

## **A New Approach to University IT Project Portfolio Management Based on Multi-Criteria Methods and the COBIT 5 Governance Framework**

**Majida LAAZIRI**

*Structural Engineering, Intelligent Systems and Electrical Energy Laboratory, National Graduate  
School of Arts and Crafts, Hassan II University, Casablanca 20670, Morocco  
E-mail: majida.laaziri@gmail.com*

**Khaoula BENMOUSSA**

*Structural Engineering, Intelligent Systems and Electrical Energy Laboratory, National Graduate  
School of Arts and Crafts, Hassan II University, Casablanca 20670, Morocco  
E-mail: khaoula.kb.pa@gmail.com*

**Abdelaziz EL ALAOUI EL AMRANI**

*Higher Normal School, Moulay Ismail University, Meknes 50050, Morocco  
E-mail: da.ens@umi.ac.ma*

**Ahmed MOUCHTACHI**

*Structural Engineering, Intelligent Systems and Electrical Energy Laboratory, National Graduate  
School of Arts and Crafts, Hassan II University, Casablanca 20670, Morocco  
E-mail: ahmedmouchtachi@yahoo.fr*

**Abstract** Project portfolio management is a major challenge for some organizations. In most organizations, there are a large number of projects active at the same time, some not necessarily delivering value or not aligned with their strategic goals. Also universities face a lot of uncertainties when selecting and prioritizing the projects that make up their portfolio. In addition, the achievement of those who are aligned with the strategy of the university becomes a great challenge. So to ensure good project portfolio management, the implementation of selection and prioritization methods and processes becomes important. For the project portfolio management to be effective, it is necessary to establish a structured method adapted to the needs and strategy of the university. In this context, this paper proposes a method for selecting and prioritizing projects within the framework of the portfolio management dedicated to universities, which can promote harmony between the university's strategy, the needs and the priority objectives for enable better decision-making. This method is based on the processes of the COBIT 5 good practice framework, and on the multi-criteria decision-making methods AHP, TOPSIS and the WSM technique, thus, it proposes seven project selection criteria based on the five axes IT governance strategies and two catalysts derived from COBIT 5 enablers. The evaluation and validation of this method was applied in the portfolio management of the Abdelmalek Essaadi Moroccan University (AUE). The result shows that this proposed method has made it possible to make a

better selection and prioritization of the portfolio of projects of Abdelmleek Essaadi University having the most value.

**Keywords** IS governance; information systems; project portfolio management; university governance; project prioritization; information technology (IT); good practice framework; COBIT 5; APO05; multi-criteria decision-making method; AHP; TOPSIS; WSM

## 1 Introduction

Information technology (IT) occupies a growing and pervasive place in our society, economically, socially and culturally. They help businesses, organizations and universities achieve their goals more effectively and propel them to new heights from day one<sup>[1]</sup>.

In fact, the proper use and management of IT within an organization requires effective governance to ensure that IT investments generate returns and to limit the risks associated with IT use. This IT governance is the responsibility of the directors and the board of directors. It encompasses the leadership, organizational structures and processes by which IT supports and extends the organization's strategies and objectives. According to the COBIT standard<sup>[2]</sup>, IT governance is the foundation that guides IT activities and ensures that IT performance meets the following requirements: i) alignment with the mandate and objectives of the organization and achievement of those-things; ii) ability for the organization to take advantage of opportunities and maximize benefits; iii) responsible use of IT resources; iv) appropriate IT risk management.

Programs and projects have been at the heart of organizations' efforts to manage change for several years. More recently, portfolio management has become an integral part of IT governance and become a central issue as organizations have become increasingly aware that delivery is partially the end: Equally important is whether the change initiatives are the "right ones" and whether the ROI (Return On Investment) potential, allowing to determine the profitability of the capital invested, is being achieved<sup>[3]</sup>. Portfolio management ensures that not only the right initiatives are funded and launched in a secure manner, but also that programs and projects are executed according to the needs and priorities of the organization<sup>[4]</sup>. It offers a set of tools, control processes and strategic decisions to monitor that the organization's efforts are effectively focused on its strategic priorities and objectives. Thus to ensure on a regular basis the adequacy between the projects, the capacity and the resources available to the organization to carry them out.

Good project portfolio management can have a direct impact on the results of the organization, is part of a process of maturing the organization towards more effective and efficient management of all of its projects. However, there are no universal rules in project portfolio management to determine which initiatives the organization should carry out as a priority according to its strategic objectives. In this context, this paper aims to propose a multi-criteria decision-making approach, for the selection and prioritization of IT projects, based on the grouping of a set of AHP, TOPSIS and WSM methodologies, in combination with the APO05 process of the framework COBIT 5 for portfolio management. This approach presents the means to apply effective portfolio and program management to such investments, in order to ensure the realization of benefits and the optimization of costs.

## 2 Literature Review

### 2.1 IT Governance

IT governance facilitates an efficient organization and opens up opportunities for the organization to gain competitive advantage. It involves an evaluation form and directs the use of IT to support and monitor the use of the organization to achieve the intended goal. It will include strategies and policies for the use of IT within an organization<sup>[5]</sup>.

Information technology governance is an instrument of control and management of computing resources such as infrastructure technology and people of all kinds, including universities according to the authors<sup>[6–8]</sup>. In addition, IT governance helps the corporate governance of the organization to support strategy, achieve objectives, goals, and mission<sup>[9]</sup>. The authors<sup>[10,11]</sup> point out that IT governance is “the policies and procedures that determine how the organization will direct and control the use of technology resources, so that these resources can be managed to facilitate achievement of the organization’s business objectives”. The famous organization ISACA (Association for Control and Audit of Information Systems) which is very interested in the field of governance defines five main axes: Strategic alignment, value creation, risk management, resource management and performance measurement<sup>[12]</sup>.

Effective governance in an organization does not happen by accident. The success of implementing effective governance in an organization associated with the right model or organization so that they can complement the strategic direction of the organization. For this, they show interest in adopting best practices and standards in IT governance because these frameworks are considered as guidelines and provide a flexible basic structure in a given environment<sup>[13]</sup>.

