Success factors for R & D projects

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Abstract. The paper presents the results of a study concerning the use of the fishbone (Ishikawa) diagram in analyzing the causes (factors) that determine the success of the research and development projects. The studied problem was "the successful development of R & D projects" and this constitutes the head of the fishbone (Ishikawa) diagram skeleton. This study aims to identify the possible, main and secondary causes that could generate the studied problem. For the proposed problem the type factors will be identified: man, methods, machines, management, materials, and others. It will draw a fishbone diagram because it has several advantages. The diagram allows for a clear definition of the problem studied and provides a visual graphical diagram of the factors that determine the problem - the success of a research and development project. It is proposed the steps of realization the diagram. They are determined many possible causes and these are grouped into seven categories of causes for the problem: Man, Methods, Materials, Machines and equipments, Management, Political factors, Social and Economic factors. This paper proposes a new diagram model (5M+P+SE), a fish skeleton that is composed of seven main branches, thus: five type M branches, one P-type branch and one SE-type branch. The development of the Ishikawa diagram in a detailed form for determining the possible causes of a problem has the advantage of giving the possibility of identifying and analyzing all the factors connected to the problem. Knowledge the success factors is important in order to create all the favorable conditions for a research and development project to be successful. Finally, the proposals for the successful development of a R & D project will materialize in practical solutions.

1 Introduction

Quality Management provides organizations with tools that help them find new solutions to ensure the continuation of the quality improvement process. Quality management tools are of two categories: some use definite data (numeric data), and others solve quality problems when there are no numeric data. In many cases solving some problems of quality management cannot be done in an analytical way and in these cases techniques for non-numeric data are used. For example, in the literature several tools are presented for analyzing and identifying the causes that generate a problem: fishbone diagram (or

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Ishikawa diagram), tree diagram, relationship diagram, matrix diagram, affinity diagram, etc.

In this paper it is used the fishbone diagram, which is based on non-numeric data, to show the causes that solve the problems proposed in the study, respectively the success in the research and development projects. Several papers have been published in the literature that deal with the use of the fishbone chart to find solutions to eliminate or reduce quality defects. A comprehensive study on the application of 5 management tools for quality improvement in universities was conducted by Al-Bashir Adnan and published in the paper [1]. The paper [2] addresses an important problem of quality management in the implementation of Quality Planning projects. Also, papers [3] and [4] present case studies on the application of quality management tools for assessing and improving the quality of cars.

The defects of the welds were also analyzed using a quality management tool and a study is given in the paper [5]. The paper [6] presents the results of a study concerning the use of the Ishikawa diagram in analyzing the public order services. Luca in the paper [7] presents the results of a study concerning the use of the Ishikawa diagram in analyzing the causes that determine errors in the evaluation of the parts precision in the machine construction field. An important application of quality management is given in the paper [8].

2 Factors influencing the successful development of R & D projects

In this paper it is proposed to apply the fishbone diagram to highlight the relationships between a proposed general objective and the actions taken to achieve it. For the diagram, the problem to be solved (also known as the general objective) is established: the successful development of the research and development projects. The steps of the diagram are proposed, according to the indications given in the paper [9]: define the effect; a list of all possible causes is drawn up, using the Brainstorming method; group the identified causes and define the main categories of possible causes; the diagram is started by writing the effect into a box on the right side; the main cause categories are positioned as power channels for the effect box; the diagram is developed by writing in the boxes all the secondary causes identified for each of the main causes.

In order to identify the causes (factors) and for achieving the proposed objective, a number of papers have been studied in which aspects of research-development projects are presented. The research of factors related to the performance of R & D projects has been addressed for many years, so the literature is relatively extensive on this subject. Specialty literature often refers to two components of project success: the project's success factors (project elements that increase the likelihood of success) and project success criteria (assessment modalities to judge success or failure).

Papers [10] and [11] deal with some aspects of the importance of creativity and innovation. Also, for the R & D activity, the importance of the technology transfer between firms and universities is also addressed, the problem addressed in the paper [12]. In the paper [13] it is shown that project leaders have an important role in providing an appropriate environment to stimulate creativity and inspiration. A factor influencing the achievement of the objectives of a project is also the social environment of the decision makers. This topic is approached by Domurath in the paper [14]. Mahmood, in his paper [15], presents 11 critical factors for the success or failure of research projects.

