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FEATURES OF INNOVATIVE SCIENTIFIC PROJECT MANAGEMENT[1]

Views of scientists concerning life cycle of an innovative scientific project are investigated are defined in the article. Two strategies (push and pull strategies) are considered and adapted for innovative scientific projects. The author's vision of the development process and implementation of innovative scientific projects based on push and pull strategies is suggested. The main structural elements of innovative scientific projects are systematized and described in the article. Duties and roles of innovative scientific project's executors are detailed.

Keywords: economic development; innovative scientific project; project life cycle; project management process; push strategy; pull strategy.
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Introduction. Scientific institutions play a significant role in the modern scientific, technological and economic development of each country. They explore the activities of individual economic entities, and define trends in the functioning of industries and the state as a whole. Such studies are mainly implemented through the application of various research projects. Current research projects cover a wide range of issues in various fields (humanitarian, technical, social, economic, medical, etc.). They can have both theoretical and applied nature. The results of their implementation are the synthesis of existing experience and the application it in other areas. Innovative research projects deal with the development of state-of-the-art theoretical and practical provisions.

Project planning and implementation require the development and identification of key aspects of their management process. Project management process requires the specification and description of the main structural elements, the appropriate allocation of roles and responsibilities between them. Another aspect of project management is to develop strategies for the project implementation. Over the past few years the share of innovative scientific projects is growing. But the theoretical framework of project management cannot keep up with such an active development. Therefore, the need to adapt the existing provisions of project management to innovative scientific project features is an undeniable fact. All these determine the relevance of the chosen research subject.

Analysis of recent research and publications. The term "project" comes from the Latin word "projectus" (which was formed from the words "pro" (forward) and "jacere" (to throw)) and means "to throw or cast forward". In general, project is an accurately stated piece of research (Webster's Seventh New Collegiate Dictionary [18]). In turn, many scientists and scientific institutions provide their own definition of "project" (Baguley Ph. [5]; Bureau of Indian Standards [12]; Gaupin G., Knopfel H., Morris E., Motzel E. and Pannenbacker O. [8]; Manning S. [11]; Raizberg B. and Lozovskiy L. [1]). A Guide to the Project Management Body of Knowledge (the 3rd and 5th editions) [2, 3] defines project as

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"a temporary endeavor undertaken to create a unique product, service, or result". In other hand, the Association for Project Management [19] provides the following definition of the concept: "Project is a unique, transient endeavor, undertaken to achieve planned objectives, which could be defined in terms of outputs, outcomes or benefits". The British Standard Institution [9, p. 3] understands a project as a set of activities: "project is a unique set of processes consisting of coordinated and controlled activities with start and end dates, performed to achieve project objectives". According to Ward J.L. [17, p. 163] project is defined as a temporary undertaking to create a unique product or service with a defined start and end point and specific objectives that, when attained, signify completion.

A big number of works are dedicated to methodical aspects of project management. For instance, Zhu J. and Mostafavi A. [20] provide the research of dimensions of project complexity (i.e., detail and dynamic complexity) and three dimensions of project emergent properties (i.e., absorptive, adaptive, and restorative capacities). In this context, the work of Russell J.S., Jaselskis E.J. and Lawrence S.P. [13] is also of great interest. They present a project performance assessment as a continuous process to understand and predict project performance outcomes based on various variables in projects.

The practical aspects of project implementation are covered in [2, 3, 16]. Thus, the key points are: the project lifecycle; the project stakeholders and team relationship; time, cost and risk management; budget planning and monitoring; monitoring and evaluation of project deliverables; etc.

The analysis of existing works allows adapting the above mentioned theoretical and methodical approaches to the needs of innovative scientific project management.

The main objective of paper is to describe push and pull strategies of innovative scientific project management, to form structural and logical scheme of project management process with the indication of the main information flows and to indicate the main structural elements of innovative scientific projects.

Basic materials. Promotion of innovative scientific projects can be provided by push or pull strategy. According to Kolodovski A. [10] push and pull strategies describe two distinct points of view in strategic level. In short, in the frame of pull strategy it is stated that recognition of demand is a more important factor in successful innovation than recognition of technical potential. On the other hand, push strategy states that the discovery of the new capabilities often leads to the more radical innovations. In other words, if project starts with stating a problem and then a solution comes, this is the pull strategy. If the project starts with a solution (technology), and then the problem it can solve defines, it is push strategy. Pull strategy starts with sponsor's initiative to grant something (individual researches or group researches) in specific thematic section (usually addressing global challenges). The sponsor's funding initiative becomes available in the form of challenges. If research team wishes to respond to a challenge, it must submit a proposal according to the admissibility conditions and eligibility criteria before the deadline. Once a proposal passes the evaluation stage a project team starts the project management process. The push strategy assumes the primacy of the research team initiative. Research team has an idea or technology which needs to be funded. If sponsor wishes to fund, the admissibility conditions and eligibility criteria must be stated. If research team wishes to cooperate with sponsor, it must present a project according to the admissibility conditions and eligibility criteria before the deadline. Once all formalities are settled, the project team starts the project management process. In general, the logic schemes of push and pull strategies are presented in figure 1.