At present, decentralized organizations such as the university, IT governance for it serves as a guide and control. IT governance enables universities to achieve: (i) greater success in aligning IT and business goals; (ii) efficient use of IT resources; risk management<sup>[14]</sup>. Thus, they need a regular review to renew the IT governance structure to take into account the changing business and technological environment. However, few studies can be found in the context of universities about IT governance<sup>[15,16]</sup>.

### 2.2 Project Portfolio Management

The purpose of portfolio management is to monitor that the organization’s efforts are effectively focused on its priorities. A portfolio is a set of programs, it is a governance tool that consolidates, standardizes and synthesizes information from different projects, in order to facilitate decision-making. The projects implemented in a portfolio are identified, evaluated and prioritized using a set of methods aimed at ensuring that the organization’s projects are in line with its strategic objectives<sup>[17]</sup>.

According to the authors<sup>[18,19]</sup>, a portfolio is defined as “A grouping of the company’s projects such that it allows the implementation of operational research methods to optimize the allocation of resources between the different projects, and methods of financial evaluation of investment projects for the establishment of priorities”. For the authors Castonguay and Miller<sup>[20]</sup>, a portfolio is seen as “A collection of projects or programs and other work that are grouped together to facilitate effective management in order to achieve the strategic objectives of the company, and the management of the project portfolio as a means of increasing profits.

It helps create a balance between business activities and strategic alignment when choosing projects". The author Petit<sup>[21]</sup> define a portfolio as "a set of projects and programs selected for the achievement of strategic and specific objectives of an organization". According to the Information Technology Center, "a project portfolio is a set of projects selected on the basis of one or more criteria, for example the value of the project and its risk". Portfolio management systematizes the choice and management of investments in this set of projects or programs. The trade-offs made are underpinned by the organization's strategic plan and the resources available.

The process of managing project portfolios generally involves the following steps<sup>[19]</sup>:

1. Identify the projects to be included in the portfolio.
2. Categorize projects according to common criteria.
3. Evaluate projects by gathering as much information as possible about them to be able to compare them more easily.
4. Select the projects to be implemented using the information collected in the previous step.
5. Prioritize projects taking into account the strategic objectives of the organization.
6. Evaluate the risks associated with the portfolio.
7. Allocate the necessary resources to achieve the objectives of the project.
8. Monitor the project portfolio and the achievement of benefits.

### 2.3 COBIT Approach

The IT Governance Institute, part of the Information System Audit and Control Association (ISACA) was published the COBIT framework, in 1992. COBIT was originally designed as an IT audit guide because it contained a comprehensive set of guidelines for improving audit and compliance, provided detailed guidance on governance practices, and offered auditors several checklists of customized controls for various aspects of control assessment<sup>[22]</sup>. These aspects make COBIT an ideal framework for establishing control over IT and facilitating measurement of IT process performance, while enabling leaders to bridge the gap between control requirements, technical issues and business risks<sup>[23,24]</sup>.

From an IT governance perspective, the primary goal of COBIT is to enable value creation by ensuring that benefits are realized, risk reduced, and value for money. It is also proclaimed to provide stakeholders with an IT governance model that improves the management of risks associated with information technology<sup>[25]</sup> and operates a top-down structure to ensure the systematic management of descriptive processes in order to achieve adequate IT governance. The COBIT Framework is viewed as a generic, comprehensive, independent and broad body of knowledge designed to measure IT process maturity in organizations of all sizes, whether commercial, non-profit, or public<sup>[26]</sup>.

It is also defined as the best framework for balancing IT goals, the business objective and the risks of the company. This is achieved by using the author's Balanced Scorecard (BSC)

dimensions<sup>[27]</sup> to set up a goal cascade mechanism that translates and links stakeholder needs to corporate goals, objectives related to information technology and enabling objectives (COBIT process). In addition to providing a set of IT governance processes, COBIT also facilitates the proper implementation and effective management of these processes by defining clear roles and responsibilities through a detailed matrix (RACI)<sup>[28]</sup>.

The COBIT 5 divides IT into five areas<sup>[29]</sup>:

1. Evaluate, Direct and Monitor (EDM);
2. Align, Plan and Organize (APO);
3. Build, Acquire and Implement (BAI);
4. Delivery, Service and Support (DSS);
5. Monitor, Evaluate and Assess (MEA).

These five areas are divided into 37 high-level IT processes and over 300 detailed IT controls covering aspects of IT management and governance<sup>[30]</sup>.

We have based our method of selecting and prioritizing IT projects on the COBIT approach, because it is the most complete approach with a set of processes covering all aspects of IT governance, more particularly the APO05 process which fits perfectly into the framework of IT project portfolio management. Thus, COBIT is designed for a global approach to governance and remains generalist compared to other good practice repositories such as ITIL, PMBOK, CMMI, ISO/IEC, VAL IT, RISK IT, etc.

## 2.4 Multi-Criteria Decision Methods (MCDM)

Multi-criteria decision methods are a set of methods that allow the aggregation of several criteria with the objective of selecting one or more decisions. Many methods have been proposed to allow decision makers to make a good choice<sup>[31]</sup>. The difference between these methods is either in the way of aggregating the judgments to choose the most satisfactory decision, or in the way of evaluating each of the decisions according to the selected criteria<sup>[32,33]</sup>.

There are several multi-criteria decision methods in the literature. In our method of selection and prioritization proposed for the IT project portfolio management of Abdelmalek Essaadi University (UAE). We based ourselves on the AHP multi-criteria decision-making methods because it is differentiated by its ability to manage different classes of qualitative and quantitative criteria, the TOPSIS method for its ease of application and which calculates the positive and negative ideal solution, and the WSM technique for its flexibility and simplicity.

### 2.4.1 AHP Method

The AHP method (Analytic Hierarchy Process)<sup>[34]</sup> is a multicriteria decision-making model proposed by Saaty and has been frequently applied in various decision-making contexts. It makes it possible to convert pairwise comparisons established on a semantic scale (at nine levels) into a priority vector<sup>[35]</sup>. It consists in representing a decision problem by a hierarchical

structure reflecting the interactions between the various elements of the problem, to then proceed to pairwise comparisons of the elements of the hierarchy, and finally to determine the priorities of the actions<sup>[36,37]</sup>.

