

# REQUIREMENTS FOR A PROJECT EVALUATION AND SELECTION METHODOLOGY

Cláudio Santos<sup>1\*</sup> and Madalena Araújo<sup>1</sup>

<sup>1</sup> Department of Production and Systems, School of Engineering, University of Minho, Azurem Campus  
4804-533 Guimarães, Portugal

\* Corresponding author: claudio.santos@dps.uminho.pt

## KEYWORDS

project, selection, requirements

## ABSTRACT

The evaluation and selection of projects is usually referred as critical for the sustainability of the competitiveness of organizations, but also as a complex process. If, on one hand, a formal and structured selection process may contribute to the clear communication of objectives and transparency, on the other hand, it may be shrouded with incomplete information and uncertainty about the real potential contribution of projects. The design and development of project selection methodologies should inevitably take into consideration organizational characteristics and constraints. Literature has provided various contributions to this topic, however, their emphasis have been on one or few requirements. This paper presents a review of the requirements for developing and implementing a project evaluation and selection methodology in organizations. This overview can support managers in fine tuning project selection practices in organizations.

## INTRODUCTION

The evaluation and selection of projects is an activity that can be decisive for the competitiveness of organizations because it enables organizations to focus their resources in the projects with the greatest chances to succeed. Depending on the expected strategic benefits to be achieved from the execution of the projects, a careful

and criteria to be used. Our research question is *“What are the requirements that need to be considered for establishing a project evaluation and methodology in organizations?”*

This study derives a preliminary list of requirements, from the literature, that can be used to characterize the implementation of project evaluation and selection practices in organizations. It considers projects that have gone through a prior process of appropriate formalization and characterization, for subsequent evaluation and selection.

## LITERATURE REVIEW

The project evaluation and selection problem has been attracting researchers' attention for over 50 years given its wide applicability and impacts on practices (Iamratanakul et al. 2008), resulting in a vast literature. In order to identify the key requirements for designing and developing a project evaluation and selection methodology for organizations, a literature review has been conducted. Papers were identified from major scientific databases using keywords search including “project”, “selection”, “evaluation” and “assessment”. No distinction will be made between project selection and portfolio project selection, at this stage. Most organizations have to deal with portfolio problems, at least from the view point of resources management. But other factors, namely synergies or conflicts due to the interaction between any new project being selected and the ones already ongoing will have to be analysed. Similar attention will be given to those interactions when selecting a set of projects to run simultaneously, under a portfolio selection process.

The widely known project diamond proposed by Shenhar and Dvir (2007) describes four dimensions that influence project management (novelty, technology, complexity and pace), however, they do not address the organizational dimension in the implementation of a project selection procedure that can contribute to project success. Perhaps the most complete work about project selection requirements was proposed by Archer and Chermazadeh (1990) who developed eleven propositions guidelines. Among them, there are: periodic re-evaluations of initial assumptions, consideration of projects interdependencies and synergies, adaptability to group support systems (GSS) and appropriate management of information flows (Jiang & Klein 1999; Cooper et al. 2000). Issues related to the convergence towards a shared vision on how to take advantage of one or more technological domains, how to foster collaborative work and the infusion of a “process-oriented” culture are important organizational dimensions to be considered in the project selection process (Daniel et al. 2003).

Life-cycle considerations of projects are key drivers during selection (Lopes & Flavell 1998). In this sense, Jeng and Huang (Jeng & Huang 2015) proposed a hybrid methodology (constituted of several techniques) for selecting project portfolio in their early initiation stages. Project selection methodologies should also take into account the diversity of project typologies (Kuchta & Skowron 2015) and the alignment with the strategies of the organization (Cooper et al. 2000), environmental factors and learning from past project experiences (Costantino et al. 2015), risk, uncertainty and ambiguity (Henriksen & Traynor 1999; Poh et al. 2001; Huang & Zhao 2016).

Linton et al. (2002) examined how portfolios of R&D projects can be selected by proposing a two stage procedure: (1) ranking and classification of projects in “accept”, “maybe accept” and “reject” through the use of a Data Envelopment Analysis (DEA) model and then (2) compare the “maybe accept” projects using a Value Creation Model (VCM). The authors argue that such separation into distinct phases allows managers to focus their attention by reducing the number of projects that require a more careful analysis. In the same line, Oral et al. (1991) proposes an approach for Industrial R&D Project Selection composed of an Evaluation phase, where the *relative value* of a given R&D project (from the viewpoint of the other projects under analysis) is estimated by the repeated use of a mathematical programming model, followed by a Selection phase, resorting to a model-based outranking method.

The choice of methods and techniques is a critical decision in designing project selection methodologies. In an attempt to address the difficulties in considering multiple (and sometimes, conflicting) criteria, to grasp the potentialities of selection methods and in involving groups of decision makers, Ghasmzadeh and Archer (2000) developed a staged framework that enables decision-makers the most adequate method in each stage. Nowack (2013) criticized methods that assume that decision-makers’ preferences are known *a priori* and proposed an interactive selection procedure that analyzes such preferences in a step-by-step approach.

