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IMPROVING PROJECT PORTFOLIO MANAGEMENT WITH STRATEGIC ALIGNMENT

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Abstract

We focus this paper on a tool to improve project portfolio management. More precisely, of the three major goals that Cooper et al. specify for project portfolio management – selecting the MVP projects, balancing portfolio, and aligning project portfolio with strategy- goal three attracted our attention. Even more precisely, we look to use strategic fit for the goal three. For this reason, we tailor our study to these three goals and show how to achieve these goals with our analytical procedures. Finally, we conclude this paper with results that come from testing with those procedures.

Introduction

Project portfolio management is always important activities in many organizations. Its tools are influenced by the goals that they are trying to achieve. These three goals are maximizing the value of a portfolio, achieving a balanced portfolio, and aligning a portfolio with business strategy. Most of existing tools are to maximize the value and then balance a portfolio with visual techniques. However, the tools to align a portfolio with strategy are limited in the existing literatures. Even though there are a few tools to achieve this goal, they are qualitative in nature. This study, as a result, is intended to present how we can improve project portfolio management with a quantitative tool to measure the magnitude of alignment. Even more precisely, we look to use strategic fit for the third goal. The project is, then, started with literature review to understand the foundation concepts of the subjects such as portfolio management, business strategy, strategic alignment, etc. The model, then, will be developed based on the foundation concepts of that literature. After the model development phase is completed, the model will be tested in the real-life setting to ensure that the model can be performed in the real-life environment. The testing phase will be required selecting a participating company, gathering the company's information, and executing the model with the company's information. The results of the model testing will be feed back to the model for further improvement and correction. The paper starts with theoretical backgrounds from various streams and tailoring them into three goals of project portfolio management. Then, we present the gap that is overlooked and management problem that involved in that gap. The analytical procedures with the results along with those three goals are shown.

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Theoretical Backgrounds

We begin our study by organizing the literature into multiple streams: a).the project portfolio management, to understand its purposes, definitions, and existing modeling process, b).the business strategy to look at its concepts in corporate environment, c). the alignment concept to study what have been done in previous and recent research, d). project success to review what literature presents in measuring success and success factors of project management, e).contingency theory to look at how the effect of fit on performance establish in terms of empirical analysis, and f).the theory building to be used as a the characteristics of the model in this study. The theoretical backgrounds are tailored to the goals of portfolio management.

1. Maximizing the Value of a Portfolio

This purpose is to maximize the value of the portfolio against one or more business objectives [3]. The objectives might be profitability, strategy, risk, etc. The end result of this objective is a selected list of projects. In order to obtain the maximized value of the portfolio, portfolios require useful methods to be used.

The methods such as scoring models [2, 4, 6, 12], Analytical Hierarchy Process (AHP) [8, 10, 11, 16], and Economic methods (Payback Time [12], Net Present Value [1, 4, 6, 9, 14, 15], Internal Rate of Return [12]) treat each project individually, without considering the interactions with other projects.

The interactions with other projects are through their multiple constraints for their selection. The constraints could be financial budget, staff limitations, supporting activities' constraints (e.g. model shop time, computer time), and other considerations (e.g. company policy). In this case, portfolio selection methods are suitable to be used for selection of projects with multiple constraints [5].

2. Achieving a Balanced Portfolio

The second purpose to consider for managing portfolio is to obtain balanced portfolios of projects, programs, and other components [3]. A balanced portfolio is a condition when its components are balanced in terms of a number of key parameters. The tools that are used to obtain the balance of portfolios are visual techniques.

The visual techniques are, for instance, portfolio maps or *bubble diagram*, histogram, bar charts, and pie charts. These techniques help portray portfolio balance. However, the most popular technique employed is a bubble diagram because the components in portfolio are shown as balloons or bubbles.

There are also some difficulties when businesses employ portfolio balance techniques. Those difficulties are the choice of dimensions and parameters on the maps or charts. These choices should be used with care because they can cause the following problems.

- They can cause information overload unless an appropriate number of dimensions of maps are chosen.
- They cannot provide a clear look how the charts and maps should be unless the right balance of dimensions and parameter are defined.

Despite these problems, the portfolio balance is a useful input for maximizing the portfolio value and an effective tool for monitoring the alignment between portfolio and corporate strategy.

