Research Article

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Applying Intelligent Portfolio Management to the Evaluation of Stalled Construction Projects

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Abstract: Much research in the construction industry is based on the concept of a unique project; hence, such concepts (or philosophy) present the construction project as a unit of analysis for the entire completion process that is usually delivered independently. Most decision support tools in construction have been designed at the project level rather than for construction institutions that often implement many projects simultaneously. Typically, these projects have common objectives that create dependencies among them. Then, the success of one project depends on other projects and the existing interrelationships among them. Thus, construction institutions still need to deal with their projects from a portfolio perspective, which requires strategic management at a portfolio level. This paper employs resource management techniques to allocate resources to manage construction portfolios. A case study targeted strategic decision making about financing projects that have stalled. The final recommendation of this paper is to use development and planning software to serve and support strategic decisions in institutions with concurrent stalled projects.

Keywords: Intelligent portfolio management, modern portfolio theory, allocated budget projects, unnamed budget projects, intelligent management for construction portfolios

1 Introduction

Investment professionals have become specialised, and financial concepts have become more sophisticated, over

the past 25 years, allowing higher quality client service and better investment performance.

When construction organisations invest in a variety of projects, these combinations of construction projects can be considered portfolios of construction projects. Concepts of intelligent portfolio management (IPM) can be applied to a portfolio of construction projects. A portfolio of diversified projects usually has less risk than individual projects. However, investment in construction projects differs from that in other sectors. These differences arise from the difficulty of applying the portfolio theory in the construction industry [1].

Although academic consideration of the construction industry has been based on the delivery of one project, management focus has recently shifted from a single project to managing a portfolio of projects to achieve strategic objectives. A portfolio approach requires a holistic analysis of the projects undertaken simultaneously. The concept of portfolio management (PM) is based on the fact that a duration estimate and a financial budget are needed for every project in the construction industry, whether it is a new development or maintenance work for an existing facility [2].

A previous studies were used to develop mathematical models that will be applied to the construction projects. The outcomes display that the PSO technique is proper for evaluating project management problems and can be utilized as a useful tool to search the optimal solutions with differs parameters [3].

Currently, in all Iraqi buildings, it was adopting a corrective maintenance approach in maintaining building rather than proper maintenance management approaches (preventive, predictive), this affects negatively on the quality and cost of building maintenance. In addition, lack of proper and specific maintenance-related documentation methods. The study proposed approach to develop the building maintenance management by using deterioration models which consist of different routes [4].

Researchers develop a clear concept about the BIM adoption in Iraq through investigating potential benefits that can be obtained through its application in construc-

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tion projects also build a measurement model for these benefits [5, 6].

Management of a project plays a critical role for investment professionals and investors and in success in the construction industry. As one of the most important methods of management, the principles of PM have been around for about 20 years [7]. Therefore, choosing a successful management technique plays a key role in completing projects [8]. The vital role of PM is to optimise resource allocation of projects within the portfolio to achieve the technology and financial objectives of the institution. The theory of PM is a normative theory that describes the standard or norm of behaviour that investors should pursue when developing a construction portfolio.

Though widely applicable, modern portfolio theory (MPT) has a stronger influence when practised in PM. In its simplest form, MPT provides a framework to predict the performance of select projects within portfolios and to determine the probability of investment risk. In the investment management field, MPT introduces new terminology. Portfolio management theory (PMT) provides a framework to specify and measure the investment risk of projects within a portfolio. In addition, PM develops relationships among expected asset returns and investment risks [9].

IPM aims to optimise the selection of investment projects by defining the strategic objectives of an institution. This selection achieves an ideal balance among projects. The dependencies in construction portfolio

projects within an institution must be considered because they have a significant effect on portfolio success. Few studies in construction PM investigate how the dependencies between projects can be handled [10].

The researcher studied the stalled projects to assess project's completion acceleration before and after the crisis (scarcity of financial resources). Situations of governmental investment plan projects also was studied from 2015 to 2018. Then the researcher summarized the financial statements for a group of suspended projects, each according to its sector (which will represent the financial portfolios later) over four years.

After filed data was collected, analysis was done. Finally, results were discussed in light of Iraqi construction industry, as given the flow chart below. Figure 1 summarizes the steps followed in this research.

2 Portfolio Management Definition

Portfolio management is a decision process to prepare lists of investment projects that need to be constantly revised, updated, evaluated, and prioritised. Generally, PM is an uncertain process with continuous changes in information. It is characterised by strategic considerations through multiple objectives and interdependencies among portfolio projects [11].

