance of operating units to ensure the continuity and stability of their productivity, especially during peak times. However, the problem is represented by the fact that these efforts are insufficient in light of the increasing need for energy. The capabilities of the ministry are insufficient in light of the lack of expertise and high-quality raw materials. In general, although Iraq needs 40.000 MW and 20.000 MW in the event of supporting local industries, Iraq generates electrical energy in several ways through 109 thermal, hydroelectric, and gas stations, with a production of 22.000 and 680 MW during 2022.

Thermal stations: Iraq has seven thermal stations to generate energy by heating water and converting it into steam, which is used to rotate steam turbine stations with high-velocity rotating machines to generate electricity with different capacities. These stations are distributed across six Iraqi governorates. In Baghdad, the capital, there are two stations: Al Doura station, which has a capacity of 640 MW, and South Baghdad station, which has a capacity of 355 MW. As for Nineveh, it includes the North station, which is the largest thermal station in Iraq, with a capacity of 2,100 MW. Salah Al-Din Governorate, on the other hand, has the Baiji thermal station with a capacity of 1,320 MW, whereas the Musayyib station, which has a capacity of 1,280 MW, is located in Babil Governorate. In Dhi Qar, there is Al-Nasiriyah station with a capacity of 800 MW, and in Basra, there is Al-Hartha station with a capacity of 400 MW. The total electricity production of thermal stations is 6,895 MW.

Hydroelectric stations: Iraq generates electric energy through eight hydroelectric stations that make use of potential hydraulic energy, such as dams and waterfalls, to rotate low-speed water turbine stations, which in turn rotate machines to generate electricity with different capacities. Two hydroelectric stations are located in Sulaymaniyah Governorate, namely the Darbandikhan Dam station with a capacity of 248 MW and the Dokan Dam station with a capacity of 400 MW. In Salah Al-Din, there are two hydroelectric stations: Al-Azim Dam stations

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with a capacity of 27 MWs and Samarra Dam station with a capacity of 84 MWs. Nineveh Governorate has Mosul Dam station (Mosul 1), which is the largest station in Iraq, with a production capacity of 1,52 MW, and Mosul Dam station (Mosul 2) with a capacity of 62 MW. In Diyala, there is Hamrin Dam station with a capacity of 50 MWs, and there is Haditha Dam station in Anbar Governorate with a capacity of 660 MWs. Thus, the total production of hydroelectric stations is 2,583 MW.

Gas stations: Iraq relies heavily on gas stations to generate electricity. It has 26 gas stations that work by converting chemical fuel energy into thermal energy to heat gases that are fed into gas turbines, converting that energy into kinetic energy first. First, these turbines transform that energy into kinetic energy, which they use to operate the gas turbines. Next, they transform it into mechanical energy, which powers the generator's rotor, and use the magnetic field to transform mechanical energy into electrical energy. The largest number of these stations are located in Baghdad, as there are eleven gas stations in Baghdad: South Baghdad stations SB1 and SB2, with capacities of 246 and 400 MW, and Al-Dora stations DS1 and DS2, with capacities of 146 and 700 MW. There are also Al-Taji stations TS1 and TS2, with capacities of 156 and 160 MW, in addition to the Al-Quds stations QS2, QS2, and QS3, with capacities of 450 MW for each of QS1 and QS2, and a capacity of 500 MW for station QS3. There is Al-Sadr station with a capacity of 160 MW and Al-Rasheed station 1 with a capacity of 94 MW. Baghdad gas stations produce a total of 3,462 MW of electricity. In Basra, there are four gas stations: Al-Rumaila station with a capacity of 1,460 MW; Shatt Al-Basra station with a capacity of 1,250 MW; Al-Zubair station; and Al-Najibiyah station with a production capacity of 500 MW for each. In Kirkuk Governorate, there are two stations: Mulla Abdullah station, which generates electricity with a production capacity of 222 MW, and Taza station, which has a capacity of 292 MW. Dohuk Governorate has one station, which is Dohuk, with a capacity of 500 MW, and in Erbil Governorate, the Erbil station has a production capacity of 1,500 MW. Anbar Governorate has Al-Anbar gas station with a production capacity of 1,646 MW, and in Sulaymaniyah, there is Al-Sulaymaniyah station with a capacity of 1,500 MW. In Najaf, there is Al-Najaf station with a capacity of 430 MW. In Diyala, Al-Mansouriya station has a production capacity of 728 MW, in addition to Karbala station, which has a production capacity of 250 MW. Therefore, the total production of gas power stations is 14,550 MW. After 2003, Iraq established 68 electrical power generation stations, varying between thermal,