Any process suggests existence of a definite list of consequent stages of its implementation. Innovative scientific projects aren't an exception. Project developers also divide projects into stages to provide better management control and appropriate information flows between project team. It is often said that the majority of authors suggest similar set of stages, but still some differences can be found.

Cooper R.G. [7] suggests using stage-and-gate process and states that a typical technology development process consists of three stages and four gates: gate 1 – idea screen; stage 1 – project

scoping; gate 2 – decision: go to technical assessment; stage 2 – technical assessment; gate 3 – decision: go to detailed technical investigation; stage 3 – detailed investigation; gate 4 – the application path gate.

The Office of Energy Efficiency and Renewable Energy [15] has designed the Stage-Gate process with flexibility to accommodate various types of research projects. This multi-step management approach produces fact-based funding decisions based on a set of defined evaluation criteria. Stage-Gate model consists of five stages and four gates: stage 1 – preliminary analysis; gate 1 – project selection; stage 2 – concept definition; gate 2 – research approval; stage 3 – concept development; gate 3 – proof of technical feasibility; stage 4 – technology development and verification; gate 4 – proof of commercial feasibility; stage 5 – information dissemination and commercialization.

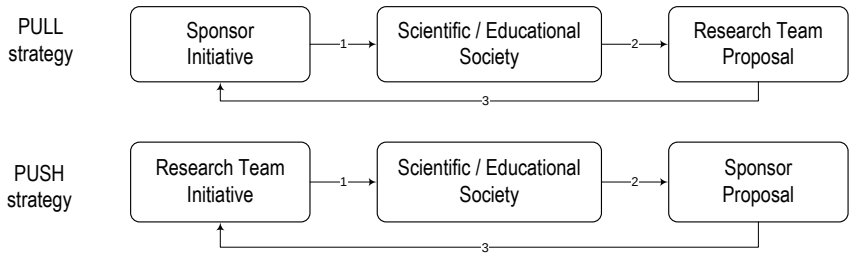

Figure 1 – **Push and pull strategies in innovative scientific projects** (authors' development)

Schindlholzer B., Uebernickel F. and Brenner W. [14] consider that project process "consists of the three main phases: preparation, design and specification, as well as the sub phases for these three main phases". During the preparation phase the following activities are carried out: creation of the environment (definition of project roles; definition of problem statement; definition of project plan; resource allocation; management of stakeholders) and preparation of the team (team selection; teambuilding; training of design team; project schedule with design team; organization of kick-off event). During the design phase a prototype development takes place. Its sub phases are performed continuously, they start from developing critical functional prototype and further one after another appear dark horse prototype, integrated prototype, functional prototype, X-Is Finished Prototype and final prototype. As a final point of project process a specification phase is carried out with the following activities: documentation, specification (documentation of results; documentation of process; specification of prototype) and transfer (review of documentation; calculation of business case; team debriefing).

On the other hand, authors of A Guide to the Project Management Body of Knowledge (the 3rd edition) [2] suggest analyzing project stages in a form of project life cycle. The project life cycle defines the phases that connect the beginning of a project to its end. The project's phase transition means existence of certain control points (deliverables), i.e., some form of technical transfer, report, and handoff. Deliverables from one phase are usually reviewed for the completeness and accuracy criterion. The next phase does not start without the positive estimation of the previous phase. A typical sequence of phases in a project life cycle and its inputs, outputs and deliverables are shown in figure 3.

One should note here that the phases of a project life cycle are not the same as the project management process groups. The project management process groups are presented as sets of elements with well-defined interfaces, roles, dependencies and information flows. There are five project management process groups that have clear dependencies and are performed in the same sequence on each project [2, pp. 39-42]:

1) initiating a process group. It defines and authorizes the overall project or a project phase;

2) planning the process group. It defines and refines project or phase objectives. It plans the course of actions required to attain the objectives and scope that the project was undertaken to address;

3) executing the process group. It integrates resources (people, materials, information etc.) to carry out the project management plan;

4) monitoring and controlling the process group. It provides the regular measurement and monitoring to identify divergences from the project management plan. On the basis of measurement and monitoring results the corrections can be provided (if it is necessary to meet the project objectives);

5) closing the process group.

