Models of Evaluation for Research Proposals in Turkey

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Abstract. Systematic approach followed by The Scientific and Technical Research Council of Turkey (TUBITAK) for the evaluation/selection of the research project proposals grouped under three categories as (1) curiosity driven academic research, and (2) customer driven applied research, both in universities and research institutions, and (3) technological and innovation driven research conducted by the private industry are summarized in this paper. The details of the "Phrase-anchored rating scale" that has been established are explained.

Key words: Proposal evaluation criteria, R&D project selection, reviewing, scoring.

Introduction

Globally, several hundred billion dollars are spent per annum for research and development (R&D). This roughly means several million projects and therefore several times as many proposals. Consequently, R&D management process involves, globally, millions of reviewers, panels, evaluations, grants and awards on local, national and international scales. The scientists who propose projects (and those who evaluate them) are highly qualified scholars. However, funds are limited, and in many cases grants are awarded by institutions using public funds. Hence, R&D project selection, as a decision making process involving many sides, has attracted the attention of all sides for many years. A comprehensive overview of recent R&D project selection literature (70 references from last 40 years) shows the wealth of theoretical and academic elaborations concerning the issue [1]. On the other hand, reviews of international experiences [2-4] and institutional and group practices [5] reveal common, as well as unique approaches.

Beginning with 1970's, the need to develop a common basis for internationally shared concepts, definitions, statistics and interpretations gave birth to manuals such as Frascati, Oslo and Canberra [6-8]. Basic concepts such as "basic research", "development" and "innovation" have been given global meanings and definitions. However, the interpretation of these concepts on the basis of each and every individual proposal and project is the privilege/duty/responsibility of the scientists who propose and those who review the work, as well as the funding bodies.

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The Scientific and Technical Research Council of Turkey (TUBITAK) is the main autonomous public institution engaged in funding and conducting scientific and technological research in Turkey. Since 1963, research proposals covering topics in natural sciences, engineering, medicine and social sciences have been selected and funded from public financial resources. Recently, a ten-fold increase has been realized in research grant funds allocated by the parliament in the fiscal budget. This resulted in increased number of calls and categories and naturally, was responded immediately by a similar increase in the interests of researchers.

Several thousand research proposals are now evaluated annually by The Scientific and Technical research Council of Turkey (TUBITAK). Three major categories of research proposals solicited are: (1) curiosity driven academic research and (2) customer driven applied research, both in universities and research institutions, and (3) technological and innovation driven research conducted by the private industry.

TUBITAK, has recently developed a "three-dimensional" evaluation criteria in collaboration with researchers and reviewers from universities, public organizations and private industry, in workshops using group techniques. The "three-dimensions" for curiosity driven academic research are: (1) intellectual / scientific / professional merit of the research, (2) expected impact of the anticipated outcome, and (3) achievability of the research with the proposed research team, equipment / facilities and methods. One dimension for customer driven applied research is "research and development merit", the second and third dimensions are the same as the latter two for academic research. The "three-dimensions" developed for industrial research are: (1) technological level of the research, (2) innovative level of the product / outcome, and (3) feasibility of the process. All three-criteria are given equal weights. "Phrase-anchored rating scale" has been favored against "Likert scale". Phrases defining "very competitive", "competitive" and "not competitive" sub-criteria developed for all criteria listed above and major features of the evaluation process are explained in the present paper.

Evaluation Criteria

Phrase anchored rating scale has been favored against Likert scale where the responses are mapped to the values of one to five. In the phrase anchored rating scale, the responses range as "very competitive", "competitive", and "not competitive". The general phrase "very competitive" addresses scientifically and professionally outstanding and very well justified projects and points to an opportunity for a major contribution to the advancement of the knowledge to the resolution of a problem of practical importance; "competitive" may be defined as scientifically and professionally competent and justified proposal which will make a contribution to the advancement of knowledge and the resolution of a problem of practical value and therefore support is suggested if funds are available; "not competitive" may be defined as work routine in character, scientifically and professionally unsatisfactory and poorly organized .

