

# Project Portfolio Management Phases: A Technique for Strategy Alignment

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**Abstract**—This paper seeks to give a general idea of the universe of project portfolio management, from its multidisciplinary nature, to the many challenges it raises, passing through the different techniques, models and tools used to solve the multiple problems known. It is intended to contribute to the clarification, with great depth, of the impacts and relationships involved in managing the projects' portfolio. It aims at proposing a technique for the project alignment with the organisational strategy, in order to select projects that later on will be considered in the analysis and selection of the portfolio.

We consider the development of a methodology for assessing the project alignment index very relevant in the global market scenario. It can help organisations to gain a greater awareness of market dynamics, speed up the decision process and increase its consistency, thus enabling the strategic alignment and the improvement of the organisational performance.

**Keywords**—Project Portfolio Management Cycle, Project Portfolio Selection, Resource Assignment, Strategy Alignment technique

## I. INTRODUCTION

**D**ESPITE all the differences on markets, cultural environment, and organisational objectives, some changes are modifying the way business occurs, turning competitive advantages difficult to accomplish. In a global marketplace scenario, changes are constant and with variable amplitude. Organisations need to be alert to all movements to counter-answer and re-align themselves with the new market conditions. Thus, it is wise to develop a flexible strategy, where it is possible to monitor the market conditions and the overall performance of the organisation.

Organisations are dealing, each time with more and more projects in their daily routines. According to [1, p.663], "Nowadays, it is hard to imagine an organisation that is not engaged in some kind of project activity. Over the past decade, organisations have been turning from operations to project management as part of their competitive advantage strategy". Reference [2] goes further on the idea of using project

management in order to substitute the traditional functional management and turning it into a key element to achieve a real competitive advantage in the 21st century. Shortly it will become 'the wave of the future in global businesses'.

Despite of being, presently, a well developed research area, it continues to be very problematic. A great number of projects exceed their budget, suffer from delays and fail in attaining their goals. It is evident that, somehow, the development of techniques and their applications are far from converging, and the large corporations face numerous problems with this hiatus. [3]

The current state of practice, in large organisations, shows three different areas in which it is very hard to accomplish a significant development. These are, according to [4]: a) the Portfolio selection and management of individual projects as well as programme management practices, thoughtfully and dynamically aligned with the business strategy and objectives; b) the definition of a group of portfolio metrics to provide regular if not continuous feedback of the portfolio performance. The provision of detailed information to the project management team would allow them to decide, in each moment, the best projects portfolio favouring, as well, the strategic alignment; and c) the effective introduction of an organisational learning process, where the explicit knowledge is combined with tacit knowledge in a way that encourages people to learn and to be actively present in the process of learning, contributing to the improvement of project management processes and practices

Today's business environment is complex and requires making decisions rapidly, with a better allocation of the enterprise's scarce resources, and a clearer strategy focus. [5] This factor, compels the organisation to become more efficient, flexible and far quicker to answer to the rapid changes of the business environments.

There is the need for regularly monitoring the organisation's performance, requiring diagnosis tools. According to [6], only with a certain maturity stage, an organisation can capitalize their assets, and as such, understand, develop, and sustain its organisational strategies to attain a clear competitive advantage and continuous improvement and growth. The areas like the Organisational Strategy, Project Portfolio Management, Organisational Learning, Decision Support Systems and Project Maturity can be seen as the Aquiles' heel of project management. In general, the dynamic environment that surrounds the project management area creates these

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peculiar difficulties, but despite that, the organisations that use these types of management approaches have a considerable level of project maturity. Nevertheless, the prominence of the areas mentioned, is normally associated with the improvement of the organisational performance, creation of sustainable competitive advantages and increase of the organisational maturity.

## II. BACKGROUND / LITERATURE REVIEW

### A. Organisational Strategy

Successful organisations developed, during time, a conscious strategy and established a closer relationship with the market. The strategic plan development tries to project the organisation into future scenario(s), defining concrete actions for attaining the organisational objectives. However, this interaction between the organisation and the market, with all their constituents, works out dynamically. So, reaching these purposes requires ability to measure the market oscillations, analysing the critical information obtained, readjusting the strategic plan with the lessons learned and conferring it some flexibility to be able to rapidly respond to the market. Usually, the better this development process gets, the greater performance the organisation attains, increasing their results. [7]

The literature review allowed us to conclude that Strategic schema, Strategic flexibility, Learning capability, Knowledge management strategy and Strategic decision making are the main characteristics required by a successful organisational strategy.

A strategic schema is something normally related with the knowledge structures that top managers use in marketing strategic decisions. Strategic schemas act as filters on the information that managers pay attention to, and consider relevant for strategy formulation. A strategic schema definition can be seen as a way to allow a better environmental fitting and so contributing for the organisational differentiation. According to [8] and [9], the key elements of strategic schemas are the concepts of complexity and focus. Complexity reflects the level of differentiation and integration of a strategic schema. Focus reflects the degree to which a strategic schema is centralized around a few 'core' concepts [10]. Nevertheless, focus may lock firms into known and historically successful strategic actions that will preclude them from absorbing new knowledge and experimenting with new alternatives. [11]

The strategic flexibility is seen as an ability to precipitate intentional changes and adapt to environmental oscillations through continuous monitoring of current strategic actions, asset deployment, and investment strategies [12]. In order to achieve strategic flexibility, managers must overcome cognitive inertia and increase organisational awareness to knowledge, and the ability to absorb it. [13]

The capacity to learn has been considered a key index of an organisation's effectiveness and potential to innovate and grow [14].