This formalizes acceptance of the product, service or result. It brings the overall project or a project phase to an orderly end.

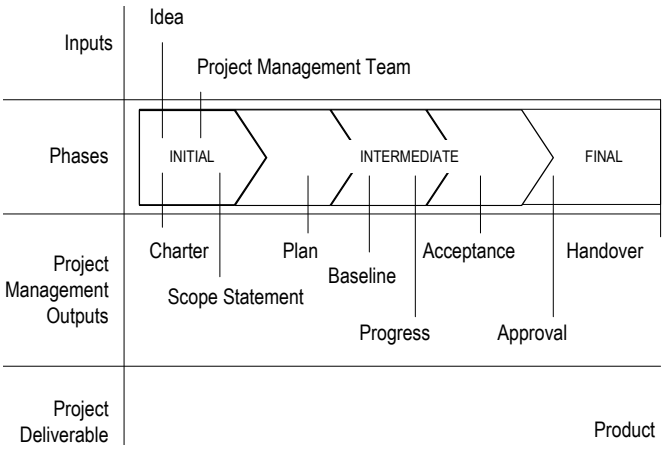

Figure 3 – **Typical sequence of phases in a project life cycle** [2, p. 23]

Allan B. [4, p. 333] mentions that "all projects involve the cyclical process":

1) defining the project;
2) basic project planning;
3) planning the schedule;
4) staffing the project;
5) costing the project;
6) developing a communication strategy;
7) project management and reporting;
8) implementation;
9) management of change;
10) project completion.

Research of publications on this issue allows to form staged of innovative scientific projects management process: 1) initiating, 2) planning & executing; 3) monitoring & controlling; 4) closing.

It should be noted that information management process within innovative scientific projects must take into account the information flows characteristics (especially it's directions and features) that arise between structural elements. The main structural elements of innovative scientific projects are the following: project team (manager, members), donors (sponsors, creditors), stakeholders, competitors, intermediaries, suppliers, community (external environment, public) and customers. We think it expedient to consider information flows in more detail (figure 4).