Table 1. Curiosity Driven Academic Research Projects

1. Intellectual / Scientific / Professional Merit of the Research		
Very Competitive	**Competitive**	**Not Competitive**
- Aims to develop a novel technology, original scientific methodology or a new conceptual / theoretical framework. - Outcomes have high potentials for publication in journals or books listed in international indexes. - Outcomes likely to be patented - The originality of the work has been supported by extensive and critical literature survey. - Hypothesis for evaluating the research topic is very well defined - Explanation and analysis of the expected outcomes reveal the superiority of the work in comparison to the existing science and technology.	- Aims to obtain an improvement or progress in the existing product, technology or theory. - Outcomes of the project have potentials for publication in peer reviewed international journals or for presentation in conferences. - Aims to find a solution for a local, national or international problem by information and technology transfer.	- The work cannot provide a significant improvement in terms of methodology, theory or knowledge. - Potential for publication in peer reviewed journals or for presentation in conferences is low. - Scientific consistency and the rationale of the research are not clearly explained. - A clear scientific / technological question is not put forward. - Project is not well organized. - Project is more like an investigation / data collection / routine work. - References provided include similar studies and literature survey does not point out the basis / importance of the project. - The research is based on unreliable data and hypothesis.
2. Expected Impact of the Anticipated Outcome		
Very Competitive	**Competitive**	**Not Competitive**
- The project will help the country to take a pioneering role in the international arena. - Very important in terms of sustainable development of the country. - The topic is among the priorities of the country. - Likely to be implemented to find solutions for the problems of society. - Likely to be employed in different scientific and technological fields. - Form the basis for generating new projects. - Very likely to motivate young researchers. - Commercialization potential of the outcomes is very high. - The project is supported by international, national or industrial sources.	- May be used in a single scientific or technological field. - Potential for creating a new project is limited. - Support from a national source or an industrial organization is limited. - Has potentials to add partial value to local economy. - Have impacts on the scientific / technological strength of the country.	- Potential for adding value to science and technology is low. - Subject of the project is not among the priorities of the country. - Not likely to result in intellectual property worth-protecting.
3. Achievability of the Research with the Proposed Research Team, Equipment / Facilities and Methods		
Very Competitive	**Competitive**	**Not Competitive**
<u>Project Team:</u> - The team is experienced in national / international projects related with the same subject. - They have publications in the journals listed in international indexes.	<u>Project Team:</u> - The team is experienced in national / international projects in different fields other than the topic of current project. - The project leader has publications / patents in different subjects.	<u>Project Team:</u> - The team is not experienced in conducting projects of this size. - The knowledge and awareness of the team is not sufficient. - They do not have important publications in the subject of the project.

- They have experience as advisors / referees / editors / book authors. - They have experience in supervising masters and doctorate studies. - The project leader can allocate enough time for the project. - Competencies / responsibilities / roles of the team members are well defined and adequate. - End users of the project outcomes are also members of the team.	- Knowledge and the education of the young researchers in the teams are sufficient.	- Some of the team members are irrelevant for the project. - Essential competencies are lacking.
<u>Infrastructure:</u> - Infrastructure of the institution is very adequate for the project. - Additional equipment requested within the scope of the project is very compatible with the existing infrastructure and the project. - Existing sources / equipment are used rather than purchasing new sources. - Requested equipment can also be used in other / future projects.	<u>Infrastructure:</u> - Infrastructure of the institution is partially adequate for the project, but supply of major equipment is necessary. - Equipment requested within the scope of the project is in accordance with the existing infrastructure and the project.	<u>Infrastructure:</u> - Infrastructure of the institution is not adequate for the project, unless supported with major equipment. - Equipment requested within the scope of the project is not compatible with the existing infrastructure and the project.
<u>Methodology:</u> - Approach / methodology are very well designed to reach the target. - Methodology is correct and well-defined; and standard methods and literature are cited. - Preliminary experiments have been conducted to rationalize the hypothesis. - Alternatives (plan B) have been considered if difficulties are encountered.	<u>Methodology:</u> - Approach / methodology are adequate to reach the target. - Methodology is well defined. - Different methods may be used in unexpected situations.	<u>Methodology:</u> - Methodology is not adequate to reach the target. - Relations between the experiments and hypothesis are not well defined. - Methodology is not explained with a common scientific basis. - Possible problems and limitations are not considered. - Statistical analytical requirements are not considered.
<u>Timeline:</u> - Proposed period and time schedule are realistic.	<u>Timeline:</u> - Proposed period and time schedule may be changed to make it realistic.	<u>Timeline:</u> - Proposed period and time schedule are not synchronized. - Time schedule is not adequate.
<u>Budget:</u> - Proposed budget is realistic and well-justified. - Project is also supported by other institutions.	<u>Budget:</u> - Proposed budget may be decreased / increased. - There is a possibility that the project may also be supported by other institutions.	<u>Budget:</u> - Budget is not well-define and requested amount is too low / high. - There is no possibility of support from other institutions.

