

## A Participatory Approach to Design a Process Model of R&D Projects Management

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### Abstract

One of the most important strategies in order to move toward a knowledge-based economy, decreasing different kinds of managerial and non-managerial challenges that organizations are faced, and also maintaining the current competitive advantages and creating new competitive advantages, is establishment and development of effective R&D departments. Although equipment, financial, and human resources are known among the most important factors in order to evaluate the rate of R&D departments' ability, all of these factors along with procedural and managerial weakness cannot provide value for corporation. In order to investigate more about this aspect of R&D projects, case study was adopted as our research method. In this regard, through comparison of theoretical achievements and current R&D process, its challenges by participating and a structural approach were identified and by using experts' comments were prioritized. In subsequent, strategies for dealing with identified challenges through some meetings have been designed and by presenting to experts have been authenticated. At last, based on achieved strategies, R&D project management process of E organization through collaboration with experts has been designed and by joint meeting with organizational stakeholders has been improved and tailored.

**Keywords:** Project Management, R&D Process, Procedural challenges.

### Introduction

Today, empowering the research and development units is a necessity due to the rapid, multilateral, and comprehensive changes in the external and internal environments of economic firms[1]. For this reason, many organizations focus on research and development projects at the global level[2, 3] and consider innovation as a value. Economists considered capital, work, and ground as fundamental factors of production. Meanwhile, the theorists of modern economy talk about the information revolution as well as knowledge owners. In this regard, Ermine (2010) believed that knowledge is the most significant output of research and development centers and this knowledge should be managed. Achieving this goal in the area of research and development is only possible through creating the efficient process of research and development[4]. Optimizing the time pressure in research and development projects through knowledge management mechanisms of process can convert time pressure into an appropriate opportunity to develop creativity in these projects[5]. Sharing knowledge between the management teams of research and development projects is significantly affected by structural factors, team dimensions, allocation of responsibility, combination of team members, integrity, and organizational culture of the team[6].

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The evolutions of the world in the last few decades led to the emergence of a trend changing the policies of countries and leading countries as well as increasing investments on research and development[7]. For example, the government of Canada declared its strategies and priorities in this field by releasing the program of “science and industry for the new century” in 1996[8]. Such investments in different fields have a different return on capital and no certain number can be determined for them. However, it can be said that every dollar spent in this regard will enhance profitability[9]. In a general evaluation, the research and development organizations and centers, with a history of new generation dating back to 1920, produced science and technology in an amazing and unexpected way and evolved the human life style. It should be noted that research and development projects are considered as the activities with multiple responsibilities in every organization requiring the cooperation of different parts of that organization with each other[10]. For this reason, it is suggested to consider these activities as an integrated system[11]. Research and development processes are the progresses for creating or improving the technologies, processes, and structures which cause competition benefits in spite of its complicated and risky nature[12]. Thus, clever design of process is critical for research and development enabling the managers to guide the research and development activities in an organized way[13]. Different models have been developed so far at different levels for this purpose[8]. Thus, some strategies can be found in the research literature which were considered for research and development at the national level[14] as well as the strategies which were developed at the level of a specific industry[15]. However, research and development processes in micro and macro levels faced some challenges. In line with the principle of continuous improvement, the present study focused on the managerial challenges of research and development process in Iranian organizations and specifically in E organization. This study attempted to use a structured approach and national-organizational variables to propose a process for dealing with some of these important challenges in an efficient way.

In order to achieve this goal, the present study is organized as follows: first, the research literature is presented by focusing on the most significant studies in line with the challenges of research and development projects. Then, the theoretical foundations, research method, and procedure of research are explained in methodology section. After that, the table resulted from the previous steps, is presented in the finding section. This table indicates the ranked challenges and the solutions to cope with them. In addition, this table includes the summary of the actions which were considered in the proposed process model to cope with the challenges with the aim of determining their relations to each challenge and solution. Then, the proposed process is introduced in brief and finally the conclusion and research limitations are mentioned.