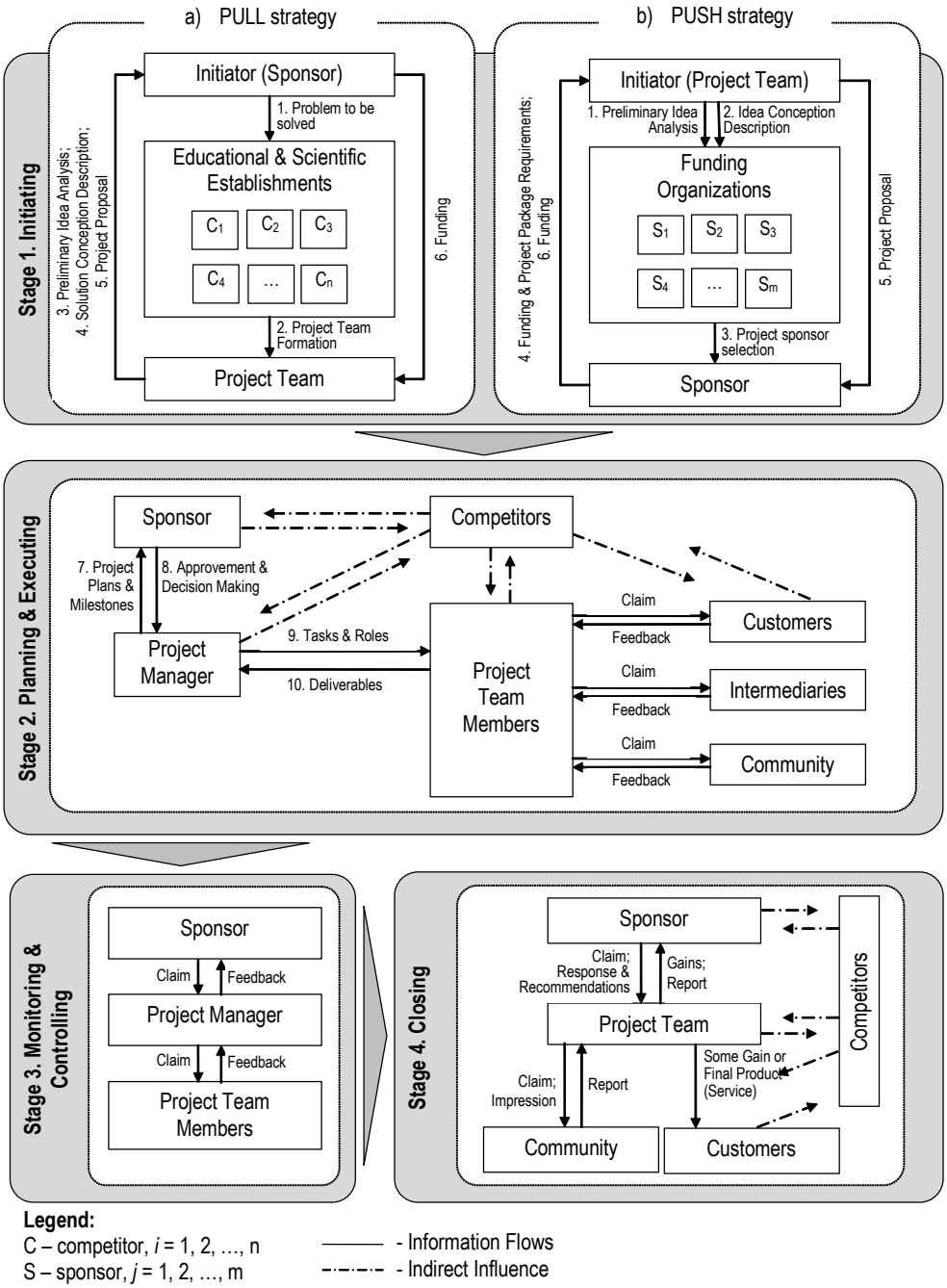

Figure 4 – **Structural and logical scheme of project management process with the indication of the main information flows** (authors' development)

The description of roles performed by main structural elements of innovative scientific projects is presented in the table 2 (developed on the basis of Brandon D. [6]; Schindlholzer B., Uebernickel F. and Brenner W. [14]).

Table 2 – **The main structural elements of innovative scientific projects**

Participants	Essence	Role (functions and duties)	Examples
1. Initiator	A person, group of people or organization which determines the nature and scope of the project	Idea creation; Preliminary analysis (business environment analysis, financial analysis, stakeholders analysis) Description of future benefits	Anyone of key project participants (stakeholders, sponsors, team members etc.)
2. Stakeholders	A person, group of people or organization, internal or external to the project team, which is impacted by, or can impact, the outcomes of the project	Managing and monitoring the process of launching and executing the project	Project team, sponsors, customers, government organizations
3. Project Team: 3.1. Project Manager (Leader)	A person responsible for ensuring that the project team completes the project	Developing the project plan with the team; Project tasks management; Securing acceptance and approval of deliverables from the project sponsor and stakeholders; Communication with project participants; Risk management; Making sure the project is delivered in budget, on schedule, and within scope	The leader of team members who has the experience in research projects and the power to influence other members
3.2. Project Team Members	People with different skills, personalities and experience who are appropriate to launch and execute the project	Executing tasks and producing; Deliverables according to the project plan and directed by the project manager	Representatives from different scientific and practical areas
4. Sponsors (donors, creditors)	A person, group of people or organization which gives funding opportunities for the project	Legitimizing the project's goals and objectives; Decision-making for the project; Participating in and/or leading project initiation; Participating in project planning ; Developing of the project initiation plan; Providing support for the project manager; Monitoring and controlling	Foundations, grant organization, government organization, business structures, banks, investment funds etc. (see more detail information below)
5. Customers	A person, group of people or organization which acts as the actual or potential consumer (user) of the final project product or service	Identifying the need; Forming the demand; Establishing final project product (service) requirements	Government organizations, community, business structures, educational and scientific establishments etc.
6. Community (external environment, publics)	Contact audiences which interact and influence the process of launching and executing the project	Providing the project team with expert knowledge and feedback	Local population, government organizations, non-government organizations, mass media etc.
7. Competitors	A person, group of people or organization which is trying to achieve such goals as the project team	Stimulating the project team to make its duties effectively; Competition formation	Educational and scientific establishments, venture enterprises
8. Intermediaries	A person, group of people or organization which offers intermediation services	Offering some added services that may not be possible provided by the project team	Insurance, financial, logistics, consulting, government, legal service organizations, suppliers, etc.

According to a Guide to the Project Management Body of Knowledge (the 3rd edition) [2] the relationship between stakeholders and the project can be performed as the following scheme (figure 5).