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gas, and solar stations. The total production of electrical energy from the new stations amounts to 18 thousand and 723 MW.

Division of electrical companies

Production companies

– The General Company for Northern Electric Power Production (Nineveh, Kirkuk, and Salah al-Din)

– The General Company for Southern Electric Power Production (Basra, Muthanna, Dhi Qar, and Maysan)

– The General Company for Central Electric Power Production (Baghdad, Wasit, Diyala, and Anbar)

– The General Company for Electricity Production of the Middle Euphrates (Karbala, Najaf, Diwaniyah, and Babylon)

Transportation companies

– General Electric Power Transmission Company - North

– General Electric Power Transmission Company - South

– General Electric Power Transmission Company - Al Wasat

– The General Electric Power Transmission Company - Upper and Middle Euphrates

Distribution companies

– Baghdad Electricity Distribution Company

– General Company for Central Electricity Distribution

– General Company for Southern Electricity Distribution

– General Company for Northern Electricity Distribution

Analytic and quantitative framework

Economic feasibility of the project

The definition of an economic feasibility study is a scientific process that determines, prior to implementation, the likelihood that a project or investment concept will succeed based on its potential to meet certain investor objectives. Therefore, the economic feasibility study is a practical tool that protects the project from risks and losses, as the study precedes any investment decision and operations as well. Therefore, the economic feasibility study is the means by which an appropriate investment decision is made to achieve the desired goals. A

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feasibility study is a group of studies that seek to determine the viability of an investment project or group of investment projects from several market, technical, financial, financing, economic, and social aspects in preparation for selecting those projects that achieve the highest possible net benefit, in addition to a number of other objectives. Thus, the feasibility study seeks to determine the viability of an investment project or group of proposed investment projects in preparation for making a decision on accepting or rejecting investment in them.

Market study

It is a study concerned with the needs for the services provided by the project in order to obtain the best estimated information about the expected demand in the target market. According to these needs, the activities, that the gas and steam turbine maintenance and rehabilitation workshops project will undertake, are determined. Table (1) shows a summary of the results, and Tables (2) and (3) show the beneficiaries of the project.

Table (1) A summary of the results required by the project

Construction, maintenance, and rehabilitation workshops for gas and steam turbines			
Hard currency needs $	87,118,330	**Currency**	U.S. dollar
Investment cost	145,197,217	**Sector**	Infrastructure
Working capital	25,329,218	**Sub-sector**	Services
Average net profits	28,646,666	**Number of job opportunities**	145
Payback period/year	5.07	**Project outputs**	Maintenance and rehabilitation services
Return on investment	0.2	**Project area/m2**	25,000
Debt ratios	0.28	**Duration of completion/working day**	1095
Opportunity cost	5,807,889	**Project age/year**	25
Central Bank exchange rate of one dollar/dinar	1,460	**The price is 1 euro/dollar**	1.05

Source: The table was prepared by researchers.

Table (2) The project beneficiaries by sector

	Beneficiaries of the project
Total number of workers in the project/individual	145
Number of beneficiaries of the project in the community/individual	40,000,000
Number of cities benefiting from the project/city	18
Age groups (1-16)	Direct benefit
Age groups (16-36)	Direct benefit

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Age groups (36-56)	Direct benefit
Age groups (56-76)	Direct benefit
Unemployed	Direct benefit
Workers in the private sector	Direct benefit
Workers in state departments	Direct benefit
Workers in the mixed sector	Direct benefit
Number of beneficiary categories	8

Source: The table was prepared by researchers.

