Study to increase the quality of the scientific research process

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Abstract. At present, increasing attention is paid to the quality of products and processes in different fields of activity. Currently, universities and other institutions with research activities are increasingly concerned with the implementation of quality management through different one’s methods and tools. Quality Management provides a range of tools that can be used to find solutions when it comes to improving quality. In this paper the authors present a study on the tree diagram determination, for quality improvement the scientific research process. The important measures to be taken have been identified for the successful completion of a scientific research process. To increase the quality of the scientific research process, has grouped the identified measures and thus leads to an orientation to three specific objectives: the organization's management adequately assures the necessary resources; the head of the research collective adequately organizes the research activity; the research collective chooses and applies an adequate research methodology on the theme. A measure from the third specific objective is considered to be a secondary objective, and for it specific actions are provided which constitute level 4 of the tree diagram. A diagram has been developed that includes: the general objective, the specific objectives, the measures identified for the achievement of the objects. The paper presents a tree diagram that can be used in the quality management within the frame of the organizations which desire to improve the quality of the scientific research activities. The use of this diagram offers the advantage to examine in a chronological and logical sense the causes which determine the quality of a scientific research process.

1. Introduction

Quality Management provides organizations with a second generation of tools called the "New Seven" to help find new solutions/actions/measures for the quality improvement process. In many situations, numerical data is rarer, and then quality issues cannot be solved by analytics. Thus, non-numerical methods (the 7 new tools of quality management) are used, in which case the problem, the causes determining a non-quality problem, solutions for solving the analyzed problem, etc. are identified. Non-numeric data can be transformed into different types of graphs that provide the possibility of a comparative analysis, highlighting trends or establishing relationships between different elements of the problem studied. The tree diagram is used to establish solutions to solve quality or non-quality problems, the ideas of all specialists in the field are being exploited and the solutions that solve the problem of quality improvement are identified. In papers [1], [2], [3], [4] and [5] there are presented non-quality issues and case studies where quality management tools (eg fish bone diagram) are applied. An interesting work is [6], in which it is used the affinity and tree diagrams, for study the control requirement volatility in software projects. The paper [3] presents a study on the application of the quality management tool - the tree diagram, to increase safety in the medical services sector. Islam
presents [8] a methodology based on the tree diagram that determines the dimensional requirements of a product according to the needs of the clients. Papers [9] and [10] also address the issue of applying quality management tools to increase the reliability of some types of mechanical transmissions.

In this paper the authors present a study on the determination of the tree diagram to show how to solve a problem - improving the quality of the research process. Any scientific research activity aims for a certain purpose, represented by knowing something or some phenomenon from reality. Scientific research does not have to happen at random, it must be thought and planned. Scientific research is a rigorously organized and planned activity. Also, scientific research should not be considered as rigid, it has some flexibility in the sense that it can be modified or adapted during the course. Before we move on to the actual scientific research, we develop a research plan that is the key to success in a research process. In order to increase the quality of the scientific research process it is necessary to establish objectives and measures for their realization. In the literature there are many papers dealing with the topic of scientific research (organization, methodology, capitalization, etc.). An interesting work is [11], in this is presented the social science research: principles, methods, and practices. The paper [12] addresses the topic of scientific research processes, which problems occur frequently in this process, the studies being carried out in a higher education institution.

Key steps in the research process are a basic element in successful research and this theme is addressed in many papers, e.g. [13]. Papers [14], [15] and [16] deal with some aspects of the importance of creativity and innovation for scientific research. Also, for the scientific research activity, the importance of the technology transfer between firms and universities is also addressed, the problem addressed in the paper [17], [18].

The authors of this paper considers that the Tree Diagram can be one of the ways to truly improve the research process and help managers implement Quality Management System to increase the performance of the organization. The tree diagram can also be used to prevent nonconformities that may occur in the research process. Laying the ground on this consideration the authors have proposed as a study objective the determination of the tree diagram in order to be used as an instrument of quality management in the organizations that have scientific research activities.

2. The tree diagram to increase the quality of the scientific research process.

For drawing the tree diagram, use the classical method that provides the following steps [19]:

1. Define the topic(s) for which solutions are being solved;
2. Organizing a Brainstorming session with specialists in the field of the problem studied;
3. The solutions proposed by the specialists are registered as to: How can scientific research process improve?
4. The proposed solutions are grouped into several objectives;
5. Develop the diagram with new possible solutions for achieving the objectives.

For the purpose of drawing up the tree diagram, we proposed as a general objective: Increasing the quality of the scientific research process. Based on the study of this topic in various specialized papers, as well as the creation of Brainstorming session with specialists, we identified the main factors influencing the research process. Based on the identified factor, more measures that were analyzed and properly grouped were proposed. The group had in mind three main factors that were considered key quality factors of a research process: the management of the organization, the organizing of activities by the head of the research collective and the applied research methodology by the team.