3. Aligning Strategy with a Portfolio

The third purpose for managing portfolios is the need to build a link between corporate strategy and portfolios because leading companies include specific goals in their business plan [3]. Those goals are, for instance, all the portfolio's components should align with business strategy, contribute to strategic objectives, and be allocated resources that reflect the strategic direction of that business.

The strategic alignment is also important for two other purposes previously discussed. For example, in order to maximize the value of portfolios, the value should be measured as part of the strategic goal of businesses. What the balance of portfolio should be is decided by senior management through strategy. There are three approaches suggested by Cooper to achieve strategic alignment in portfolio management: top-down, bottom-up and the combination of top-down and bottom-up approaches.

The Room for Improvement

The significant change in the role of project management – from tactical view of the triple constraint to being the basic building block of an organization – opened new questions for the project portfolio. Namely the choice of project portfolio has become the issue of strategic importance, because it really should depict the nature, direction and speed of business strategy. Now, the alignment of projects with business strategy, i.e. tools to do that receive first-rate importance, tools for the accomplishment of goals of the portfolio management defined by Cooper *et al*: 1) maximizing the value of the portfolio, 2) achieving a balanced portfolio, and 3) strategic alignment within the portfolio. In this group of tools, most room for improvement is centered on the third goal, or put it differently, they are mostly qualitative.

However, before we elaborate more details on the possibility of this improvement, let us first establish what is missing in these streams of literature. The concepts reviewed in this study imply that those literature cover on a variety of notions and methodologies, but there are still some gaps that might be overlooked or not adequately addressed. The identification of gaps that follow forms the proposed study. These gaps provide what articles are called for. The identification of gaps is conducive to challenges for a comprehensive study that could be covered in broad and breadth enough for advanced level of anticipated research.

The gaps that we found indicate that portfolio models lack quantitative tools to achieve the third goal of the portfolio. This is because the existing research dealing with the strategic alignment only in the qualitative way such as 'Top-down', and 'Bottom-up' approach These two approaches clearly depict how strategy can align with a portfolio, but do not provide the magnitude of alignment.

Management Problem linked to the Gap

Management problem is related to one of the goals of managing portfolio .To explain that, we'll first address the purpose of the portfolio. Now, goals of the alignment of projects with business strategy and the creation of the portfolio, according to Cooper

et al., are: 1). Maximizing the value of the portfolio (MVP), 2) Achieving a balanced portfolio (ABP), and 3) Aligning strategy with portfolio (ASP). In this group of tools, a room for improvement is centered on the third goal, or put it differently, they are mostly qualitative. Of these three goals, goal one and two, selection of MVP (the most valuable projects) and balancing a portfolio are covered in the literature and do not represent any new materials. Goal three, in turn, deals with strategic alignment (quantitative way) is not covered in the literature, but it is covered in this study, and represents its contribution.

The management problem simply can be expressed in project portfolio management as –there is difficult to accomplishing the third goal – aligning projects with strategy- because it lacks of quantitative tools for measuring a degree of alignment.

Tasks in Project Portfolio Management

Tasks will be presented by goals in order to manage project portfolio. First, tasks will be described in goal 1 and goal 2 (shown in figure 1), which are well explained and covered in literature. Then, tasks in goal 3 will be discussed and are the contribution of this study because they are new in the literature. We now will move to details of each goal.

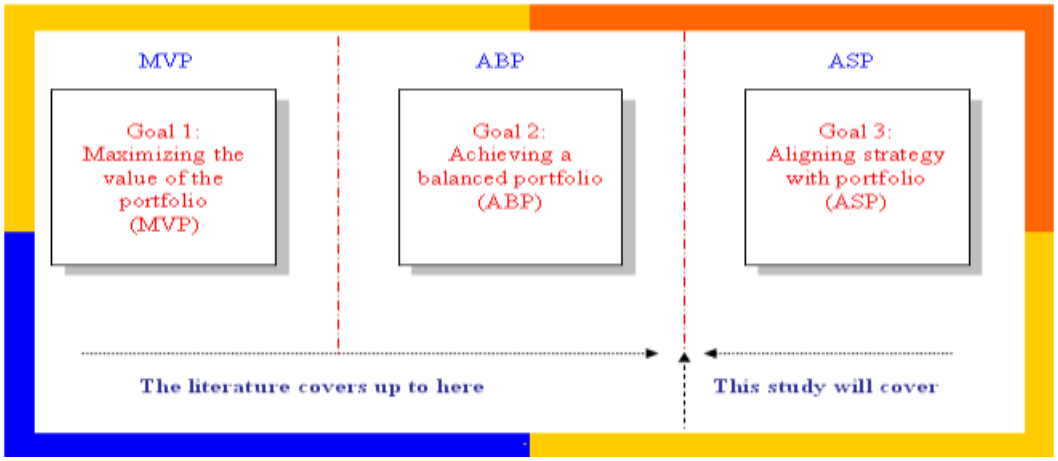

Figure 1. Three goals in project portfolio management

Goal 1: Maximizing the Value of a Portfolio

Analytical procedure

The procedure for maximizing the value of the portfolio against one or more business objectives involves four stages:

