Received: June 4, 2023. Revised: August 29, 2023. 386

International Journal of
Intelligent Engineering & Systems

http://www.inass.org/

A New Strategic Value for Money Methodology for IS/IT Project Portfolio under Variability

Anass Zaidouni[1]* Mohammed Abdou Janati Idrissi[1] Adil Bellabdaoui[1]

[1]ENSIAS, Mohammed V University in Rabat, Morocco,
Avenue Mohammed Ben Abdallah Regragui, Madinat Al Irfane, BP 713, Agdal, Rabat, Morocco
* Corresponding author's Email: anasszaidouni@gmail.com

Abstract: Information system (IS) and information technology (IT) Portfolio value management enables to measure the intended IS/IT project portfolio value, in pursuit of strategic objectives. Yet, the captured IS/IT project portfolio value should be articulated in the different IS/IT project portfolio segments in order to measure each category value contribution. Moreover, it should consider the strategic objectives variability throughout the portfolio lifespan. Therefore, this study proposes a novel methodology for the strategic portfolio value (SPV) calculation, using the rank order distribution (ROD) weights model for strategic objectives variability modelling, and the value for money (VfM) technique of the management of portfolios (MoP™) guidance based on expert judgments. Besides, this study provides a new IS/IT project portfolio categorization. An IS/IT project management office (PMO) case study demonstrates the outcome of the new methodology, which is the calculated SPV of *0.68*, and how it aids, decision-making and performance management, identify under uncertainty the most strategically valuable IS/IT Project Portfolio categories.

Keywords: IS/IT project portfolio value, MoP™ value for money, Portfolio uncertainty, ROD weights, Performance management.

1. Introduction

All The discipline of Portfolio value management has evolved with the awareness of decision-makers, investors, portfolio managers, project managers and other practitioners of the importance of leveraging the values of their Portfolios of investments in organizations. In finance, portfolio value is defined as the return of assets compounding the portfolio, under a certain variance or risk [1]. Many guidances, such as the MoP™ and the project management body of knowledge (PMBoK) have provided processes, tools, and techniques to measure and monitor the intended value from initiatives of change within the whole portfolio [2, 3]. The seventh version of PMBoK reserved a project management principle focused on value [4]. According to the MoP™ guidance, an initiative of change value assessment goes through the evaluation of the value of the strategic objectives the initiative aims to achieve [2]. For this goal, the portfolio management definition practice "categorize" of the MoP™ guidance enables to categorize the portfolio into segments for appropriate investing, and provides the value for money (VfM) or the value profiling (VP) technique to measure this value [2]. In information system (IS) and information technology (IT), the expected IS/IT project portfolio strategic value should incorporate the benefits behind the realization of the strategic objectives of portfolio IS/IT project. Moreover, this value should be measured taking into account uncertainty, caused by internal and external factors that can affect the IS/IT initiatives success, such as business requirements, budgeting, resource availability, IS/IT security, data governance, regulatory compliance, etc. This risk inherence compromises strategic planning throughout IS/IT project portfolio lifespan, and the realization of the strategic objectives, which are value drivers within the IS/IT project portfolio [1, 5]. To model this variability of value drivers, the rank order distribution (ROD) weights model in [6], which aims to assess the

volatility of attributes via surrogate weights using probability density distribution functions, can be adopted by considering the IS/IT project portfolio value drivers as the model attributes.

This study measures the IS/IT project portfolio strategic value, taking into account the variability of strategic objectives, as value drivers, during the IS/IT project portfolio lifespan. Precisely, the objectives of the present study are:

- Constructing a novel methodology to calculate the strategic portfolio value (SPV), under the variability of the strategic objectives based on the VfM technique and the ROD weights model, and testifying its effectiveness in a case study.
- Providing a new categorization of the IS/IT project portfolio by adopting the portfolio management practice "categorize" of the MoP™ guidance, thus identifying using the elaborated methodology the most strategically valuable IS/IT project portfolio categories under uncertainty.

Our study has first theoretical contributions, as long as the proposed methodology incorporates the surrogate weights model, to represent the volatility of strategic objectives or value drivers in term of their relative importance in the IS/IT project portfolio lifecycle. Second, it has practical contributions by supporting the IS/IT project management offices (PMOs) decision-making, with the calculated SPV as a relevant key performance indicator (KPI) that enriches performance measurement and monitoring within the organization. Besides, with the evolving digital transformation and agility, IS/IT investments can be strategically appraised in term of value, and the most to least strategically valuable segments can be identified using the new IS/IT Project Portfolio categorization, thus informing decision-making to undertake appropriate actions.

This study is intended to decision-makers, portfolio managers, IS/IT PMOs, and value managers who are aware of value appraisal in performance management in the organization.

The paper is structured as follows. After the introduction, section 2 gives a literature review. Then, section 3 outlines the main steps of the new methodology. Afterwards, section 4 provides an IS/IT PMO case study. Section 5 gives the discussion and contributions. Finally, a conclusion and future work are given in section 6.