It is based on the following three principles: (1) decompose the problem by identifying the important elements, (2) state comparative judgments on the elements thus identified, (3) deduce the measures of relative importance from the comparison matrices by pair which are recombined to determine the priorities of actions. The AHP method can be broken down into four steps<sup>[38,39]</sup>:

- **Step 1** Hierarchically break down the decision-making situation into interrelated elements. We find at the top of the hierarchy the goal and at the lower levels, the elements contributing to achieve this goal. The branches starting from a node in the hierarchy should be as independent as possible. The last level is that of actions.
- **Step 2** Perform pairwise comparisons of items at each hierarchical level against an item at the higher hierarchical level; this step makes it possible to build comparison matrices. The values of the elements of these matrices are obtained by transforming the judgments made on the semantic scale into a numerical value according to the Saaty scale (Scale of binary comparisons), while respecting the principle of reciprocity:

$$p_C(E_A, E_B) = \frac{1}{p_C(E_B, E_A)}.$$

- **Step 3** Determine the relative importance of the elements by calculating the eigenvectors corresponding to the maximum eigenvalues of the comparison matrices.
- **Step 4** Check the consistency of judgments.

The integration of the Analytical Hierarchy Process (AHP) and the Order of Preference Technique by Similarity to the Ideal Solution (TOPSIS) provides a better solution for portfolio selection and management<sup>[40,41]</sup>.

#### 2.4.2 TOPSIS Methods

The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution), proposed for the first time by the authors Hwang and Yoon<sup>[42]</sup> based on a dominance relation which results from the distance from the ideal solution and is characterized by a Compensatory aggregation between criteria<sup>[32]</sup>. This method is part of the techniques used in the field of multi-criteria decision support, the aim of which is to be able to classify in order of choice a certain number of alternatives based on a set of favorable or unfavorable criteria. Its principle consists in determining for each alternative a coefficient between 0 and 1 on the basis of the (Euclidean) distances between each alternative on the one hand and the ideal favorable and unfavorable solutions<sup>[41]</sup>.

The method is as follows<sup>[43]</sup>:

- **Step 1** Build the standardized decision matrix

Transform the different dimensions of attributes into non-dimensional attributes, which allows a comparison between the attributes.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}.$$

- **Step 2** Build the weighted normalized decision matrix

$$V_{ij} = W_j * R_{ij}.$$

- **Step 3** Determine ideal solutions and negative ideal solutions
- **Step 4** Calculate the separation measure:

1. Ideal separation

$$S_i^{\pm} = \sqrt{\sum_{i=1}^n (V_{ij} - V_i^{\pm})^2}, \quad i = 1, 2, \dots, m.$$

2. Negative-ideal separation

$$S_i^{\pm} = \sqrt{\sum_{i=1}^n (V_{ij} - V_i^{\pm})^2}, \quad i = 1, 2, \dots, m.$$

- **Step 5** Calculate the relative proximity of the ideal solution
- **Step 6** Sort the order of preference

A set of alternatives can now be preferably ranked in descending order of  $ci^*$ .

Research into multi-criteria decision support methods has led to the appearance of another TOPSIS-2N method with two normalizations proposed by [44] takes this name by applying, separately, two process normalizations in the decision matrix of the problem, thus generating two normalized decision matrices and two ranking of alternatives. This gave the possibility of building a hybrid method AHP-TOPSIS-2N also proposed by [44] which integrates two MCDA methods with widespread uses: AHP and TOPSIS.

AHP-TOPSIS-2N uses AHP to calculate criteria weights and uses TOPSIS twice to generate rankings, each time with a different type of normalization. This can allow comparison of results and analysis of robustness in several domains<sup>[45]</sup>.

In our project management approach we used the combination of AHP and TOPSIS methodologies because we worked on simple university projects, as well as the integration of the APO05 process from the COBIT 5 good practice repository facilitates project portfolio management.

### 2.4.3 WSM Method (the sum of scores)

Also called the weighted sum or the Weight Sum Method (WSM), this method is the simplest of the multicriteria methods, it is commonly used for the evaluation and selection of software

packages<sup>[32]</sup>. It requires that the criteria be quantitative, that they all have the same unit and fall on the same scale or range of values, or that they all be standardized. It is calculated according to the relation<sup>[46]</sup>:

$$\text{Weighted sum} = a * \text{CrltA} + b * \text{CrltB} + c * \text{CrltC} + d * \text{CrltD} + \dots$$

The coefficients  $a$ ,  $b$ ,  $c$  and  $d$  are the weighting coefficients. The more important a criterion is, the greater the value assigned to its weighting coefficient. The best alternative is the one with the highest score.

### 3 Research Methodology

The literature lists several methods of selecting portfolio projects. The methodology that we propose based on the research method by semi-structured interviews, thanks to this method we had collected information from the managers who have a clear vision on the projects in the direction of the universities more particularly on the IT projects in the Abdelmalek Essaadi University (UAE). The information collected was used to start the project portfolio management process. The analysis of this information revealed that the UAE University puts in place only traditional methods to manage the projects based on the project needs of the university, the resources allocated where they bring the most value to it. No entity has the mission of project portfolio management, we can deduce several met: Managers do not have a global view of the initiation and strategic planning of projects, do not manage to manage their priorities strategically way and do not know whether the projects are aligned with the university's strategy or not. The management has an insufficient picture of the use of its resources and the performance of projects, lacks effective management of the use of resources (capacity management).

To this end, we have proposed a portfolio management approach dedicated to universities called PPMUNIV to select, evaluate and prioritize the projects put or to be implemented in a portfolio, taking into account the contribution of the projects to the achievement of the university's objectives, and its values in improving the performance and universities image (the case studied is the UAE University). This approach is based on the COBIT 5 framework.

The proposed methodology is broken down into six stages, and divided into two parts, the first consists in preparing the portfolio of which we will categorize the portfolio and identify the projects, and the second consists in planning the portfolio. From this step, we will evaluate the criteria, select, prioritize the projects, and finally Adjust / balance the portfolio. Thus, it offers five project selection criteria based on the five strategic axes of IT governance and two catalysts derived from COBIT 5 facilitators.