Table (3) The project beneficiaries by sector.

Beneficiaries of the project according to sectors			
Universities and educational institutions.	Beneficiary	Insurance sector.	Beneficiary
Travel, tourism, hotel, and restaurants.	Beneficiary	Job opportunities and jobs.	Beneficiary
State departments, institutions, and unions.	Beneficiary	Banks.	Beneficiary
Wholesale and retail trade sector	Beneficiary	Clothes and accessories	Beneficiary
Industrial institutions and factories.	Beneficiary	Medical sector	Beneficiary
Machinery, machinery and equipment sector.	Beneficiary	Toys and flowers.	Beneficiary
Agriculture and livestock.	Beneficiary	Sports and clubs.	Beneficiary
Electronic services and the Internet.	Beneficiary	Real estate and property.	Beneficiary
Construction and building materials.	Beneficiary	Transport and communications.	Beneficiary
		Number of beneficiary sectors	18

Source: The table was prepared by researchers.

Table (4) shows the estimation of working capital as a measure of the efficiency of business operations and activities. This estimation can be found by calculating the difference between the company's existing current assets on the one hand and its current liabilities on the other hand. It can also be done by evaluating the organization's performance and financial health.

Table (4) shows a summary of working capital.

Capital summary		
Cash	Amount	
Bank deposits	3461408	
Cash in hand	393342	
3854749		
Inventory	Amount	

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Raw materials	25250549	
Fuel and spare parts activity	78668	
	25329218	
Total working capital	29183967	
Total investment costs	145197217	
		Estimating annual variable costs
Cost matrix / complete maintenance and spare parts	Number of turbines in the network	Total amount
GE Frame 9 units repairer	70	139610520
GE Frame 6 units repairer	14	19,572,084
GE Frame 5 units repairer	56	25,831,008
Others (FIAT TG20, 13 D,GT 13 E 2,GT8C2,H25,SGT5 2000E,SGT5 4000F, SGT5 800) units repairer	52	19,796,400
	204,810,012	
Total annual fixed costs	29,275,288	
Total annual variable costs	207,439,112	
Total operational costs	236,714,400	

Source: The table was prepared by researchers.

Table (5) The expected returns of the project as shown in the table below:

Table (5) Estimation of returns.

	Estimating returns
Services and products	**Total amount**
GE Frame 9 units repairer	181,493,676
GE Frame 6 units repairer	19,572,084
GE Frame 5 units repairer	25,831,008
Others (FIAT TG20, 13 D,GT 13 E 2,GT8C2,H25,SGT5 2000E,SGT5 4000F, SGT5 800) units repairer	19,796,400
	246,693,168

Source: The table was prepared by researchers.

Table (6) (7) show the statement of income and cash flows, which companies are required to prepare as an integral part of their financial statements for each period for which financial statements are submitted. The statement of cash flow is considered one of the most important financial statements that helps users of these lists identify the financial conditions of the organization. The significance of cash flows is demonstrated by the fact that they provide an accurate representation of the cash effect of every activity the company engaged in throughout the financial period, identifying whether the impact was internal or external to the business. It

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also helps to identify strengths and weaknesses in terms of the ability of the company to make cash.

Table (6) Statement of Income and Cash Flows.