PM is a decision process comprising several decision-making processes within institutions through periodic reviews of all portfolio projects. Which projects require new institutional selection strategies and new resource-allocation decisions can be determined through the analysis of the set of projects compared against each other [11]. Moreover, PM is vital for successful project innovation. The PM process ranges from strategic choices for resources and technologies needed to execute construction portfolios to how institutions spend scarce engineering, financial and marketing resources to deliver results. PM deals with the balance between the adequate number of projects that should be done and the available resources or capabilities of institutions [12]. Thus, PM considers the manifestation of the institutional strategy to explain or dictate where and how institutions invest in the future. Construction PM treats investment projects as financial investments like a fund manager treats stocks [12].

In addition, PM deals with achieving the strategic investment of a portfolio aligned with the overall institutional strategy. This alignment can be accomplished by maximising the portfolio value and investment return and balancing priorities in the portfolios. The successful per-

Figure 1: Flowchart of the research methodology.

formance of institutions requires managing the execution priority of projects within the portfolio. This step is vital for the following reasons [13]:

- Senior management can achieve strategic institutional objectives for various types of implemented projects using the PM methodology.
- The type of construction projects selected and the execution technology determine the institution's allocations for the next five years.
- Construction PM is about the allocation of scarce engineering, financial, and operational resources.
- PM addresses the critical issue of balancing the available or scarce resources.
- For the construction industry in Iraq, doing many projects with limited available resources results in a longer execution cycle and poor quality or underperforming projects.

Construction institutions increasingly take on projects to achieve firm objectives more efficiently and to augment their number of projects. These additional projects create the need for the intelligent management of construction portfolios to plan for a multitude of synchronous projects in an institution. Therefore, PM is not uniform and must be adapted to the institutional situation and the responsibilities and roles of institutional managers [14].

Studies conducted by the Project Management Institute (PMI) have reviewed the practices for PM and investigated the results of multiple methods. The findings demonstrate that high-performance institutions usually apply PM methodologies. These PM methodologies may be applied to processes, tools, or manager responsibilities that arose to address the complex requirements of the construction environments. This situation is very different at low-performing institutions [15].

Project management should be a part of PM, especially when related to corporate governance. Therefore, PM should have approaches to settle contract requirements. According to the Project Management Association, PM is a framework or structure that should comprise the following [15]:

- portfolio direction effectiveness,
- project sponsorship efficiency,
- project management performance, and
- disclosure and reporting.

In addition, PM can be divided into two parallel perspectives. The first perspective concerns interrelationships among various similar projects. The requirements for project management require investigation to acquire the overall objectives of the institution. The second perspec-

tive is adopting the correlation of various project objectives to maximise the outcomes of combination projects, which led to developing the concept of the portfolio. The PMI defines 'portfolio' as a group of related programmes, processed in close coordination to achieve high control and more efficient performance, which may not occur when processing them individually [16]. The development of PM techniques defines the centralised management of one or more portfolios by identifying, prioritising, managing, and controlling the projects to achieve specific strategic institutional objectives. Indeed, the portfolio theory can be comprehended as the integration of similar projects grouped to facilitate effectively reaching the strategic objectives of an institution. Portfolio theory is not necessarily interdependent or directly related to the projects of a construction portfolio [16].

3 Necessity of New Philosophy for Management

Strategic management is considered a monopoly of top management, whereas the management of a project issue is the responsibility of project management. This perspective fails to perfect the interactive relationships between both fields, especially in project-based industries. Initially, functioning strategic management is considered a precondition for aligning the evaluated project with the portfolio. Thus, the PM process may be essential for executing the institution's formulated objectives [17]. Some characteristics of the construction industry must be considered when using strategic management. More than other sectors, the construction industry has been slow to adopt new strategic management methods, and these adoptions require many considerations [18].

First, the base institutional model for construction portfolio projects is an obstacle when a temporary institution (individual projects) does not allow the implementation of complex strategies. Some studies have found that medium-sized construction institutions are less likely to implement strategic management practices. Such institutions are less concerned about strategic management and are more proactive towards one-unit production [19]. The educational backgrounds of managers of construction institutions have led them to be less aware of the role of strategic management because most construction enterprises require an engineering background. Many of these managers lack formal training about formulating and implementing strategic management methods [20].

Research into strategic management methods for construction continues, despite the delayed acceptance of the portfolio theory in construction management. While the changing strategy formulation has received more attention, the mechanism for implementing the developed strategies in the construction industry is still poorly researched.

The rapid acceleration of urbanisation requires the construction industry to adopt a new management method. Traditional project management cannot handle the complexity of some construction projects. Thus, new management methods are needed to achieve several objectives [21]:

- to integrate the activities of construction organisations during project realisation,
- to achieve more added value in service markets in the construction industry,
- to diversify financing sources in construction projects,
- to achieve high-performance standards for underperforming projects,
- to find raw materials and modern technologies in the construction industry,
- to interact with authorities and suppliers throughout all construction phases of a project.