### **Deliberation on R&D challenges**

Most important identified challenges of R&D project in literature can be summarized as follows:

- Not considering creativity and innovation as a significant part of the driving force of research and development project management[8, 16]
- Presenting the general models without considering the unique nature[13] and features of research and development projects and changing the complexity level of these projects over the project life cycle[17]
- Focusing on the development of new products and disregarding the other issues such as human resources management[13]
- Having no communications and appropriate recognition of organization on experts and researchers in the field of research and development[18, 19]
- Having ambiguity in the real value of the projects which are implemented[20]

- Understanding the required efforts for the management of technology complexities and multi-disciplinary subjects in research and development projects[21]
- Not selecting an appropriate investment project form research and development projects[22, 23]
- Having no appropriate resource allocation such as human resources, equipment, research spaces, and budget to the projects under implementation[3]
- Paying insufficient attention to fundamental studies due to high risks and low profit margin by companies[24]
- Losing the knowledge obtained from research and development projects (especially implicit knowledge) due to the short term nature of these projects and inappropriate conventional mechanisms[12, 25, 26]
- Paying no appropriate attention to quality management in the process of research and development projects[27]
- Having the stress between temporary organization and permanent organization due to the lack of power balance[21]
- Emphasizing the quantitative methods and ignoring the qualitative aspects and complicated human aspects of the selection process of research and development projects[22, 28]
- One of the serious challenges in research and development projects is the stress between research and development projects manager and the active scientists in this field. In other words, creative and innovative freedom of scientists is placed in the limitations of time, cost, Etc.[29].

## **Research methodology**

### **Theoretical foundations of research method**

The approach governing the methodology of this study is participatory and qualitative[30]. This approach is in line with the recommendation of a lot of studies emphasizing the need to establish the findings and solutions on a practical field in the area of project management knowledge[31-37]. Thus, identifying the challenges, developing the solutions, process model, and finally validating the process model were conducted in a systematic way through deep interviews and aggregating the data based on the participation of stakeholders and experts by focusing on the research and innovation unit of E organization. For this reason, the reflection of field realities and the likelihood to implement the results as well as its performance bond increase because everyone participated in detecting the field realities, challenges, and development of the solutions which realize their interest and demands and that is why they all believe and trust in it deeply.

### **Research procedure**

As indicated in Figure 1, first the most significant challenges and achievements were studied in the process of research and development project management. Then, the research and development process of several Iranian companies and E organization were identified using the documents, field interviews, and multiple meetings. After that, the challenges and distance between threshold achievements and whatever flowing in research and development process were identified and discussed using brainstorming sessions (N=3) where the researchers of this study and two experts of research and development attended. The identified challenges were adjusted in form of open questionnaire and provided to the active experts and researchers in research and development area to be ranked and to add new challenges to the list of these challenges faced by research and development process in the country. Then, the researchers developed some solutions for coping with the challenges based on their significance according to the theoretical achievements on the creative process of brainstorming sessions (N=4) with the participation of stakeholders and experts (Table 1). In order to develop and strengthen the solutions were provided to ten

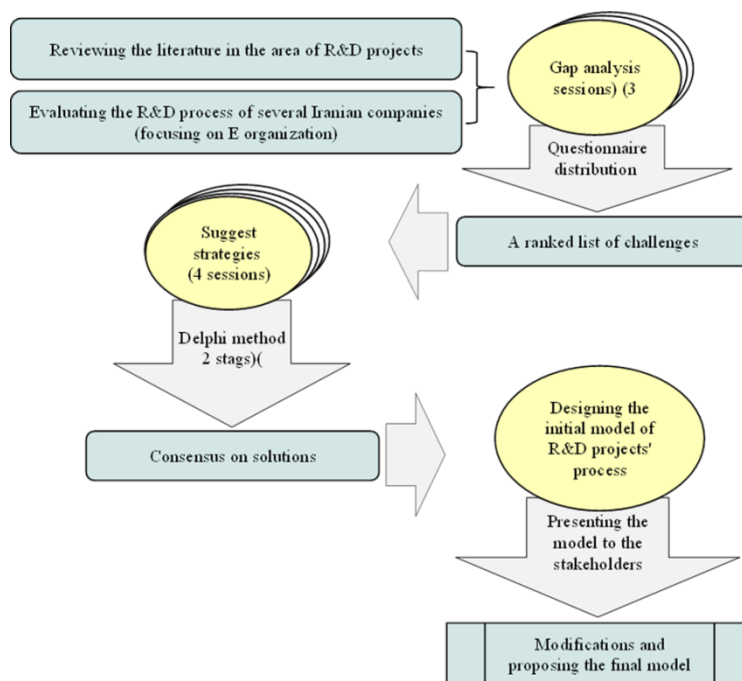
selected researchers and stakeholders having experience and expertise in research and development area to remake the list based on the proportion between the desired solution and challenge to present new solutions. Then, the list of challenges and proposed solutions were analyzed to develop an optimal process model. Then, several sessions with organizational stakeholders were held to adapt and improve such a model. Finally, the summary of the measures conducted in line with the obtained solutions to cope with the identified challenges were stated in column 4 of Table 1. In order to determine the relationship and proportion between the solutions and challenges, the proposed solutions were mentioned.