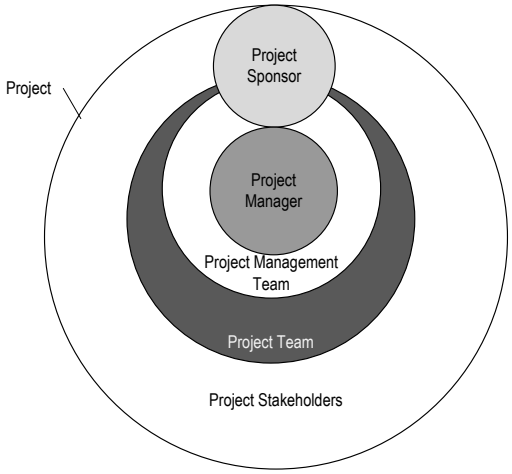

Figure 5 – **The relationship between stakeholders and the project** [2, p. 25]

Conclusion and directions for further research. In this article are considered both, the theoretic basis of project management (approach to defining a term "project" and its key elements) and practical aspects of implementation and maintenance of projects in innovative scientific spheres. According to the results of the investigation, the following author's suggestions were introduced:

1. The authors analyzed the approaches to strategic project management. Push and pull strategies were selected as a result. Push and pull strategies describe two distinct points of view in strategic level. Authors developed the logic schemes of push and pull strategies in innovative scientific projects based on this analyses. If an innovative scientific project is started with sponsor's initiative to grant something, it is a pull strategy. On the other hand, push strategy starts with a solution (technology) and problem definition.

2. Authors reviewed different approaches to project process stages. Despite the fact that the majority of authors suggest similar set of stages, but still some differences can be found. Authors shared the opinion of Allan B. [4] that "all projects involve the cyclical process" and suggested the following stages of innovative scientific projects management process: 1) initiating, 2) planning & executing; 3) monitoring & controlling; 4) closing.

3. Authors developed structural and logical scheme of project management process with the indication of the main information flows based on allocated push and pull strategies, and formed stages of innovative scientific projects management process. The place and the role of the main structural elements of innovative scientific projects (project team (manager, members), donors (sponsors, creditors), stakeholders, competitors, intermediaries, suppliers, community (external environment, public) and customers) were defined in this scheme. Also, the main information and indirect flows that arise between structural elements were specified.

According to the authors' vision the course of action at the Stage 1 "Initiating" is determined by the fact who is the initiator. Thus, push and pull strategies are implemented. The Stage 2 "Planning and Executing" includes assessing the competitors' and contact audiences' analysis, identifying project deliverables and milestones, establishing project schedule, defining the distribution of competences and

performance, creating the supporting activities (human resources plan, communication and dissemination plan, risk mitigation strategies, etc.). The basics for providing organizational and instrumental support of project team also are formed at this stage. Stage 3 “Monitoring and Controlling” measure the progress and the performance indicators of the project. The key points of monitoring and control are financial flows, material flows, quality of deliverables, dissemination activity. By the result of this stage, the corrective measures can be applied. The closing stage assumes preparation the final report and presentation the core product of the project (i.e. product, technology, process or methodology, set of recommendations, etc.).

4. The essence, roles, functions and duties of the main structural elements of innovative scientific projects are summarized in the article. Examples are given of what objects can perform a particular role in the project management process.

The research presented in this paper was focused primarily on the theoretical perspective. **The potential for the future research** is, in this context, in development of the practical suggestions. Further opportunity can be in the analysis of experience of innovative scientific project implementation, allocation of success and failure factors, and formation of the risk reduction activities.

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Особливості управління інноваційними науковими проектами

У статті розглядаються підходи вчених до визначення життєвого циклу інноваційного наукового проекту. Стратегії протягування і проштовхування розглядаються і адаптуються до специфіки управління інноваційними науковими проектами. Пропонується авторське бачення процесу розроблення і впровадження інноваційних наукових проектів на основі стратегій протягування і проштовхування. У статті систематизовано та описано основні структурні елементи інноваційних наукових проектів. Узагальнено обов'язки і ролі виконавців інноваційних наукових проектів.

Ключові слова: економічний розвиток, інноваційний науковий проект, життєвий цикл проекту, процес управління проектами, стратегія проштовхування, стратегія протягування.

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Особенности управления инновационными научными проектами

В статье рассматриваются подходы ученых к определению жизненного цикла инновационного научного проекта. Стратегии протягивания и проталкивания рассматриваются и адаптируются к специфике управления инновационными научными проектами. Предлагается авторское видение процесса разработки и внедрения инновационных научных проектов на основе стратегий протягивания и проталкивания. В статье систематизированы и описаны основные структурные элементы инновационных научных проектов. Представлены обязанности и роли исполнителей инновационных научных проектов.

Ключевые слова: экономическое развитие, инновационный научный проект, жизненный цикл проекта, процесс управления проектами, стратегия проталкивания, стратегия протягивания.

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