### B. Project Portfolio Management (PPM)

According to [15] and [16] the project portfolio is defined as a group of projects that compete for scarce resources and are conducted under the sponsorship or management of a particular organisation. The three main well-known objectives of portfolio management are, the following: maximising the value of the portfolio, linking the portfolio to the strategy and the continuous monitoring/assessment of the portfolio.

Reference [17] adds to the previous definition that the project portfolio management can be considered a dynamic decision process, and for that reason has to be continuously updated and revised, to select in each moment the best solutions possible. Project portfolio selection is an important management activity of the organisation, where the project team must assess every detail, carefully, in order to amplify the performance of the organisational assets and to align them with the strategic objectives of the organisation, although there are usually more projects available for selection than can be undertaken within the physical and financial constraints of a firm, so choices must be made in making up a suitable project portfolio. [15]

According to [18, p.57], "Efficiency of project portfolio management, therefore, could be determined by estimating the degree to which the portfolio fulfils its objectives: strategic alignment, balance across projects, and value maximization".

References [5] [19] [20] have identified, and point out, the common problems in project selection and portfolio management, faced by companies. So the following reasons can be related with the difficulties on managing, and on selecting, the proper projects to the portfolio: a) *No link between strategy and project selection*: Projects tend not to be fully related with the organisation's strategic objectives, which affects the organisation overall performance; b) *Poor quality portfolios*: the organisations, normally, do not have judicious criteria for selecting viable projects from half-baked ideas; c) *Reluctance to kill projects*: there is, commonly, an umbilical relationship between the organisation (team members) and the project itself, which sometimes constitutes a major organisational failure for continuing investing scarce resources in an unviable project; d) *Scarce resources*, a lack of focus and management capability, to balance properly the resources, often creates additional pressure to multitask, contributing to produce unexpected errors and not assimilate the important lessons from the project development; e) *Selecting short-term and easy projects*: Companies tend to implement easy and cheap projects, which consequently reduces their potential to prosper and to achieve competitive advantages; f) *Information overflow and lacking quality of information*: Regardless of the quality and sophistication of the portfolio selection and decision tools, it is fundamental to obtain the proper information to make accurate decisions; g) *Decision making based in power*: Usually the decision is an exercise of power, which means that there may be situations in organisations where decisions tend not to reflect the organisational future success, by being deprived of the sphere of influence and

power of the top management.

Other problem, commonly related with the project portfolio selection and management is the 'resource allocation syndrome'. The portfolio management team is normally concerned and overwhelmed with issues like the prioritization of projects and the continuous distribution of personnel from the different projects to overcome the urgent crises. Although, most of the time, however, there are no resources available and when they were redistributed it often produced negative effects on unexpected places in the project portfolio. [21]

Some problems among the organisational assets for the different projects are intimately related with the resource allocation problems, because most of the projects were dependent on the same resources (personnel) for their execution, according to [21, p.406], "Due to ambiguous cause-effects relationships, unclear project priorities, and conflicting interests between different projects and departments, unsettled issues were frequently boosted up through the organisational hierarchy to be resolved by portfolio management. Consequently, portfolio management level was overloaded with problems". This situation, in the long-term, conditions the knowledge development and achievement, because it puts pressure in the project team to solve the short-term problems, helping to create a feeling of inefficiency and demotivation among the project members.

An interesting metaphor pointed out by [22] calls it the 'canary cage approach' to portfolio planning, i.e. making an interesting analogy between the behavior of new canaries (projects) when thrown into cages without assessing the effects of the other canaries already in the cage.

As stated by [23, p.426], "In analyzing a portfolio, the desired combination is a balanced portfolio defined as an assortment of projects that enables a company to achieve the growth and profit objectives associated with its corporate strategy without exposing the company to undue risks".

### C. Key Performance Indicators (KPI)

Today's competitive environment is highly dynamic, and many firms face rapidly changing customer needs. In order to be successful, firms must continuously adjust their competitive strategies. [24]

More and more businesses are aligning their activities with the principles of sustainable development, trying to develop indicators adapted to their business realities, values and culture. According to [25], there are three key lessons for companies which want to develop performance indicators:

- 1) Try to encourage debate across the organisation on what might be the best indicators.
- 2) Involve external stakeholders in developing indicators.
- 3) Recognise standards for measurement and reporting may serve as useful reference points.

Time, cost and quality are the basic criteria to project success, and they are identified and discussed for several authors in articles about project success. [26] [27] [28] [29] [30]. Reference [31] called these three criteria the "iron triangle".

Reference [26] advocates that the process of developing KPIs should consider the following aspects: a) Focus on critical aspects of outputs or outcomes; b) Be limited to a number of manageable KPIs, without being too complex or even time and resource consuming; c) Use a systematic and consistent approach in all projects; d) Data collection must be made as simple as possible; e) For performance measurement to be effective, the measures or indicators must be accepted, understood and owned across the organisation; f) The KPIs can evolve to better and more adjusted versions and therefore be able to change and refinement; g) and Graphic displays of KPIs need to be simple in design, easy to update and accessible.