Statement of income and cash flows					
	First year	Second year	Third year	Fourth year	Fifth year
Growth rate %	0.6	0.7	0.8	0.9	1
Sales	148,015,901	172,685,218	197,354,534	222,023,851	246,693,168
Sales returns	0	0	0	0	0
Net sales	148,015,901	172,685,218	197,354,534	222,023,851	246,693,168
Cost of sales	124,463,467	145,207,378	165,951,290	186,695,201	207,439,112
Total operating income	23,552,434	27,477,839	31,403,245	35,328,650	39,254,056
Operating expenses	8,644,688	8,644,688	8,644,688	8,644,688	8,644,688
Net operating income	14,907,746	18,833,152	22,758,557	26,683,963	30,609,369
All other revenues	0	0	0	0	0
Net income before tax	14,907,746	18,833,152	22,758,557	26,683,963	30,609,369
Tax	0	0	0	0	0
Net income after tax	14,907,746	18,833,152	22,758,557	26,683,963	30,609,369
23,030,600	37,938,346	41,863,752	45,789,157	49,714,563	53,639,969
Sales	148,015,901	172,685,218	197,354,534	222,023,851	246,693,168
Cost of sales	124,463,467	145,207,378	165,951,290	186,695,201	207,439,112
Total operating income	23,552,434	27,477,839	31,403,245	35,328,650	39,254,056
Depreciations	25,834,000	25,834,000	25,834,000	25,834,000	25,834,000
Earnings before interest and taxes	-2,281,566	1,643,839	5,569,245	9,494,650	13,420,056
Benefits	2,400,000	2,240,000	2,080,000	1,920,000	1,760,000
Taxable profit	-4,681,566	-596,161	3,489,245	7,574,650	11,660,056
Tax	0	0	0	0	0
Post tax Profit	-4,681,566	-596,161	3,489,245	7,574,650	11,660,056
Net cash flow	23,552,434	27,477,839	31,403,245	35,328,650	39,254,056
	1	2	3	4	5

Source: The table was prepared by researchers.

Table (7) Statement of Income and Cash Flows.

			Statement of income and cash flows		
	Sixth year	Seventh year	Eighth year	Ninth year	Tenth year
Growth rate %	1.05	1.05	1.05	1.05	1.05
Sales	259,027,826	259,027,826	259,027,826	259,027,826	259,027,826
Sales returns	0	0	0	0	0
Net sales	259,027,826	259,027,826	259,027,826	259,027,826	259,027,826
Cost of sales	217,811,068	217,811,068	217,811,068	217,811,068	217,811,068

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Total operating income	41,216,759	41,216,759	41,216,759	41,216,759	41,216,759
Operating expenses	8,644,688	8,644,688	8,644,688	8,644,688	8,644,688
Net operating income	32,572,071	32,572,071	32,572,071	32,572,071	32,572,071
All other revenues	0	0	0	0	0
Net income before tax	32,572,071	32,572,071	32,572,071	32,572,071	32,572,071
Tax	0	0	0	0	0
Net income after tax	32,572,071	32,572,071	32,572,071	32,572,071	32,572,071
23,030,600	55,602,671	55,602,671	55,602,671	55,602,671	55,602,671
Sales	259,027,826	259,027,826	259,027,826	259,027,826	259,027,826
Cost of sales	217,811,068	217,811,068	217,811,068	217,811,068	217,811,068
Total operating income	41,216,759	41,216,759	41,216,759	41,216,759	41,216,759
Depreciations	25,834,000	25,834,000	25,834,000	25,834,000	25,834,000
Earnings before interest and taxes	15,382,759	15,382,759	15,382,759	15,382,759	15,382,759
Benefits	0	0	0	0	0
Taxable profit	15,382,759	15,382,759	15,382,759	15,382,759	15,382,759
Tax	0	0	0	0	0
Post tax profit	15,382,759	15,382,759	15,382,759	15,382,759	15,382,759
Net cash flow	41,216,759	41,216,759	41,216,759	41,216,759	41,216,759
	6	7	8	9	10

Source: The table was prepared by researchers.

Table (8) shows the net present value (NPV): (NPV) is how much the invested amount is currently worth, when it flows in the future in five or more years. It refers to the difference between the present value of cash inflows and the present value of cash outflows. The alternative that achieves the greatest net present value in comparison to other alternatives is the best alternative, as the alternative is considered economically acceptable when it achieves a positive net present value.

