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ADAPTING SYSTEMS ENGINEERING TO EVALUATE TECH STARTUPS: AN INNOVATIVE FRAMEWORK BASED ON OMG ESSENCE

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Abstract
The adaptation of system engineering to evaluate technical startups through an innovative framework based on the OMG Essence standard is a modern approach to simplify the process of analyzing and managing startups at various stages of their development. In this study, a universal framework was proposed that allows evaluating technical startups from the point of view of system engineering. This approach takes into account key aspects of startup development, such as requirements, stakeholders, technology, and team, which makes it an important tool for evaluating innovative projects.
The main purpose of the proposed framework is to apply the principles of systems engineering to the evaluation of startups, focusing on technical aspects such as system architecture, integration capabilities, and the ability of the team to solve complex tasks. Traditional methods of evaluating startups, often focusing on business aspects, may not always take into account all the technical difficulties and risks that arise when developing software products. The OMG Essence-based framework fills this gap by providing a more comprehensive tool for analyzing and managing startup development.
OMG Essence, as a standardized method, acts as a basis for formalizing practices and facilitating interaction between various project participants. The framework based on it offers the possibility of modular adaptation, which allows you to evaluate startups regardless of their complexity and current stage of development. An important feature of OMG Essence is the ability to integrate with other methodologies, which makes it universal for various fields. The application of this standard in the evaluation of startups allows you to obtain more objective results and improve the decision-making process.

Keywords Adaptation of system engineering, assessment of technical startups, OMG Essence framework, software development methodologies, technical assessment of startups, flexible adaptation of processes, standardization of startup assessment, integrated risk analysis, startup lifecycle management.

INTRODUCTION

In the context of the rapid growth of technology startups, investors and mentors face a significant challenge in objectively evaluating such projects. Technology startups are characterized by high uncertainty, complex structures, and a fast pace of change, which makes their analysis difficult using traditional methods. Standard approaches to evaluating startups, which often focus on financial and business indicators, are not always capable of reflecting the technical aspects of a project, such as architectural decisions, the degree of technological innovation, and the team's competencies. These

elements play a key role in the future success of the project but remain outside the scope of classical evaluation methods.

Currently, there are several commonly used methods for evaluating startups, such as the Business Canvas model, product life cycle analysis techniques, evaluation tables, and success metrics. However, these approaches often do not take into account all the technical risks and specificities of startups, limiting themselves to a superficial analysis. Moreover, many of them are poorly suited to the dynamic conditions of technology project development, leading to an incomplete picture of the startup's status and reducing the accuracy of forecasting its success. In such situations, there is an increasing need for a more systematic and structured approach that can consider all aspects of the product life cycle and provide a detailed technical analysis.

The development of a new evaluation method based on systems engineering principles allows for consideration of the technological characteristics of startups and a more accurate assessment of their prospects. Systems engineering, by integrating various disciplines and focusing on comprehensive project management, offers a universal tool for evaluation, covering both technical and organizational aspects. The OMG Essence standard, developed to formalize processes and improve interaction among project participants, provides a convenient platform for creating such a framework. It allows the structuring of key project elements and the tracking of their evolution at each stage of the life cycle.

The goal is to develop an innovative framework for evaluating technology startups based on systems engineering and the OMG Essence standard.

METHODS

Widyani Y. notes that the Essence standard was approved by the International Object Management Group (OMG) to formalize methods and practices. The Flow System has also integrated this standard. Essence allows the structuring of practices and related information in an accessible and visual form. This ensures their easy transfer, understanding, and further adaptation, either independently or in combination with other methodologies. In turn, the Flow System applies an extended version of the OMG standard, covering all aspects of complex system management [1].

Samar Batool Shirazi S. and Saud Khan M., in their article "State of Research Based on Essence," note that the OMG Essence standard (Kernel and Language for Software Engineering Methods) was developed as part of the SEMAT initiative and published in November 2014. It consists of two key components: a language designed to describe software engineering methods and a kernel, representing a set of entities reflecting methodological approaches in this field.