2. Literature review

The concept of value is extremely related to Portfolio Management. In [7], it is stated that organizations adopt portfolio management as a strategic and tactical tool to deliver business value and maximize investments benefits. It is stated that IT portfolio value results from the investments benefits exceeding their costs [7]. Through IT portfolio management, it can be articulated the company core values in order to make decisions in alignment with those values. The value categories can be stated as financial, strategic, and tactical. However, an approach ought to be established for striking a consensus in senior management with regard to value drivers priorities [7]. In benefit realization, value can a tangible or an intangible benefit. Portfolio value management is a domain in the PMI standard for portfolio management, destined to yield the expected return from portfolio investment, as defined by the organizational strategy [3]. Moreover, this value ought to be monitored throughout the investment execution as well as after its closure [2]. The MoP™ guidance prescribed a portfolio management definition practice "categorize", which tailors investment criteria to suit a specific category or segment of the portfolio [2]. It utilizes the VfM technique. In strategic alignment, this technique enables to perform a mapping between strategic objectives, derived from the strategic planning exercise, and the projects fulfilling these objectives, thus splitting the spending into portfolio categories. PMI stated that the articulation of the overall value is a result of risk diversification in the portfolio mix, independently from portfolio components [3]. Besides, it is cited the strategic alignment and benefits model mapping using a cause-effect diagram to connect a balanced scorecard strategic objective with its corresponding initiative while getting through the four BSc perspectives [8]. This map enabled to measure strategic alignment in project portfolio setup and monitoring consistently with the targets. Yet this project portfolio benefit model for ongoing and incoming projects is time-consuming and does not afford strategic value measurement and scores weighting. Furthermore, it is cited methodology of identification and assessment of the ecological, societal and learning values generated from strategic and non-commercial drivers values in project portfolio management [8]. In [9], an ontological semantic structure of strategic alignment framework was developed for IS and IT project management governance. The value perspective of this framework enabled to track down and achieve the maximum business value of an incoming or an ongoing IS/IT project, under constraints of reasonable risk and low cost, throughout the application of a set of procedures, management strategies and activities in order to select the investments with the greatest potential for value creation. However, this framework stays at project

level, as it does not assess the sets of IS/IT projects in Portfolio, and it lacks a practical implementation to effectively measure and assess the IS/IT project value.

IT portfolio management is also destined to monitor the value. In [7], the key objective of portfolio management is to spread out its risk tolerance on its investments decisions as long it asserted the risk level of each investment category. The establishment of the organization values by Portfolio Management is realized through strategic alignment, senior management commitment, priorities balance, setting short and long-term benefits, resource allocation and sustainable processes execution [3]. Moreover, two specific portfolio management principles with respect to the organization value were given [3], which are:

- Alignment of investments in portfolio components with the organization strategy and governance practices;
- Balance of the portfolio value against overall risks.

With regard to capturing the strategic value from project portfolio management, it is cited the mixed-integer nonlinear optimization model for project portfolio selection considering the value maximization as a key measure in portfolio optimization besides strategic alignment, balance, and future preparedness [10]. Value analysis is perceived as an effective strategic assessment method that increase the IS/IT project success rate [11]. Based on a system-value approach and imitation modelling, a conceptual model of management of technologically integrated industry development projects was elaborated in order to uncover many interconnected raw material production projects, logistics projects and projects of creating finished products for consumers, and in fine forming value [12]. Furthermore, it is cited the project portfolio model based on information entropy for portfolio value maximization, considering the value of each compounding project [13]. Therewith, it is stated the project portfolio formation model that balances between achieving strategic and agile transformation goals in the project portfolio value KPI [14].

Another theoretical concept of value is the whole life value (WLV), which is the value thinking theory defined by as the perceived value that spans the whole life of an asset from inception, design, implementation, and maintenance phases [15]. WLV is seen as the achieved optimum between stakeholders expectations, needs and requirements, and the asset over life costs [16]. This compromise is performed through the utilization of different methods, techniques and tools such whole-life costing, life-cycle assessment, multi-criteria analysis, and value and risk management. In [5], it is devised the WLV conceptual model assesses the project value as the asset net discounted value from inception to handout, considering the whole life costs as capital investment with a time factor representing the study period that starts from the handout date. Where the VfM technique covers project implementation lifetime, WLV spans the whole operations. Both VfM and WLV can be compared on same scale according to [5].

When it comes to uncertainty modelling within portfolio value, it is stated a project portfolio selection method combining return and risk evaluation using Mean-Gini, and PROMETHEE II [17]. Also, the portfolio decision analytic framework was elaborated integrating a MCDM method for measuring restoration plans value and maximizing portfolio allocations of restoration actions and resources using the Pareto frontier [18]. However, this framework is characterized by a bias on the value and cost factors in the MCDM method. In finance, Theory of portfolio investment is ruled by a return under a degree of risk or uncertainty. In [1], Markowitz stated that a diversified portfolio of high and low risk investments produces a higher return rather than an only high-risk investments portfolio or an only low risk investments portfolio. In [19], many techniques are stated in portfolio theory to calculate the expected returns forecasts such as the efficient Markets theory, the valuation models such as the capital asset pricing model, and the discounted cash flows models. Meanwhile, other models considered less available information and random noise like the constant growth model, the two-period growth model, and the three-period model. Moreover, there are the Finite Horizon models based on discounting expected dividends from stocks in a finite horizon and the cross-sectional regression analysis. There is not a unique optimal portfolio, but more than one produced efficient portfolios that maximize value at a given risk level assumed by the investor [19].

Furthermore, the conditional value at risk (CVaR) measure was adopted to model financial portfolio return under uncertainty [20, 21]. Moreover, a multi-trend CVaR was proposed to consider multiple trends and their impacts in finance portfolio optimization then the interior point method was applied for computing the portfolio [22]. In order to aid decision-making for risk averse investors, it is formulated a dynamic portfolio selection problem based on benchmark process combined with a dynamic value-at-risk constraint using stochastic dynamic programming techniques, and adopted the lagrange multiplier method for optimal portfolio strategies [23]. Whereas, the entropic VaR was used as a coherent risk measure, characterized by its financial

Table 1. ROD Weights for 2 to 10 attributes

	Attributes								
Rank	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	.6932	.5232	.4180	.3471	.2966	.2590	.2292	.2058	.1867
2	.3068	.3240	.2986	.2667	.2410	.2174	.1970	.1808	.1667
3		.1528	.1912	.1955	.1884	.1781	.1648	.1565	.1466
4			.0922	.1269	.1387	.1406	.1375	.1332	.1271
5				.0619	.0908	.1038	.1084	.1095	.1081
6					.0445	.0679	.0805	.0867	.0893
7						.0334	.0531	.0644	.0709
8							.0263	.0425	.0527
9								.0211	.0349
10									.0173