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Table (8) Net Present Value

The condition of providing sufficient information necessary for the evaluation and comparison process, taking into account the time factor			
Discounted standards			
Minimum discount rate used		2%	
Maximum discount rate used		3%	
The value of the amount invested in the project		-145197217	
	Year	Cash flow	Current value
Cash outflows	0	-145197217	-145197217
Cash inflows	1	23,552,434	23,090,621
	2	27,477,839	26,410,841
	3	31,403,245	29,591,979
	4	35,328,650	32,638,212
	5	39,254,056	35,553,608
	6	41,216,759	36,599,302
	7	41,216,759	35,881,669
	8	41,216,759	35,178,107
	9	41,216,759	34,488,340
	10	41,216,759	33,812,098
	11	39,254,056	31,570,586
	12	39,254,056	30,951,555
	13	39,254,056	30,344,662
	14	39,254,056	29,749,669
	15	39,254,056	29,166,342
329,830,374			

Source: The table was prepared by researchers.

Table (9) Net present value and internal rate of return.

Standard	Calculated			
0≥	329,830,374	0.02	Minimum discount rate used	Net present value (NPV)
0≥	294,152,020	0.03	Maximum discount rate used	
A positive net present value is evidence that the project is capable of generating positive cash flows				
0≥	0.11	Internal rate of return (IRR)		
		It expresses the marginal adequacy of capital		
More than 1	2.27	Profitability Index (PI)		
		It is the net return or present value achieved by the invested monetary unit		
More than 1	3.27	Cost/benefit (CB) criterion		
		The total return of the invested monetary unit is determined and consists (of (the original amount invested + the net return		

Source: The table was prepared by researchers.

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Table (10) Non-discounted criteria under certainty conditions.

Undiscounted criteria under certainty conditions			
The condition of providing sufficient information necessary for the evaluation and comparison process, without taking into account the time factor			
1	Payback period	5.07	Year
	The number of years needed to cover the amount in the project when the annual net flow is constant		
2	Operating cost coverage rate	1.04	Times
	Using revenues to cover operating costs		
3	Benefit coverage rate	103	Times
	Using project revenues to cover interest costs		
4	Return on investment	0.2	
	Measuring the profitability of the project to the total investments		
5	Liquidity	0.15	More than 1
	Measuring the rapid possibility to pay the obligations		
6	Trade rate	1.11	More than 1
	The covering of the wave of liabilities		
7	Average assets	1.28	More than 1
	The ability of project to exploit the available resources		
8	The average of working capital	5.07	More than 1
	The efficiency of the administration in the use of working capital		
9	Returning to the right of ownership	0.07	%
	The ratio of the return to the owned capital		
10	Profit Index (PI)	2.27	%
	Relative indexes for the project's profitability		
11	Debt ratio	28%	%
	It measures the extent of dependence on debt to finance investment in comparison to the funding provided by the owners		
12	Return on investment without a loan	0.26	

Source: The table was prepared by researchers.

Table (11) Analysis of fixed costs.

Fixed cost analysis		
Statement	Ratio	Amount
Services, fuel, and spare parts of the management	0.002	62,738
Administrative expenses	0.011	310,000
Marketing expenses	0.002	50,500
Interests and fees	0.082	2,400,000
Depreciations	0.705	20,630,600
Technological development	0.178	5,203,400
Amortization of establishment expenses	0.005	144,050
Salaries and wages for administrators	0.016	474,000
Total fixed costs	29,275,288	

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Source: The table was prepared by researchers.

Table (12) Variable cost analysis.

Variable cost analysis		
Statement	**Ratio**	Amount
Statement	**0.99**	204,810,012
Cost matrix/including maintenance and spare parts	**0**	105,900
Production services, fuel, and spare parts	**0**	530,000
Public production expenses	**0.01**	1,993,200
Total variable costs	207,439,112	

Source: The table was prepared by researchers.

Table (13) Cumulative net profits for the first five years of the project's life

Cumulative net profits for the first five years of the project's life				
1 Year	Cumulative			
14,907,746	14,907,746			
1 Year	2 Year	Cumulative		
14,907,746	18,833,152	33,740,898		
1 Year	2 Year	3 Year	Cumulative	
14,907,746	18,833,152	22,758,557	56,499,455	
1 Year	2 Year	3 Year	4 Year	**Cumulative**
14,907,746	18,833,152	22,758,557	26,683,963	83,183,418
1 Year	2 Year	3 Year	4 Year	5 Year
14,907,746	18,833,152	22,758,557	26,683,963	30,609,369
113,792,787		**Cumulative**		

Source: The table was prepared by researchers.