As for the language component, Essence represents a new stage in the development of situational method engineering standards, significantly differing from its predecessors, such as OMG SPEM 2.0 and ISO 24744. The main innovation lies in a fundamental simplification: the language has become less academic, the notation has been simplified, and the methods of application have been reduced to practical tools, such as visualization through cards. However, this "simplicity" may be perceived as excessive in some aspects. For example, instead of the usual terms "ontology" or "meta-model," Essence uses the expression "common ground" [2].

The life cycle of a standard project, as described in OMG Essence, is represented through the integrated interaction of all key alphas. The transition between alpha stages is facilitated by checklists provided in the standard for the initial stage. Subsequently, the project method can be

customized to specific conditions, offering broad opportunities for customization. In cases where standard checklists do not fully reflect the specific tasks of the project, new items can be added, or their placement between project phases can be modified, depending on the dynamics.

Additionally, the standard allows for the inclusion of extra alphas if the integrated representation proves insufficient. Alpha is an abstract entity that, in practical work, is projected onto physical objects: for requirements, these are documents; for the system, components, and modules; for work, tasks; and for the team, the actual participants in the process. These physical objects move through the stages of development, testing, and operation, gradually evolving as the project progresses.

Essence must allow for tracking not only changes in these objects but also the state of individual integral aspects, such as the team's competencies when implementing new technologies or the identification of strategic alphas necessary for project development. A distinctive feature of Essence is its approach to adaptation: it suggests starting with simplicity and adding complexity as needed, in contrast to models like RUP or PMBOK, which are complex from the outset and require the exclusion of unnecessary elements, potentially disrupting system integrity [3].

This approach makes Essence a convenient tool for use not only in complex projects but also in focused tasks. For example, the experience of CUSTIS, described by Olga Tsyganova at the "Applied Systems Thinking" conference, demonstrates the successful use of Essence for team formation, which is relevant to many IT companies. The ease of mastering Essence was a crucial lesson that Ivar Jacobson learned from developing RUP, and this aspect was central in the creation of the standard. In this context, it is interesting to note the experience of Anatoly Levenchuk, who actively applied Essence in his course at MIPT, replacing previous standards with it [4].

Essence provides for five standard levels of competence:

- Basic level — an individual has initial knowledge and is capable of performing tasks under supervision.

- Practical application — a specialist can independently apply knowledge in simple contexts and accumulate experience.

- Expert proficiency — a specialist demonstrates confident application of knowledge in various situations and can work without constant supervision.

- Adaptation — a specialist can adapt and apply knowledge in complex conditions and transfer it to others.

- Innovation — a specialist is a recognized expert who develops new approaches and inspires others to implement innovations [4].

The framework developed based on the OMG Essence standard represents a universal tool suitable for use in various software development scenarios. This standard, grounded in academic principles, encompasses a wide range of methods and practices, beyond the scope of this review. A thorough immersion into the content of the standard allows for a deeper understanding of its application and offers valuable insights for optimizing development processes.

Systems engineering is a multidisciplinary field aimed at designing, integrating, and managing complex technical systems throughout their entire life cycle [5].

Thus, systems engineering integrates across a broad range of disciplines, providing effective management of complex projects in various industries.

RESULTS

Large corporations such as NASA, Boeing, SpaceX, Virgin, Lockheed Martin, Siemens, and others widely use systems engineering to simplify the management of complex projects, minimize risks, and ensure that products comply with strict standards. In 2014, the Essence standard was introduced, serving as a guideline for the development, implementation, and improvement of software development methodologies. This standard is supported by the International Open Standards Consortium (OMG) and is part of the SEMAT initiative. SEMAT stands for "Software Engineering Methods and Theory" and was initiated in 2009 by Ivar Jacobson, Bertrand Meyer, and Richard Soley [6].

Let us take a closer look at the core of the Essence standard. In this context, a "problem area" refers to a specific aspect or direction in software development that requires attention. Within a business context, these areas are key elements of product creation and form the foundation for the successful functioning of the organization:

- Customer: covers all processes related to the use of the product and its operation, ensuring value for both customers and end-users.

- Solution: encompasses all aspects related to the development and specification of the product, aimed at meeting customer requirements.