Stage 1- Data collection: Identify interactions and nominate candidate projects,

The inputs that are required to apply the portfolio selection methods are data of candidate projects and company policies. The data for candidate projects include a budget limitation of $600K, there are only 4500 Model shop hours available, and only 700 hours of computer time available. Within these constraints, you wish to select

projects that will maximize payoff. Let consider the following data on candidate projects. Candidate projects include 16 projects with the information of total cost in thousands dollars (Cost $K), Model Shop Hours (ShopHrs), Computer Hours (CompHrs), Risk in terms of probability of success (Prob(Sxs)), and net present value in million dollars (NPV $M).

Stage 2- Identify criteria and policies: Set criteria for PSM and determine what company policies will play the role in portfolio management,

For each candidate project, the criteria (or factors) are identified based on the uses of limited resource over and above the budget that might constraint the possible combinations of projects. Criteria depend on the types of projects and their situation as well.

The criteria that are used in the analysis are computer hours, shop hours, cost, and net present value. In this case, a company policy requires at least one project must support an existing product and another project must support a new product.

Stage 3: Set up the optimization problem: Choose the portfolio selection model (PSM),

Suppose that maximizing the value of the portfolio is to maximize NPV, defined as a constant B, subject to the constraints of total cost, defined as a constant C, model shop hours, defined as a constant Sh, and computer hours, defined as a constant Co. Also, suppose that each project is defined as a decision variable, x_j $(j = 1, 2, ..., n)$, where n is defined as a total number of project (in this case $n = 16$). In addition, the projects will be selected to obtain the optimum solution or the most profitable project in the portfolio by using 0 and 1 to represent whether a project is selected or not selected. Since a budget limitation, model shop hours available, and computer time available are \$600K dollars, 4500 hours, and 700 hours, respectively, if applying these input data of these 16 projects into the mathematical representation of these variables are:

(Maximize payoff) $\quad \textit{Maximize} \quad \sum_{j=1}^{n} B_j x_j \ ,$

Subject to

(Total cost constraint) $\quad \sum_{j=1}^{n} C_j x_j \le 600 ,$

(Model Shop hours constraint) $\quad \sum_{j=1}^{n} Sh_j x_j \le 4500 ,$

(Computer hours constraint) $\quad \sum_{j=1}^{n} Co_j x_j \le 700 ,$

(Company policy constraint) $\quad n_j + e_j \le 1 ,$

(Binary constraint) $\quad x_j \in \{0,1\} , \quad$ for $j = 1, 2, ..., 16$

(Non-negativity constraint) $\quad x_j \ , \ n_j \ , \ e_j \ge 0, \quad$ for $j = 1, 2, ..., 16$

Stage 4: Determine the optimum portfolio: Find the solution for the problem.

Once the problem is completely set up, the Solver can calculate the optimum portfolio directly shown in table 1.

Table 1. Optimal solution to the portfolio selection problem

Project	Selected	Cost $K	Prob(Sxs)	NPV ($M)	Shop Hrs	Comp Hrs	Curr Prod	New Prod
1	0	43	0.7	255	311	70	1	0
2	0	44	0.64	113	213	70	0	1
3	1	16	0.51	244	489	43	0	0
4	1	30	0.73	870	375	47	0	0
5	1	49	0.9	885	116	49	1	0
6	1	17	0.85	807	375	55	0	1
7	1	27	0.78	437	463	54	0	0
8	0	48	0.98	204	374	59	0	1
9	0	63	0.56	231	114	50	1	0
10	1	96	0.53	879	372	64	0	0
11	1	67	0.64	762	225	50	0	0
12	1	79	0.74	866	476	42	0	1
13	0	74	0.86	141	323	40	0	0
14	1	68	0.76	330	176	38	1	0
15	1	64	0.76	427	212	49	0	0
16	1	70	0.8	927	493	43	0	1