Note: Reprinted from "Weight approximations in multi-attribute decision models" by R. Roberts and P. Goodwin, *Journal of Multi-Criteria Decision Analysis*, Vol. 11, No. 6, pp. 291–303, 2002. Copyright © 2002 John Wiley & Sons, Ltd.

properties and its applicability to large-scale sample based portfolio optimization [24], outperforming the CVaR. There is also the guided pelican algorithm that outperformed three algorithms for optimizing the Portfolio of stocks problem [25]. In [26], there is the methodology that consists of comparing the economic trade-offs between microalgae growth and composition in a portfolio of products, and assessing techno-economically the intrinsic algal biomass value. Also, it is cited the model in [27] consisting of the borrower credit risk with the cash flow method for consumer credit portfolio economic value assessment. Therewith, it was cited the Bayesian model in [28] adopted in project portfolio selection to cope with portfolio uncertainty, which aims to increase expected portfolio value, selected actions number within optimal portfolio, and eliminate the discrepancy between the realized portfolio value and the estimated portfolio value. With regard to portfolio segmentation, an investor profiling approach based on expectation maximization, K-Means, and hierarchical clustering algorithms, was applied on plantation stocks in order to aid stocks portfolios selection [28].

Besides the statistical approaches used in literature to model portfolio value under risk, there is also the ROD weights model [6]. In a multi-attribute decision-making, the ROD weights are surrogate weights that take into consideration volatility in each attribute relative importance. Thus, these weights are called “swings”. Surrogate weights are proposed to convert real weights to take into account the swings. In [6], three surrogate weights, which are ROD, rank order centroid, rank sum and rank reciprocal, were compared and it was demonstrated that ROD weights best approximate the true weights. The weights calculation was performed via probability density distribution functions for ten attributes [6]. From raw weights denoted w^*, ranging such as $w_1^* = 100, 0 < w_2^* \leq 100,\ 0 < w_3^* \leq w_3^*$ and, in general, $0 < w_{i-1}^* \leq w_i^*$ where $i \neq 1$, the new ROD weights are normalized as their sum is 1. Table 1 presents the ROD weights.

Related to performance management, it was demonstrated in [29], through four small and medium-sized enterprises case studies the value of IT strategic alignment through IT and non-IT capabilities in supporting the companies business objectives. In [30], it was emphasized on performance measurement at the project-portfolio level, the importance of using performance metrics in projects, and performance measurement was proved to support attaining project management and organizational success. Furthermore, the empirical study in [31] concluded that there is a strategic business value to be captured from big data analytics capabilities, and this strategic value has mediating effects on attaining organization performance. However, none of these three former studies elaborated a KPI to really measure the captured strategic value.

Given the aforementioned literature, it can be stated that previous techniques, from one hand, didn’t decline mostly strategic alignment in their value measurement, and they are not adapted to measuring the captured value from strategic objectives as drivers of value, and from another hand, they didn’t devise strategic portfolio value KPIs to measure portfolio performance from the value perspective. It is noteworthy that the ROD weights model has good representation of uncertainty and better approximation within each attribute contribution. Meanwhile, the VfM technique is appropriate for value measurement considering weighting and scoring of the value drivers with regard to strategic

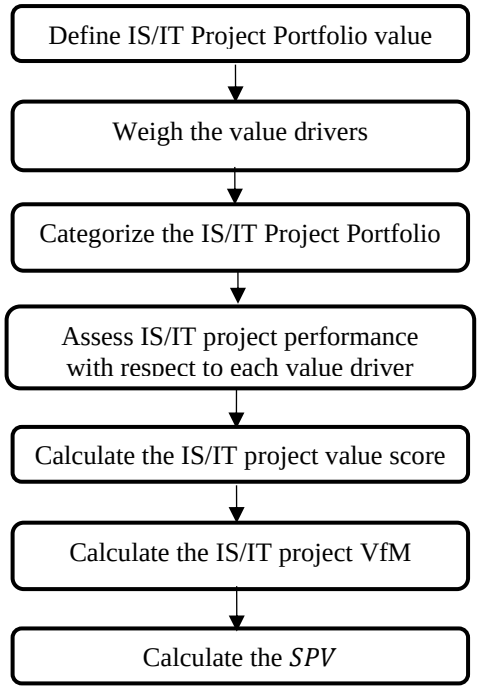

Figure. 1 SPV calculation methodology flowchart

alignment. Therefore, the present study aims to elaborate a new SPV methodology for IS/IT project portfolio under variability, that leverages the advantages of the VfM technique in IS/IT project portfolio value measurement, by articulating the value contribution of each strategic objective as a value driver, and the ROD weights model in modelling the variability of IS/IT project portfolio strategic objectives in the strategic planning lifespan. Underpinned by the new methodology, the present study provides a new categorization of the IS/IT project portfolio, in order to identify the most strategically valuable IS/IT Project Portfolio categories under uncertainty. The experimentation of the new methodology is carried out in an IS/IT PMO case study.

3. Methodology

The new strategic VfM methodology we propose, calculates the SPV for the IS/IT project portfolio under variability, based on the "categorize" MoP™ standard practice [2]. This practice prescribes the VfM technique that calculates the IS/IT projects values, and the categorization approach to produce new IS/IT project portfolio strategic categories. In the IS/IT project portfolio value appraisal, each of these categories has a strategic contribution in matter of value, within the IS/IT project portfolio. To model uncertainty, the ROD weights are applied to the strategic objectives in the new methodology.

The new strategic VfM methodology, whose flowchart is depicted in Fig. 1, is outlined as follows:

- **Step 1:** Define IS/IT project portfolio value drivers

In the strategic planning exercise, the IS/IT PMO defines the strategic objectives within a horizon of IS/IT project portfolio span. These strategic objectives are referred as value drivers of the IS/IT Project Portfolio.