The reasons above are the result of the complexity of the organisational structure in the construction production process and its development as an independent economic entity. Modern computing techniques monitor construction activities to promote efficiency, and institutional departments coordinate employees and activities with other institutions. However, opportunities and the capacities of the construction industry are restrained because institutional construction managers lack construction PM skills owing to the following [22]:

- Construction managers prefer to work in the traditional planning economy.
- Construction institution owners must employ a construction project management specialist with a civil engineering degree.
- The educational system must focus on preparing highly skilled narrow-specialisation engineers.

PMT addresses more extensive tasks, including integrating interactions between design teams and subcontractors involved in the same project and organising building operations owned by several stockholders. Figure 2 summarises the differences between the two strategic management methodologies.

Figure 2: Differences between productive management methods in the construction industry [23] PPM: Project portfolio management; PM: project management

4 Portfolio Management Domain

The essential purposes of PMT are to achieve a relatively lofty investment return rate ($R\%$) for the level of specified tasks or the lowest possible risk for a specified investment return rate. Risks may include the probability that the actual return ($r\%$) is less than the expected return ($R\%$), where the risk and return usually have a logical correlation (i.e. increasing investment returns result in greater risks [14]). The environment of PM must be combined with computer technology that makes financial information sources accessible throughout the institution. In addition, PM enables senior institutional managers to make more efficient decisions.

Construction PM is linked to the implementation of strategy in two ways. First, management strategies for implementing projects have been studied extensively. Second, PM practices are developed by modifying top management strategies. This concept can be applied for single and multiple management projects, specifically in project-based industries, such as the construction industry, where projects have paramount strategic relevance [22]. Intelligent construction PM (ICPM) is a method of selecting and managing institutional projects using risk factors and the return rate. While the techniques originated in the financial industry, they can be applied to the evaluation of a construction project portfolio. The PMT targets a broader set of activities (e.g. the selection of projects, controlling resources, continuous risk management, and reporting a wider range of factors). Construction portfolios are different from others in terms of the subprojects that have shared objectives but compete for allocated resources and strategic assets [24].

The essential tasks of PM include investigating the suitable available projects, selecting and prioritising projects based on the resources, and evaluating the running process concerning meeting portfolio requirements.

Such activities typically involve an optimisation technique and algorithm management for specific project selection criteria. However, project selection criteria are the most important means of aligning PM strategies; thus, criteria deserve the attention of practitioners, researchers and scholars [25]. The prediction of progress for individual construction projects is a complex process because of the uncertain and unique nature of the construction industry. The selection of project packages in a portfolio must be rearranged when the risk profile of a project changes after its initiation. The initial risk evaluation and continued information updates in a portfolio lead to high-performance project progress. This improved outcome may be the main motivation for the development of strategic management, such as PM, in institutions [26].

5 Diversification in Project Funds

An intuitive premise in the construction industry is providing sufficient reasonable information from the viewpoint of the contractor before negotiating the decision about the execution of a project [10]. Given the difficulties of acquiring and evaluating information for similar projects in the construction and industrial world, investment institutions have adopted PM. Institutions use PM to monitor the portfolios under construction, instead of simply selecting projects for the portfolios [18].

Debt and equity are the two primary capital sources for funding a new product or project. Debt capital represents borrowing assets from outside the institution. Capital should be repaid at a pre-agreed interest rate on an agreed schedule. Debt funding may represent capital borrowed via mortgages, loans, or bonds, with a risk that the borrower cannot repay the borrowed funds. In such a case, the lender's profits are shared using revenues. Outstanding debt is usually listed in the liabilities section on the balance sheet [26]. Equity capital is 'corporate money comprised of funds of owners and retained earnings. Owners' funds are further classified as common and preferred stock proceeds or owners' capital for a private (non-stock-issuing) company. Retained earnings are funds previously retained in the corporation for capital investment'. Equity is usually listed in the section on the net worth on the balance sheet [26].

In IPM, construction institutions must control the product pack (projects) in a portfolio regularly in addition to allocating assets and resources. Allocation of resources can be determined using a priority system for implementing the projects within the portfolio to meet the expecta-

tions of the strategic asset allocation or the available resources. Controlling a product pack also requires a comprehensive monitoring process to provide detailed information for the financial situation of the organisation. Rearranging the asset allocation strategy is a consequence of monitoring and controlling processes, which might cause several changes at the resource-allocation level of the projects. Management of a portfolio is a comprehensive asset management process characterised by changes. Institutions regularly update their decisions as a response to the circumstances [6]. The application of PM in the construction industry requires a huge amount of information regarding the financial performance of institutions that top management must effectively understand to make wise decisions.