**The questionnaire of the first level**

In order to distribute the questionnaire, first the statistical population of the study was clarified well. The number of samples was studied to distribute the questionnaires of different methods. Since there is no certain list of the people with knowledge and experience in the area of research and development project as the statistical population of this study, the researcher estimated the number of these individuals as the maximum of 80 in best status based on the field observations and the study conducted before distributing the questionnaire. Based on this hypothesis and Cochran formula used for calculating the number of samples for interval data with small size of population (maximum of 150), the number of required samples was estimated as 67 to supply the least validity of the research. In order to achieve 67 samples, 90 questionnaires were distributed of which 53 questionnaires were completed (59%) which was a relatively favorable rate. In addition, Cronbach’s alpha coefficient was used based on the type of questions for evaluating the questionnaire reliability. For this purpose, the coefficient of 0.726 was achieved after analyzing the data.

**Delphi method**

In this step of the analysis, an attempt was made to achieve consensus between ten experts and stakeholders having experience and expertise in the area of research and development projects using Delphi method in relation to the development of the solutions which were selected based on previous steps. Accordingly, Delphi method was implemented in two steps.



**Figure (1) Research process(source: authors)**

### **The first step of Delphi**

In order to adapt the obtained solutions to the conditions of organization, the questionnaire of the first step of Delphi was designed as open to enable the experts to reduce some solutions from the determined list, add a new solution to the list, or state their explanation in relation to any solution. This questionnaire including the definition of each strategy was distributed on paper among different experts to create a shared understanding between them. In line with each solution, the respondents were asked to choose one of the following statements .

- The proportion of solution to the challenge is very high.
- The proportion of the solution to the challenge is high .
- The proportion of the solution to the challenge is average .
- The proportion of the solution to the challenge is low.
- The proportion of the solution to the challenge is very low.

### **The second step of Delphi**

In order to re-evaluate the results obtained from the questionnaire of the first step of Delphi, the results obtained in the first round with the difference between online comments were provided to the respondents one week before sending the questionnaire of this second step. The purpose of this re-evaluation was to provide the possibility of comparing between the option selected by each expert and the option supported by the majority and provide the contexts for creating a consensus among the experts. Then, the questionnaire of the second step of Delphi was sent after one week by focusing on the solutions with high difference between experts as well as increasing some solutions for each expert. The respondents were asked to mention their reason for selection in case of selecting another option different from the option supported by the majority. Finally, after passing the dual steps of Delphi, the results were summarized in form of second, third, and fifth columns of Table 3 .

### **Meetings with Stakeholders**

After presenting the model based on the identified challenges and solutions in the previous step, the researchers held some meetings with stakeholders and provided them with a summary of the research procedure as well as their goals and results. In addition, the stakeholders were provided with a summary of research reports and were asked to announce their corrective options as written or verbally during three weeks. After three weeks, the corrective comments were received and verbal comments were documented in person. Finally, the comments were integrated by researchers due to the limitations and conflicts and the accepted comments were applied to the model. This process was repeated in three steps with key stakeholders and two steps by other stakeholders in order to increase the adaptability of the model and perform its implementation with less resistance and higher performance bond.