One of the most famous methodologies, developed by [32] and [33], was the Balanced Scorecard architecture to develop organisational performance system and link business strategy to measures. The balanced scorecard is a means of monitoring, evaluating and controlling the evolutionary path of the organisation's strategy and strategic positioning. It may highlight performance gaps or areas of activity requiring immediate strategic attention. In particular, the refocusing on processes of feedback and learning and re-translating the vision are essential for processes of benchmarking, strategic re-orientation and change. [34] [35]

### D. Project alignment with the organisational strategy

Projects and project management serve as primary capabilities of an organisation to respond to change and thereby maintain a competitive edge [36]. Projects may be considered as building blocks in the design and execution of future strategies of the organisation [37]. Several authors have emphasized the importance of linking projects and their management to strategy and proposed different models describing how the management processes at project and multi-project levels can be integrated with the organisational strategy management process [38, 39, 40, and 41].

Finally, some authors have noticed the importance of meaningful and reliable information as a prerequisite of successful management and high-quality decision-making [42]

The results reveal that organisations which are the most successful in managing their strategic intentions in a multi-project environment tend to review the objectives of their ongoing projects in linkage with strategy formulation. [43]

In addition, the linkage between strategy process and project management, as well as the availability of high-quality information are identified as success factors. [44]

## III. PROJECT PORTFOLIO MANAGEMENT (PPM) CYCLE AND PHASES

According to the authors' view, tailored by the literature review, the project portfolio selection normally, involves five distinctive phases: a) the strategic consideration and orientation, towards the selection of the projects with better strategic alignment; b) the project evaluation phase, where the benefits derived through the evaluation methods are to determined, as well as the individual contribution of each

project to the portfolio objectives; c) the portfolio selection, involving a continuous comparison of projects, which compete between each other, with the final intention of ranking in the top positions to achieve the entrance to the organisational portfolio; d) the organisational resources assignment, because the organisational assets are limited and constantly requested for different projects, which can cause an extremely complex managerial problem; e) and the monitoring and control phase, which is responsible for assessing, recurrently, the portfolio performance and all that is related to the portfolio range.

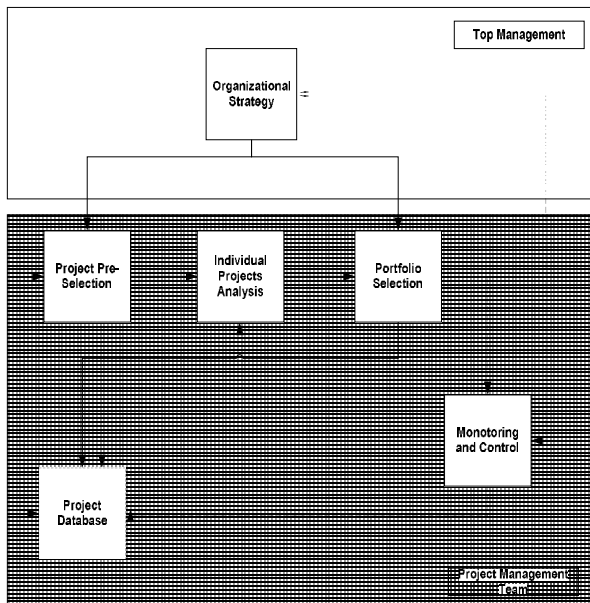


Fig. 1 Project Portfolio Management selection and monitoring

Figures 1 and 4 try to demonstrate the different steps required for obtaining the projects portfolio. The strategic implications of portfolio selection are generally complex and vary immensely from each type of organisation, involving the consideration of factors both external and internal to the firm, including the marketplace and the company's strengths and weaknesses. [46]

The process described in Figure 2, precedes the portfolio calculations, and its intent is to guaranty that any project considered for the portfolio fits on the organisational strategic schema. It is clear that the strategic direction of the firm must be determined before individual projects can be considered for a project portfolio. [38]

The strategic alignment phase will be treated in more detail in Section IV of this article, where a strategic alignment technique will be proposed and described.

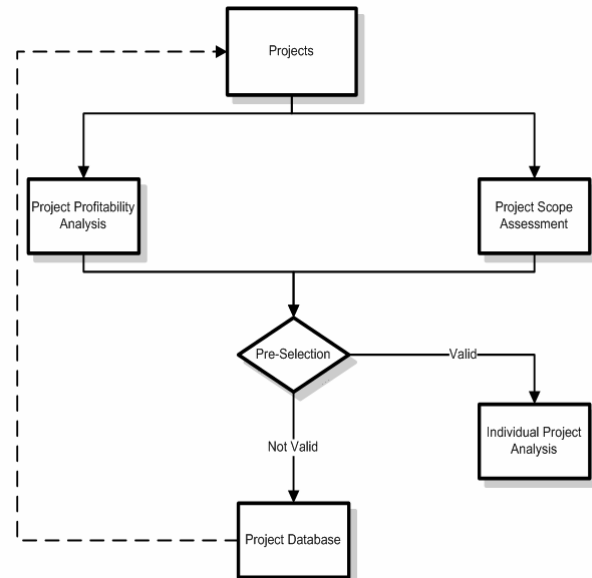


Fig. 2 Individual Project Pre-selection

This intends to eliminate any non-starters projects, which do not have conditions to integrate the portfolio and also to reduce the number of projects to be considered simultaneously in Individual Project Analysis stage. The stopping criterion should be adjusted to the amount of projects that need to be considered, because according to [15, p.209], "...the complexity of the decision process and the amount of time required to choose the portfolio increases geometrically with the number of projects to be considered".