On the basis of the studies presented, but also as a result of a Brainstorming meeting, they were drawn up a list of the factors that determine the achievement of the proposed objective. This list contains a number of 43 factors defined as follows:

Man (Human being)
  The moral behavior of every member of the team
  The experience of the project leader
  The experience of the research team
  Positive behavior of the project team
  Communication skills of project team members,
  Professional training
  The commitment of the participants to the project
Methods
  Collaborations with universities or research institutes in the project field
  Collaborations with industrial companies,
  Using a diagnostic method for the failure rate
  Identifying the risk factors,
  Preventive control of risk factors
  Elaboration of working procedures for project activities
  Respecting the research methodology
  Periodic evaluation of the project stage
Materials
  Sufficient consumables for equipment and machines
  Materials for experiments
  The team has specialized books in the project theme
  The team has up-to-date standards in the project theme
Machines and equipments
  Adequate equipment for research studies,
  Working machines according to current technologies
  High precision measuring and control devices
  Computers with adequate software
  Computers with Internet access to international databases
Management
  Adequate behavior of the project leader
  Organization of the project on objectives and activities, with responsibilities, deadlines and financial resources,
  Optimal planning of all project activities
  Clarity of the role and responsibilities of project partners
  Real engagement of the top management
  Using an efficient communication system
  The theme of research and development is in a field of great interest
  Ensuring sufficient financial resources and accessing funds for research projects
Political factors
  Promoting a legislative framework favorable to research activities
  The existence of special policies to fund projects in key areas of research,
  Public investment and development policies in the field of research,
  Promoting the areas of projects funded by the European Union
  Policies to stimulate young researchers,
  Political stability and economic development
Social and Economic factors
  Stability of the social environment, stability of young specialists
  Raising the level of education
  Very good economic development in the project theme
  Removing barriers in research-economy technology transfer,
  Stable macroeconomic conditions.

3 A new model of the fishbone diagram for success factors of R & D projects

This article attempts to synthesize a new classification of factors that determine the success of R & D projects, based on the theory of the fishbone diagram. In order to achieve the fishbone diagram, the causes (factors) were identified and grouped in 7 main categories: Man, Methods, Materials, Machines and equipment, Management, Political factors, Social and Economic factors.

Figure 1 shows the fishbone diagram with a new formula: 5M + P + SE. The head of the fish is the studied problem: the successful realization of the research and development projects. Fish skeleton has 7 main ramifications according to the 7 main categories of causes (factors). For each of the main causes, specific secondary causes (factors) are highlighted.

The research team has a great role in successfully realizing the project, the team has to be productive and efficient and that is why we considered that the team members participating in the project can be a major cause of the problem being studied. In defining the secondary causes it was taken into consideration that each member of the team has a certain functional role in the project and to have positive results must have some qualities. As a secondary cause, the experience of the project leader has been added separately, because it must have additional qualities for colleagues in the project team.

In the diagram, the second main cause was defined by the methods that can be used to successfully implement research and development projects. When determining the secondary causes, several aspects influencing the implementation of the project were considered, such as: the implementation and use of working procedures, the identification of risk factors, the use of a diagnostic method for the failure rate, the observance of the research methodologies, etc.

The diagram highlights the main cause and the materials that are necessary for carrying out the activities of a project. Thus, several components were identified: experimental materials, consumables for machines and equipment used in the project, study materials (books, journals, standards), etc.

Also the success of a project is determined by the machines and equipment used in the research and development activities. These must be consistent with modern and appropriate technologies to the project requirements. Control of executed operations must be done with appropriate precision measuring and control devices. The team must have adequate software to do high level research.

Another main cause proposed and represented in the diagram refers to Management. When defining the secondary causes, we considered issues related to project management by the project leader, but also top management in the organization where the project is running.

The diagram has a major cause - Political factors, as public policies need to help successfully implement R & D projects by allocating financial resources and stimulating human resources to this area of activity.

R & D projects are also determined by the socio-economic environment in which they take place. A stable socio-economic environment contributes positively to the success rate of the project. In this sense, another main cause - Social and Economic factors - has been defined. Stability of the social environment, macroeconomic stability, increasing the level of education were taken into account.