**Table 1-The identified challenges, solutions, and features of the proposed process (source: authors)**

challenges	solutions	The features of the proposed process for realizing the solutions	Percentage of agreement
Non-project look at research and development and the non-use of project management knowledge	step by step and combined implementation of project management standards	<ul style="list-style-type: none"> <li>• Using PMBOK and Prince 2 standards at project level.</li> <li>• Using the MoP standard of OGC institute at the project portfolio level</li> <li>• Developing the contexts of using project management methods</li> </ul>	80
Ignoring participation as a guiding principle	Using the IPD project system and implementing collaborative approach at different levels	<ul style="list-style-type: none"> <li>• Developing the participation mechanisms of stakeholders in the project definition phase to formulate the evaluation criteria for evaluating research results and implementation results</li> <li>• Using a Project Integrated Project (IPD) to convert the mutual relations of employer, executive, etc. to collaborate and participate in the project goals in line with the high level of project uncertainty and complexity</li> <li>• Participation of all stakeholders in profit and loss</li> <li>• Participation of all stakeholders in the evaluation of results</li> <li>• Creating a mechanism for the participation of all stakeholders in identifying the weaknesses of the process and creating solutions</li> <li>• Providing a context for defining the joint project and co-financing</li> </ul>	80
The inefficiency of the process of selecting and defining research and development projects (strategy-portfolio)	<ul style="list-style-type: none"> <li>-Regarding the strategic management</li> <li>-Using the innovation management</li> <li>-Using the feasibility studies</li> <li>-Using the portfolio management</li> </ul>	<ul style="list-style-type: none"> <li>• Developing a strategic plan and research priorities of research and development unit</li> <li>• Considering "project strategy" and its implementation mechanisms</li> <li>• Implementing the project portfolio management standards</li> <li>• Establishing a feasibility mechanism with an independent approach coordinated to project portfolio management</li> </ul>	85
The inefficient process of idea creation and	The reflection of idea creation and acquisition process regarding the	<ul style="list-style-type: none"> <li>• Establishing ideas bank and developing the joint memorandum to use the vast potential of universities, companies, employees within the organization, etc.</li> </ul>	87.5

acquisition	inputs and its relationship to the project definition phase	<ul style="list-style-type: none"> <li>Establishing a workshop on creativity and idea development with the participation of experienced people and stakeholders in structuring the transformation of idea into a project and considering the principle of flexibility to combine, promote and make ideas more realistic as well as empower and encourage the employees to make ideas</li> </ul>	
The incomplete life cycle of research and development projects and the lack of realized interests	<p>-Using the experiences and findings of successful research and development models</p> <p>-The need to pay attention to the realization of interests and the appropriate definition of the project</p>	<ul style="list-style-type: none"> <li>Establishing the process of project implementation in five steps for improving the process of idea acquisition and transformation of ideas into a project of a specific scope, realizing the benefits through the implementation of research results, and ultimately evaluating the extent to which the goals are realized.</li> </ul> <ol style="list-style-type: none"> <li>acquisition, creation, and feasibility of ideas</li> <li>definition of research and development project</li> <li>research implementation</li> <li>implementation of research results</li> <li>Project termination</li> </ol>	82.5
The structure of inefficient monitoring and controlling of research and development projects	Simultaneous use of modern theories of supervision and motivation to increase efficiency and decrease regulatory levels	<ul style="list-style-type: none"> <li>Structural and process reform to align the interests of stakeholders with the project to reduce the need for regulatory mechanisms</li> <li>Establishing a project supervisor in the project team for the f continuous monitoring of Level 1</li> <li>Establishing a project portfolio management for continuous monitoring of Level 2 on the implementation of research and development projects.</li> <li>Establishing a project evaluation committee for providing independent evaluation reports on the implementation results of the project</li> </ul>	75
Disregarding the unique features of research and development projects	The necessity to recognize the low level of definitions of goals and the methodology of research and development projects as well as using the appropriate management approaches	<ul style="list-style-type: none"> <li>IPD project implementation system for addressing the high level of risk and low definition of research and development projects</li> <li>Emphasizing the OGC gateway and result-oriented controls for better addressing of the level of uncertainty and low definition of projects.</li> <li>Creating minimum formalities and bureaucracy as well as emphasizing incentive systems.</li> </ul>	80
Inefficiency in the combination of	-The necessity to define the connection structures between	<ul style="list-style-type: none"> <li>Using the MOP portfolio portfolio management mechanism to better align of more research</li> </ul>	67.5