- Endeavor: covers everything related to teamwork and methodology, aimed at the effective realization of the solution for the customer.

This model provides opportunities for more effective management of key tasks related to customer needs, solution development, and team organization (Fig.1).

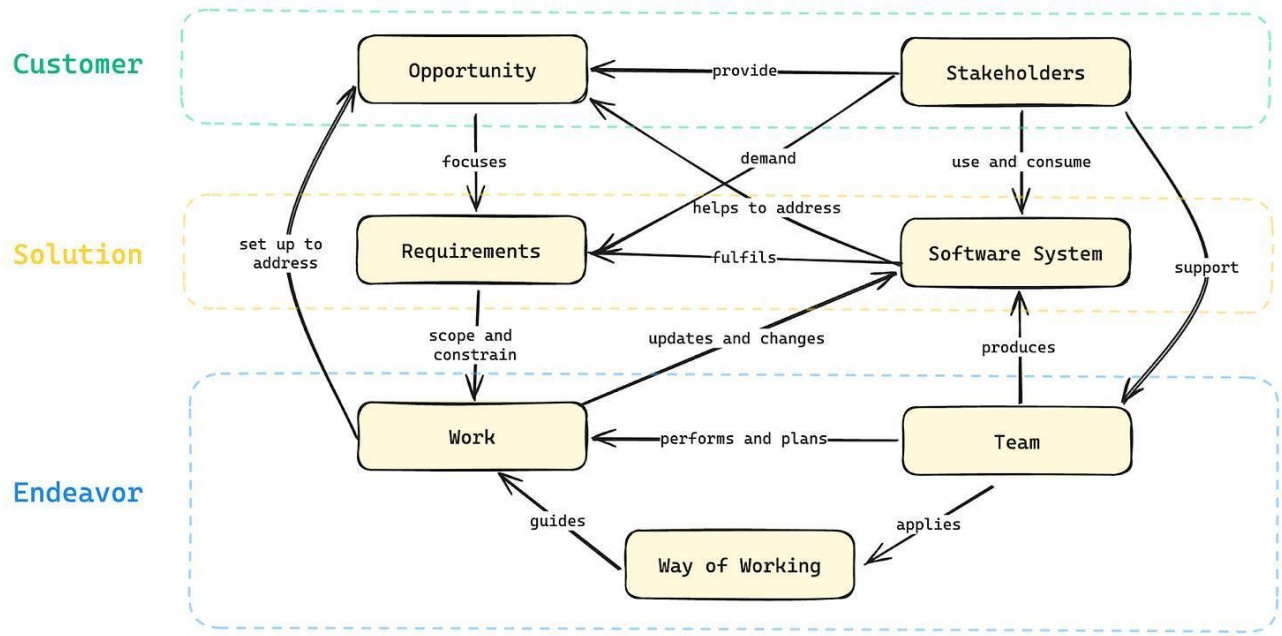

Fig.1. Diagram of the Essence standard model [6].

These areas and related activities form a structured framework for addressing numerous tasks in software development, enabling a

thorough analysis of the key aspects involved in this process. In each area, so-called alpha elements are identified, which can be interpreted as key indicators requiring attention and management at various stages of development. These alpha elements, representing dynamic components of a project, require constant monitoring and management to achieve successful outcomes. Each element has specific stages, and tracking the changes in these stages helps objectively assess the current state and progress of the project. The interrelationship between alpha elements is also considered, allowing for a more precise understanding of the mutual influence of processes and stages.

Alpha versions, with all their states and stages, serve as indicators of the project's current status, helping to identify problem areas that require attention, as well as providing the ability to track overall progress and the effectiveness of implemented solutions. Based on the standard, key metrics are proposed that are important for understanding the completeness and effectiveness of the startup development process:

- Stakeholders — individuals or groups whose actions can directly impact the success of the system.

- Opportunities — factors or conditions that create prospects for system development or improvement.

- Requirements — descriptions and characteristics of the system that need to be implemented.

- Software system — the software platform itself, the result of the development process.