The measures or actions identified to achieve the overall objective were grouped into three specific objectives:

1. The organization's management adequately assures the necessary resources,
2. The head of the research collective adequately organizes the research activity,
3. The research collective chooses and applies an adequate research methodology on the theme.

For these specific objectives, the following measures/actions were identified:

Specific Objective 1. The organization's management adequately assures the necessary resources.
This objective is achieved through actions such as:
- Support the formation of the best research team and collaboration with scientific consultants in fields related to the research theme;
- Ensure with the necessary equipment the methods and the working techniques appropriate to the research object;
- Provide on time all the necessary materials for research;
- Ensure the equipment and software necessary for data processing;
- Provide the necessary book and standards for research;
- Assign the necessary financial resources to capitalize on research results.

**Specific Objective 2.** The head of the research collective adequately organizes the research activity.

For this it acts as follows:
- Chooses a research theme to bring something new in the field, in relation to the current state of scientific research on the subject;
- Knows very well the fundamental, classical well-established data in the scientific field of the research theme;
- Plans an adequate duration of scientific research, depending on the degree of difficulty of the objective pursued by the theme;
- Defines very well the theoretical and practical importance of the research subject as well as the expected results and their value for the theoretical and/or practical scientific knowledge development.
- Establishes precisely the category of research (fundamental scientific research or applied scientific research);
- Establishes precisely the main objective of the research as well as the secondary objectives;
- Appropriately chooses the place of the research activity, in close correlation with the specific research activities;
- Contributes to the correct constitution of the research team, consisting of specialists with competences in the field of the researched theme and the corresponding distribution of responsibilities;
- Contributes to the right choice of collaborators or scientific consultants in fields related to the research topic.

**Specific Objective 3.** The research collective chooses and applies an adequate research methodology on the theme.

The following measures are proposed for this objective:
- Correctly formulates the working hypotheses from which they leave;
- Chooses work methods and materials appropriately (this becomes a secondary objective with specific measures):
  - Chooses the appropriate working methods and techniques;
  - Chooses the appropriate machines and tools;
  - Chooses the materials used in research accordingly;
  - Establishes correctly the research groups (objects or persons subject to scientific research);
- Processes the data in the best conditions (statistical or mathematical processing, modeling, etc.);
- Strictly checks the results of the research, in terms of their validity;
- Interprets the results of the research so as to highlight their value, their validity and their importance in theoretical and practical terms;
- Formulates conclusions (a synthesis of the research) that will constitute future scientific theories or will use to carry out projects of a practical nature in the field of researches carried out;
- Supports the capitalization of research results by publishing specialized books, articles in specialized journals, thematic debates with colloquial character, extensive and original studies in the form of PhD thesis, inventive patents, etc.;
- Presents possible research topics in the future as an extension of the research topic.

A tree diagram for the proposed problem has been developed- Increasing the quality of the scientific research process. The proposed problem, which is also the general objective, is the first level of the
For the second level of the diagram we proposed the three specific objectives identified. The appropriate measures proposed for each of the three objectives are Level 3 of the Diagram. A measure at level 3 (objective 3) becomes a secondary objective and it provides for specific actions constituting a level 4 of the tree diagram. The measures proposed in the diagram answer to the question “HOW?” can the quality of the research process increase.

The diagram was drawn in color for better highlighting and is shown in figure 1.

![Diagram](image)

**Figure 1.** The tree diagram

In the tree diagram of Figure 1, a series of measures are presented to increase the quality of the scientific research process. The measures have been grouped on three specific objectives based on the analysis of the causes that determines the quality of the scientific research process.

The proposed measures for the three specific objectives have taken into account all the potential factors influencing a research process.

**Conclusions**

The tree diagram can be one of the ways to really improve the products or the processes and helps managers implement the Quality Management System and increase the performance of the organization. The literature shows that quality management tools can be used in various activities, in organizations with very different profiles.

The authors of these paper proposed as the study objective the creation of a tree diagram in order to be used as a quality management instrument in the organizations that have scientific research activities. In this paper, the starting point was a given theme and there were investigated possible solutions. The proposed theme was the increase of the scientific research quality process.
The result of the study lead to the creation of a tree diagram which shows that this tool is intended to be used to solve the increase the quality of the scientific research process. The specific objectives and actions identified for each objective are suitable for a graphical representation of the tree diagram type.

The grouping of measures on the three main objectives offers the possibility of a better orientation of the management in the ensuring and improvement of the scientific research quality process. The use of this diagram offers the advantage to examine in a chronological and logical way the causes that determine the quality of a scientific research process.

The diagram helps in picking better and optimal solutions in order to realize a high quality scientific research process.

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