- **Step 2:** Weigh the value drivers

The IS/IT PMO experts assign the aforementioned ROD weights (Table 1) to the strategic objectives from the most to the least strategic according to an expert judgement based on lessons learnt about past variability of the strategic objectives, in order to account for the evolving variability within the IS/IT project value during the IS/IT Portfolio lifespan.

- **Step 3:** Categorize the IS/IT project portfolio

This step enables to perform a categorization through the utilization of the MoP™ standard practice "categorize" [2]. The IS/IT PMO experts assign the IS/IT projects to new IS/IT project portfolio strategic categories based on the relationship between the benefits of the IS/IT projects and the IS/IT project portfolio values drivers.

- **Step 4:** Assess IS/IT project performance with respect to each value driver

In this step, the IS/IT project managers assess their respective IS/IT projects performance with regard to the value drivers. They responded to questionnaire given in Appendix A, rating performance following a 10-points scale.

- **Step 5:** Calculate the IS/IT project value score

The IS/IT project value score indicates how well the project fulfils the organization strategic requirements, which is the aggregated performances of value drivers using the ROD weights. It is calculated as it follows:

$$VS_i = w_j \times perf_{ij} \quad (1)$$

Where VS_i is the i^{th} IS/IT project value score with respect to the j^{th} value driver, w_j is the ROD weight of the j^{th} value driver $j = 1..10$, and $perf_{ij}$ is the performance of the i^{th} IS/IT project with respect to the j^{th} value driver.

- **Step 6:** Calculate the IS/IT project VfM

The IS/IT project VfM is the IS/IT project value score on its budget, as it is outlined:

$$VfM_i = \frac{\sum_{j=1}^{10} VS_j}{budget_i} \quad (2)$$

Table 2. IS/IT project portfolio categorization

Project	Description	Budget (MAD)	Category	IS/IT PMO phase
SI_2010_01	Business GIS	6000000	IS	Implementation
SI_2015_01	Commercial IS	450000	IS	Implementation
SI_2016_01	Business Planning Consolidation	10000000	IS	Implementation
SI_2017_01	Asset management IS	6500000	IS	Preparation
SI_2018_01	BIRD web monitoring	6000000	IS	Demand
IT_2016_01	SAP Infrastructure	8700000	IT	Exploitation and support
IT_2017_01	Non SAP infrastructure	750000	IT	Implementation
IT_2018_01	SAM solution	8000000	IT	Preparation
IT_2018_02	BPC on HANA	1000000	IT	Preparation
IT_2018_03	VDI solution	2800000	IT	Preparation
SI_2019_01	SAP Process Orchestrator	8000000	IS	Preparation
SI_2020_01	Business Intelligence BW4HANA	1000000	IS	Exploitation and support
IT_2020_01	Internet Of Things	2800000	IT	Implementation
IT_2020_02	Datacenter acquisition	2800000	IT	Exploitation and support

Table 3. IS/IT project portfolio value drivers

Value Driver	Statement of the objective
Primary Value driver 1	Ensure IS/IT strategic alignment
Primary Value driver 2	Apply IS/IT security
Primary Value driver 3	Streamline and standardize IS processes
Primary Value driver 4	Implement IS/IT agility
Primary Value driver 5	Undergo organizational and business change
Primary Value driver 6	Apply performance management
Primary Value driver 7	Control water and sewer demand
Primary Value driver 8	Manage water resource development
Primary Value driver 9	Reinforce governance
Primary Value driver 10	Improve operational and economic efficiency

Where: VfM_i is the calculated VfM of project i, $i = 1..N$, N is the number of IS/IT projects.

- **Step** 7: Calculate the SPV

The SPV is the sum of the IS/IT projects VfMs within the whole IS/IT Portfolio, as it is outlined:

$$SPV = \sum_{i=1}^{N} VfM_i \quad (3)$$

Where: VfM_i is the calculated VfM of IS/IT project i, $i = 1..N$.

3.1 Data collection

Data of 14 IS/IT projects compounding a Portfolio of an IS/IT PMO case study are listed in Table 2. This data gives for each IS/IT project, its budget, initial category (IS or IT), and phase within the IS/IT Portfolio.

3.2 Data processing

According to the SPV calculation methodology flowchart (Fig. 1), the steps are proceeded as follows:

- **Step** 1: The strategic objectives identified from the strategic planning exercise spanning the period from 2017 to 2022 are provided by the IS/IT PMO. These strategic objectives are referred as value drivers of the IS/IT project portfolio for this period. The elaboration of these value drivers was performed by the IS/IT PMO using the specific, measureable, achievable, realistic, and time-bound technique. Table 3 exhibits the IS/IT project portfolio value drivers.
- **Step 2:** The IS/IT PMO assigned the value drivers to their relative ROD weights according to an expert judgement based on lessons learnt about past variability of the strategic objectives. Then, the ROD surrogate weights are outlined on the elaborated IS/IT project portfolio value profile in Fig. 2 to model the relative importance of each value driver.
- **Step 3:** As recommended by the MoP™ guidance 'categorize' practice, the IS/IT PMO assigned each IS/IT project to a new category among a