Table 1 describes the prioritization criteria on which we used for the evaluation of the project and the associated processes. Each prioritization criterion is associated with one or more processes in the COBIT 5 model.

In order to select and prioritize university IT projects according to COBIT 5 processes, we have developed a new approach devised in two parts: The first consists of portfolio planning (selection and prioritization) and the second concerns portfolio monitoring which the project will be aligned with (optimization). In this paper we have focused on the first part and more particularly on the selection and prioritization of IT projects (Figure 1).

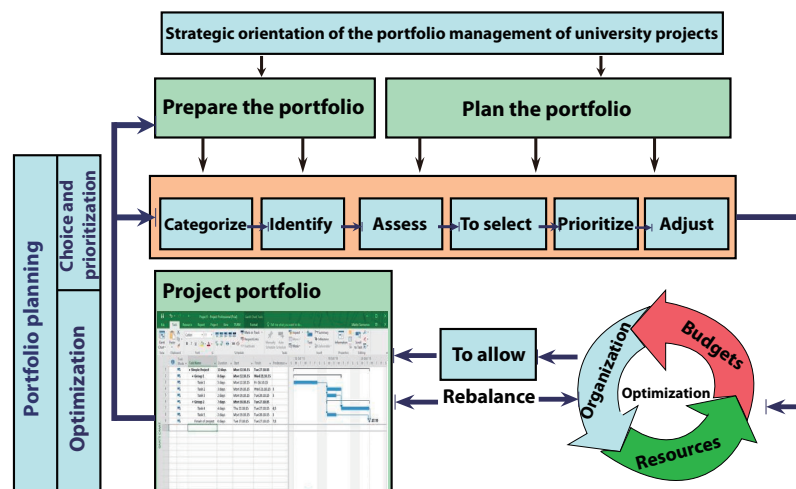


**Table 1** Prioritization criteria and associated processes

Criteria	Description	Associated processes
Strategic alignment	Strategic Alignment is about ensuring that IT plans remain aligned with business plans; target the most relevant projects for the university's strategy, define, update and validate IT value added proposals; and to align the functioning of IT with the functioning of the university <sup>[47,48]</sup> .	EDM01: Ensure the definition and maintenance of the governance framework APO: Align, plan and organize BAI06: Manage changes BAI07: Manage acceptance of change and transition VAL IT: Principle 1 VG8 set strategic orientations.
University needs (stakeholders)	The needs (objectives) of stakeholders must be determined in terms of sustainability in order to identify and select the projects that best meet their needs.	EDM05 Ensure transparency for stakeholders BAI02 Manage the definition of requirements BAI03 Manage the identification and design of solutions VAL IT principle VG 5: Define information requirements.
Value contribution (Realization of profit)	The Value Contribution consists of determining the added value of each project, ensuring that the projects bring the expected benefits from a strategic point of view, only these projects will be included in the portfolio.	EDS02 Ensure delivery of benefits APO09 Manage service agreements BAI04 Manage availability and capacity SEM01 Monitor, evaluate and measure performance and compliance APO11 Manage quality LSS04 Manage continuity VAL IT principle 3 IM12: Generate / monitor profits.
Resource optimization	Consists of optimizing the investment in IT resources and ensuring proper management of resources: Applications, information, infrastructure and people, and their alignment with strategic objectives.	EDS04 Ensure optimization of resources APO06 Manage budget and costs APO07 Manage human resources APO10 Manage suppliers BAI09 Manage assets VAL IT Principle 2: PM5 monitor resource requirements and their use.
Risk management	Managing portfolios requires an awareness of risk on the part of managers, a clear vision of the university's risk appetite, and the assignment of risk management responsibilities within the university.	EDS03 Ensure risk optimization APO12 Manage risks APO13 Manage security LSS02 Manage service requests and incidents LSS03 Manage Problems LSS05 Manage security services LSS06 Manage business process controls.

**Table 1** (Continued)

Criteria	Description	Associated processes
Respect for the values, culture and ethics of the university	The culture, ethics and behavior of individuals and the university must be taken into account when selecting projects. It is a factor of success in governance and management activities. A supportive and open-minded culture is necessary to build effective personal relationships, and to build a positive and collaborative environment.	Cobit 5 Enabler 4 Culture, ethics and behavior.
Think about the skills of the administrative and technical managers of the university.	University managers must be at least as qualified and competent in administrative management services, technical and general skills including Relationship Management, Conflict Management, Influence, Negotiation to be able to effectively design and govern processes and activities.	APO08 Manage Relationships Cobit 5 Enabler 7 People, skills and competences.

**Figure 1** Proposed approach to portfolio management

### 3.1 Description and Implementation of Our Proposed Portfolio Management Approach: Case Study Abdelmalek Essadi University (UAE)

- **Step 1** Categorize the portfolio

We can build our portfolio structure in several ways. The university process helps us determine the most suitable structure for our university or department. This includes the overall content of the portfolio, the categories of benefits and therefore the components of the portfolio and the balancing of the work, which we are trying to achieve. It may also include the benefit models and / or financial models that we will use to assess portfolio projects and the

roles and responsibilities of those involved. Clearly defining the portfolio category will allow the objective to be better targeted in the identification process that follows. In this step, we have chosen the UAE IT projects.

- **Step 2** Identify the projects

The implementation of portfolio management begins with the identification of portfolio projects, these should be identified according to the financial cost / benefit implications, and the academic strategy that is generally expressed as general statements, which describe what the university seeks to achieve (through goals and objectives) and how the university plans to achieve them (strategies and tactics).

The projects proposed by the UAE University in this step shown in Table 2.