'Do not put all of your eggs in one basket' is conventional wisdom in the investment world. In technical terms, this aphorism addresses diversification benefits. Moreover, MPT quantifies the concept of diversification by introducing a statistical association for the covariance or dependence between combined units. It is important to prioritise the execution of projects in a construction institution that may become bankrupt, especially when organisational resources are limited [27]. The concept of diversification is intuitive and applies to many different fields within finance. Applying the concept of diversification and introducing a new method of obtaining improved estimates of variances and covariances allows for a more precise measure of diversification and a more careful measure of risk [27].

6 Field Analysis and Study

The construction industry in Iraq has undergone many changes, emergencies, and modifications over the past decade, and building remains largely dependent on state treasury funding. A high proportion of the Iraqi budget and gross domestic product (GDP) consists of oil revenue. The Global Financial Crisis affected many countries, especially oil-producing countries and their military circumstances. These factors led to the end of Iraqi infrastructure projects that provided necessities for society's demands, needs, and advancement. The financial crisis prompted the investigation and employment of modern techniques to manage the financing of construction projects that stalled five years ago. First, the researcher studied the stalled projects to assess project completion acceleration before and after the crisis (scarcity of financial resources). Governmental investment plan projects

Table 1A: Situations of Investment Plan Projects for 2015 to 2018*

Sector Name	2015					2016				
	No. of projects	Total project cost (M.ID)	Annual allocation fund (M.ID)	Cumulative payments (M.ID)	Develop. gap (M.ID)	No. of projects	Total cost of projects (M.ID)	Annual allocation fund (M.ID)	Cumulative payments (M.ID)	Develop. gap (M.ID)
Industry Sector	395	112,138,047.7	17,270,175.7	41,865,925.8	70,272,121.9	247	109,613,353.6	15,955,998.9	51,147,791.8	58,465,561.7
Agriculture Sector	195	23,921,995.8	477,181.0	6,488,768.60	17,433,227.2	129	22,680,212.9	174,832.24	4,757,680.4	17,922,532.5
Buildings & Services	1,744	86,028,583.6	11,686,909.6	23,888,791.0	62,139,792.6	1,225	59,040,816.1	3,421,176.7	21,632,512.4	37,408,303.8
Transportation Communication	371	27,579,131.9	1,447,967.9	5,525,323.3	22,053,808.6	241	21,799,679.2	370,479.8	4,931,919.4	16,867,759.7
Programme Province Investment	3,830	37,652,679.8	4,338,654.8	-	-	3,170	33,479,428	1,818,274	-	-
Total	6,535	287,320,439.0	30,220,889.0	77,768,808.7	171,898,951	1,842	213,134,062	19,922,487	82,469,904	130,664,158

Table 1B: Situations of Investment Plan Projects for (2015–2018)*

Sector Name	2015					2016				
	No. of projects	Total project cost (M.ID)	Annual allocation fund (M.ID)	Cumulative payments (M.ID)	Develop. gap (M.ID)	No. of projects	Total cost of projects (M.ID)	Annual allocation fund (M.ID)	Cumulative payments (M.ID)	Develop. gap (M.ID)
Industry Sector	256	114,774,070.4	17,997,140.6	42,010,073.3	72,763,997.2	232	112,047,708.7	17,318,102.4	-	-
Agriculture Sector	105	12,635,586.92	520,835.92	4,930,214.13	7,705,372.79	108	12,724,845.95	4,460,371.2	-	-
Buildings & Services	1,086	60,548,886.80	4,791,785.09	23,363,911.5	37,184,975.3	1,009	52,001,945.81	-	-	-
Transportation Communication	237	16,488,318.16	488,069.00	4,709,600.56	11,778,717.2	231	16,384,551.76	-	-	-
Programme Province Investment	3,039	27,868,265.1	-	-	-	2,743	25,711,664.3	-	-	-
Total	4,723	232,315,127.0	23,797,830.6	75,013,799.5	129,433,063	4,323	218,870,716.5	21,778,473.6	-	-

*Source: Ministry of Planning, Department of Sector Planning, General Director Office

Table 2: Expected Iraqi Oil Production and Revenues

Year	Oil production million (bbl./d)	Oil export million (bbl./d)	Expected oil revenues per IMF (B.ID)	Expected oil revenues per Ministry of Oil (B.ID)	Expected oil revenues per Budget Strategy Committee (B.ID)
2018	4.7	3.9	75045	75715.9	74033.4
2019	4.7	3.9	74537	75715.9	74033.4
2020	4.7	3.9	76055	75715.9	74033.4
2021	4.9	4.0	77232	94914.9	74033.4
2022	4.9	4.0	79076	103543.2	74033.4
Total	23.9	19.7	381940	425605.5	370167

*Source: Ministry of Planning – National Development Plan (2018-2022) IMF: International Monetary Fund

Table 3: Expected Miscellaneous Income*

Year	Direct taxes	Indirect taxes	Other	Total
2018	4996.6	2213.7	5799.8	14923.9
2019	5146.1	2313.1	6038.4	14430.4
2020	5303.4	2390.7	6262.4	13956.5
2021	5466.5	2471.6	6492.3	13497.6
2022	5639.8	2555.8	6728.3	13009.7