research and development process and the permanent structure of the organization	<p>projects and the permanent structure of the organization.</p> <p>-The necessity for the deep knowledge of e formal and informal structures to increase the probability of successful model implementation</p>	<p>and development projects as well as the permanent structure of the organization</p> <ul style="list-style-type: none"> <li>• Adapting he proposed research and development process units and current units in the organization for more integration.</li> <li>• Determining the roles and responsibilities of the project team consistent with the roles and responsibilities of the organization</li> </ul>	
Financing of research and development projects	Emphasizing the definition of joint projects and the necessity for collaborative financing	<ul style="list-style-type: none"> <li>• Defining and implementing the joint projects with other companies through co financing</li> <li>• Using the financial capacities of universities by defining a joint project while providing the access to information and equipment aimed at more industry and university closeness.</li> </ul>	77.5
The challenge of idea and talent acquisition to the research and development process	The need to design and establish more collaborative mechanism between the research and development unit , universities, and research centres	<ul style="list-style-type: none"> <li>• Developing a strategic plan and roadmap for collaboration with universities and research institutions.</li> <li>• Improving the structure and process of idea acquisition through ideas bank and specialized committees.</li> <li>• Designing and establishing the contexts. Implementing an integrated database implementation and information management to better understand the opportunities and capacities of research centres.</li> </ul>	75
No comprehensive use of information technology	The need for the hierarchy of management principles, management process and a comprehensive information technology system based on two previous levels	<ul style="list-style-type: none"> <li>• Designing the process by considering the possibility of creating and developing an information technology network</li> <li>• Considering the current infrastructure of the organization</li> </ul>	60
Non-use of risk management	Establishing the risk management mechanism at portfolio level and promoting it to the project level	<ul style="list-style-type: none"> <li>• Establishing a risk management mechanism in the framework of portfolio management of research and development projects</li> <li>• Developing the techniques and methods of management at the project level</li> </ul>	80



Disregarding knowledge management	The need for creating and developing knowledge management system	<ul style="list-style-type: none"> <li>• Establishing the knowledge storage and management system for using the knowledge gained from research and development projects</li> <li>• Integrating the knowledge management system and the process of project implementation to use the capacity of all</li> </ul>	70
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### Research findings

In the first part of this study, the challenges found in the R&D project management process and the solutions to cope with them, obtained in the research method section, are stated in form of Table 1. In addition, the process model of research and development project management which is recognized as the main output of the research is presented in Figure 2 and its different aspects are briefly explained. The most significant measures considered in the model to cope with challenges were mentioned separately in column 3 of Table 1 to make it easy and readable for readers.

### The process model of research and development projects management (Figure 2)

#### The main units of the process

#### Innovation secretariat

The members of innovation secretariat are selected based on the guidelines by the head of research and development unit and some of the most important tasks of this secretariat include:

1. Developing the research priorities based on the strategies of research and development unit as well as developing and updating the ideas bank and executives bank
2. Identifying the current opportunities as the starting point of the activities related to investment
3. Identifying and documenting the capacities of universities as well as signing joint memorandums for defining the participatory projects and the relationship between industry and university
4. Organizing the cooperation with the marketing unit, independent researchers, and generally all of those insides or outside the organization having an idea in their minds

Innovation secretariat collects the idea and information of executives and collaborative institutions by some forms and monitors them by appropriate software. Innovation secretariat is not only responsible for capturing ideas. This unit should provide the context through well-known scientific methods encouraging the

interested individuals, groups, and organizations to make ideas and attempting in this regard. In addition, the contexts for integrating, developing, and improving the ideas through specialized committees should be provided.

In this regard, the recognized techniques and structures such as brainstorming, mind mapping, etc. are considered as very strategic and key subjects. In addition, the representatives of innovation secretariat should consider the development of strategy and definition of project based on strategy as a key target in their board meetings of E organization projects based on documents. In addition, the portfolio board should provide the innovation secretariat with the project documents and priorities to select the appropriate projects.

### **Project feasibility group**

Decision for taking advantage of feasibility studies depends on the type of project and adapted by innovation secretariat. In order to observe the principles of dependency, this group is independent of research and development process and innovation secretariat is in charge of it. In addition, a part of the commitments by feasibility team should be dependent on the realization of the project goals as the good performance guarantee. Furthermore, the performance of feasibility group should be documented and be in line with the clarity of information available to stakeholders.

#### **The most important tasks of this group are:**

- Studying the ideas confirmed in specialized committees such as different aspects including economic and technical aspects depending on the type of environmental project based on specific instructions.
- Evaluating the executive capabilities for project implementation
- Depending on the project type, specific aspects of each project should be evaluated as addressed in the feasibility report

### **The board of project portfolio management**

It is a board including the head of research and innovation unit, the head of innovation secretariat, the head of knowledge management center, and the secretary of project portfolio. The head of research and innovation unit is in charge of managing this board. The most important tasks of this board include:

- Developing the strategies in line with the projects by the strategies of research and development unit
- Prioritizing the feasible projects based on financial limitations, resources, and acceptable risk level of the company
- Monitoring all phases of research and development projects
- Coordinating and managing the risk and resources optimally

-Developing the macro strategies and main orientations in different areas such as memorandums and participating with other research institutes and private companies

The members of the evaluation board are employer, executive, project manager, project supervisor, special representative of the head of organization, and the representative of portfolio management group to keep the independence of the board and if necessary the representative of engineering deputy. The tasks of this board include:

-Providing the head of research and innovation unity and other stakeholders with the implemented results based on the evaluation implemented by the supervisor, the special representative of the head of organization, collection of contextual data, and the report created by the implementation board to increase transparency.