The diagram allows for a clear definition of the problem studied and provides a visual graphical chart of the causes that influence the problem. The diagram highlights the factors that determine the success of a research and development project.
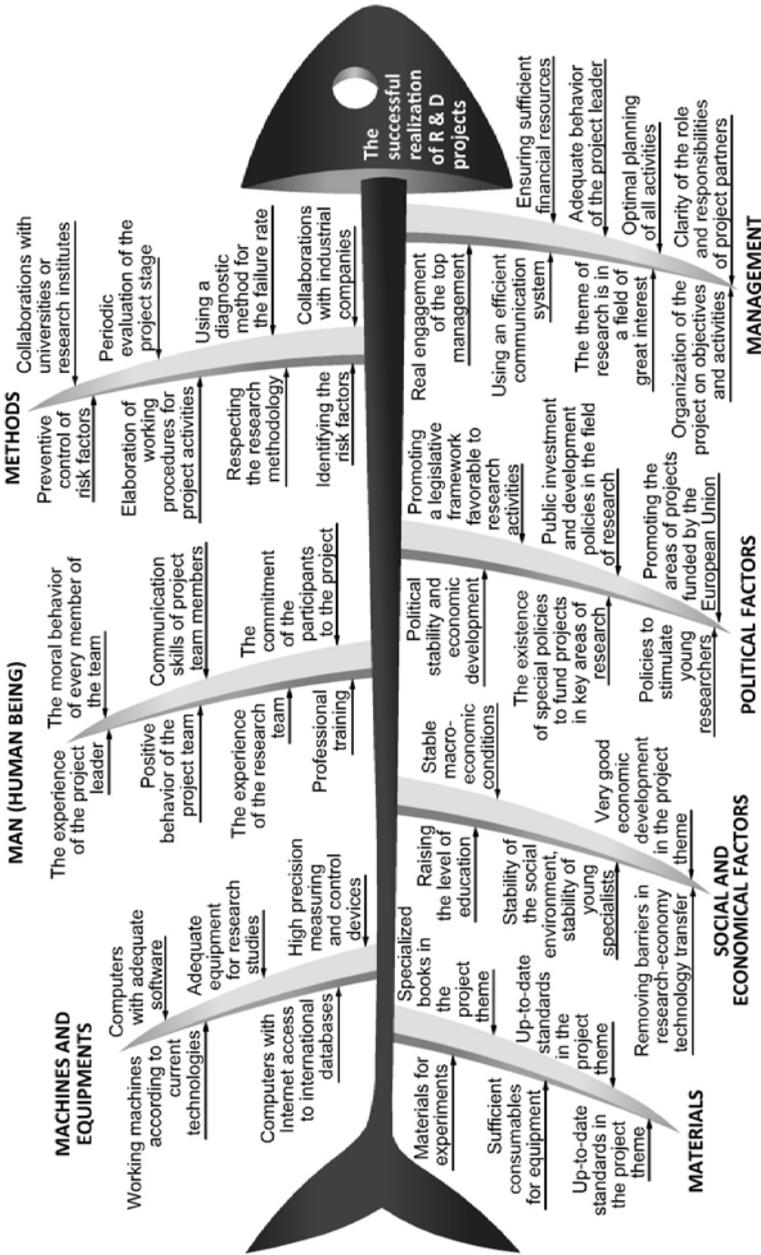
Fig. 1. Fishbone diagram.

4 Conclusions

In all cases where the solving of quality problems cannot be done in an analytical way, use of techniques and tools for non-numeric data is used. Applying the fishbone diagram shows a number of advantages, such as: reducing the causes that generate nonconformities; reducing customer complaints; improving the image of the organization; increasing sales and increasing profit for the organization.

Drawing up the fishbone diagram is appropriate to make a brainstorming session organized within an organization that has to solve a process quality problem. The diagram, through its design, stimulates creativity and challenges the imagination of the participants in search of suitable ideas for solving the problem. Finally, the proposals for the successful development of a development research project will materialize in practical solutions. Knowledge of success factors is important to create all the favorable conditions for the project to complete successfully.

Industrial organizations should be interested in applying best practices in carrying out specific activities. Applying quality management tools guides organizations to improving quality. Quality assessment and finding solutions to eliminate non-compliances, based on world-wide methods that have shown positive effects, should be a primary focus in quality assurance and assessment policy.

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