- Work progress — necessary planning, task execution, and control throughout the project lifecycle.

- Team — specialists with the required competencies, including both technical and management skills.

- Way of working — approaches and tools used by the team to achieve project goals.

The OMG Essence standard proposes the use of checklists for monitoring the status of alpha elements. These checklists help track project progress, identify deviations from the plan, and promptly respond to emerging issues, allowing for the maintenance of project balance and the prevention of potential failures.

DISCUSSION

The implementation of the mentorship concept for startups can become an important strategic tool, fostering the development and support of entrepreneurial projects at every stage of their formation. This framework also might be applied to the VC due diligence process. One effective method is the use of a mental model for analyzing and interviewing startup teams, which enables an assessment of the current state of the business and its growth dynamics.

For example, during the first interview or series of interviews during due diligence with a startup team, it is crucial to gather comprehensive data that will serve as the foundation for making precise management decisions. A lack of such information can lead to distorted perceptions, which may affect the success of the project. Using the Essence system as a tool for evaluation allows for an in-depth analysis of the business's current state, ensuring that every critical area is addressed.

At the initial stage, special attention is given to the analysis and study of the customer base. A key aspect is forming a clear understanding of the target audience. Detailed research on the target group, confirmation of the problem's existence, and ensuring a deep understanding of the interests of all involved parties play a significant role in the successful implementation of the project. Additionally, assessing the economic feasibility of

the project, considering factors such as cost structure, market needs, and competitive advantages, is of critical importance (Fig.2).

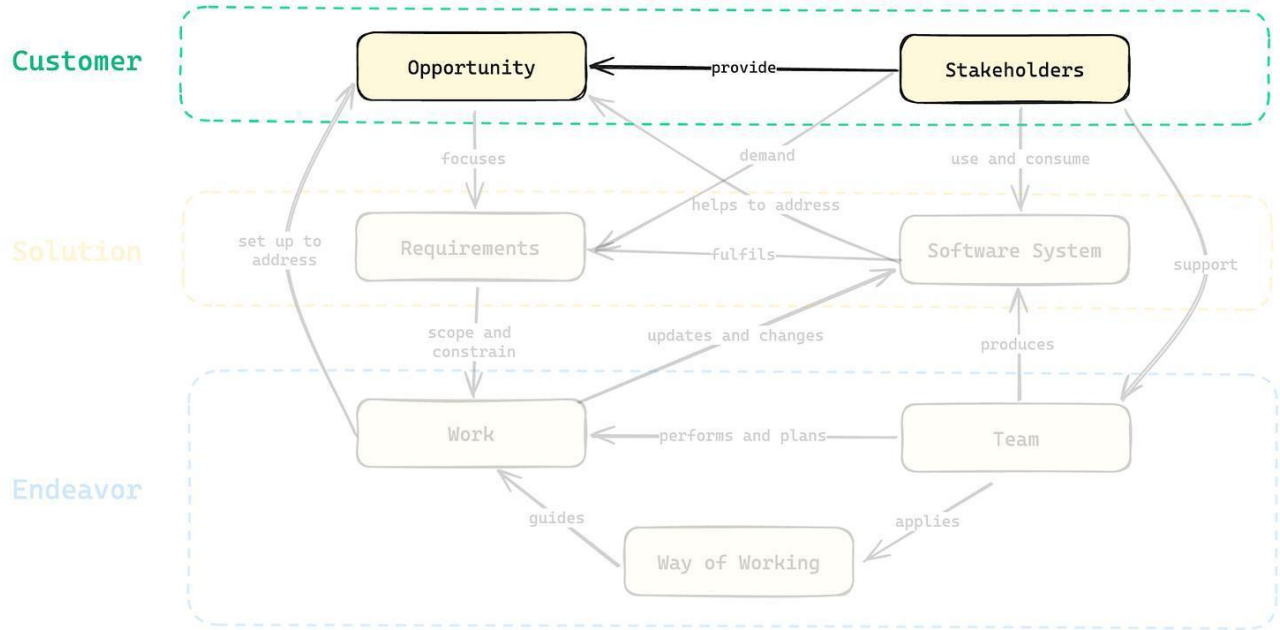

Fig.2. The client in the Essence standard [6].