*Source: Ministry of Planning – National Development Plan (2018-2022)

were also studied from 2015 to 2018. Then the researcher summarized the financial statements for a group of suspended projects, each according to its sector (which will represent the financial portfolios later) over four years. Investment budget projects and their costs, adjusted allocations, and cumulative expenditure in the government sector from 2015 to 2018 are shown in the following tables. The data were extracted from unified annual reports on the follow-up of investment budget projects. According to the implementing agencies, 'Amounts [are] in millions of dinars (M.ID), and [the] information represents [the] last update on (15/Mar./2020) [15 March 2020]. [The] Iraqi Ministry of Planning (MOP) [has] also launched a National Development Plan (NDP) for the next five years (2018-2022)'. Ta-

ble 1A&1B summarises some financial data for the stalled projects.

In another endeavour, the researcher investigated the financial inputs' expectations of the federal budget, based on estimates of some federal financial authorities, such as the IMF, the Ministry of Oil and the Budget Strategy Committee. Tables 2 to 4 illustrate expectations of financial inputs from oil production, oil export, and non-oil proceeds for the next five years.

Target growth rates of investments in the national economy for each sector as envisaged by successive governments are shown in Tables 5 to 7. National development plans established the targeted growth rates for each sector in line with the expectation of financial inputs over the next five years. Based on the above, the total amounts that can be spent on each sector are shown below. The researcher summarized the targeted growth rates for each sector in Tables 5 to 7.

The portfolios of the stalled construction projects were named according to the state sectors: agricultural, energy, service, infrastructure, and other project portfolios. The portfolio in this study is a set of stalled projects that were suspended due to a lack of funding. Usually, projects in

Table 4: Overall Expected Income

Year	Expected oil revenues (BID)			Miscellaneous income (BID)		
	International Monetary Fund	Ministry of Oil	Strategic Budget Committee	Direct taxes	Indirect taxes	Other
2018	75045	75715.9	74033.4	4996.6	2213.7	5799.8
2019	74537	75715.9	74033.4	5146.1	2313.1	6038.4
2020	76050	75715.9	74033.4	5303.4	2390.7	6262.4
2021	77232	94914.6	74033.4	5466.5	2471.6	6492.3
2022	79076	103543.2	74033.4	5639.8	2555.8	6728.3
Summary		370.2 (B.ID) 84.1%			69.8 (B.ID) 15.9%	
Total			440,000 (B.ID) 100%			

Source: Ministry of Planning – National Development Plan (2018-2022)

Table 5: Target Growth Rates of Investments in National Economic Sectors from 2018 to 2022*

Sector	2015 base year (B.ID)	Target growth next five years	Planned investment amount (B.ID)	of investment	Distribution of planned investments over five years (B.ID)				
					2018	2019	2020	2021	2022
Agricultural	3707.5	8.4%	7574.2	3.4%	1280.2	1388.4	1505.0	1631.5	1768.5
Oil	100929.2	7.5%	84683.7	38.4%	14579.5	15673	16848	18112	19470.5
Mining	330.0	1.0%	5677.2	1.0%	1077.9	1105.9	1134.7	1164.2	1194.5
Transformative industries	1535.1	10.5%	4854.3	2.2%	787.2	689.9	961.2	1062.2	1173.7
Energy	2130.7	6.0%	20243.3	9.2%	3591.1	3806.5	4034.9	4277.0	4533.7
Infrastructure	13768.4	6.8%	12233.6	5.5%	2135.8	2281.1	2436.2	2601.8	2778.8
Transport and communications	14313.9	7.0%	39582.1	17.9%	6883.0	7362.8	7880.3	8431.9	9022.1
Trade	14872.9	8.3%	8545.1	3.9%	14479.9	1568.0	1698.2	1839.1	1991.8
Insurance	11815.1	2.6%	1077.9	2.6%	1077.9	1105.9	1134.7	1164.2	1194.5
Services sector	19777.8	4.5%	37219	16.9%	6803.3	7109.5	7429.4	7763.7	8113.1
Non-oil activities	81402.0	6.1%	NA	NA	98201.8	104255.3	110721.6	117631.5	125017.3
Total (B.ID)	182331200	7.0%	220640.0	100%	38592.2	41172.8	43934.2	46889.4	50052.5
Total (B.\$)	154090400	7.0%	186465	100%	32600	34800	37200	39700	42300

*Data from Ministry of Planning – National Development Plan (2018-2022) NA: not available

Table 6: Target Growth Rates of the Gross Domestic Product (GDP) for (2018-2022)*