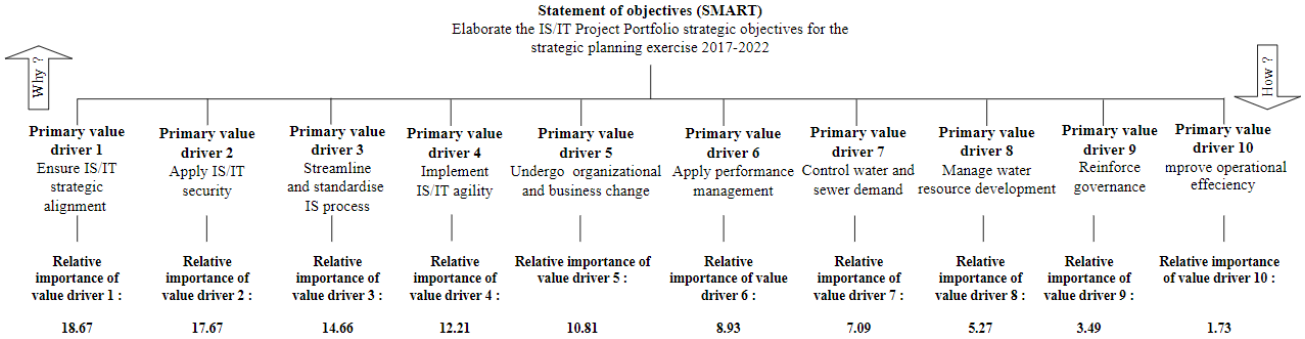

Figure. 2 IS/IT project portfolio value profile

Table 4. IS/IT project portfolio categorization

Project	Description	New category
SI_2010_01	Business GIS	Strategic
SI_2015_01	Commercial IS	Strategic
SI_2016_01	Business Planning Consolidation	Migration
SI_2017_01	Asset management IS	Strategic
SI_2018_01	BIRD web monitoring	Service
IT_2016_01	SAP Infrastructure	Support
IT_2017_01	Non SAP infrastructure	Support
IT_2018_01	SAM solution	Strategic
IT_2018_02	BPC on HANA	Migration
IT_2018_03	VDI solution	Service
SI_2019_01	SAP Process Orchestrator	Strategic
SI_2020_01	Business Intelligence BW4HANA	Migration
IT_2020_01	Internet Of Things	Strategic
IT_2020_02	Datacenter acquisition	Service

predefined list of categories: Strategic, Migration, Service, and Support.

- **Step 4:** A close-ended questionnaire was used to collect the performances of the IS/IT projects using a 10-point scale from the respective IS/IT project managers regarding the value drivers. This questionnaire is given in Appendix A.
- **Step 5:** The IS/IT projects value scores are calculated using Eq. (1).
- **Step 6:** The IS/IT projects VfMs are then calculated using Eq. (2).

Step 7: The VfM for each category can be calculated as the sum of the VfMs of IS/IT projects within this category. Then, the *SPV* is calculated using Eq. (3).

3.3 Results

The steps 3, 5, and 6 provide the results of our proposed methodology as follows:

- **Step 3:** Table 4 depicts the new IS/IT project portfolio categorization
- **Step 5:** Table 5 provides the calculation of the SI_2010_01 project value score as an example. The other IS/IT project value scores were calculated in a similar way.
- **Step 6:** The VfM of the SI_2010_01 project, given as an example, is provided in Table 5. Fig. 3, given below, depicts the respective new category and the VfM we calculated for each IS/IT project of the case study IS/IT portfolio.
- **Step 7:** Fig. 4 gives the VfMs of the IS/IT project portfolio categories.

Finally, the calculated *SPV* was *0.68*.

4. Discussion and contributions

Throughout the experiment carried out in the client IS/IT PMO, it was possible to calculate the *SPV* in order to measure the expected IS/IT project portfolio strategic value during the IS/IT project portfolio lifetime. The *SPV* appraisal took into account variability of strategic objectives, which represent the value drivers within the strategic planning horizon. This variability was represented by applying the ROD surrogate weights model to the value drivers.

As a first finding, the new strategic IS/IT project portfolio categorization, assigned first, by IS/IT PMO experts shifted the IS/IT project portfolio from two IS and IT segments to new categories which are strategic, migration, service, and support responding to the IS/IT PMO need. As a second finding, the new methodology enabled to measure the *SPV* in a granular way, by evaluating how strategically worthy is the IS/IT portfolio of IS/IT initiatives, and by consequent its four new constituting segments, and

Table 5. VfM of the SI_2010_01 project

Value Drivers	ROD weights (%)	Performance	Value score	Budget (MAD)	VfM
Ensure IS/IT strategic alignment	18.67	4	74.68	10000.00	
Apply IS/IT security	16.67	8	133.36	8000.00	
Streamline and standardize IS processes	14.66	9	131.94	6000.00	
Implement IS/IT agility	12.71	4	50.84	3000.00	
Undergo organizational & business change	10.81	2	21.62	6000.00	
Apply performance management	8.93	7	62.51	10500.00	
Control water and sewer demand	7.09	3	21.27	4000.00	
Manage water resource development	5.27	9	47.43	3000.00	
Reinforce governance	3,49	10	34.9	7500.00	
Improve operational efficiency	1.73	8	13.84	2000.00	
Total			592.39	60000.00	0.01