Contributions from the literature to characterize project selection methodologies have focused on one or few requirements, thus lacking an integrated perspective. For example, Lopes and Flavell (1998) emphasized the need to include non-financial criteria in project selection to provide a more comprehensive overview about the expected benefits of each candidate project. Lawson et al. (2006) investigated the adoption of practical R&D project selection models in UK-based small and medium enterprises (SMEs), and concluded that the implementation of structured documentation tools for managing information is still a poorly observed practice in SMEs. Information management is a critical dimension in project selection, much like any information-intensive decision-making process. As a matter of fact, Baker and Freeland (1975) long ago argued that project selection methodologies would

transition from purely “decision models” to “decision information systems”, which now seems to be an accurate prediction given the increasing pervasiveness of information and communication technologies (ICT) nowadays in organizations.

### PROPOSED SET OF REQUIREMENTS

The review performed enabled the identification of the requirements for establishing a project evaluation and selection methodologies in organizations, which are described in Table 1.

Among such aspects, the consideration of uncertainty and risk during project selection is frequently cited. Being of particular importance for R&D projects, the development of new technologies and products are subjected to uncertainties and risks concerning the achievement of technical and market goals. Risk, in its widest meaning, should be previewed and managed throughout all the R&D project stages (including selection) in order to improve success rates. The earlier risks are identified and evaluated, the more time managers have to develop and implement mitigation strategies.

The readiness level(s) of the technologies (TRL) involved in the projects’ selection pool is another critical dimension. For example, criteria basic research projects (low TRL) tend to be subjective by nature, while in later stages of maturity (greater TRLs), project selection require more pragmatic approaches, such as related to expected economic benefits. In this sense, greater preference has been given to scoring and multiple criteria methods, which take into consideration qualitative factors, in earlier stages of technological maturity. More quantitative methods are preferred as market and economic factors become more critical in later stages, although strategic factors should not be ignored in any way. Knowing the maturity of technologies involved ensures that projects can be evaluated using appropriate criteria and methodology, thus ensuring an equitable comparison.

Another highly cited requirement is related to a dedicated information management architecture for project selection. The approach organizations follow to *plann, organize, collect, analyze and disseminate data and information* (Norling et al., 2000) *should be carefully taken if organizations desire to reduce uncertainty and ambiguity from incomplete information in project selection*. Recent advances in ICT enables the analysis of massive amounts of data, and improvements in the sophistication of selection methods, driven by significant algorithmic work done in the Operations Research area, offers new opportunities for embedding project selection processes in organizations. The identification of information needs is primarily driven by the criteria through which projects are compared.

Other worth-noting requirements include the managerial approach in project selection, which includes decisions such as which techniques to be used, the re-evaluation methods, controlling mechanisms, which groups of

people should be involved and in which phases, among others. The strategic orientation is often reflected in qualitative and non-financial criteria, and it is a critical

requirement for projects selected to be aligned with the organization's strategy.

**Table 1 - A review of project evaluation and selection requirements**

Requirements	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Consideration of internal and external business factors				x													x		
Organized in a number of stages				x															
Enable reviews and re-evaluations				x															
Time dependent nature of projects resource competition				x															
Enable controlling mechanisms				x															
Adaptable to group decision support systems				x															
Non-financial (or qualitative) criteria			x					x					x		x				
Consider project typologies		x		x					x	x	x	x						x	
Should consider risk and uncertainty	x				x	x	x												x
Infusion of a process oriented culture																	x		
Shared vision																	x		
A dedicated information management architecture											x			x	x				
Consider projects' life cycle stages			x																

**Legend:**

1 - (Fahmi & Spätig 1990); 2 - (Mitchell 1990); 3 - (Lopes & Flavell 1998); 4 - (Archer & Ghasemzadeh 1999); 5 - (Henriksen & Traynor 1999); 6 - (Ghasemzadeh & Archer 2000); 7 - (Poh et al. 2001); 8 - (Meade & Presley 2002); 9 - (Coldrick et al. 2005); 10 - (Tidd et al. 2005); 11 - (Lawson et al. 2006); 12 - (Verbano & Nosella 2010); 13 - (Martinez et al. 2011); 14 - (Jiang & Klein 1999), 15 - (Cooper et al. 2000), 16 - (Daniel et al. 2003), 17 - (Costantino et al. 2015), 18 - (Kuchta & Skowron 2015); 19 - (Huang & Zhao 2016)

**CONCLUSIONS AND FURTHER RESEARCH**

The topic of project evaluation and selection has been discussed for decades. Its applicability extends beyond the borders of projects, including technologies selection, suppliers' selection and many others.

In this paper, we present an overview of the most important requirements for implementing project evaluation and selection practices in organizations. This review, which is by no means exhaustive, indicates that literature has been focusing in the R&D type of projects. As an indication of future work, it would be interesting to analyze the applicability of the identified requirements in other projects' typologies.