**Table 2** List of proposed projects

A1	Professional integration system.	DIP
A2	Assessment and self-assessment system.	DEAE
A3	Moroccan scientific research information system <sup>[49–54]</sup> .	SIMARECH
A4	Student support system.	DAE
A5	Moroccan Information System for University Cooperation <sup>[55–58]</sup> .	SIMACOOOP
A6	Mobility management platform.	PGM

- **Step 3** Evaluation of the criteria

The evaluation of project requests can only be carried out correctly if the evaluation criteria and their respective weight have been defined beforehand. The criteria should be structured by theme and by typology. It is important to be a little imaginative and not be satisfied with the traditional strategic alignment or ROI (which is only very rarely assessed ...) and know why a criterion is important. Our method is based on the comparison of several criteria, of which we assess the relative importance of one criterion over another, using an appropriate scale for this. SAATY (1991) which converts pairwise comparisons established on a semantic scale (at nine levels) into a priority vector, shown in Table 3.

IS managers from Abdelmalek Essaadi University evaluated the prioritization criteria indicated previously using the peer comparison (Table 4), then we calculated the weight of each criterion by the AHP method, the result of the latter is important for the evaluation of the probability, since it will be used to indicate the relative importance of each operative criterion (Table 5)<sup>[60–62]</sup>.

- **Step 4** Selection of projects

The selection of projects is made based on the results obtained in the previous step. Based on the constructed criteria comparison matrix to allow analysis of the weight of each project. The objective of this step is to facilitate decision-making on the prioritization of projects that had better meet the expectations of the university. Table 6 shows the values of the proposed projects against each criterion, these values deduced by the UAE IS managers.

**Table 3** Scale proposed by SAATY<sup>[59]</sup>

Degrees of importance of each characteristic	Definition	Explanation
1	Equal importance	Two characteristics contribute in the same way to the goal.
3	Low importance of one characteristic over another.	Personal experience and appreciation slightly favor one characteristic over another.
5	Strong or decisive importance	Experience and appreciation strongly favor one characteristic over another.
7	Very strong or proven importance	A characteristic is strongly favored and its dominance is attested in practice.
9	Absolute importance	The evidence favoring one characteristic over another is as convincing as it gets.
2, 4, 6, 8	Values associated with intermediate judgments	When a compromise is necessary.

**Table 4** Pairwise comparison

	C1	C2	C3	C4	C5	C6	C7
C1	1	5	4	4	4	5	5
C2	1/5	1	5	3	3	3	1/2
C3	1/4	1/5	1	1/3	1/3	1	1/4
C4	1/4	1/3	3	1	3	2	1
C5	1/4	1/3	3	1/3	1	3	1
C6	1/5	1/3	1	1/2	1/3	1	1/3
C7	1/5	2	4	1	1	3	1

**Table 5** Calculation of the weight with the AHP method

Criteria	Priority	Ranking
C1	30.6%	1
C2	12.8%	4
C3	11.2%	5
C4	13%	3
C5	10.3%	6
C6	4.7%	7
C7	17.5%	2

**Table 6** Values of proposed projects

$a_{ij}$	C1	C2	C3	C4	C5	C6	C7
A1	90	70	60	60	60	70	80
A2	90	60	80	60	60	70	70
A3	90	80	80	60	60	70	70
A4	90	70	80	50	60	70	70
A5	90	70	80	60	60	60	70
A6	90	50	70	50	50	70	60

• **Step 5** Prioritization of projects

It is during this step that we will have enough information to prioritize all the projects for the portfolio, the project that carries a high value is the one that best meets the selection criteria of a project that will be authorized. financed according to the available budget. To do this, the TOPSIS method and the WSM technique have been proposed. For the ranking and prioritization of all projects, we used the TOPSIS method (Tables 7~11) and the WSM technique (Table 12).

These tables determines and calculates the ideal separation distance and the negative ideal separation distance for each competing alternative.

**Table 7** Calculation matrix for the sum of the criteria of each alternative

$a_{ij}$	C1	C2	C3	C4	C5	C6	C7
A1	8100	4900	3600	3600	3600	4900	80
A2	8100	3600	6400	3600	3600	4900	4900
A3	8100	6400	6400	3600	3600	4900	4900
A4	8100	4900	6400	2500	3600	4900	4900
A5	8100	4900	6400	3600	3600	3600	4900
A6	8100	2500	4900	2500	2500	4900	3600
SUM	48600	27200	34100	19400	20500	28100	29600

**Table 8** Standardized Decision Matrix

$R_{ij}$	C1	C2	C3	C4	C5	C6	C7
A1	0.41	0.42	0.32	0.43	0.42	0.42	0.46
A2	0.41	0.36	0.43	0.43	0.42	0.42	0.41
A3	0.41	0.49	0.43	0.43	0.42	0.42	0.41
A4	0.41	0.42	0.43	0.36	0.42	0.42	0.41
A5	0.41	0.42	0.43	0.43	0.42	0.36	0.41
A6	0.41	0.30	0.38	0.36	0.35	0.42	0.35

**Table 9** Selection of minimum and maximum values

$V_{\max}$	0.41	0.49	0.43	0.43	0.42	0.42	0.46
$V_{\min}$	0.41	0.30	0.32	0.36	0.35	0.36	0.35

**Table 10** Calculation of the measure of separation of alternatives

Ideal separation									
$(v - v_{i,\min})2$	C1	C2	C3	C4	C5	C6	C7	SUM	$S_{\min}$
A1	0	0.0147	0	0.0052	0.0049	0.0036	0.01351	0.375144	0.61249
A2	0	0.0037	0.0117	0.0052	0.0049	0.0036	0.00338	0.032376	0.179935
A3	0	0.0331	0.0117	0.0052	0.0049	0.0036	0.00338	0.395122	0.628587
A4	0	0.0147	0.0117	0	0.0049	0.0036	0.00338	0.038251	0.195579
A5	0	0.0147	0.0117	0.0052	0.0049	0	0.00338	0.37318	0.610885
A6	0	0	0.0029	0	0	0.0036	0	0.006491	0.080568
Ideal-negative separation									
$(v_{i,\max} - v)2$	C1	C2	C3	C4	C5	C6	C7	SUM	$S_{\max}$
A1	0	0.0037	0.0117	0	0	0	0	0.015407	0.124124
A2	0	0.0147	0	0	0	0	0.00338	0.351418	0.351418
A3	0.0011	0	0	0	0	0	0.00338	0.351418	0.06689
A4	0	0.0037	0	0.0052	0	0	0.00338	0.345543	0.587829
A5	0	0.0037	0	0	0	0.0036	0.00338	0.010614	0.103022
A6	0	0.0331	0.0029	0.0052	0.0049	0	0.01351	0.3929	0.626818

**Table 11** Calculate the relative proximity of the ideal solution

	G	Projects
A1	83.1%	DIP
A2	23.2%	DEAE
A3	90.3%	SIMARECH
A4	24.9 %	DAE
A5	85.5 %	SIMACOOOP
A6	11.3%	PGM

We recalculated the prioritization of all the projects; we used another WSM technique (Table 12).