The second major category is the customer driven applied research both in universities and research institutions. One of the dimensions is the research and development merit of the project. The sub-criteria are explained as follows:

Table 2. Customer Driven Applied Research

1. Research and Development Merit		
Very Competitive	**Competitive**	**Not Competitive**
-Aims to develop a national / international novel technology (methodology, system, product, process / technique). - Brings comparable superiority to the existing system. - Outcome will be a technology to be protected under the intellectual property rights. - Work consists of a scientific and rationale approach. - An interdisciplinary project with the collaboration of the Public-Private Industry-University-Research Institutions. - Outputs are applicable and producible. - Resolves a significant (social) problem of the country. - Can derive and trigger other novel projects (Avalanche effect).	- Analyzes the origin and reasons of country's important problems. - Aims to develop a technology known in the world, but not used in the country. - Aims to improve the applied methodology, products, and existing technology. - Aims to provide an increased quality, security and speed in the function of the company. - Aims and objectives have been stated clearly. - Literature survey and market survey have been carried out.	- Literature survey and market survey are not satisfactory. - No scientific / technological rationale and integrity in the project. - It is a study that had been done before in the country. - Aim, objective and motivation are not clear. - Outcome is not qualified as "applicable / usable". - Not related with a real need / problem. - Work is based on unreliable data.
2. Expected Impact of the Anticipated Outcome		
Very Competitive	**Competitive**	**Not Competitive**
- Outcome is qualified to help the country to play a pioneering role in the world. - Target audience is known and almost all of them will benefit from the outcome. - Project very likely to have substantial impact on the formation and development of R&D knowledge. - Project is directed toward the use of the national resources - Has high potential of establishing new innovative companies. - Has high potential of increasing the national competition force. - Will contribute to the economy - Will contribute to increase the number of R&D staff. - Likely to reduce import and has an export potential; and may contribute to trademarking process. - Aims to make the technology and the life standards of the society compatible with the international norms. - It is supported by the international / national sources.	- Outcomes will provide an impact on the whole institution and shareholders. - Has a significant motivation effect on the R&D infrastructure - Contributes to the increase in the productivity. - Provides a solution to a regional / national problem. - Outcome has positive impact on the end-users. - Adds a special value to the country in the field that is not present in similar countries. - Affects the future generations. - Outcomes result in new innovation studies.	- The procedure will not provide a change in the methodology and technology. - Period of usefulness is very limited or not effective. - Does not provide national benefit / additional value. - Does not provide new areas of work and does not increase employment. - Subject is not a priority of the country. - Does not form a basis for generating new projects.

3. Achievability of the Research with the Proposed Research Team, Equipment /Facilities and Methods		
Very Competitive	**Competitive**	**Not Competitive**
Project Team: -The team and the institution have substantial experience in R&D and project implementation. - Team is very adequate in terms of quality (background, expertise, and competency), quantity, and commitment. - Team has national / international collaboration experience. - Products developed before have been commercialized.	Project Team: - The secret projects have secrecy certificate. - Quantity and quality of the staff are sufficient or can be outsourced. - Knowledge / experience are adequate but can be improved.	Project Team: - Team is not adequate in terms of the quality and quantity. - No experts in the fields required in the project. - Staff do not have enough knowledge. - "Project management" is ignored by the institution. - The contributions of the researchers are not clear.
Infrastructure*: - Have R&D culture and well-developed procedures for executing projects.	Infrastructure*: - Enough knowledge and experience for using the equipment.	Infrastructure*: - Environment is not suitable for application of the project. - Critical materials / components can not be provided. - Equipment expenses have a high ratio in the overall budget.
Methodology*: - For the projects with budgets > $1,000,000, the institution had successfully carried out and R&D project with $100,000 budget. - For the projects with budgets > $100,000 the project director is a professional manager / holds a project management certificate. - An extensive risk analysis has been done. - Aftermath of the project has been planned realistically. - Intellectual property rights have been defined.	Methodology*: - For projects with budgets > $100,000, management system is sufficient. - Regulations of the institution is appropriate for the project. - Holds a clearance from the ethics committee (if required).	Methodology*: - Regulations are not appropriate. - No one experienced in project management.
Timeline*:	Timeline*: - Project has been divided into work packages and timeline for each of these is realistic. - Time to obtain the anticipated outcome has been determined according to the need.	Timeline*: - The time researchers spend in the project is not enough. - There are some unnecessary and / or missing work packages.
Budget*: - Institution has allocated R&D budget and the project has received significant national resource contribution.	Budget*:	Budget*:

* The items mentioned in Table 1 for the same sub-criteria are also valid for this section, only additional items are listed.