The project evaluation phase, Figure 3, is used to assess the impact on the portfolio, through methods where the individual contribution of each project to the portfolio objectives is determined. There are several recurrent techniques used like the economic return throughout well known indicators (Net Present Value (NPV), Internal Rate of Return (IRR), Return on Original Investment (ROI), Return on Average Investment (RAI), Payback Period (PBP), Expected Value (EV)); it is very common to assess other issues like the project risk using also several approaches (sensitivity analysis, Cost/Benefit, simulation techniques, project's work breakdown structure (WBS)), where risk events relating to each activity are identified, and their probabilities and consequences estimated. [45]

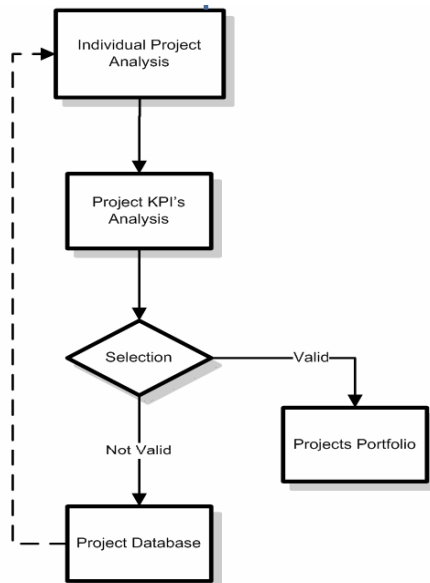


Fig. 3 Individual Project Analysis

The Portfolio selection involves a continuous comparison of projects, which compete between each other. There are innumerable portfolio selection techniques that can be used to carry out the desired portfolio selection. Some of them will be briefly mentioned: a) Ad hoc approaches; b) Comparative approaches including Q-Sort [47], pair wise comparison [45], the Analytic Hierarchy Procedure (AHP) [48]; c) Scoring models [45]; d) Portfolio matrices [49] [46] generally used as strategic decision making tools, and also to allocate resources among competing projects; e) and Optimization models [50] [51] [52] [53], fuzzy and Artificial intelligence algorithms [54] [55] which are generally based on some form of mathematical programming, to support the optimization process and to include project interactions such as resource dependencies and constraints. Some of these models can also support sensitivity analysis, but most do not seem to be used extensively in practice, probably because of the necessity to collect large amounts of data. Despite all the different techniques and approaches possible to the project portfolio selection it is important to pay continuous attention to the project interactions, to the resource competition which must be considered, as well as to the time dependent nature of project resource consumption.

According to [15, p.210-1], "...decision makers must be able to make adjustments, but they should receive feedback on the resulting consequences, in terms of optimality changes and effects on resources".

The evaluation period should be determined when new projects are being considered for selection, or when the portfolio premises are altered, and the organisational context, internally or externally, obliging to re-assess the current portfolio projects, and possibly doing some adjustments.

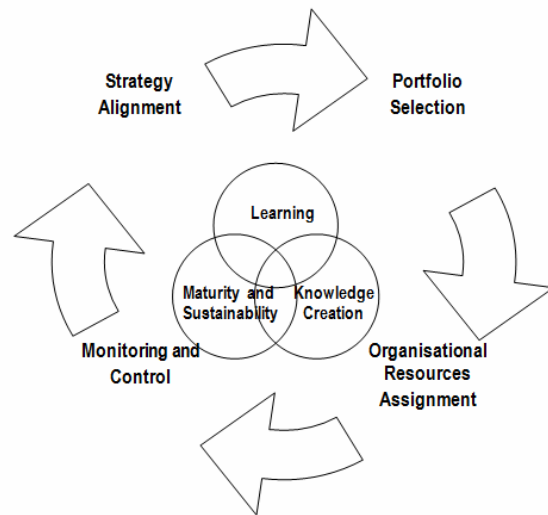


Fig. 4 Project Portfolio Management Cycle

In addition, some researchers have found other important factors that can be related to portfolio management, learning and knowledge creation [56] [57] [58] [59], as well as the organisational maturity and sustainability [60] [61]. Figure 4 points out these important pillars that can catapult the organisation to levels of efficiency and high performance, thus promoting the acquisition of sustainable competitive advantages.

Projects portfolio plays an important role in achieving the learning that takes place within many organisations [62] [63]. Organisations also acquire new knowledge through experience [64] or learning by doing. Through trial and error experimentation, organisations can learn about new approaches to accomplish the work at hand [64] [65] [66]. An organisation can also learn from feedback on the consequences of its actions, learning about projects by feedback and experience, developing project work, and transferring the lessons learned to other projects. [67]

So, it is very important to be prepared for these new challenges and differentiation paradigms. With the proper organisational maturity and sustainability culture it will be possible to attain the higher levels of efficiency, performance and of sustainable growth in the organisation.

#### IV. PROJECT ALIGNMENT TECHNIQUE

The project alignment index calculation phase intends to quantify the data collected from the indicators presented in subsection IV A, and then determine an index for each project in the evaluation process. The top management, according to the strategic definition of the organisation and the weighting of the minimum values of attractiveness for each of the indicators, will contribute to the allocation of the projects by defining a cutting area in which each project must be selected.

This technique is divided in three main steps, which consist of:

- 1) set the minimum values of attractiveness by indicator;
- 2) calculate the indicators score by project; and finally

3) sort the different projects in study.