Sector	2015 base year (B.ID)	Target growth next five years	Distribution of planned development – gross domestic product(B.ID)				
			2018	2019	2020	2021	2022
Agricultural	3707.5	8.4%	4722.5	5119.2	5549.2	6015.3	6520.6
Oil	100929.2	7.5%	125384.0	134787.5	144896.9	155764.2	167446.5
Mining	330.0	1.0%	340.0	343.4	346.8	350.3	353.8
Transformative industries	1535.1	10.5%	2071.2	2288.7	2529.0	2794.5	3088.0
Energy	2130.7	6.0%	2537.7	2690.0	2851.4	3022.4	3203.8
Infrastructure	13768.4	6.8%	16772.5	17913.0	19131.1	20432.0	21821.4
Transport and communication	14313.9	7.0%	17535.1	18762.6	20076.0	21481.3	22985.0
Trade	14872.9	8.3%	18892.1	20460.2	22158.4	23997.5	25989.3
Insurance	11815.1	2.6%	12760.8	13092.6	13433.0	13782.3	14140.6
Services sector	19777.8	4.5%	22569.8	23585.4	24646.7	25755.8	26914.9
Non-oil activities	81402.0	6.1%	98201.8	104255.3	110721.6	117631.5	125017.3
Total (B.ID)	182331200.0	7.0%	223585.8	239042.8	255618.5	273395.7	292463.8
Total (B.\$)	154090400	7.0%	189.2	202.2	216.3	231.3	247.4

*Data from Ministry of Planning – National Development Plan for (2018-2022)

Table 7: Expected income [31]

Year	Expected oil revenues (BID)			Miscellaneous income (BID)		
	International Monetary Fund	Ministry of Oil	Strategic Budget Committee	Direct taxes	Indirect taxes	Other
2018	75045	75715.9	74033.4	4996.6	2213.7	5799.8
2019	74537	75715.9	74033.4	5146.1	2313.1	6038.4
2020	76050	75715.9	74033.4	5303.4	2390.7	6262.4
2021	77232	94914.6	74033.4	5466.5	2471.6	6492.3
2022	79076	103543.2	74033.4	5639.8	2555.8	6728.3

Table 8: Target growth rates for portfolios [32]

Portfolio*	Target growth next 5 years	Investment planned (bID)	Investment %	Distribution of planned investments over five years (bID)				
				2018	2019	2020	2021	2022
P1	8.4%	7574.2	3.4%	1280.2	1388.4	1505.0	1631.5	1768.5
P2	7.5%	84683.7	38.4%	14579.5	15673	16848	18112	19470.5
P3	1.0%	5677.2	2.6%	1077.9	1105.9	1134.7	1164.2	1194.5
P4	10.5%	4854.3	2.2%	787.2	689.9	961.2	1062.2	1173.7
P5	6.0%	20243.3	9.2%	3591.1	3806.5	4034.9	4277.0	4533.7
P6	6.8%	12233.6	5.5%	2135.8	2281.1	2436.2	2601.8	2778.8
P7	7.0%	39582.1	17.9%	6883.0	7362.8	7880.3	8431.9	9022.1
P8	8.3%	8545.1	3.9%	14479.9	1568.0	1698.2	1839.1	1991.8
P9	4.5%	37219	16.9%	6803.3	7109.5	7429.4	7763.7	8113.1

*Portfolios are coded for data organisation.

Table 9: Priority Matrix Assessment for Portfolios

Assessment Axes of Priority Matrix*	Portfolios*								
	P1	P2	P3	P4	P5	P6	P7	P8	P9
Strategic Alignment	8%	9%	4%	12%	11%	8%	10%	10%	10%
Achieving Portfolio Requirements	8%	9%	8%	8%	2%	10%	5%	5%	2%
Aligned with the Portfolio Plan	3%	5%	10%	10%	1%	5%	7%	4%	5%
Spatial Development	3%	5%	3%	4%	8%	8%	6%	5%	3%
Precedence of the Portfolio	6%	8%	7%	6%	7%	10%	9%	8%	6%
Social Feasibility	8%	10%	2%	8%	9%	6%	10%	8%	10%
Economic Feasibility	9%	10%	10%	5%	4%	7%	2%	10%	8%
Percentage Completion	5%	8%	10%	7%	7%	6%	10%	5%	7%
Financial Percentage Completion	7%	5%	8%	6%	3%	5%	2%	4%	5%
Payable Financial Dues	4%	4%	5%	5%	9%	10%	8%	8%	10%
Possibility of Cost Reducing	10%	8%	7%	4%	5%	7%	6%	10%	4%
Possibility of Converting to an Invest.	4%	5%	9%	8%	6%	7%	10%	4%	10%
Possibility of Tran. to the Oper. Budg.	15%	10%	7%	5%	8%	4%	10%	6%	10%
Problems of Project	10%	4%	6%	7%	7%	10%	5%	8%	10%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

*Portfolios and assessments are coded for data organization

the construction portfolios have many common characteristics to address many strategic objectives of the government sector. For each construction portfolio, the projects are in the same class; therefore, a project in the portfolio is submitted to the same valuation factors for the priority matrix. The data and results obtained from the field survey are summarised in tables to track the analysis of the study [28, 32].

