



R&D project efficiency management in the Spanish industry

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Abstract

This paper shows the results from a survey to Spanish manufacturing firms on the use of indicators and techniques to analyze the efficiency of their R&D projects. Factor analysis revealed that project's profitability and time indicators were those which most explained the variance of company's efficiency analysis. On the other hand, ratios and financial analysis are the most used project evaluation methods. The differences in the use of indicators and techniques were significant for the most R&D intensive companies. The use of some evaluation methods was related to the control mechanisms applied to R&D projects. © 2002 Elsevier Science Ltd and IPMA. All rights reserved.

Keywords: Manufacturing; R&D; Investment; Evaluation

1. Introduction

R&D projects are risky investments for a private company. For example, many studies evidence that a 40% average of new product development projects fail to get benefits from the market [1]. As a consequence, R&D project efficiency is a very critical issue to CEOs and project managers. A survey carried out among the most intensive USA companies found that the main issue facing R&D managers was to measure and improve project efficiency [2].

However, R&D project efficiency is not an easy measurable concept. The measure of R&D efficiency includes not only information about the output and outcomes, such as patents, new products and profits, but also about the process leading to them. R&D project efficiency may be defined as the optimal use and management of R&D inputs and processes in order to achieve the project's technology and market goals. An efficiently managed project uses more productively than the scarce resources of the R&D organization.

R&D managers are sometimes reluctant to measure and control the R&D work because that might hinder people's creativity. There are then very few empirical studies that have analyzed the use of project efficiency indicators and techniques in industrial companies. For

example, a study of R&D intensive USA companies [3] found that 60% did not measure R&D efficiency and that only 7% regularly used some project efficiency indicators. Other studies [4,5] also found very little use of project efficiency analysis among industrial companies. Project managers were most sceptical about the usefulness of efficiency analysis [6].

These empirical studies indicate that very little is known about what managers do to analyze R&D project efficiency. In order to give empirical evidence and to help R&D project managers to improve their efficiency analysis, this paper studies the use of R&D project efficiency indicators and techniques in Spanish industry. The paper is structured in the following way. Section 2 briefs the metrics available to project efficiency analysis followed by a model of efficiency indicators from a review of the literature. Then the paper's research hypotheses are established, followed by the methodology and the discussion of the results from a survey to Spanish industrial companies on their use of project efficiency indicators and techniques. Finally the paper's conclusion is highlighted.

2. R&D project efficiency metrics

In order to consistently achieve the results of quality products and an efficient and effective organization, the R&D process must possess a set of necessary characteristics: systematic, objective, accurate, precise, unambig-

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uous, timely and simple [7]. Ideally, developing a R&D process with the above characteristics both enables informed cost–performance–schedule tradeoff decisions at critical points and provides a basis for making informed tradeoff decisions and identify early both those ongoing projects with the greatest probabilities of success and those that are destined for failure. It is therefore argued that project evaluation must not be seen as an end in itself, but should form part of a process which includes the encouragement of ideas, coordination between R&D and the company and the identification of the “needs” of the organization defined in a wide sense. The need to evaluate any R&D project in any industry is sometimes difficult, because of the lack of objective measures, but experience shows that in case of doubt, expenditure will cease in this area because so often, effectiveness cannot be proved. Thus the need to measure for value, to explore and develop objective measures within the company, whatever the difficulty.

Whatever a R&D project is evaluated — selection, efficiency, cancellation — managers must use metrics to measure the project’s performance. Efficiency metrics are usually classified into two groups: quantitative and qualitative indicators [8]. R&D decisions are not exclusively, or even mainly, adopted on the basis of quantified cash criteria. There may be many more quantified inputs to be taken into account in evaluation and these must feature prominently in a system for monitoring and guiding R&D projects [9]. The quantitative measures are based on numerical variables of a R&D project’s inputs and performance. Under this head are collected R&D costs, capital expenditure, sales volume and cost savings adjusted from year to year of the project life where appropriate. The estimates of these quantities used are the best available to the project manager at the time of making the evaluation and will be based on project records or opinions of experienced technical and marketing people. Sometimes these same people will be asked to describe in subjective probability terms the distribution of values they expect for their estimation of various costs, times and incomes. A common efficiency indicator is the ratio of sales or benefits increase due to the project results divided by the investment in R&D projects [10]. The advantage of these metrics is that they are easy to use, and are specially recommended to later stages of the R&D project when all quantitative information is already available. A study of USA and German companies [11] found that project managers emphasized the use of quantitative ratios such as patents obtained by R&D investment.

One reason against the use of quantitative methods in R&D is the high level of uncertainty present in research and development. The uncertainty is, in fact, an integral feature of the R&D work. Accordingly, methods of R&D evaluation should accept the uncertainty and be aimed at expressing qualitative aspects of the R&D

project that cannot be included in the quantitative indicators and therefore give more information to analyze the R&D project. The qualitative metrics are based on subjective evaluations that may then be transformed in numerical values using such techniques as check-lists, scoring models or Likert scales. Some qualitative metrics are not valued numerically but subjectively, i.e. good, excellent, by any of the following methods:

1. Self-evaluations. Each person evaluates his or her own contributions to the goals of the R&D project. They are subject to biases due to self-esteem and inaccurate self-perceptions.
2. Supervisory ratings. They are more objective than self-evaluations, although they may also be subject to biases. There are empirical studies that evidence that a supervisor’s rating is correlated significantly with the scientist’s patent productivity [12].
3. Peer-rating systems. All members of the R&D project evaluate themselves and each other. An assessor then correlates the data and condenses it into an overall evaluation statement [13]. This technique tends to undervalue any R&D effort that it will not be measured by the assessors, either scientific publications or patents [14].
4. External audits. They are generally more comprehensive. An audit is usually on the entire department or R&D project. They are used both in public research and in the private sector [15].

Qualitative measures are more suitable to early stages of a R&D project when sometimes the lack of information makes it more difficult to use quantitative metrics. The advantage of qualitative techniques is that they facilitate the communication and teamwork during the project evaluation. Nevertheless, they require greater training and expertise by project managers. Both quantitative and qualitative metrics are needed to analyze R&D project efficiency [16]. Section 3 describes a model of efficiency indicators based on a review of the literature. Both quantitative and qualitative indicators are classified in four groups: inputs, process, outputs and results indicators (Table 1). These groups include the whole resources and innovation process from the early generation idea stage to the final market evaluation of innovation diffusion [17].

3. Model of R&D efficiency indicators

3.1. *Input indicators*

3.1.1. *Cost and time development*

To the sponsor of industrial research, time and cost are two important elements. Time has value since it reflects the span over which uncertainty will prevail as to the commercial outcome. Other things being equal, a

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