Analysis of the results

After estimating the investment and operational costs and making all predictions based on the market study, in addition to estimating the revenues of the project, conducting a field survey, and drawing the results, it was found that the payback period for the project was approximately five years. The ability of the project to pay its short-term obligations was approximately 50% of what was required. As for the liquidity of the project, it was 11%, whereas the ability to exploit the available resources was within 36% of what was required. The project management was highly efficient in using working capital, estimated at

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approximately 29 times more than what was required. The criterion for using revenues to cover operational costs reached a good result, estimated at approximately 236% of what was required. The profitability of the project was approximately 22% in comparison to the total investments. The project is not sensitive to increases in costs and decreases in revenues. However, it creates new job opportunities and can provide them with sufficient skills and experience with ease and without additional costs. The project serves a fair number of groups and segments of society and cities. In this project, all production elements are available, and the degree of localization is 0.25. Thus, the project area is considered an attractive and encouraging area for establishing the project there. The cost-saving standard was excellent in all its sub-criteria. Nonetheless, at the level of descriptive criteria, we mention the most important of them, as the project evaluation was encouraging regarding the per capita rate and human development indicators, the development of technical knowledge and the increase in the experience curve. The Profitability Index (PI) was excellent as it exceeded the correct one (2.27).

Conclusions and recommendations

First: Conclusions

1- Iraq needs periodic maintenance of its electrical power systems for several reasons. The most important one is the use of old methods of maintenance that are not commensurate with the volume of energy demand, especially in the summer. This is considered one of the biggest challenges facing the Iraqi Ministry of Electricity.

2- Huge sums of money are spent on maintenance at the present time that are not proportional to the gains achieved, whether in sustainment, generation, equipment, or transportation.

3- We conclude from the project, according to the cost-economy criterion, that the proportion of purchasing raw materials and project inputs is reduced by 25%. The level of salaries and wages for workers was very reasonable, and the treatment of environmental impact was low.

4- It is concluded from the project regarding the descriptive criteria that the per capita rate, human development indexes, direct and indirect benefits of the project, as well as raising the level of income and providing infrastructure, were very good. As for increasing the level of technical and training skills, raising the

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social level, and the criterion for balancing spending on the project, as well as developing technical knowledge and support, they were at an excellent rate.

5- When looking at the study in terms of savings in foreign currency, the cost of primary and complementary materials and the depreciation of machines, equipment, and other inputs were at a moderate rate. There were high costs of technical knowledge and the training plan for foreign staff.

6- Viewing the study, all the results were positive, as the ability of the project to pay its short-term obligations was about 50% of what was required. As for the liquidity of the project, it was 11%, whereas the ability to exploit the available resources was nearly 36%, creating new job opportunities and providing sufficient skills and experience with ease and without additional costs. The payback period was five years, the expected return on investment was 20%, and the average annual net profit was $28.6 million. In comparison to the opportunity cost of $5.8 million, the investment is more likely to be profitable.

Second: Recommendations

1- When investigating the project and the results presented by viewing the market study, cash flows, and income statement, we decided to provide an investment opportunity to establish gas and steam turbines in Baghdad Governorate because all the results presented were positive for establishing such a project.

2- The Ministry of Electricity should grant central licenses to at least three investment companies to establish a project for maintenance workshops for power stations for two reasons: the first is to accelerate the return to the energy system and energy infrastructure in Iraq, and the other is to create competition between companies to achieve the highest standards of quality and reliability among competing companies.

3- Training and awareness courses shall be conducted for workers in the Ministry of Electricity in the field of gas and steam turbine maintenance to stop financial waste. A more comprehensive strategy should be adopted by a national government program.

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