The alphas of opportunities and stakeholders serve as key benchmarks in project analysis. The opportunity alpha focuses on identifying the problem the startup is addressing, as well as assessing the market presence for the proposed solution and the potential for team interaction. The stakeholder alpha involves examining the main participants involved in the project, such as customers, partners, and investors. For a thorough analysis, the following questions can be considered:

- What factors define current market trends for this project? Is there a demand for the proposed initiative?

- How many interviews with potential customers have been conducted, and what conclusions can be drawn from them?

- Are customers aware of the problem the startup is solving?

- How deeply does the team understand the needs and pain points of its target audience?

- What arguments support the idea that the team has sufficient resources and competence for the successful implementation of the project?

- Who among the project participants are the key stakeholders, and what are their roles?

- Have all significant stakeholders been considered in the project development process?

- How is the team's interaction with the main stakeholders organized?

These questions can form the basis for interviews, allowing for deeper discussion and revealing additional aspects as the conversation progresses.

At the next stage, known as the "Solution," work is conducted with system requirements and the overall software. This stage involves a detailed evaluation of the proposed technical solution to

determine its alignment with the customers' needs and expectations. Special attention at this stage is given to the study of project and architectural documentation, as well as other materials that describe the system in detail. The requirements must be based on the analysis of stakeholder opinions and should take into account potential business opportunities.

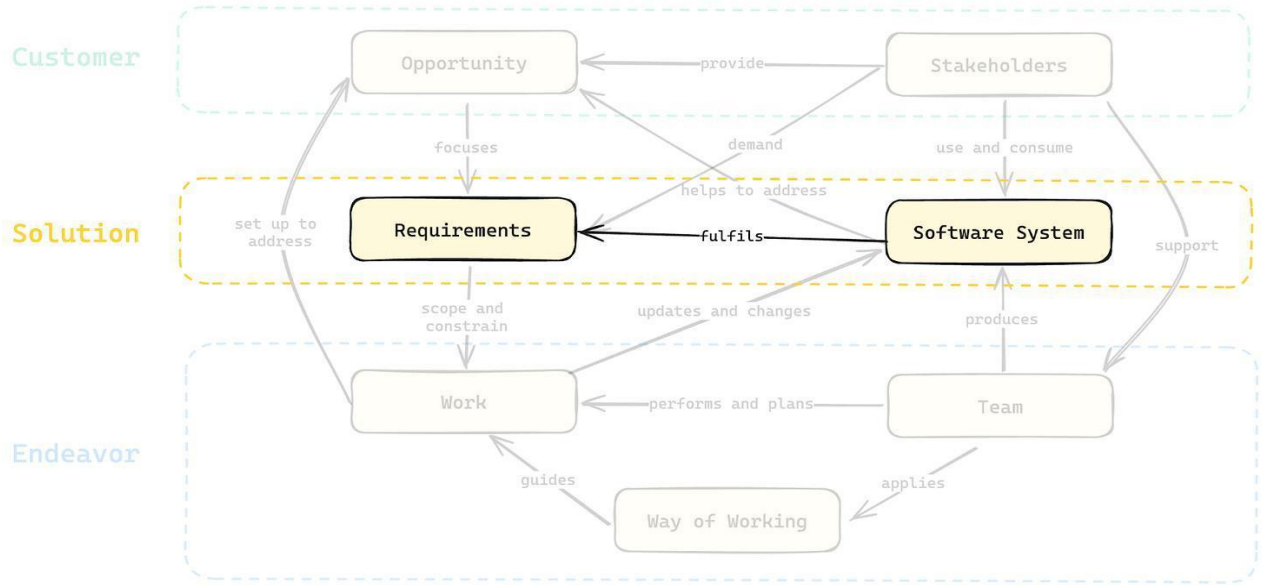

Fig.3. The principle of operation of the solution stage in the Essence standard [6].

Aspiration. At this stage, most system components have been reviewed, and attention is now focused on the final problem area — "Endeavor" which encompasses all actions necessary to ensure the full functioning of the system (Fig.4).