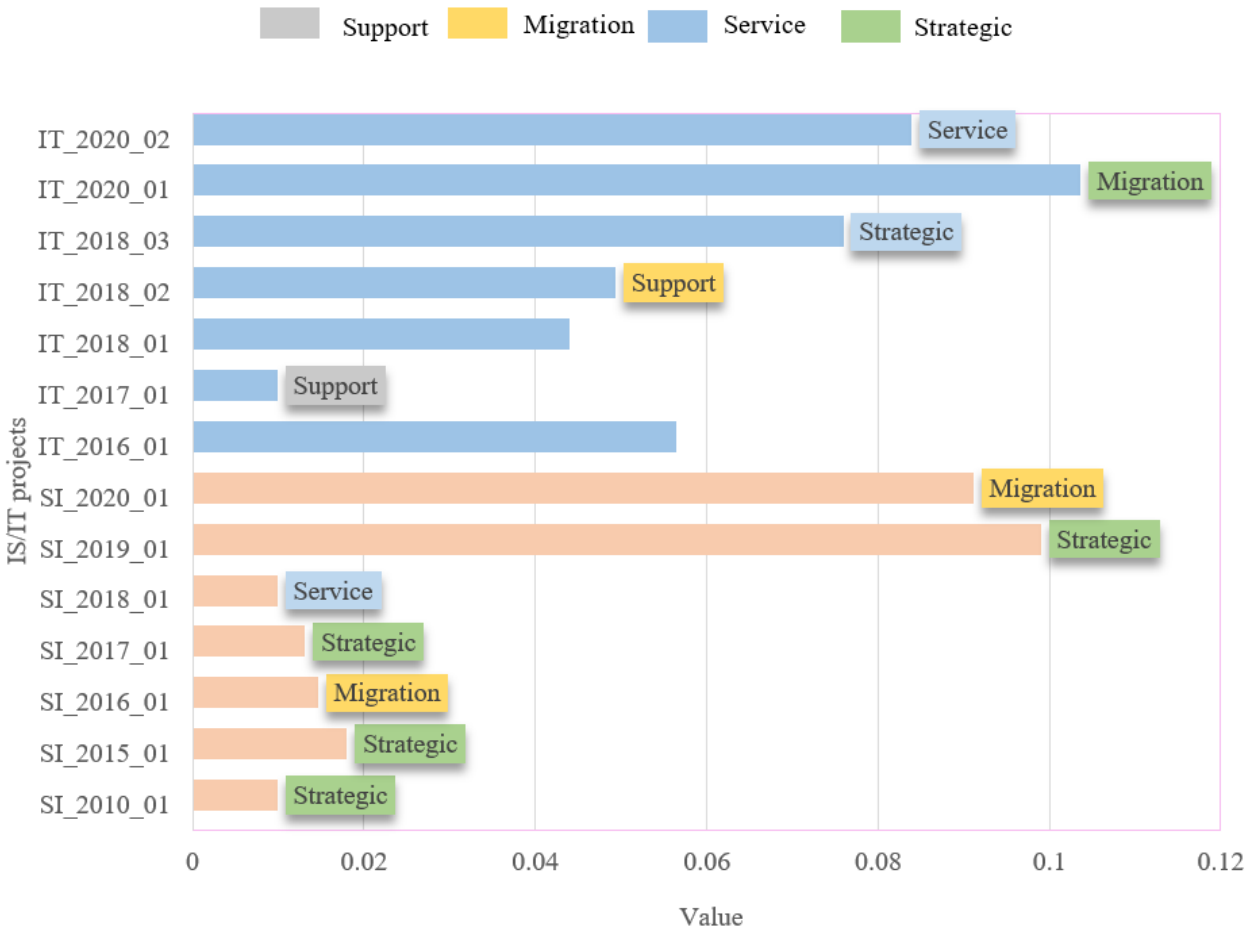

Figure. 3 IS/IT projects VfMs with their new categories

this in the context of variability affecting the realization of its strategic objectives.

Concretely, with regard to the the IS/IT project portfolio categories VfMs (Fig. 4), the following conclusions can be drawn:

- The strategic IS/IT portfolio segment has the highest expected value 0.29, which conveys that the IS/IT projects codified by SI_2010_01, SI_2015_01, SI_2017_01, IT_2018_01, SI_2019_01, and IT_2020_01, and stated as strategic by the IS/IT PMO in the new IS/IT Portfolio categorization, have effectively the greatest expected value;

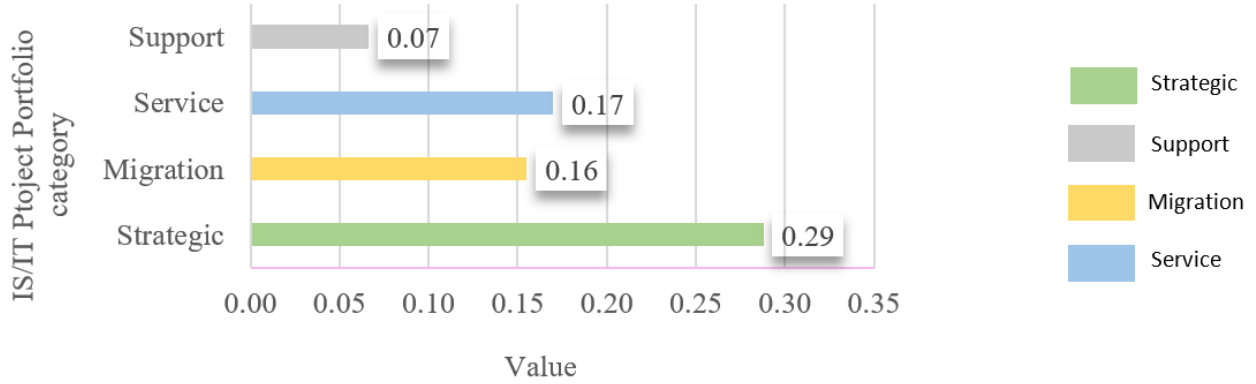

Figure. 4 IS/IT project portfolio strategic value per category

- The service IS/IT portfolio segment follows with expected value of 0.17, showing that the IS/IT projects SI_2018_01, IT_2018_03, and IT_2020_02 have a second importance expected strategic value. These IS/IT projects scope consulting missions in IS and IT, and are stated as less strategically in view of IS/IT PMO;
- The Service IS/IT portfolio segment follows with expected value of 0.17, showing that the IS/IT projects SI_2018_01, IT_2018_03, and IT_2020_02 have a second importance expected strategic value. These IS/IT projects scope consulting missions in IS and IT, and are stated as less strategically in view of IS/IT PMO;
- The migration IS/IT portfolio segment consisting of SI_2016_01, IT_2018_02, and SI_2020_01 IS/IT projects, concerning migration of IT infrastructure, comes at third rank, with strategic value of 0.16 as expected by IS/IT PMO.
- At last, there is the support IS/IT portfolio segment compound of IT_2016_01 and IT_2017_01 IS/IT projects, scoping SAP and non-SAP infrastructure support, value strategically 0.07. In fact, these IS/IT projects are the least important in the digitalization roadmap of IS/IT PMO.