-Preventing the reports of implementation results to the board of portfolio management of research and development projects to free the organizational capacities completely from the relevant projects and allocate it to new projects and other current projects

- Reporting the implementation results as well as completing and collecting the knowledge management form for conducting more analyses in knowledge management center.

- Sending the report of implementation results as the input of innovation secretariat as well as idea feasibility unit

- Evaluating the predicted objectives to attract and make ideas feasible in future and evaluating the project team performance

### **Project team**

In line with the participation strategy and based on the integrated system of project implementation includes the employer, executive, project supervisor, and project manager. This strategy has a certain role and responsibility in each phase of definition, execution, and implementation, as discussed in the next section in detail.

### **The main phases of the process**

#### **The acquisition, creation, and feasibility of ideas**

The minimum formality and bureaucracy should govern this phase and the idea production should be completely open to use all ideas inside and outside the organization. For this purpose, creating sufficient incentives and advertisements are of key significance. In this phase, the bank of idea, innovation, and information of executives is used to enrich and increase the efficiency of idea production phase and improve the assets of organizational process. The strategies of research and innovation unit should turn into research priorities and idea suggestion should be in the framework of these priorities. This issue realizes the strategic alignment to some extent. The ideas specified in this phase are evaluated based on pre-determined indicators by six committees (based on the studied subject) according to the type of the project. Such indicators can involve different criteria such as the alignment with organizational strategies, financial feasibility, and technical feasibility, etc. Thus, the strategies of organizations and consequently the strategies of research and innovation unit should

be developed and determined before investigation. Project team (including employer, project manager, project supervisor, and executive) is initially allocated to the ideas which can gain the required minimum score in this phase and these ideas enter the feasibility phase. Feasibility phase is separated from the phase of idea reviews and involves an independent team because the feasibility of research and development projects has mainly costs both in time and money. Thus, the projects having some minimums in the field of feasibility enter this phase. Furthermore, most ideas should be integrated, promoted, and developed before entering the feasibility phase using the mechanism of creativity and idea development workshop (specialized committees) to take more realistic aspect. It should be noted that all ideas should not necessarily pass all above-mentioned phases in the process model to become a project. Under specific conditions and according to the demand of the head of innovation secretariat and agreement of the head of research and innovation unit, the projects can be exempted from some phases or steps of the process. After the project feasibility, if the project is not feasible, its information will be stored in the knowledge base. In case of feasible project, the board of project portfolio management should conduct three phases of understanding, classification, and prioritization of research and development projects having technical, economic, and environmental feasibilities according to the OGC standard of portfolio management .

#### **The definition of research and development project**

After confirming the project by the board of portfolio management, the primary project team is officially assigned to the project after applying some probable changes and then the project definition phase begins. In this phase, three forms should be completely filled based on the appropriate and realistic estimates by the project team through a consensus-oriented approach. Project management plan form (this form can be completed based on project management standard forms according to the instruction of this standard or be designed for organization in a specialized way), the form of “evaluation indicators of research results”, and the form of evaluation indicators of implementation results.“