#### A. Indicators

Variables:

M = Number of indicators:  $\{1, \dots, 5\}$

$\Omega$  = Project Alignment Index

P = Indicator values

Q = Weighting values

Parameters:

K = Number of projects in assessment:  $M = \{1, \dots, 10\}$

The four indicators proposed come from different elements whose combination produces information considered critical to guarantee the project alignment with the organisational strategy.

1)  $M_1 = \text{Degree of Innovation Expected}$  - The degree of innovation expected varies between 0 and 5, and quantifies the level of impact that each project may have on the technological structure, and its level of attractiveness in emerging markets that can enhance organisational performance;

2)  $M_2 = \text{Risk Perception}$  - The risk perception is quantified by the decision agents and varies between 0 and 5, being 0 the absence of risk and 5 corresponding to the most complex and sensitive environments in which the degree of volatility is very high;

3)  $M_3 = \frac{\text{Net income expected}}{\text{Investment projected}}$  This indicator reflects the return on investment (ROI). Despite of the literature indication that the selection of projects should not only rely on economic and financial indicators, it is of common and mandatory use. Projects must have this type of information available. This indicator is usually presented in monetary values or percentage;

4)  $M_4 = \frac{\text{Nr. critical resources}}{\text{Nr. of Projects}}$  This indicator considers the number of critical resources project, and also foresees some future problems of allocation and balancing of resources that may exist at later stages, as well as the risk of concentrating in one project several key organisational resources;

5)  $M_5 = \frac{\text{Project schedule}}{\text{Market Clockspeed}}$  This indicator shows the degree of anticipation that the organisation has towards the market clockspeed. The numerator and denominator should be measured on a time scale, preferably in months or years. This indicator should be, in ideal situations, less than 1, presenting the ability of innovation and flexibility of the organisation. It can be translated into increased performance and into achievement of sustainable competitive advantages.

#### B. Data and formula calculation

The final purpose of this approach is to discover, according to the evaluation and the classification of the different decision makers for each indicator, what is the list of markets that best

suits the organisational profile, and thus where should the organisation focus and investment be directed.

Before the individual calculation of the project alignment index, the decision team establishes its value of reference, which reflects the minimum values of attractiveness for the different indicators as well as its weighting for each one. (See Appendix I)

The proposed simple calculation of the project alignment index is the following:

$$\Omega_K = \sum_{M=1}^5 P_M * Q_M \quad (1)$$

Simulated data for 10 projects is treated in *Appendix I* allowing for the calculation of the projects' alignment index

#### V. CONTRIBUTIONS AND PROPOSED FUTURE RESEARCH

This paper seeks to give a general idea of the universe of project portfolio management, from its multidisciplinary nature, to the many challenges it raises, passing through the different techniques, models and tools used to solve the multiple problems known.

It is intended to contribute to the clarification of the impacts and relationships involved in managing the projects' portfolio. It aims at proposing a way of measuring the project alignment with the organisational strategy, in order to allow a pre-selection of projects. Only projects passing this pre-selection criterium will be considered, later on, for further analysis, in order to select the final organisational portfolio.

We intended to propose a technique independent of the business area of application, thus only generic indicators with a low level of granularity are used. This is a starting point of development. In the future, applying this approach to business case studies, hopefully, will allow the introduction of new and more specific indicators related to the area of intervention as well as to the specificity of the projects in hand, enriching and diversifying the technique, tailoring it adequately.

Other future work we intend to undertake, is to model in detail all the following phases of the project portfolio selection and management, in one or more organisations with a strong tradition in managing portfolio, and an extensive history data to analyse and compare the decisions taken and the techniques used with the new approaches developed. The following phases previously mentioned will be treated, suggesting new indicators for the individual evaluation of projects, developing a methodology or technique to select and rank the projects for the portfolio, also adapting or developing a technique, or a model, or methodology, for assigning and balancing the organisational scarce resources, and, finally, introducing a way to monitor and control the whole system where all the different phases take part.

#### VI. DISCUSSION AND CONCLUSIONS

The organisational urge for using and applying new tools, methods and techniques is tremendous. The market competitive pressing, the reduction of error margins and the need to do things perfectly at the first shot are creating an increasing demand for solutions that can resolve those

problems, achieving the best performance possible with the minimum risk and cost. There is no consensus about the type of method or technique that automatically improves any organisation, despite their own problems or status, restrictions and competitive advantages, strengths and weaknesses.

Nevertheless, project management tries to see the organisation as a whole, and systematically challenge the difficulties encountered with new re-thinking processes in order to increase the organisational performance.

The market determines the best fit in each moment for selecting determinant characteristics that favours some organisations at the expense of others. For this reason, the awareness of studying conveniently the market can alter the organisational strategy, and even the definition of the organisational objectives.

We consider the development of a methodology for assessing the project alignment index very relevant in the global market scenario. It can help organisations to gain a greater awareness of market dynamics, speed up the decision process and increase its consistency, thus enabling the strategic alignment and the improvement of the organisational performance.

In addition, the PPM cycle proposed, allows the creation of an excellent base of information that, with some extension and analysis may be transformed into organisational knowledge, facilitating the post-mortem analysis of the decisions taken and of the market conditions in a specific period of time. This ability can enhance the organisational learning, gathering valuable lessons in order to avoid the repetition of past errors.

