Resource Allocation in Project Portfolio Management: Practice in the Baltic States

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Abstract **The resource allocation problem is to find an optimal allocation of limited resources to a number of projects for optimizing the objectives. A wide variety of resource allocation models have been introduced over the years, including linear programming, scoring models, group decision techniques and so on. Some of these techniques are not widely used because they are too complicated for decision making. This paper presents the results of research carried out in enterprises in the Baltic States on the use of resource allocation tools in making decisions concerning project portfolio management.**

Index Trems – **Project portfolio, project portfolio management, resource allocation models, resource allocation tools, decision making.**

I. Introduction

Project portfolio management (PPM) has secured a stable and central position both in project management research, product development management research, and companies' management practices during the past decade. Despite the variety of instructions on how projects should be selected to the portfolio, how resources should be allocated across projects, how to align the entire portfolio with strategy, and how to assess the success of the portfolio, companies still struggle with the resource sharing problem across projects (Martinsuo, 2012). In order to help decision makers properly allocate resources, project portfolio management specialists (Elahi & Najafizadeh, 2012; Murray, Alpaugh, Burgher, Flachbart, & Elrod, 2010; Rafiee, Kianfar & Farhadkhani, 2013; Bhattacharyya, Kumar & Kar, 2011; Rebiasz, 2013 and others) developed different resource allocation models. However, some authors (Liberatore & Titus, 1983; Schmidt & Freeland, 1992; Eilat, Golany & Shtub, 2006; Solak, Clarke, Johnson & Barnes, 2010; Lawson, Longhurst & Ivey, 2006; Meredith & Mantel, 2008; Verbano & Nosella, 2010; Ghasemzadeh, & Archer, 2000) concluded that the use of quantitative and computer-aided project selection and resource allocation methods, due to their complexity, is rather limited. Additionally, there is no consensus as to which methods are the most effective.

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The study of Cooper *et al.* (2001) identified methods which are most commonly used and those which are dominant in the decision-making process. Their findings showed that financial methods are most widely used, although they can seldom be used all by themselves. They pointed out that a combination or a hybrid approach could be better used to define a project portfolio (Dutra, Ribeiro & de Carvalho, 2014).

We carried out an analysis of the use of resource allocation tools in construction enterprises in the Baltic States. The construction sector was chosen because it is one of the main production sectors in the European Union and one of the key drivers of economic development.

The objectives of this article are as follows: 1) to review the literature on quantitative modelling approach for resource allocation in the project portfolio, 2) to present the results of research on the use of resource allocation tools in enterprises in the Baltic States.

The research methods: analysis of scientific literature and other information sources, survey and statistical analysis (IBM SPSS Statistics 22).

II. Overview of Resource Allocation Models

Current literature on project portfolio management covers a large number of resource allocation methods and techniques. There are also several classifications of resource allocation and project selection methods and models (Baker, Souder, Shunway, Maher & Rubenstein, 1976; Hall & Nauda, 1990; Martino, 1995; Heidenberger & Stummer, 1999; Iamratanakul, Patanakul & Milosevic, 2008). We updated previous classifications and divided resource allocation methods and models into 8 groups, namely benefit measurement methods, mathematical programming models, decision and game theory, simulation, heuristics, cognitive emulation, real options and ad hoc models.

Benefit measurement methods are most frequently referred to in the literature. They help to determine the benefits of each doubtful project. Benefit measurement methods are divided into comparative models, scoring models, traditional economic models and group decision techniques. *Comparative models* are used in order to evaluate a group of projects linking one project offer to another project offer or several alternative project offers (Martino, 2003). Models also rely on group project evaluations, when respondents have to compare one offer with another. An offer can be added or removed from the group under consideration at any time, and the entire process has to be repeated. The advantages of comparative models include ease of understanding, ease of use, and possibility of integrating quantitative and qualitative analysis. As far as their disadvantages are concerned, these models are characterised by lack of explicit consideration of risks, repetition of the entire process when new projects are added or deleted, difficulty in use in the case of a large number of projects to be compared and incapability to identify really good projects. *Scoring models* are used by many practitioners and constitute the core of most project portfolio management solutions (Arlt, 2010). The popularity of scoring models primarily depends on their ease of use based on standardized weighting of priorities and objectives, and the potential to include both qualitative and quantitative criteria. However, this approach assumes that candidate projects are independent which is not always true; consequently, the best individual projects do not necessarily make the best portfolio (Carazo, Gomez, Molina, Diaz, Guerrero & Caballero, 2010). *Traditional economic models* are designed to perform cost-benefit analysis and/or assess the financial risk of a project. They are based on cash-handling methods and are closely interrelated or related to extensions of traditional methods used in capital budgeting. The use of *group decision techniques* allows for a systematic collection and collation of knowledge and evaluations of specialists in specific areas of expertise. Therefore, this method is regarded as appropriate in the performance of practical operations or at least as a means of verification for the purpose of receipt of data necessary for the development of a more complex model.