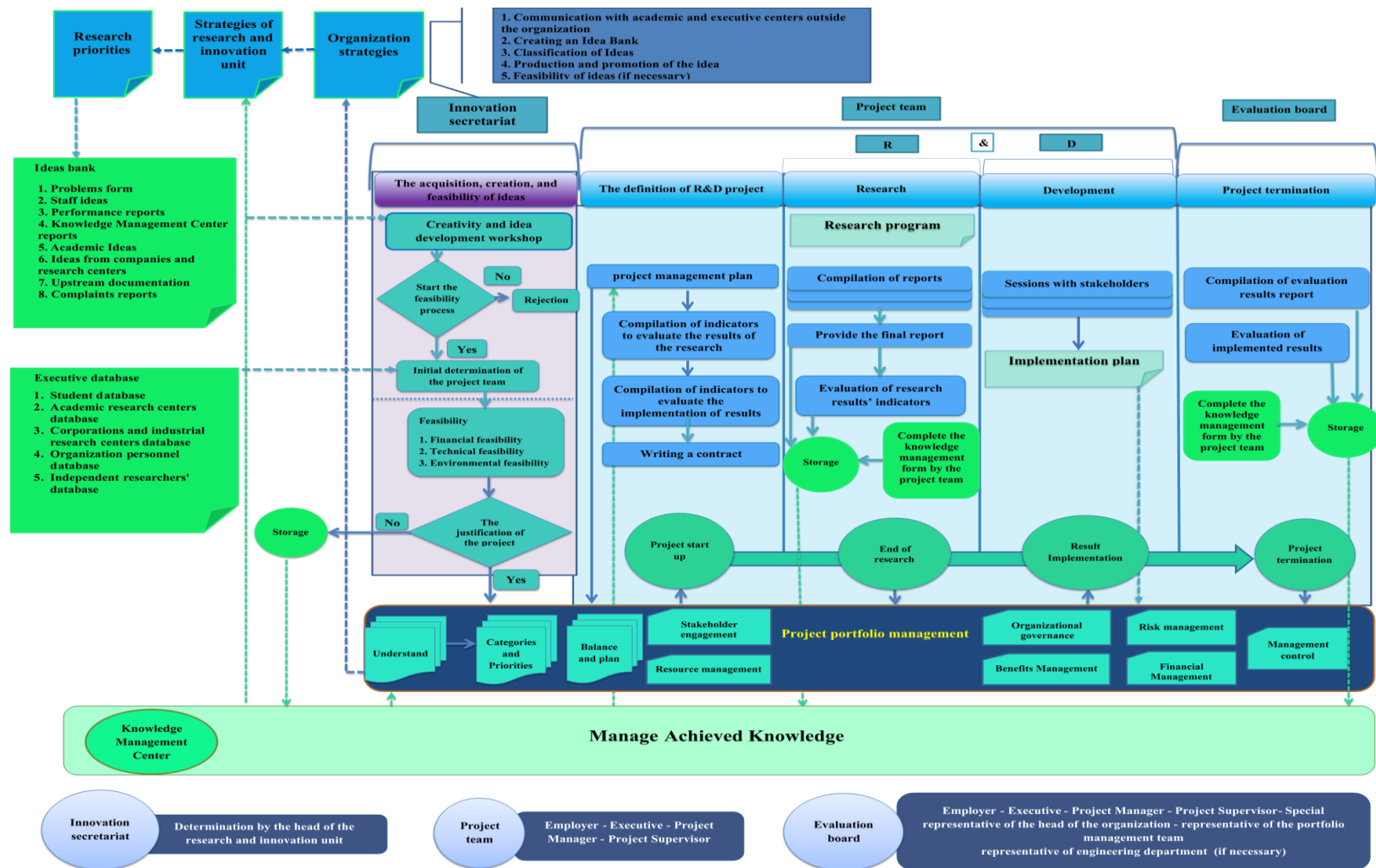


Figure (2) The process model of research and development projects management(source: authors)

## Research

In this phase, the project team should form some meetings based on the determined scheduling and monitor the progress of the project through periodical reports. Finally, after receiving the final report, the project team specifies the fulfillment of commitments and feasibility or non-feasibility of continuing the study based on the comparison of final report and evaluation criteria of the research result. The other relevant forms in this phase are completed by the supervisor and provided to the board of portfolio management. This board gives these forms to the engineering deputy, if necessary, and this deputy determines the implementation of the project. Three decisions may be made in this phase:

- The project is in line with the primary goals and can enter the implementation phase
- The project is deviated from the primary goals and requires corrective measures
- The project cannot continue and enter the implementation phase and should be stopped to use the theoretical achievements in knowledge management center

In addition, the project may be of pure service projects. In such conditions, projects directly enter the completion phase. Due to the complexities encountered by projects in terms of internal and external changes, the necessity and significance of continuing the study should be consistently evaluated and documented. This issue is known as business case in the project management standard of OGC institute. For this purpose, the project is stopped whenever the evaluation group concludes that continuing the project has no value added to the organization. Meanwhile, the role of supervisor and his formal relationship to the board of portfolio management is of great significance for decision-making in this area. In addition, considering this point has a significant effect in allocating optimal resources based on project requirements and effective risk management. At the end of this phase, the reports of the projects as well as the completed forms by the project team are collected and stored by the representative of knowledge management center and then transferred to knowledge management center for more analyses.