The third major category, which is technological and innovation driven research conducted by private industry are explained with the following sub-criteria in Table 3.

Table 3. Technological and Innovation Driven Research Conducted by the Private Industry

1. Technological Level of the Research	
Very Competitive / Competitive	**Not Competitive**
- Technology / product developed aims to fulfill a gap in the existing technology or replace the existing technology within the following 3 years. - Aims to provide know-how to the country. - Has an interdisciplinary approach to solve more than one problem. - Potential to get a patent / trademark is very high. - Rationale of the R&D is well established (theoretical / analytical / experimental). - Added value of the anticipated outcome of the R&D project is considered. - Target audience is considered. - Have contribution to increase R&D staff. - Directed towards the use of the national resources - Subject is among the priorities of the country. - A doctorate / masters study is incorporated within the project and the outcomes have potentials to be published in national/international journals.	- Literature survey and market survey are not enough. - No scientific/technological advance and integrity in the project. R&D rationale (analytical and /or experimental) is not adequate. - Aim, objective and motivation are not clear. - Not related with real need/problem. - Work is based on unreliable data. - Procedure that has been used will not provide a change / improvement in the methodology and technology. - Subject of the project is not a priority of the country.
2. Innovative Level of the Product/Outcome	
Very Competitive	**Not Competitive**
- Outputs are applicable and producible. - Aims to increase product variety of the company. - Outcomes may lead to spin-off company (within a technopark). - Outcomes include production standards and technical specifications. - Outcomes will affect other sectors as well. - Very likely to be a basis for generating new projects / products. - Outcomes likely to increase the export capacity of the country. - Economical value of the outcome is calculated with respect to R&D expenses.	- It is a study that had been done before in the country - Outcome is not qualified as “applicable/usable”. - Does not provide national benefit/additional value. - Period of usefulness is very limited or not effective. - Does not provide new areas of work and as a result it does not increase employment. - Expenditure for the R&D study is far beyond the expected economical benefit of the product. - Support provided by the private organization is not sufficient.
3. Feasibility of the Process	
Very Competitive	**Not Competitive**
Project Team: - Knowledge of the team members is sufficient. -Top management of the private organization fully supports the project team and the company has an R&D culture. - Team has carried out R&D projects before and has product development experience. - Team is sufficient in terms of quality (background, expertise and competency), quantity, commitment. - Team includes members with PhD/Masters degree. - Team members have patents for the products previously developed. - There will be cooperation/collaboration of the private sector with other public institutions and universities. - Support provided by the private organization is significant.	Project Team: - Team is not sufficient in terms of quantity and quality. - Team had never carried out a comprehensive R&D project previously.

Infrastructure**: Methodology**: - Outsourcing contracts are very adequate for the work package / services / products to be provided by sub-contractors. - An extensive risk analysis has been done. Timeline**: Budget**:	Infrastructure**: Methodology**: Timeline**: Budget**:

** The items mentioned in Table 1 and 2 for the same sub-criteria are also valid for this section, only additional items are listed.

Review Process

Typically, "five to eight reviewers" individually evaluate "ten to fifteen proposals" in similar fields, by referring to the sub-criteria phrases listed in Tables 1 to 3. It should be noted that phrases from both "very competitive" and "competitive" and even "not-competitive" groups of sub-criteria may very well define the various aspects of each dimension of the same proposal. Reviewers are welcome to use additional phrases or propose them for inclusion in the tables. A reviewer is free to select any mixture of phrases, however, he/she should reach a single verdict, either "very competitive" or "competitive" or "not-competitive" for each dimension of the proposal. The scores are three, two and zero for "very competitive", "competitive" and "not competitive" dimensions, respectively. Then, the "five to eight reviewers" come together in a panel meeting to reach a final verdict for all the "ten to fifteen proposals". Hence, all proposals are given a final total score between zero and nine points. Finally, TUBITAK management may increase the total score by a maximum of one point for the proposals coming from underrepresented institutions or projects in very high priority fields.

Conclusions

The model has been very well accepted by the reviewers as it reduced the burden of the review process on them, as well as reducing subjectivity and variability of the opinions of the individuals. They enjoy the convenience of selecting from a comprehensive list of phrases as well as the freedom of offering their own judgments. Researchers are also satisfied with the process because they find the sub-criteria phrases to be very instrumental in guiding the development of their proposals.

Acknowledgement

Hundreds of scientists, researchers and reviewers participated in workshops for the development of the criteria and phrases listed in the tables. Their contributions are gratefully acknowledged.

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