• **Step 6** Portfolio adjustment

Once the projects have been selected and prioritized, a portfolio adjustment is made. This process involves organizing the priority components into a blend such that when implemented, it is best aligned, and best supports the strategic plan of the university. The portfolio is reorganized following the analysis carried out in the previous steps. The projects with the most weight will be implemented as a priority.

1. Portfolio adjustment with the TOPSIS method (Table 13).
2. Portfolio adjustment with the WSM technique (Table 14).

**Table 12** Prioritization of alternatives with the WSM technique

	A1	A2	A3	A4	A5	A6	weight
C1	90	90	90	90	90	90	30.6
C2	70	60	80	70	70	50	12.8
C3	60	80	80	80	80	70	11.2
C4	60	60	60	50	60	50	13
C5	60	60	60	60	60	50	10.3
C6	70	70	70	70	60	70	4.7
C7	80	70	70	70	70	60	17.5
Weighting score	7449	7368	7626	7370	7451	67223	

**Table 13** Portfolio adjustment using the TOPSIS method

SIMARECH	90.3%	1
SIMACOOOP	85.5%	2
DIP	83.1%	3
DAE	24.9 %	4
DEAE	23.2 %	5
PGM	11.3%	6

**Table 14** Portfolio adjustment with the WSM technique

A1	SIMARECH	7626	1
A2	SIMACOOOP	7451	2
A3	DIP	7449	3
A4	DAE	7370	4
A5	DEAE	7368	5
A6	PGM	6722	6

Tables 13 and 14 rank the university projects in order.

After the calculation results obtained in the portfolio adjustments step, it turns out that the TOPSIS method and the WSM technique give the same result.

## 4 Discussion and Result

The objective of our PPMUNIV approach was to propose a multi-criteria decision-making method for the selection and prioritization of IT projects dedicated to the Abdelmalek Essaadi University (UAE), based on the grouping of a set of methodologies, and the use of the COBIT 5 IT governance framework processes.

The success of the IS / business alignment relies mainly on good management of the project portfolio in the university, dealing with all the changes within the structure (and not only those of the IS). The management of the project portfolio includes the implementation of the IS strategy stemming from the university's strategy. It achieves alignment by prioritizing projects based on their strategic fit, the risks they entail and the expected benefits.

COBIT 5 is a comprehensive framework in terms of coverage, which should be tailored to each organization, taking into account the nature of its business and specific needs, the uniqueness of its IT function, and various internal and external factors. Among its portfolio management processes is mainly the APO 05 process which is part of the APO domain (Align, Plan and Organize). At the base of this process, the university will have a broad type of IT

framework necessary to support effective portfolio management.

When constructing our proposed approach, we applied the principles of COBIT 5, more particularly APO05, which fits perfectly into the framework of project portfolio management. This proposed approach provides portfolio managers with the criteria and information necessary to maintain an organized portfolio.

Our method generated a single categorization of the portfolio which is IT, made up of 6 university projects.

To facilitate the selection, we have proposed a ranking of projects based on the AHP and TOPSIS and WSM methodology, which is relevant and fits perfectly into the framework of the UAE project portfolio selection problem. In our approach we have taken into consideration and used several dimensions to manage the PPMUNIV project portfolio among them the choice of multicriteria variables, the decision is generally taken according to several parameters to be integrated, we are also interested in the static case, we consider then that at the time of the decision all the projects are candidates, the interaction between the projects for example between the costs of the projects, the interaction then generates savings. All these dimensions constitute, themselves, simplifications of our approach in order to lay the foundations for future studies.

The results obtained show that our proposed approach PPMUNIV offers:

1. A basis of best organizational practices.
2. A set of decision points.
3. Prioritization of projects based on the value of the project for the organization (university).
4. The proposal of a multi-criteria method for evaluating the value of projects.
5. Advocates a participatory approach by soliciting the collaboration of various stakeholders.

After the evaluation of the six projects proposed by the management of the UAE University, the values of the result show that the Moroccan Information System for Scientific Research (SIMARECH) is the highest ranked project among these alternatives. It takes the prioritization of its management (planning and implementation) at the level of Abdelmalek Essaadi University. Monitoring by the Moroccan Information System for the Governance of University Cooperation (SIMACOOOP), Professional integration system, Mobility management platform, Student support system and evaluation and self-assessment system.

## **5 Conclusion**

The ability to establish effective governance of projects requires the use of a method to select, prioritize, evaluate, adjust and monitor the project portfolio. Project portfolio management provides methods that can be used to increase the profitability, efficiency of the organization and achieve set goals. Since strategic alignment is essential to achieve organizational goals. The purpose of this paper has been to propose and present a method to be adopted when building and organizing a projects portfolio, suitable for universities. The objective of applying



a portfolio of project management methodology is to facilitate decision-making and allow the right project to be carried out at the right time.

The method presented in this paper made it possible to carry out the selection and prioritization of six projects proposed by the management of the University Abdelmleek Essaadi having the most value, using criteria for identifying and selecting projects, in association with the processes and practices of the COBIT 5 framework and the AHP, TOPSIS and WSM multi-criteria decision-making methods. The evaluation of the prioritization criteria using the proposed selection matrices has made it possible to identify the projects, which are the most profitable, the most aligned with the university's strategy and which have an acceptable level of risk.

This method brings a new way of doing things in the context of the selection and prioritization of projects in a portfolio and its use in the university could be very effective. The combination of multi-criteria decision-making methods and the processes of the COBIT 5 framework is a very good approach to provide managers with a simple and comprehensive method to address the complex problem of selecting and organizing project portfolios. With this method, projects with low values are eliminated and the available resources remain focused exclusively on those meeting the current and immediate needs of the university, which will therefore give it more transparency and increase its performance.