Total NPV ($M)	7434

Constraints	Used		Available
Total Cost	583	<=	600
MDShopHrs	3772	<=	4500
CompHrs	534	<=	700

The optimal solution shown in table 1 indicates that the total payoff for this portfolio is $7434 million dollars. The total cost for this portfolio is $583 thousand dollars, which turn out to be almost binding constraint. This means the projects consume almost the entire budget. On the contrary, the model shop hours and computer time still include larger availability on their resource to satisfy a strict equality in the optimal solution. The model shop hours and computer time that satisfy this optimal solution consume 3772 hours and 534 hours, respectively. The solution suggests selecting project 3, 4, 5, 6, 7, 10, 11, 12, 14, 15, and 16 to obtain the maximum payoff $7434 million dollars.

The maximum value of portfolio can be achieved by using a project selection tool, which contains multiple constraints on the selection of projects. Although this solution does not use all of the resource available, it is still the best possible solution to the problem. The analytical procedure is also useful to determine optimum portfolio since it portrays a systematic way to find a solution. This section only shows the model with the objective to maximize the revenue. However, it can also apply to other types of

project that do not involve directly with revenue generation. This leads to measure of whether candidate projects are good or bad in either large or small portfolio.

Goal 2: Achieving a balanced portfolio

Analytical procedure

The procedure for achieving a balanced portfolio involves five stages:

Stage 1- Input: Prepare information for project roster,

The information inputs that require for balancing a project portfolio is project roster with projects' numerical scores. The numerical scores include financial gauges of reward, namely, the risk-adjusted NPV of the project and the probability of success scores. The risk-adjusted NPV is the net present value of the future stream of earnings (cash flow) from the project and their costs. The risk adjustment is carried out by using a risk-adjusted discount rate. The data of project roster is shown in table 2.

Table 2. Candidate projects with inputs information for balancing a portfolio

Project	NPV (in millions of dollars)	Probability of Success Pr_j
1	255	0.7
2	113	0.64
3	244	0.51
4	870	0.73
5	885	0.9
6	807	0.85
7	437	0.78
8	204	0.98
9	231	0.56
10	879	0.53
11	762	0.64
12	866	0.74
13	141	0.86
14	330	0.76
15	427	0.76
16	927	0.8

Stage 2- Chart selection: Select the chart type,

The portfolio dimensions determine the type of charts. Since the most popular way to display balance in a portfolio is bubble diagrams, we devote considerable time to them in this study [3]. Bubble diagrams use more as a discussion tool to display the breakdown of current portfolio. Bubble diagrams are well accepted because they can

convey meaningful information in the graphic way [12]. They also help to distinguish projects in less desired quadrants and easy to visualize whether projects are balanced or unbalanced.

Stage 3- Scale selection: Choose and scale dimension on the axes,

The particular interest in this study lies into the risk-return diagram because it is very popular in research and development projects. Thus, the next section will show how to draw this type of chart and what this chart can specify.

Stage 4- Chart construction: Draw the chosen chart,

Once the data in stage 1 have been prepared and the types of charts are selected, it is possible to draw projects on the bubble diagram. The NPV is used as the horizontal axis (from right to left), while the vertical axis is the probability of success (from top to bottom). The size of each bubble shows the annual resources to be spent on each project. The chart can be drawn as shown in figure 2.