The managerial implications of this study is that our SPV measurement methodology will be a valuable asset to the IS/IT PMO in order to assess and measure the expected IS/IT project portfolio strategic value, as long as this metric is a relevant KPI in performance management within the organization. Thus, it can be used to inform decision-making for senior management, and to carry out actions appropriately by the IS/IT PMO.

Particularly, it can be possible to calculate, granularly, each IS/IT Project Portfolio category strategic value, deriving from an IS/IT Project Portfolio categorization.

Besides, our proposed methodology is characterized by its simplicity and ease of adaptability, and can be applied either, at early stage to calculate the expected IS/IT project portfolio strategic value, or while the execution of IS/IT project portfolio, in order to appraise strategically its value under the volatility of strategic objectives. By consequent, an adjustment on the IS/IT portfolio funding, resourcing, and other IS/IT investment constraints can be operated by the IS/IT PMO in order to update the calculatedSPV, and document a portfolio benefit realization plan. Furthermore, the worthiness of our proposed methodology enables to spread risk among multiple decisions of IS/IT investments as it is also a guiding principle of portfolio management for maximizing value. Using a tailoring approach, it was also possible to adopt the 'categorize' practice from the MoP™ guidance by an IS/IT PMO in order to harvest the expected strategic value of the IS/IT project portfolio.

In comparison with previous studies, the new methodology outstrips the study in [32] that consisted of launching a strategic initiative in term of co-creation of actions for cost reduction in the form of value meetings, in order to reach cost-efficiency in portfolio of public construction projects, but didn't elaborated the created portfolio value as a KPI in the organization. Meanwhile, in pursuit of maximizing project portfolio value, it was demonstrated in [33] that dynamic capabilities are positively related to Portfolio agility, and the late is mediating between dynamic capabilities and portfolio success, but a measurement of this value was not elaborated, which proves factually that the new methodology is better comparing. To set up performance management, it is not only a matter of organizational structure that positively impacts value-based management sophistication as in [34], but it is worth-designing value appraisal KPIs to measure performance in

organization as our study proposes as our proposed methodology performed.

Our proposed methodology has a theoretical implication in the sense that it was possible to model uncertainty and risk inherence as a probability density within the weights of the value drivers derived from the strategic planning exercise, and then to calculate the expected SPV. Value and risk can be intertwining, thus the calculation of expected SPV should consider uncertainty as risk inherence whose events probabilities of occurrence are sometimes difficult to be established. That accounts for our modelling of uncertainty through the ROD weights model with their density portability equations given in [6]. Alongside, a short-term stock fuzzy trading system based on time series based on financial indicators resulted in less losses and better profits, and enabled to aid decision-making [34]. Herein, uncertainty is modelled by Fuzzy logic, whereas our methodology models variability within each value driver weight to calculate in fine the expected SPV.

5. Conclusion

To sum up, the devised methodology of a SPV profiling for IS/IT Project Portfolio under variability will aid IS/IT PMOs on decision-making, as long as these structures are accountable on IS/IT project portfolio value continuous viability during its lifespan while achieving strategic objectives. This way, it feeds the IS/IT project portfolio performance measurement and monitoring of the organization. Through the new IS/IT project portfolio categorization, it is possible to measure the strategic contribution of each IS/IT project portfolio segment, thus identifying the most strategically valuable IS/IT project portfolio categories under uncertainty. Moreover, it was possible to model uncertainty and risk inherence as a probability density within the weights of the value drivers derived from the strategic planning exercise, in the aim to calculate the expected SPV. As a future direction, it is aimed to integrate the SPV KPI within an IS/IT project portfolio dashboard to have the big picture on IS/IT project portfolio performance, from a strategic value perspective, and improve its calculation as it was conducted after a first experimentation in the case study IS/IT PMO.

Conflicts of interest

The authors declare no conflict of interest.

Author contributions

Methodology and data processing were performed by the 1st author; Supervision and administration of the project were performed by the 2nd and 3th authors.

References

[1] H. Markowitz, "Portfolio Selection*", *The Journal of Finance*, Vol. 7, No. 1, pp. 77–91, 1952.

[2] "AXELOS Limited", *Management of Portfolios*, TSO. 2011.

[3] "Project Management Institute, Ed.", *The Standard for Portfolio Management*, Fourth Edition. PMI, Newtown Square, PA., 2017.

[4] "Project Management Institute", Ed., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Seventh Edition. PMI, Newtown Square, PA., 2021.

[5] J. Kelly, S. Male, and D. Graham, "Value Management of Construction Projects", *Second Edition*, p. 546, 2014.

[6] R. Roberts and P. Goodwin, "Weight approximations in multi-attribute decision models", *Journal of Multi-Criteria Decision Analysis*, Vol. 11, No. 6, pp. 291–303, 2002.

[7] B. Maizlish and R. Handler, "IT Portfolio Management Step-by-Step: Unlocking the Business Value of Technology", *John Wiley & Sons, Hoboken*, N.J. 2005.

[8] L. Romano, "How to evolve a project portfolio using balanced scorecards: a case study", In: *PMI Global Congress—North America*, 2013.

[9] L. Moudoubah, A. E. Yamami, K. Mansouri, and M. Qbadou, "Development of Ontology for Semantic Structure of Strategic Alignment Framework for IT Projects Combining PMBOK, PMI and VAL IT", *International Journal of Intelligent Engineering and Systems*, Vol. 14, No. 5, pp. 458–469, 2021, doi: 10.22266/ijies2021.1031.40.

[10] T. C. L. Albano, E. C. Baptista, F. Armellini, D. Jugend, and E. M. Soler, "Proposal and Solution of a Mixed-Integer Nonlinear Optimization Model That Incorporates Future Preparedness for Project Portfolio Selection", *IEEE Transactions on Engineering Management*, Vol. 68, No. 4, pp. 1014–1026, 2021.