## References

- [1] De Haes S, Van Grembergen W. Enterprise governance of IT, alignment and value. Springer International Publishing, 2015: 1–10.
- [2] ISACA. COBIT5: A business framework for the governance and management of enterprise IT. 2016.
- [3] De Reyck B, Grushka-Cockayne Y, Lockett M, et al. The impact of project portfolio management on information technology projects. *International Journal of Project Management*, 2005, 23(7): 524–537.
- [4] Oliinyk V, Kozmenko O. Optimization of investment portfolio management. *Serbian Journal of Management*, 2019, 14(2): 373–387.
- [5] International Organization for Standardization (ISO). ISO/IEC 38500: 2008, Corporate governance of information technology. Switzerland, 2008.
- [6] Bajgoric N. Business continuity management: A systemic framework for implementation. *Kybernetes*, 2014, 43(2): 156–177.
- [7] De Haes S, Van Grembergen W. An exploratory study into IT governance implementations and its impact on business/IT alignment. *Information Systems Management*, 2009, 26(2): 123–137.
- [8] Hicks M, Pervan G, Perrin B. A study of the review and improvement of IT governance in Australian universities. *CONF-IRM 2012 Proc.*, May 2012.
- [9] Grembergen W V. Strategies for information technology governance. Idea Group, 2004.
- [10] Hardy G. Using IT governance and COBIT to deliver value with IT and respond to legal, regulatory and compliance challenges. *Information Security Technical Report*, 2006, 11(1): 55–61.
- [11] Posthumus S, Solms R V. A framework for the governance of information security. *Computers & Security*, 2004, 23(8): 638–646.
- [12] ISACA. Official website. <https://www.isaca.org/>.
- [13] Ajami R, Al-Qirim N. Governing IT in Higher education institutions. *Advanced Science and Technology Letters*, 2015, 36: 1–5.
- [14] Pries-Heje J, Venable J, Bunker D, et al. Human benefit through the diffusion of information systems design science research. *AICT-318*, 2010.
- [15] Nugroho H, Surendro K. Proposed model of vocational university governance and measurement model by utilizing the ISO 38500 framework and COBIT 5 enabler. *International Conference on ICT for Smart Society*, 2013: 86–90.

- [16] Sadikin M. IS strategic plan for higher education based on COBIT assessment: A case study. *International Journal of Information and Education Technology*, 2015, 5(8): 629–633.
- [17] Blomquist T, Stadnick P. Project portfolio management practices for innovation — A case study at ABN AMRO-Brazil. *Handelshgskolan Vid Ume Universitet*, 2007.
- [18] De Maio A, Verganti R, Corso M. A multi-project management framework for new product development. *European Journal of Operational Research*, 1994, 78(2): 178–191.
- [19] Fernez-Walch S, Gidel T, Romon F. Innovative projects portfolios as a new management subject matter. *Revue Française de Gestion*, 2006, 165(6): 87–103.
- [20] Castonguay J, Miller R. La gouvernance des grands projets d'infrastructure publique - Le démarrage des grands projets publics: Éléments de réflexion. *CIRANO Project Reports*, May 2006.
- [21] Petit Y. Project portfolios in dynamic environments: Organizing for uncertainty. *International Journal of Project Management*, 2012, 30(5): 539–553.
- [22] Anthes G H. Model mania. *Computerword*, 2004: 41.
- [23] Rouyet-Ruiz J. COBIT as a tool for IT governance: Between auditing and IT governance. *The European Journal for the Informatics Professional*, 2008, 9(1).
- [24] Van Grembergen W, De Haes S, Guldentops E. Structures, processes and relational mechanisms for IT governance. Van Grembergen W. *Strategies for Information Technology Governance*. IGI Global, 2004. Doi: 10.4018/978-1-59140-140-7.ch001.
- [25] Oliver D, Lainhart J. COBIT 5: Adding value through effective Geit. *EDPACS*, 2012, 46(3): 1–12.
- [26] Mallette D, Jain M. IT performance improvement with COBIT and the SEI CMM. *Information Systems Control Journal*, 2005, 3: 46–50.
- [27] Kaplan R S, Norton D P. The balanced scorecard — Measures that drive performance. *Harvard Business Review*, 2005, 83(7–8): 172–180.
- [28] Johnson R B, Onwuegbuzie A J. Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 2004, 33(7): 14–26.
- [29] Ridley G J, Carroll P. COBIT and its utilization: A framework from the literature. *Proceedings of the 37th Annual Hawaii International Conference on System Sciences*, 2004: 8.
- [30] ISACA. COBIT 5: A business framework for the governance and management of enterprise. 2012.
- [31] Al Mohamed A A, Al Mohamed S, Zino M. Application of fuzzy multicriteria decision-making model in selecting pandemic hospital site. *Future Business Journal*, 2023, 9(1): 1–22.
- [32] Harathi R. *Facteurs de qualité et personnalisation de l'information*. Lyon, 2005.
- [33] Debnath A, Majumder M, Pal M. Potential of fuzzy-electre MCDM in evaluation of cyanobacterial toxins removal methods. *Arabian Journal for Science and Engineering*, 2016, 41(10): 3931–3944.
- [34] Saaty T L. What is the analytic hierarchy process? *Mathematical Models for Decision Support*, Berlin, Heidelberg: Springer Berlin Heidelberg, 1988: 109–121. Doi: 10.1007/978-3-642-83555-1-5.
- [35] Saaty R W. The analytic hierarchy process — What it is and how it is used. *Mathematical Modelling*, 1987, 9(3): 161–176.
- [36] Guitouni A, Martel J M, Bélanger M. *Cadre méthodologique pour différencier les méthodes multicritères*. 2010.
- [37] dos Santos M, de Araújo Costa I P, Gomes C F S. Multicriteria decision-making in the selection of warships: A new approach to the AHP method. *International Journal of the Analytic Hierarchy Process*, 2021, 13(1): 147–169.
- [38] Saaty T L. Analytic network process. *Encyclopedia of operations research and management science*. Dordrecht: Kluwer Academic Publishers. Doi: 10.1007/1-4020-0611-X-32.
- [39] Baric D, Zeljko L. Multi-criteria decision-making on road transport vehicles by the AHP method. *Archiwum Motoryzacji*, 2021, 94(4): 17–26. Doi: 10.14669/AM.VOL94.ART2.
- [40] Bafail O A, Abdulaal R M S. A combined BWM-TOPSIS approach versus AHP-TOPSIS approach: An application to solid waste management. *IEIM 2022: The 3rd International Conference on Industrial Engineering and Industrial Management*. Doi: 10.1145/3524338.
- [41] Sharma D, Sridhar S, Claudio D. Comparison of AHP-TOPSIS and AHP-AHP methods in multi-criteria decision-making problems. *International Journal of Industrial and Systems Engineering*, 2020, 34(2): 203–223.
- [42] Hwang C L, Yoon K. *Multiple attribute decision making*. Berlin, Heidelberg: Springer Berlin Heidelberg,