As mentioned by [68, p.58], "Good intentions are not enough to guarantee improvements – commitment, support and skill are all essential. Furthermore, a clear and shared understanding of the organisation's objectives is important if organisations are to learn collectively and thereby reap the significant benefits associated with collaborative reflection".

So it is of great importance to develop a flexible and expandable Decision Support System, which considers all the different criteria in the most suitable selection of the project portfolio, involving the full participation of the decision-makers and providing the users with a quick feedback impact, in certain parameters, with the consequences of the changes produced. [69]

#### APPENDIX

**Table 1 –Organisational ponderation for project alignmet index calculation**

	Indicators	Minimal attractiveness (P)	Weight (Q)
M1	Degree of innovation expected	2.5	20%
M2	Risk perception	1.5	10%
M3	Net Income expected	50.00%	25%
	Investment projected		
M4	Nr. Critical resources	2	25%
	Nr. Projects		
M5	Project Schedule	0.9	20%
	Market Clockspeed		
		<b>1.46*</b>	<b>100%</b>

\* Calculated using Eq. (1) presented in section IV B

**Table 2 - Random Numbers Generation for the Multiple Project Indicators**

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
M1	2.96	2.95	3.93	1.34	3.21	1.81	2.42	4.91	1.79	3.39
M2	4.72	1.47	2.77	4.24	3.22	1.43	2.57	1.89	3.44	4.95
M3	57	15	86	26	27	15	87	27	27	25
M4	1	2	4	4	3	1	4	3	4	4
	4	6	9	1	4	5	7	6	4	3
M5	18	21	13	14	9	15	14	13	17	11

For each project random numbers were generated, between the ranges presented in section IV A. The indicator M5 remained divided because the two items listed are inherent to a project characterisation, specially the project schedule.

**Table 3 - Simulation and calculation of the Project Alignment Index**

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
M1	2.96	2.95	3.93	1.34	3.21	1.81	2.42	4.91	1.79	3.39
M2	4.72	1.47	2.77	4.24	3.22	1.43	2.57	1.89	3.44	4.95
M3	57.00	15.00	86.00	26.00	27.00	15.00	87.00	27.00	27.00	25.00
M4	1.00	2.00	4.00	4.00	3.00	1.00	4.00	3.00	4.00	4.00
M5	0.22	0.29	0.69	0.07	0.44	0.33	0.50	0.46	0.24	0.27
$\Omega_k$	15.61	5.04	23.70	8.21	8.55	4.57	23.59	8.76	8.50	8.48

The *Project Alignment Index* was calculated to all the projects, as we can see in Table 3. The data presented shows that all the projects obtained different results, and with higher indexes compared to the minimal attractiveness index stipulated for the organisation.

The data marked in red highlights values which are in disagreement with the policy defined by the organisation, as for example, the values of M2 and M4. In the first case, because they are above the limit of acceptable risk; in the second case, because of the concentration of critical resources in the project. However, it is important that the pre-defined values of Table 1 are not too restrictive; some balance will need to be attained, otherwise there may not be any project that respects the limits imposed.

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#### REFERENCES

- [1] Maylor, H., Brady, T., Cooke-Davies, T., Hodgson, D., 2006. "From projectification to programmification", *International Journal of Project Management*, Vol. 24, No.8, pp 663-674.
- [2] Pinto, J.K., Kharbanda, O.P., 1996. "How to fail in project management (without really trying)", *Business Horizons*, Vol. 39, No.4, pp 45-53.
- [3] Gabriela F., 2004. *Desenvolvimento de Metodologias para Avaliação de Projectos de Investimento Multisectorial*, Master of Applied Science Thesis, Minho University, Portugal.
- [4] Cooke-Davies, T., 2002. "The 'real' success factors on projects", *International Journal of Project Management*, Vol. 20, No.3, pp 185-190.
- [5] Elonen, S., Arto, K.A., 2003. "Problems in managing internal development projects in multi-project environments", *International Journal of Project Management*, Vol. 21, No. 6, pp 395-402.