The Iraqi government's financial budgets for the past ten years have been studied and analysed. Then, the researcher employed the theories of IPM with the support of administrative and financial cadres in the MOP. The study aimed to determine how to achieve optimal financial decisions that ensure project continuity. In addition to completing the stalled projects, this will help open it to the public as soon as possible.

The researcher classified the projects according to the sector as a portfolio with separate functional characteristics and independent requirements. Therefore, the strate-

gic projects have two categories according to the funding resources:

Allocated budget projects have a predefined schedule (start and end information). The relationships between the activities are examined. For these portfolios, the researcher applied the concepts of resource levelling and smoothing, as shown in Eq. (1) [33]:

$$(F.F.) act. = \min[(E.F.) act. - (E.S.) next act.], \quad (1)$$

where $F.F.$ is the free-float activity within the project in the portfolio, $E.F.$ is the early finish of non-critical path activities, and $E.S.$ is defined as 'the minimum early start of sequential activities'.

Within a portfolio, free-float activities are applied to the momentum equation (Eq. (2)) [33]. Thus, the effectiveness of the activity is moved to the right position. The subsequent tables depict a summary of the results:

$$(I.F) act. = r.r. * \left[\sum R^o - \sum \check{R} - m * r.r. \right], \quad (2)$$

Table 10: Results of the Studied projects

Portfolio	Projects	Cost (MID)	Payment (%)	Complete (%)	Assess. of PM	Decision (no. 347) of 2015
Agricultural project portfolio	Lining the irrigation canals	122904	4%	18%	52	NE
	Regulation of the river	115750	68%	68%	60	NE
	Jay barrage	100000	32%	99.5%	55	NE
	Closed irrigation project	25424	93.27%	99.7%	74	NE
	Irrigation project	23138	34%	73%	60	NE
	Expansion of the rivers	100000	10%	11%	54	NE
	Construct modern villages	359000	55.2%	40%	65	NE
Oil project portfolio	Increase operational storage capacity for liquid gas/16 ball tank	183910	91%	86.2%	84	Continuous
	Water supply to the refinery	104575	87.26%	96.22%	40	Continuous
	Development of the oil field	533110	67.8%	72.48%	84	Continuous
	14 in. pipe with pumping stations	225000	80.2%	70.7%	78	Continuous
	Rehabilitation of gas pressing stations	118000	39.79%	61.01%	71	Continuous
	Rehabilitation of K3 station	96900	88.59%	79%	84	Continuous
	Development of oil field	14163.3	0%	0%	69	Continuous
Transformative Industry portfolio	Project sealed lead-acid battery MF and solar batteries	25000	3%	77%	55	Continuous
	Rehabilitate the company for petrochemical industries	1200000	99%	90%	61	Continuous
	Rehabilitate the fertiliser plant No. 3 with an electricity conversion station	105075	90%	98%	68	Continuous
	Rehabilitate the southern fertiliser plant IQ-P6	303790918	69%	57%	63	Continuous
	Geological survey, investigation and evaluation	62500	69%	56%	32	Continuous
	Rehabilitate the electric stations in the northern region	25231.917	0%	0%	83	Continuous
	Rehabilitate gaseous electric stations	1237099.82	7%	20%	80	Continuous
Energy project portfolio	Rehabilitate the thermal electric station	462554.429	22%	50%	80	Continuous
	Rehabilitate the hydropower electric stations	72416.9028	32%	74%	80	Continuous
	Develop electrical networks at central regions	1147636	11%	5%	67	Continuous
	Build electricity control centres in northern governorates	63000	30%	40%	73	Continuous
	Develop electrical networks for city centres	128	60%	65%	73	Continuous
	Residential complex	70000	92%	95%	68	Continuous
	Residential complex	55186	95%	97%	69	Continuous
Infrastructure project Residential complex	Infrastructure for developing scientific capacity	138300	0.07%	0.07%	45	NJ
	Rehabilitate the infrastructure	13000	0.96%	0.95%	82	NJ
	Rehabilitate the complex of the ministry	43875	15%	28%	48	Stalled
	Establish a general hospital	147500	61%	83%	69	Continuous
	Low income housing project	74078.864	10%	12%	57	Continuous
	Develop telecommunication networks for the main cities	155222	0.19%	1%	49	Continuous
	Optical cable network project (access network)	216000	0.99%	0.57%	62	Continuous
Transport and Communications portfolio	Develop satellite channel	28098	0.03%	0.6%	0.23	Continuous
	West breakwater project of port	951000	52%	56%	69	Continuous
	Railway	57000	0.476%	0.94%	46	Stalled
	Rehabilitate airport	23016.4	0.385%	0.92%	66	Stalled
	Rehabilitate airport	59000	0.808%	0.9%	57	Stalled
	Install electromechanical equipment for silo	23000	0%	0.25%	70	Continuous
	Rehabilitate horizontal high-capacity silos	20000	0.27%	0.58%	71	Continuous
Trade project portfolio	Rehabilitate electromechanical/control the two groups (D&E)	26250	0.22%	0.27%	75	Continuous
	Construct a metal silo	12000	0.46%	0.6%	67	Continuous
	Construct a metal silo	12000	0.48%	0.57%	67	Continuous
	Maintain and operate sewage water treatment projects	34014	99.9%	85%	82	NE
	Water purification plants/greater project	847017	50.39%	35.3%	76	NE
	Water purification project	50000	58%	77.6%	66	NE
	Water purification project	15000	87%	69%	80	NE
Service project portfolio	Water purification project	73000	34%	71.3%	66	NE
	Land acquisition for water projects in governorates	30000	26%	26%	75	NE