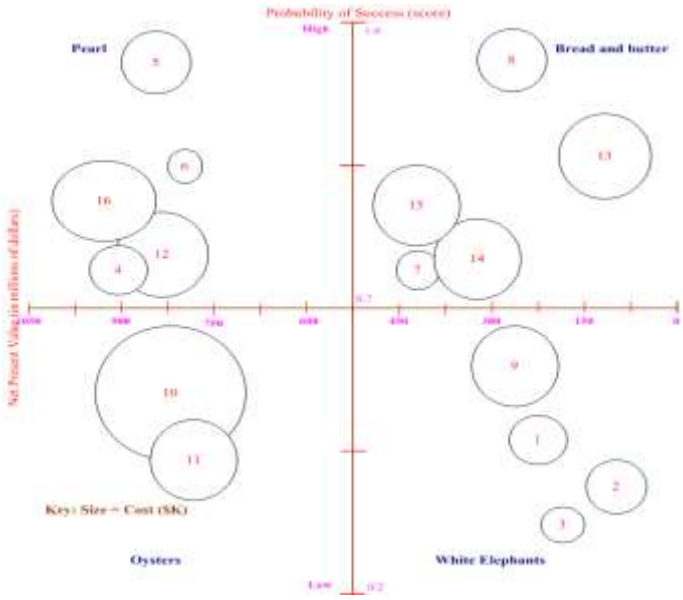

Figure 2. A bubble diagram of NPV versus probability of success

Stage 5- Chart Interpretation: Interpret the chart,

Figure 2 illustrates a bubble diagram of a risk (probability of success) versus a return (net present value). The size of each bubble shows the cost to be spent on each project. The four quadrants of the bubble diagram model are indicated as follows:

- *Pearls* (upper left quadrant): These are the potential star projects with a high likelihood of success and a high rewards. There are a good number of projects on this quadrant, which are five projects. The cost associated with these projects is also reasonable for their spending because the sizes of projects are moderate.

- *Oysters* (lower left quadrant): These are projects that create high returns, but with low probability of success. Figure 2 illustrates two projects, which one is the most costly project in the portfolio.
- *Bread and Butter* (upper right quadrant): These are small, simple projects with a high probability of success, but low reward. Five projects in figure 2 are in this quadrant, which is the same amount as the "*pearls*" quadrant.
- *White Elephants* (lower right quadrant): These are the low reward projects with a low likelihood of success. There are too many projects in this quadrant because any business wish to have a few projects fell in this category. They are less attractive for business compared to other projects that fell in other categories.

Stage 6- Make a decision: Act and balance a portfolio.

After interpretation of projects in the diagram, management debates the appropriateness of the current portfolio and makes necessary actions. The projects in figure 2 could be taken the following balancing actions.

- To decrease projects in the white elephants due to their less attraction, management can review those projects again with more strict constraints regarding reallocating resources to these projects,
- To decrease projects in the bread and butter due to accounting too much of resources, which should allocate to projects that make more rewards than ones in bread and butter, management can cancel or postpone projects that fell in this category to free up more resources to support high rewards' projects,
- To increase resources due to cutting back on the low reward projects, management can use bubble diagram in figure 2 to periodically review and make appropriate actions (approve, hold, or cancel unnecessary projects) to support important projects that lack of resources, but have high returns. This can create the growth in a business.

To achieving a balanced portfolio, tools that use to conceptual this goal are easier in practice than tools in obtaining a high-value of the portfolio (MVP). The tool that use in this case is bubble diagram, which is controversy by some practitioners for relying too much on substantial financial data. This creates information overload and complexity to be used. The bubble diagram can also be misleading if inappropriate data used to create the diagram. In addition, the bubble diagram can not provide rank-ordered list of preferred projects.

Despite of problems in the bubble diagram discussed above, it is still able to provide the meaningful information in visualization. The visualization in the diagram is useful for indicating the difficulty or simplicity of a particular project that intends to make distinction from others. It is also hard to find other methods to implement with a project portfolio and can include a visual capability. This is a unique attribute in a bubble diagram.

Goal 3: Achieving a balanced portfolio

Analytical procedure

The procedure for achieving a balanced portfolio involves six stages:

Stage 1- Data collection: Identify candidate projects,

In a portfolio, it includes several projects inside a portfolio. For example, in 2006 a portfolio in a high-tech company is composed of 16 projects that can be used as the sample. This sample represents the entire population of a portfolio. We use the sample as the entire population because our population is small. In this case, the entire population is 16 projects. Israel [7] suggests that if the population in the study is small, the entire population is used as the sample. The approach that uses the entire population as the sample is called a census, which eliminates sampling error and provides data on all the individuals in the population. The census fixes the errors in questionnaire design and developing the sampling frame because they will be the same for samples of 20, 50, or 200, etc. The census would have to be samples in small populations to achieve a desirable level of precision. In project portfolio management, not every company has a portfolio, a collection of projects. Some companies perform only 1-2 projects, which are not the portfolio. However, the big company that has enough projects to be a portfolio handles only around 100 projects per portfolio, which are small populations. Thus, the census approach is appropriate to represent the sample because the nature of project portfolio management dealing only with small populations. The sampling that is obtained by a participating company is shown in the table 3.