- [6] Teece, D.J., Pisano, G., Shuen, A., 1997. "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18, No. 7, pp. 509–533.
- [7] Makadok, R., and Barney, J.B., 2001. *Strategic Factor Market Intelligence: An Application of Information Economics to Strategy Formulation and Competitor Intelligence*. Management Science, Vol.47, NO. 12, pp 1621-1638.
- [8] Kahneman, D., Slovic, P. and Tversky, A., 1982. *Judgment Under Uncertainty: Heuristics and Biases*. New York, Cambridge University Press.
- [9] Khatri, N. and Alvin, H., 2000. "The role of intuition in strategic decision making", *Human Relations*, Vol. 53, No. 1, pp 57-86.
- [10] Eisenhardt, K.M. and Martin, J.A., 2000. "Dynamic Capabilities: What Are They?", *Strategic Management Journal*, Vol. 21, No. (10-11), pp 1105-1121.
- [11] Farjoun, M., 1999. "Towards an organic perspective on strategy", *Strategic Management Journal*, Vol. 23, No. 7, pp 561-594.
- [12] Eisenhardt, K.M., 1989. "Making fast strategic decisions in high-velocity environments", *Academy of Management Journal*, Vol. 32, No.3, pp 543-576.
- [13] Nadkarni, S. and Narayanan, V.K., 2006. "Strategic schemas, strategic flexibility, and firm performance: the moderating role of industry clockspeed", *Strategic Management Journal*, Vol. 28, No. 3, pp 243-270.
- [14] Child, J., Chung, L. and Davies, H., 2003. "The Performance of Cross-Border Units in China: A Test of Natural Selection, Strategic Choice and Contingency Theories", *Journal of International Business Studies*, Vol. 34, No. 3, pp 242-254.
- [15] Archer, N.P., Ghasemzadeh, F., 1999. "An integrated framework for project portfolio selection", *International Journal of Project Management*, Vol. 17, No. 4, pp 207–16.
- [16] Dye, L., Pennypacker, J., editors, 1999. *Project portfolio management. Selecting and prioritizing projects for competitive advantage*. USA: Center for Business Practices.
- [17] Cooper, R.G., 1993. *Winning at New Products*, 2nd edition. Reading, Addison-Wesley, MA.
- [18] Martinsuo, M. and Lehtonen, P., 2007. "Role of single-project management in achieving portfolio management efficiency", *International Journal of Project Management*, Vol. 25, pp 56-65.
- [19] Cooper, R.G., Edgett, S.J., Kleinschmidt, E.J., 1998. *Portfolio management for new products*. New York: Perseus Books.
- [20] Cooper, R.G., Edgett, S.J., Kleinschmidt, E.J., 2000. "New problems, new solutions: making portfolio management more effective", *Research Technology Management*, Vol. 43, No. 2, pp 18–33.
- [21] Engwall, M. & Jerbrant, A., 2003. "The resource allocation syndrome: the prime challenge of multi-project management?", *International Journal of Project Management*, Vol. 21, pp. 403-409.
- [22] Clark, K.B., Wheelwright, S., 1992. *Revolutionizing product development: quantum leaps in speed, efficiency, and quality*. New York: The Free Press.
- [23] Mikkola, J.H., 2001. "Portfolio management of R&D projects: implications for innovation management", *Technovation*, Vol. 21, pp. 423-435.
- [24] Van Veen-Dirks, P. & Wijn, M., 2002. "Strategic Control: Meshing Critical Success Factors with the Balanced Scorecard", *Long Range Planning*, Vol. 35, pp 407-427.
- [25] Keeble, J.J., Topiol, S. & Berkeley, S., 2003. "Using Indicators to Measure Sustainability Performance at a Corporate and Project Level", *Journal of Business Ethics*, Vol. 44, pp 149-158.
- [26] Chan, A.P.C. & Chan, A. P. L., 2004. "Key performance indicators for measuring construction success", *Benchmarking: An International Journal*, Vol.11, pp 203-221
- [27] Belassi, W. and Tukel, O.I., 1996. "A new framework for determining critical success/failure factors in projects", *International Journal of Project Management*, Vol. 14 No. 3, pp.141-51.
- [28] Hatush, Z. and Skitmore, M., 1997. "Evaluating contractor prequalification data: selection criteria and project success factors", *Construction Management and Economics*, Vol. 15, No. 2, pp. 129-47.
- [29] Walker, D.H.T., 1995. "An investigation into construction time performance", *Construction Management and Economics*, Vol. 13 No. 3, pp. 263-74.
- [30] Walker, D.H.T., 1996. "The contribution of the construction management team to good construction time performance – an Australian experience", *Journal of Construction Procurement*, Vol. 2 No. 2, pp. 4-18.
- [31] Atkinson, R., 1999. "Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria", *International Journal of Project Management*, Vol. 17 No. 6, pp. 337-42.
- [32] Kaplan, R.S. and Norton, D.P., 2001. "Transforming the balanced scorecard from performance measurement to strategic management: Part I", *Accounting Horizons*, Vol. 15 No. 1, pp 87-104.
- [33] Kaplan, R.S. and Norton, D.P., 2004. *Strategy Maps: Converting Intangible Assets into Tangible Outcomes*, 1st ed., Harvard Business School Publishing Corp., Boston, MA.
- [34] Shi-Ming Huang, Chia-Ling Lee & Kao, A.-C., 2006. "Balancing performance measures for information security management: A balanced scorecard framework", *Industrial Management & Data Systems*, Vol.106, pp 242-255.
- [35] Thomas, H., 2007. "Business school strategy and the metrics for success", *Journal of Management Development*, Vol. 26, pp 33-42.
- [36] Turner R.J., 1999. *The handbook of project based management*. 2nd ed. London: McGraw-Hill.
- [37] Cleland, D.I. The strategic context of projects. In: Dye LD, Pennypacker JS, editors. *Project portfolio management – selecting and prioritizing projects for competitive advantage*. West Chester, PA, USA: Center for Business Practices; 1999. p. 3–22.
- [38] Cooper, R.G., Edgett, S.J., Kleinschmidt, E.J., 1997. "Portfolio management in new product development: lessons from the leaders – II", *Research Technology Management*, Vol. 40, No. 6, pp 43–52.
- [39] Bridges DN. *Project portfolio management: ideas and practices*. In: Dye LD, Pennypacker JS, editors. *Project portfolio management – selecting and prioritizing projects for competitive advantage*. West Chester, PA, USA: Center for Business Practices; 1999. p. 45–54.
- [40] Spradlin, T., Kutolowski, D., 1999. "Action-orientated portfolio management", *Research Technology Management*, pp 26–32.
- [41] Englund, R.L., Graham, R.J., 1999. "From experience: linking projects to strategy", *Journal Production Innovation Management*, Vol.16, No. 1, pp 52–64.
- [42] Matheson, J., Menke, M. Using decision quality principles to balance your R&D portfolio. In: Dye LD, Pennypacker JS, editors. *Project portfolio management: selecting and prioritizing projects for competitive advantage*. West Chester, PA, USA: Center for Business Practices; 1999. p. 61–9.
- [43] Dietrich, P. & Lehtonen, P., 2005. "Successful management of strategic intentions through multiple projects - Reflections from empirical study", *International Journal of Project Management*, Vol.23, No.5, pp 386-391.
- [44] Tikkanen, H., Kujala, J. & Artto, K., 2007. "The marketing strategy of a project-based firm: The Four Portfolios Framework.", *Industrial Marketing Management*, Vol. 36, No., pp 194-205.
- [45] Martino, J.P., 1995. *R&D Project Selection*, Wiley, New York, NY
- [46] Hax, A. and Majluf, N.S., 1996. *The Strategy Concept and Process: A Pragmatic Approach*, 2nd edn. Prentice-Hall, Upper Saddle River, NJ.
- [47] Souder, W.E., 1984. *Project Selection and Economic Appraisal*, Van Nostrand Reinhold, New York, NY
- [48] Saaty, T.L., Rogers, P.C. and Pell, R., 1980. "Portfolio selection through hierarchies", *Journal Portfolio Management*, Vol. 6, No. 3, pp 16-21.
- [49] Roussel, P.A., Saad, K.N., Erickson, T.J., 1991. *Third Generation R&D – Managing the Link to Corporate Strategy*. Arthur D. Little, Inc.
- [50] Abdelaziz, F.B., Aouni, B. & Fayedh, R.E., 2007. "Multi-objective stochastic programming for portfolio selection", *European Journal of Operational Research*, Vol. 177, pp. 1811-1823.
- [51] Doerner, K.F., Gutjahr, W. J., Hartl, R. F., Strauss, C. & Stummer, C., 2006. "Pareto ant colony optimization with ILP pre-processing in multi-objective project portfolio selection", *European Journal of Operational Research*, Vol. 171, pp. 830-841.
- [52] Kavadias, S. & Loch, C.H., 2003. "Optimal Project Sequencing with Recourse at a Scarce Resource", *Production & Operations Management*, Vol. 12, pp. 433-444.
- [53] Loch, C. H. & Kavadias, S., 2002. "Dynamic Portfolio Selection of NPD Programs Using Marginal Returns", *Management Science*, Vol. 48, pp. 1227-1241.