Mathematical programming models allow optimizing certain target functions taking into consideration constraints relating to resources, strategy, project logic, technology, project dynamics, etc. Numerous PPM software solutions provide the functionality for constrained optimization, which is complex to perform without computational aid, especially for large portfolios. Mathematical programming models are divided into linear programming, non-linear programming, integer programming, goal programming, dynamic programming, stochastic programming and fuzzy mathematical programming models.

Both *decision and game theory methods* clearly emphasize possible future events or reactions of the company environment that are undefined in their scope. The difference between these methods is that decision-making theory states that environmental changes do not depend on the company's actions, whereas game theory clearly emphasizes rational competitors (Heidenberger & Stummer, 1999). Decision-making and game theory models are divided into decision tree methods and game-theoretical models. *Decision tree analysis* can deal with individual decision problems. It allows analysing the expected values of a project at each event node to choose the case with the maximum value. However, it cannot address decision problems of a continuous type. If we try to apply it to a large number of activities, the tree branches would rapidly grow to an impractical degree of complexity (Sato & Hirao, 2012). *Game-theoretical models* are useful in evaluating resource allocation strategies, taking into consideration rationally operating competitors. Most game-theoretical methods are limited in that they emphasize duopoly competition in two-stage race for patents, where the second stage starts only after the successful completion of the first one.

Simulation models allow for a much more detailed expression of real systems as compared to optimization models, while during modelling only "what-if" type of questions have to be answered. They are used in cases where experiments in reality are inappropriate, too expensive or take too long, and the performance of complex analytical procedures is impossible or they cannot be applied without exceeding permissible costs or taking too (Heidenberger & Stummer, 1999). Simulation is very appropriate for a portfolio in a dynamic organization. However, its limitation is prohibited of its practice when an organization does not have a well established standard and flow of information (Iamratanakul, Patanakul & Milosevic, 2008).

Heuristic modelling is designed for finding acceptable although not necessarily optimal decisions. Heuristic procedures can be divided into four groups: PR-based X-pass heuristics, classical meta-heuristics, non-standard meta-heuristics, and miscellaneous heuristics (Browning & Yassine, 2010).

Cognitive emulation methods are designed for the development of a model of actual decision-making process within an organization (Hall & Nauda, 1990). They are based on the previous experience acquired under similar circumstances where, given the possible data, drawing conclusions seems reasonable. Cognitive emulation models can be divided into statistical methods, expert systems and decision process analyses.

Real options approach helps translate project options into visualized effects. It can reduce both downside and upside risk associated with project investment. It can also quantify the value of postponing the investment decision. Despite the benefits, real option requires extensive data and analysis (Iamratanakul, Patanakul & Milosevic, 2008).

Ad hoc models are a simplified version of scoring, where projects that do not meet certain criteria are eliminated from choice set (Arlt, 2010). Although this can be efficient, the applicability of such techniques is limited. Because of the interdependent nature of projects in a portfolio, particular care is needed, as profiling may exclude projects that do not meet a pre-defined threshold, but may be required as a prerequisite for a crucial other project (Arlt, 2010).

III. USE OF RESOURCE ALLOCATION TOOLS IN ENTERPRISES IN THE BALTIC STATES

Research was carried out in Lithuanian, Latvian and Estonian construction enterprises. The questionnaire was sent out to 500 enterprises in each country selected on the basis of their turnover (at least 5 million LTL) and number of employees (at least 100). The questionnaire was completed by 159 Lithuanian enterprises, 62 Latvian enterprises and 58 Estonian enterprises. The average number of years of experience of managers in project management is 12 years in Lithuania, 11 years in Latvia and 14 years in Estonia (see Table 1).