Table 3. Sample of this study

Projects	Prob(Sxs)	ShopHrs	CompHrs	Cost ($K)	NPV ($M)
	x_1	x_2	x_3	z	y
1	0.7	311	70	43	255
2	0.64	213	70	44	113
3	0.51	489	43	16	244
4	0.73	375	47	30	870
5	0.9	116	49	49	885
6	0.85	375	55	17	807
7	0.78	463	54	27	437
8	0.98	374	59	48	204
9	0.56	114	50	63	231
10	0.53	372	64	96	879
11	0.64	225	50	67	762
12	0.74	476	42	79	866
13	0.86	323	40	74	141
14	0.76	176	38	68	330
15	0.76	212	49	64	427
16	0.8	493	43	70	927

Stage 2- Variables definition: Set up variables in the model,

The model includes three main variables: portfolio, business strategy, and performance. These variables comprise of metrics associated with them. The metrics are used to measure alignment between a portfolio and business strategy that drive business performance. In this case, a portfolio in 2006 includes 16 projects. Each project has metrics associated with it as follows:

- The matrices for project portfolio variable (X) are: 1). portfolio risks (in terms of probability of success), and 2). milestone completion (in terms of model shop hours and computer hours),
- The metric for business strategy variable (Z) is and cost leadership (in terms of cost),
- The metric for business performance variable (y) is financial performance (in terms of NPV).

Based on three variables and their matrices that are used to indicate those variables, the sample of this study is shown in the table 3.

Stage 3- Model development: Choose the solution method,

The mediation regression analysis was chosen to show that fit between the strategy (cost leadership) and the performance (NPV) involves an intervening mechanism through project portfolio (portfolio risks and milestone completion). The mediation regression analysis is used in this case because the number of variables in the specification of fit is greater than two variables [13]. Another reason is that the model involves the portfolio as an intervening variable between strategy and performance, which the mediation regression is appropriate for this case.

The form of a model could include the relation between predictor (independent or antecedent) and criterion (dependent or consequent) variables. Suppose the business strategy variable is defined by metrics Z, the portfolio variable is defined by metrics X, and the business performance is defined by metrics Y. The mathematical representations of these variables are:

$$Y = f(X, Z)$$
$$X = f(Z)$$

Where the business performance variable (Y) is the function of the business strategy and the portfolio variables $(Z \text{ and } X)$, the project portfolio variable (X) is also the function of the business strategy variable (Z). These sets of variables form the following model.

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 X_i + e_1$$
$$X_i = \beta_0 + \beta_1 Z_i + e_2$$

Where the alignment scores between the business strategy and the project portfolio that drive the business performance are defined as α_1 and α_2, respectively, α_0 is the constant term chosen in a way that results in the smallest amount of the predictor error. For the variable e_1 and e_2, they are the error terms of the model in the first and second equations, respectively. The variable β_1 is the alignment score between the

business strategy and the portfolio, where β_0 is the constant term that minimized the error obtained by using the prediction equation.

To make it be clear, the diagram of the model is shown below.

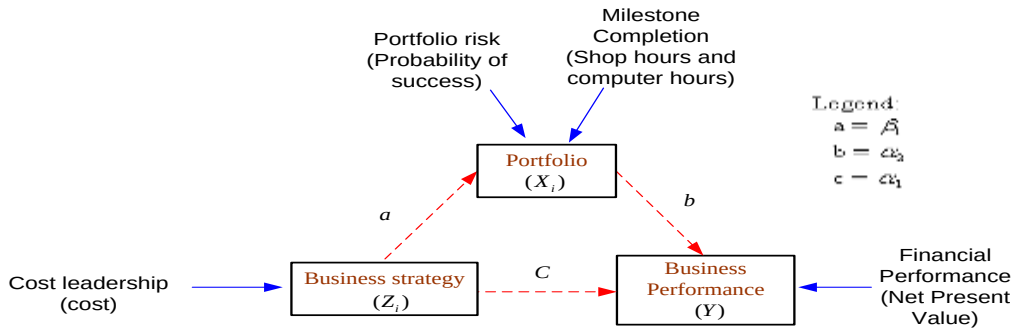

Figure 3. Model diagram

Stage 4- Project assessment: Calculate alignment scores per equation of each project,

To solve this model, we conduct a regression analysis with X and Z predicting Y, $Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 X_i + e_1$. The output of the model is shown in table 4.

Table 4. Regression output for the model in figure 3.