The identified requirements can benefit organizations in providing guidance for implementing formalized and structured project evaluation and selection procedures. These requirements are intended for generic types of

projects, and future work should be directed towards: (1) the refinement to consider different taxonomies of projects, (2) analysing how these dimensions relate to each other in driving the implementation of a project selection model and (3) testing them in real organizational settings.

**REFERENCES**

Archer, N. & Ghasemzadeh, F., 1999. An integrated framework for project portfolio selection. *International Journal of Project Management*, 17(4), pp.207–216.  
 Baker, N. & Freeland, J., 1975. Recent Advances in R&D Benefit Measurement and Project Selection Methods. *Management Science*, 21(10), pp.1164–1175.  
 Coldrick, S. et al., 2005. An R&D options selection model for investment decisions. *Technovation*, 25(3), pp.185–193.  
 Cooper, R.G., Edgett, S.J. & Kleinschmidt, E.J., 2000. *New Problems , New Solutions: Making Portfolio*

- Management More Effective. *Research Technology Management*, 43(2), pp.18–33.
- Costantino, F., Di Gravio, G. & Nonino, F., 2015. Project selection in project portfolio management: An artificial neural network model based on critical success factors. *International Journal of Project Management*, 33(8), pp.1744–1754.
- Daniel, H.Z., Hempel, D.J. & Srinivasan, N., 2003. Project selection. A process analysis. *Industrial Marketing Management*, 32(1), pp.39–54.
- Fahrni, P. & Spätig, M., 1990. An application-oriented guide to R&D project selection and evaluation methods. *R&D Management*, 20(2), pp.155–171. Available at: <http://dx.doi.org/10.1111/j.1467-9310.1990.tb00693.x>.
- Ghasemzadeh, F. & Archer, N.P., 2000. Project portfolio selection through decision support. *Decision Support Systems*, 29(1), pp.73–88.
- Henriksen, A.D. & Traynor, A.J., 1999. A practical r&d project-selection scoring tool. *IEEE Transactions on Engineering Management*, 46(2), pp.158–170.
- Huang, X. & Zhao, T., 2016. Project selection and adjustment based on uncertain measure. *Information Sciences*, 352–353, pp.1–14.
- Iamratanakul, S., Patanakul, P. & Milosevic, D., 2008. Project portfolio selection: From past to present. *2008 4th IEEE International Conference on Management of Innovation and Technology*, pp.287–292.
- Jeng, D.J.-F. & Huang, K.-H., 2015. Strategic project portfolio selection for national research institutes. *Journal of Business Research*, 68(11), pp.2305–2311.
- Jiang, J.J. & Klein, G., 1999. Project selection criteria by strategic orientation. *Information & Management*, 36(2), pp.63–75.
- Kuchta, D. & Skowron, D., 2015. Classification of R&D projects and selection of R&D project management concept. *R&D Management*.
- Lawson, C.P., Longhurst, P.J. & Ivey, P.C., 2006. The application of a new research and development project selection model in SMEs. *Technovation*, 26(2), pp.242–250.
- Linton, J.D., Walsh, S.T. & Morabito, J., 2002. Analysis, ranking and selection of R & D projects in a portfolio. *R and D Management*, 32(2), pp.139–148.
- Lopes, M.D.S. & Flavell, R., 1998. Project appraisal - A framework to assess non-financial aspects of projects during the project life cycle. *International Journal of Project Management*, 16(4), pp.223–233.
- Martinez, L.J., Joshi, N.N. & Lambert, J.H., 2011. Diagramming qualitative goals for multiobjective project selection in large-scale systems. *Systems Engineering*, 14(1), pp.73–86.
- Meade, L.M. & Presley, a., 2002. R&D project selection using the analytic network process. *Engineering Management, IEEE Transactions on*, 49(1), pp.59 –66.
- Mitchell, G.R., 1990. Alternative frameworks for technology strategy. *European Journal of Operational Research*, 47(2), pp.153–161.
- Norling, P. M., Herring, J. P., Rosenkrans, W. A., Stellplug, M. & Kaufman, S. B. 2000. Putting Competitive Technology Intelligence To Work. *Research-Technology Management*, 43, 23-28.
- Nowak, M., 2013. Project portfolio selection using interactive approach. In *Procedia Engineering*. pp. 814–822.
- Oral, M., Kettani, O. & Lang, P., 1991. A Methodology for Collective Evaluation and Selection of Industrial R&D Projects. *Management Science*, 37(7), pp.871–885.
- Poh, K. I., Ang, B. w. & Bai, F., 2001. A comparative analysis of R&D project evaluation methods. *R&D Management*, 31(1), pp.63–75.
- Shenhar, A.J. & Dvir, D., 2007. *Reinventing project management: the diamond approach to successful growth and innovation* 1 edition., Harvard Business Review Press.
- Tidd, J., Bessant, J. & Pavitt, K., 2005. *Managing innovation: integrating technological, market and organizational change* Third. 4th Edition, ed., West Sussex, England: John Wiley & Sons, Ltd.
- Verbano, C. & Nosella, A., 2010. Addressing R&D investment decisions: a cross analysis of R&D project selection methods. *European Journal of Innovation Management*, 13(3), pp.355–379.