1981. Doi: 10.1007/978-3-642-48318-9.
- [43] FERHATI Fatima Zohra Et KAOUANE Nissia. Conception d'un outil d'aide multicritère à la décision pour le ranking des projets d'exploration dans l'amont pétrolier (SONATRACH). Boumerdès, 2017.
  - [44] De Souza L P, Gomes C F S, De Barros A P. Implementation of new hybrid AHP-TOPSIS-2N method in sorting and prioritizing of an it CAPEX project portfolio. *International Journal of Information Technology & Decision Making*, 2018, 17(4): 977–1005. Doi: 10.1142/S0219622018500207.
  - [45] De Siqueira Silva M J, Tomaz P P M, Diniz B P, et al. A comparative analysis of multicriteria methods AHP-TOPSIS-2N, PROMETHEE-SAPEVO-M1 and SAPEVO-M: Selection of a truck for transport of Live Cargo. *Procedia Computer Science*, 2022, 214: 86–92. Doi: 10.1016/J.PROCS.2022.11.152.
  - [46] (INERIS) Direction des Risques Chroniques. Panorama des méthodes d'analyse multicritère comme outils d'aide à la décision, 2009.
  - [47] Wu S, Straub D W, Liang T P. How information technology governance mechanisms and strategic alignment influence organizational performance: Insights from a matched survey of business and IT managers. *MIS Quarterly*, 2015, 39(2): 497–518.
  - [48] Belalcázar A, Díaz J, Molinari L. Towards the strategic alignment of corporate services with IT, applying Strategic Alignment Model (SAM). *Journal of Computer Science and Technology*, 2016, 16(1): 52–68.
  - [49] Benmoussa K, Laaziri M, Khouliji S, et al. SIMARECH 3: A new application for the governance of scientific research. *The First International Conference on Affective Computing, Machine Learning and Intelligent Systems*, 2017, 5: 776–784. <http://scholarpublishing.org/index.php/TMLAI/article/view/3429>.
  - [50] Benmoussa K, Laaziri M, Khouliji S, et al. Web information system for the governance of university research. *Engineering, Technology and Applied Science Research*, 2018, 8(4): 3287–3293.
  - [51] Benmoussa K, Laaziri M, Mouchtachi A, et al. Extended strategic alignment model (SAM) for information systems governance. *International Journal of Applied Decision Sciences*, 2022, 1(1): 1. Doi: 10.1504/IJADS.2022.10041873.
  - [52] Benmoussa K, Laaziri M, Khouliji S, et al. Intelligent system for the use of the scientific research information system. *International Journal of Advanced Computer Science and Applications*, 2018, 9(6). Doi: 10.14569/IJACSA.2018.090619.
  - [53] Benmoussa K, Laaziri M, Khouliji S, et al. Impact of system quality, information quality and service quality on the efficiency of information system. *Proceedings of the 3rd International Conference on Smart City Applications*, 2018(41). Doi: 10.1145/3286606.3286818.
  - [54] Benmoussa K, Laaziri M, Khouliji S, et al. Evaluating the usability of a Moroccan University Research Management Web Platform. *The 12th International Conference Interdisciplinarity in Engineering*, 2019, 32: 1008–1016. Doi: 10.1016/j.promfg.2019.02.315.
  - [55] Laaziri M, Benmoussa K, Khouliji S, et al. SIMACoop: A framework application for the governance of university cooperation. *Transactions on Engineering and Computing Sciences*, 2017, 5(4). Doi: 10.14738/tm-lai.54.3431.
  - [56] Laaziri M, Benmoussa K, Khouliji S, et al. Information system for the governance of university cooperation. *Engineering, Technology and Applied Science Research*, 2018, 8(5): 3355–3359.
  - [57] Laaziri M, Benmoussa K, Khouliji S, et al. Implementation of an intelligent tutoring system for the use of university governance information systems. *Proceedings of the 3rd International Conference on Smart City Applications — SCA'18*, 2018: 1–7. Doi: 10.1145/3286606.3286819.
  - [58] Laaziri M, Benmoussa K, Khouliji S, et al. Outlining an intelligent tutoring system for a university cooperation information system. *Engineering, Technology and Applied Science Research*, 2018, 8(5): 3427–3431.
  - [59] Ramos A, Cunha L, Cunha P P. Analytic hierarchy process (AHP) applied to the landslides study in a coastal area of the central Portugal: Figueira da Foz-Nazaré. *Geo-Eco-Trop*, 2014, 38(1): 33–43.
  - [60] Benmoussa K, Laaziri M, Khouliji S, et al. AHP-based approach for evaluating ergonomic criteria. *The 12th International Conference Interdisciplinarity in Engineering*, 2019, 32: 856–863. Doi: 10.1016/j.promfg.2019.02.294.
  - [61] Benmoussa K, Laaziri M, Khouliji S, et al. Enhanced model for ergonomic evaluation of information systems: Application to scientific research information system. 2019, 9(1): 683–694. Doi: 10.11591/ijece.v9i1.
  - [62] Benmoussa K, Laaziri M, Khouliji S, et al. Enhanced model for measuring information systems success. *Springer, Cham*, 2019: 713–726. Doi: 10.1007/978-3-030-11196-0-59.