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 99%*	*Upper 99%*
Intercept	$\alpha_0 = 0$							
Portfolio (X)	$\alpha_1 = 4.345$	2.446	1.776	0.099	-0.940	9.630	-3.024	11.714
Business Strategy (Z)	$\alpha_2 = 0.926$	0.417	2.222	0.045	0.026	1.827	-0.329	2.182

In addition, we conduct a regression analysis with Z predicting X, $X_i = \beta_0 + \beta_1 Z_i + e_2$. The output of the model is shown in table 5.

Table 5. Another regression output for the model in figure 3.

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 99.0%*	*Upper 99.0%*
Intercept	$\beta_0 = 0$							
Strategy (Z)	$\beta_1 = 0.706$	0.092	7.648	0.000	0.508	0.904	0.431	0.981

Note: This is only partial results from the mediation regression analysis.

Stage 5- The effect of fit: Establish the effect of fit between business strategy and project portfolio on performance of business.

The fit score between business strategy (BS) and project portfolio (PP) that drive business performance (BP) is summarized in table 6. This score is normalized to scale from 0 to 100%.

Table 6. The fit score between business strategy (BS) and project portfolio (PP) that drive business performance (BP)

Portfolio No.	Fit score (Percentage)		
	BS-BP (α_1)	BS-PP (β_1)	PP-BP (α_2)
Portfolio with X1	0.366	0.080***	0.554*
Portfolio with X2	0.171**	0.026***	0.803*
Portfolio with X3	0.568	0.092***	0.340
Average fit score	36.85%	6.60%	56.55%

Legend: BS - Business Strategy, BP - Business Performance, PP - Project portfolio

* p<0.05, ** p<0.01, ***p<0.001

Table 6 indicates that the fit score between business strategy and business performance is 36.85% and only one portfolio variable is significant to the strategy variable within 0.01 levels ($p < 0.01$). While the fit score between business strategy and project portfolio is only 6.60%, the all three variables of portfolio are important to the strategy variable within 0.001 significant levels ($p < 0.001$). The fit score between project portfolio and business performance is 56.55% with only two portfolio variables are significant to the performance variable under 0.05 levels ($p < 0.05$).

The alignment between the strategy, project portfolio and performance of business is a central concern of project portfolio management. This study used mediation regression to explore the mediating influence of the alignment between project portfolio and business strategy on the performance of business. In results of the regression analysis, the direct effect of project portfolio on the performance of business is relative large and adds up more than 56 percent of the correlation in the alignment. The indirect effect that involves an intervening mechanism through project portfolio variables takes into account about 44 percent of the correlation in this alignment. The results establish the context in which to measure the alignment between business strategy and project portfolio on performance of business.

Contribution

The study could benefit a manager addresses questions of interest. In this case, the manger could be interested in:

Research question 1: How a strategic fit can be used to help determining a project portfolio that is the most aligned with business strategy?

Research question 2: What are the variables inside the model for using strategic fit to help determining project portfolio that is the most aligned with business strategy?

Research question 3: How well the model is translated into the operating reality, described in its contents, and performed based on the underlying theory?

As a result of this study, it could illustrate the potential value of the model to an organization by providing the magnitude of the alignment between project portfolio and business strategy. It could also provide a platform to study the alignment between project portfolio and business strategy that could leverage the growing appreciation of this subject.

Limitation

This study will be mostly limited by the type of research design and availability of data. In particular, this study assumes that:

- The model examines only linear relationship among variables.
- The model assumes multivariate normality (normally distributed data).
- All measured variables, regardless of their status as dependent variables or independent variables are screened together for outliers.
- Small number of sample was used in the testing because the population is small.
- Only NPD projects were used.
- Projects were only in USA, especially in Oregon.

Conclusion and Future Research

The study tailoring to three goals of the portfolio management is captured the following points:

- The model includes the policy constraint that provide the systematic way to select projects,
- The bubble diagram use to make a right balance of a portfolio. The portfolio balance is important in order to manage risk,
- The quantitative model to measure a degree of alignment in the portfolio management is presented and tested with the company's information. The results establish the context in which to measure the alignment between business strategy and project portfolio on performance of business.

The model and its measurement will validate with real-life information, which is to ensure that it can be applicable to practice and replicable to real word behavior. The results of validity testing not only provide insights into the model, but also help management to solve and answer their questions and problems of interest. Managers can also improve their management to make better decisions in a systematic manner, which can be a platform to study the alignment between project portfolio and business strategy that could leverage the growing appreciation of this subject.

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