TABLE 1
YEARS OF EXPERIENCE OF MANAGERS IN PROJECT MANAGEMENT

	Lithuania	Latvia	Estonia
Average experience	**12**	**11**	**14**
Minimum experience	**4**	**3**	**4**
Maximum experience	**25**	**23**	**26**

More than half of the respondents in each country had over 10 years of experience in project management (56% in Lithuania, 58% in Latvia and 60% in Estonia).

The organisational project management maturity model and project management maturity assessment questionnaire (Tamošiūnienė & Dobrovolskienė, 2013) were used to assess the maturity of project management in each organisation on a scale of 1 to 5 (see Table 2). The highest level of average project management maturity is in Estonia.

TABLE 2
PROJECT MANAGEMENT MATURITY

	Lithuania	Latvia	Estonia
Average project management maturity	**2.69**	**2.56**	**3.23**
Standard deviation	0.85	1	0.8
Minimum project management maturity	**1.31**	**1.25**	**2.1**
Maximum project management maturity	**3.7**	**4.2**	**4.6**

This research aimed at determining whether resource allocation tools are used by organisations. Research showed that as much as 44% of the respondent enterprises in Lithuania did not use any resource allocation tools; this figure in Latvia and Estonia is 55% and 34% respectively (see Table 3). This was mainly explained by resource allocation tools being complicated to apply in practice.

TABLE 3
USE OF RESOURCE ALLOCATION TOOLS

	Lithuania	Latvia	Estonia
Do not use any resource allocation tools	**44%**	**55%**	**34%**
Not aware of such tools	**25%**	**38%**	**26%**
Difficult to apply	**75%**	**62%**	**74%**

Furthermore, research revealed that there is a statistically significant, moderate linear correlation between the use of resource allocation tools in an enterprise and the manager's experience in project management (see Table 4).

TABLE 4
CORRELATION BETWEEN THE USE OF RESOURCE ALLOCATION TOOLS AND EXPERIENCE IN PROJECT PORTFOLIO MANAGEMENT

	Lithuania	Latvia	Estonia
Pearson Correlation	**,515****	**,520****	**,635****
Sig. (2-tailed)	**,000**	**,000**	**,000**
N	**159**	**62**	**58**

** Correlation is significant at the 0.01 level (2-tailed).

The average years of experience of managers in project management in enterprises that do not use resource allocation tools are 10 years in Lithuania, 8 years in Latvia and 10 years in Estonia, whereas the average years of experience of managers in project management in enterprises using resource allocation tools are 14 years in Lithuania, 15 years in Latvia and 17 years in Estonia.

Moreover, there is also a statistically significant, moderate linear correlation between the use of resource allocation tools and the maturity of project management in an organisation (see Table 5).

TABLE 5
CORRELATION BETWEEN THE USE OF RESOURCE ALLOCATION TOOLS AND PROJECT MANAGEMENT MATURITY

	Lithuania	Latvia	Estonia
Pearson Correlation	**,519****	**,708****	**,729****
Sig. (2-tailed)	**,000**	**,000**	**,000**
N	**159**	**62**	**58**

** Correlation is significant at the 0.01 level (2-tailed).

The average maturity of project management in enterprises that do not use resource allocation tools is 2.22 in Lithuania, 1.91 in Latvia and 2.93 in Estonia. Accordingly, the average maturity of project management in enterprises using resource allocation tools is 3.06 in Lithuania, 3.34 in Latvia and 3.98 in Estonia.

IV. Conclusion

The overview of resource allocation models showed that there is a wide range of methods that can be used by decision makers to ensure efficient allocation of resources. Each model may be appropriate and practical, depending on its application. There are also several classifications of resource allocation and project selection models and methods. Our updated classification divides methods into 8 groups, namely benefit measurement methods, mathematical programming approaches, decision and game theory, simulation, heuristics, cognitive emulation, real options and ad hoc models.

The results of research carried out in the Baltic States corroborate previous findings that the use of resource allocation models, due to their complexity, is rather limited. It should be noted that complexity was indicated as the main reason for not using any resource allocation tools by approximately 70% enterprises (75% in Lithuania, 62% in Latvia, 74% in Estonia) that do not use such tools. Finally, this research revealed that the use of resource allocation tools depends on a manager's experience in project portfolio management and the maturity of project management in an organisation.

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