- [54] Lee, D. H. & Park, D., 1997. "An efficient algorithm for fuzzy weighted average", *Fuzzy Sets and Systems*, Vol. 87, pp 39-45.
- [55] Lin, C. & Hsieh, P. J., 2004. "A fuzzy decision support system for strategic portfolio management", *Decision Support Systems*, Vol. 38, pp. 383-398.
- [56] Williams, T. (2003) "Learning from projects", *Journal of Operations Research Society*, Vol. 54, No. 5, pp 443-451.
- [57] Williams, T. (2004) "Identifying the hard lessons from projects – easily", *International Journal of Project Management*, Vol. 22, No. 4, pp 273-279.
- [58] Argote, L., 2005. "Reflections on Two Views of Managing Learning and Knowledge in Organisations", *Journal of Management Inquiry*, Vol.14, No.1, pp 43-48.
- [59] Cooper, K.G., Lyneis, J.M.& Bryant, B.J., 2002. "Learning to learn, from past to future," *International Journal of Project Management*, Vol.20, No. 3, pp 213-219.
- [60] Kerzner, H., 2001. *Project management: A systems approach to planning, scheduling, and controlling* (7th ed.). New York: John Wiley & Sons Inc.
- [61] Jugdev, K. & Thomas, J., 2002. "Project management maturity models: The silver bullets of competitive advantage", *Project Management Journal*, Vol. 33, pp. 4-14.
- [62] Arthur, M.B., DeFillippi, R.J. & Jones, C. (2001) "Project-based Learning as the Interplay of Career and Company Non-financial Capital," *Management Learning*, Vol. 32, No.1, pp 99-117.
- [63] Keegan, A. & Turner, J.R., 2001. "Quantity Versus Quality in Project-based Learning Practices," *Management Learning*, Vol. 32, No. 1, pp. 77-98.
- [64] Huber, G.P., 1991. "Organisational learning: The contributing processes and the literatures," *Organisation Science*, Vol. 2, No. 1, pp. 88-115.
- [65] Levitt, B. & March, J.G. (1988) "Organisational Learning," *Annual Review of Sociology*, Vol.14, pp. 319-340.
- [66] Garvin, D.A. (1993). "Building a learning organisation". *Harvard Business Review*, Vol. 71, pp 78–91.
- [67] Suikki, R., Tromstedt, R. & Haapasalo, H. (2006) "Project management competence development framework in turbulent business environment", *Technovation*, Vol.26, No. 5/6, pp. 723-738.
- [68] Roth, G. & Kleiner, A., 1998. "Developing organisational memory through learning histories," *Organisational Dynamics*, Vol.27, No. 2, pp 43-60.
- [69] Andersen, E., Jessen, S., 2003. "Project maturity in organisations", *International Journal Project Management*, Vol. 21, No.6, pp. 457–61.