[11] M. Özturan, F. Gürsoy, and B. Çeken, "An empirical analysis on the effects of investment assessment methods on IS/IT project success", *International Journal of Information Systems and Project Management*, Vol. 7, No. 4, pp. 33–52, 2021.

[12] A. Tryhuba, I. Tryhuba, O. Bashynsky, I. Kondysiuk, N. Koval, and L. Bondarchuk, "Conceptual Model of Management of

Technologically Integrated Industry Development Projects", In: *Proc. of 2020 IEEE 15th International Conference on Computer Sciences and Information Technologies (CSIT)*, pp. 155–158, 2020.

[13] S. Bushuyev, S. Onyshchenko, N. Bushuyeva, and A. Bondar, "Modelling projects portfolio structure dynamics of the organization development with a resistance of information entropy", In: *Proc. of 2021 IEEE 16th International Conference on Computer Sciences and Information Technologies (CSIT)*, pp. 293–298. 2021.

[14] R. Dixit, H. Singh, and R. B. Chinnam, "Balancing Pragmatism and Values in Business Decision Maki ng", In: *Proc. of 2020 IEEE Aerospace Conference*, pp. 1–12, 2020.

[15] OGC, "Achieving Excellence in Construction", *Office of Government Commerce*, 2003.

[16] D. Mootanah, "Researching whole life value methodologies for construction", In: *Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference*, 2005.

[17] G. Marcondes, "Project Portfolio Selection Considering Return-risk Evaluation and Multiple-Criteria Decision Analysis", In: *Proc. of International Conference on Operations Research and Enterprise Systems*, SCITEPRESS, pp. 264–269, 2019.

[18] M. Convertino and J. V. L. James, "Portfolio Decision Analysis Framework for Value-Focused Ecosystem Management", *PloS One*, Vol. 8, p. e65056, 2013.

[19] E. J. Elton, "Modern Portfolio Theory and Investment Analysis", *Ninth edition. Wiley, Hoboken*, NJ. 2014.

[20] V. Dixit and M. Tiwari, "Project portfolio selection and scheduling optimization based on risk measure: a conditional value at risk approach", *Annals of Operations Research*, Vol. 285, 2020.

[21] S. Mohammadi and A. Nazemi, "On portfolio management with value at risk and uncertain returns via an artificial neural network scheme", *Cognitive Systems Research*, Vol. 59, pp. 247–263, 2020.

[22] Z. R. Lai, C. Li, X. Wu, Q. Guan, and L. Fang, "Multitrend Conditional Value at Risk for Portfolio Optimization", *IEEE Trans Neural Netw Learn Syst*, Vol. PP, 2022.

[23] Q. Zhang and Y. Gao, "Portfolio selection based on a benchmark process with dynamic value-at-risk constraints", *Journal of Computational and Applied Mathematics*, Vol. 313, pp. 440–447, 2017.

[24] A. A. Javid and M. F. Tafti, "Portfolio optimization with entropic value-at-risk", *European Journal of Operational Research*, Vol. 279, No. 1, pp. 225–241, 2019.

[25] P. D. Kusuma and A. L. Prasasti, "Guided Pelican Algorithm", *International Journal of Intelligent Engineering and Systems*, Vol. 15, No. 6, pp. 179–191, 2022, doi: 10.22266/ijies2022.1231.18.

[26] B. C. Klein, R. E. Davis, and L. M. L. Laurens "Quantifying the intrinsic value of algal biomass based on a multi-product biorefining strategy", *Algal Research*, Vol. 72, p. 103094, 2023.

[27] P. Piccoli, "Valuating consumer credit portfolios", *Latin American Journal of Central Banking*, Vol. 3, No. 3, p. 100067, 2022.

[28] K. H. Ng and K. C. Khor, "Evaluation on rapid profiling with clustering algorithms for plantation stocks on Bursa Malaysia", *Journal of Information and Communication Technology*, Vol. 15, pp. 63–84, 2016.

[29] C. Pelletier and L. Raymond, "Investigating the strategic IT alignment process with a dynamic capabilities view: A multiple case study", *Information & Management*, p. 103819, 2023.

[30] T. Korhonen, A. Jääskeläinen, T. Laine, and N. Saukkonen "How performance measurement can support achieving success in project-based operations", *International Journal of Project Management*, Vol. 41, No. 1, p. 102429, 2023.

[31] G. Elia, E. Raguseo, G. Solazzo, and F. Pigni, "Strategic business value from big data analytics: An empirical analysis of the mediating effects of value creation mechanisms", *Information & Management*, Vol. 59, No. 8, p. 103701, 2022.

[32] T. Beste, and O. Jonny, "Strategic change towards cost-efficient public construction projects", *International Journal of Project Management*, Vol. 40, No. 4, pp. 372–384, 2022.

[33] J. Bechtel, C. Kaufmann, and A. Kock, "The interplay between dynamic capabilities' dimensions and their relationship to project portfolio agility and success", *International Journal of Project Management*, Vol. 41, No. 4, p. 102469, 2023.

[34] S. Nowotny, B. Hirsch, and C. Nitzl, "The influence of organizational structure on value-based management sophistication", *Management Accounting Research*, Vol. 56, p. 100797, 2022.

[35] A. Tealab, H. Hefny, and A. Badr, "Short-Term Stock Market Fuzzy Trading System with Fuzzy

Capital Management", *International Journal of Intelligent Engineering and Systems*, Vol. 11, No. 3, pp. 49–58, 2018, doi: 10.22266/ijies2018.0630.06.

Appendix A: IS/IT project portfolio strategicvalue questionnaire

- What is the level of IS/IT strategic alignment?
- To which extent is IS/IT security is implemented?
- What is the measure of level of IS streamlining, standardization and coherence?
- What is the level of IS/IT agility?
- What is the level of induced organizational and business change?
- What is the measure of performance management? What is the level of control of Water and sewer demand?
- What is the development level of water resource?
- What is the level of governance?
- To which extent are operational and economic efficiency been achieved?