*Projects are coded for data organisation. NE: not evaluated; NJ: not yet judged

where $I.F.$ is the moment factor of the shifted activity within a project of the portfolio, $r.r.$ is the resource rate of activity, and m is the minimum number of moved cells.

Projects planned without a named budget show a community need. However, no financial capacity exists to establish these projects. Therefore, these projects are constructed depending on the revenues or internal operating amounts obtained by sponsoring institutions. An annual investment budget is usually used to complete these types of projects. Therefore, these projects have a known start time but no known end.

For this type of project, the researcher and competent cadres of MOP designed a methodology to assess the priorities of implementing the suspended projects called the priority matrix. The priority matrix prioritises each project package within the same portfolio. This methodology arranges the projects within a specific portfolio from the highest importance to the least importance. Within the portfolio, many projects await funding. The researcher developed priorities to allocate spending on the most important projects, to the least, according to evaluation axes related to the added value resulting from accelerating the implementation of each suspended project. Evaluation axes

consist of 14 axes (strategic alignment, achieving portfolio requirements, aligned with the portfolio plan, spatial development, precedence of the portfolio, social feasibility, economic feasibility, percentage completion, financial percentage completion, payable financial dues, possibility of cost reducing, possibility of converting to an investment, possibility of transfer to operational budget, problems of project) whose total specific weight equals 100 per cent. Table 9 summarises the assessment using the priority matrix for each portfolio. Table 10 summarises the results.

The researcher applied the concept of resource leveling where determinants of resources are directly related to the costs following the budget. The researcher relied on amounts allocated by the country's annual budget, the 'investment budget'. The investment budget is usually spent on stalled projects suspended during the year (*i.e.* it is distributed to projects in need according to priority). Within a portfolio, the budget should determine what is required for specified resources for each time unit. The national economy is weak but not because of production, which covers not only domestic consumption but also diversification of exports, which is almost zero. Generally, financial elements of the public state budget depend on oil sector production. This is not surprising because the country contains the world's second-largest oil reserves. As a result, the revenues of oil account for about two-thirds of the country's GDP for all exports and fiscal revenue. The petroleum industry represents a pivotal element of the national economy, contributing to the country's GDP and growth and constituting 90% of the state revenue and almost all exports. Thus, the country's GDP comprises the production volume fluctuation and oil prices.

7 Conclusions

In the present study, a numerical analysis has been carried out to verify and evaluate the applicability of intelligent portfolio management theory in the Iraqi construction industry. The field study conducted by the researcher indicated that strategic departments of national construction industry in Iraq need modern and effective administrative systems, national bodies need to improve the reality of its' infrastructure by multi mid-term and long-term programmatic agenda strategies as five-year plans. Lack of professionalism in most of strategic management departments in Iraqi bodies, particularly with regard to financial allocation for service sectors as well as spread of corruption, nepotism and absence of transparency and justice. Priorities of financial resource allocation for infras-

tructure financing usually subject to several social and political considerations and personal convictions sometimes by the senior administrations in national construction industry. So, adopting intelligent portfolio management concepts' in national institutions of the construction industry to solve state budget shortage, enhance enterprises' efficiency for resource consumption. Also, this will support, financial decisions taken by senior management departments. The current study focused on settlement strategies regarding the risks of the national construction industry as effective solutions to the existing stalled construction projects. The increased use of portfolios is a means to share construction risks among construction projects. Construction institutions have adopted the use of portfolios for relatively low cost initial capital construction projects. The portfolio concept for such projects is oriented differently, where project importance and priority lead to new considerations when adopting the portfolio management theory in national construction industry.

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