## Development

In this phase, the project evaluates the feasibility of implementing the research results in the first meeting. A representative from engineering deputy should attend this meeting in case of necessity. In this meeting, different dimensions of implementation and its side effects are determined and documented. The implementation board should specify the stakeholders affected by the project implementation based on previous documents and determine their effectiveness. Based on this analysis and after sending the project to all stakeholders, they are asked to present their opinions and state their agreement or disagreement on implementing the project as well as the effects of project implementation on their sector. Based on the received feedback, the project evaluation board invites some key stakeholders of the project to the second meeting for more investigation and better coordination of plan implementation. Finally, the implementation plan is developed based on the relevant form and given to the board of portfolio management after holding the required number of meetings and applying the changes based on received verbal and written feedbacks. This board should compare the different dimensions of implementation to the capacity and feasibility of the organization. The board of portfolio management makes decisions in line with the implementation of non-implementation of research results and its appropriate time. After confirming the plan, the research results are conducted based on the scheduling time with the agency of project executive and manager as well as the guidance and supervision of project employer and supervisor. The implementation plan of research results should have a certain amount of details based on the project type.

### **Project termination**

In this phase, the results implemented by the evaluation board are studied based on the forms of ‘evaluation indicators of research results’ and ‘evaluation indicators of implementation results’. In addition, this board presents a report in this regard to the head of research and innovation unit. In this report, a summary of other information of the project as well as the results of implementation and the most significant features of the project should be presented. The form completion should have a completing process. In other words, each specified part of the form should be completed by each relevant individual and then updated if necessary. In this phase, the report of evaluation result and completed forms of knowledge management center should be completed by the project team to store and conduct more analyses in line with the extraction of project knowledge and process management knowledge, and evaluated by the representative of knowledge management center, and then sent to the knowledge management center.

### **Knowledge management in the proposed process**

There are different models for knowledge management each one having almost similar phases of knowledge management but different from each other in some limited details. Probest’s Building Stones Model that was introduced as an appropriate model for introduced projects in theoretical resources were used for Eorganization research and development process model. This model has the phases of knowledge goals, knowledge evaluation, knowledge discovery, knowledge acquisition, knowledge development, knowledge sharing, and knowledge retention. The central core of knowledge management in this model is firm by the knowledge management center which is responsible for supporting and implementing the knowledge activities in the model. The significant abilities of this model obtained by the knowledge processes in the model include the possibility to improve the model continuously. This can be realized by storing the implicit knowledge of the project team (in different projects) and evaluating it in knowledge and management center and, if necessary, defining a new project for solving the problem.

### **Conclusion**

In this study, the researchers first identified the challenges of research and development projects management process by comparing the theoretical findings and whatever being current in Iranian companies and especially in E organization. Then, the most appropriate solutions were developed through questionnaire and Delphi technique to deal with the ranked challenges. Accordingly, the process of research and development project management in E organization was designed and then adapted by presenting it to stakeholders. The most important achievements of the proposed process for managing research and development projects include changing the attitude of stakeholders to research and development unit from an operating unit to a project-based unit, using the project management knowledge and a wide range of solutions and techniques developed in this area, increasing the probability to achieve the benefits through a clear definition, and creating a complete connection between the phases of research and development projects life cycle, fitting the defined process and conditions of E organization through increasing flexibility and the ability to support a variety of projects encountered by E organization, using portfolio management approach, strategic alignment and its extensive interests, considering the principle of continuous improvement and its successful combination with knowledge management system, reducing stress, increasing efficiency, and reducing the need for monitoring the process by aligning the interests of various stakeholders especially the project team, assigning the project manager and project supervisor to strengthen the project team, establishing independent and multi-layered monitoring mechanisms, increasing transparency at different levels, using participation as a major strategy and spirit governing the process especially in the area of project system, project financing, and determining the project success criteria.

### Limitations and suggestions for future studies

This study faced some limitations such as the lack of access to information, lack of cooperation and resilience of some stakeholders, the lack of appropriate infrastructure, and so on. In addition, there are many other challenges requiring further research in the future. Such challenges include the effective structures and processes for the development of cooperation between universities and research centers and research and development units of companies, evaluating the required structure and processes for the development of cooperation, defining joint projects between research and development units of different companies, studying the area of strategic plan of research and development units and better alignment of research and development projects and strategies, and finally providing the financing strategies for research and development projects.

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