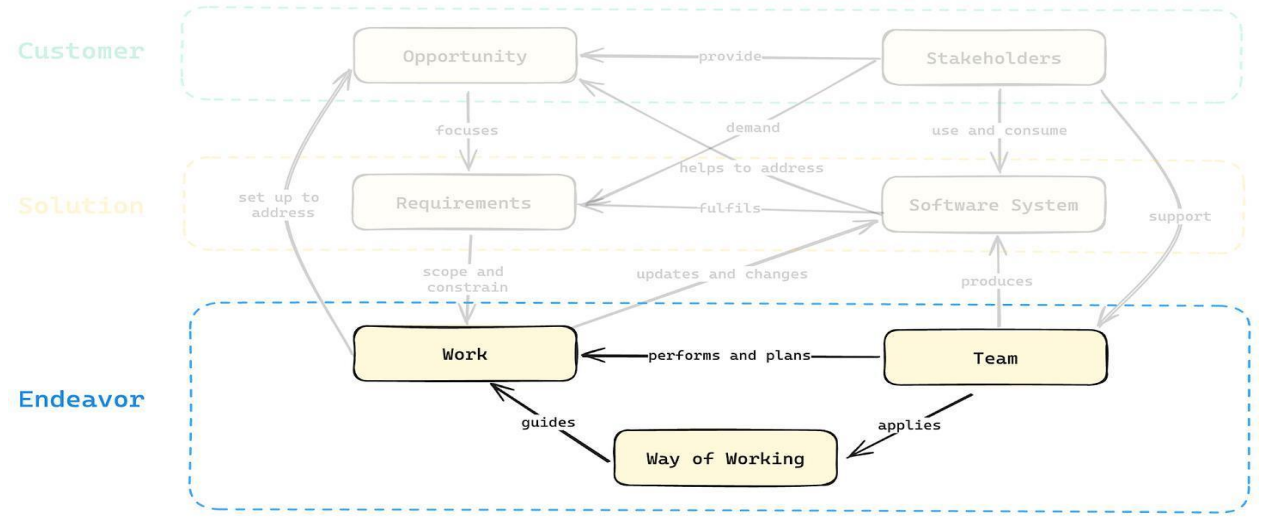

Fig.4. Description of the principle of aspiration in the Essence standard [6].

This section provides a detailed analysis of the team, tasks, and methods for their implementation. The team is considered a group of specialists possessing the necessary competencies to execute the project. It is important to account for not only technical skills but also managerial and other applied abilities. The success of the project largely depends on work planning and regular monitoring of its execution. The way processes are organized describes the team's approach to solving tasks, including the use of methodologies, frameworks, and technologies.

The concept of relationships acts as a navigational tool, helping to determine how various elements of the startup interact with each other. This is crucial for forming a holistic understanding of processes and creating structured interview questions [6].

Thus, the OMG Essence standard serves as a powerful tool for assessing software solutions and startups. This approach helps more accurately identify the current stage of business development and ensures careful consideration of critical areas when making strategic decisions.

Moreover, while the Essence standard provides a reliable foundation for evaluating software solutions, it should be noted that other models, such as the "Lean Canvas," "Value Proposition Canvas," and "Business Model Canvas," also exist. These models provide valuable data for evaluating business development, and in combination with Essence, allow for a comprehensive analysis of startups and software products, forming more effective strategies. The application of such a system can significantly improve the quality of management and development, contributing to the success of projects in various fields.

CONCLUSION

The framework proposed in this study, based on the OMG Essence standard, has demonstrated its value for evaluating technology startups by providing a systematic and structured approach to analyzing their development. The application of systems engineering allowed for deeper integration of key aspects such as project architecture, technological solutions, and team competencies, which traditional methods often overlook. The framework successfully covered the entire startup life cycle, enabling more accurate tracking of progress and improving project management.

The main advantage of using OMG Essence lies in its ability to adapt to the specifics of each project and provide flexibility in customization to meet particular conditions. Through the structure of alphas and checklists, the framework not only allows for the evaluation of the current state of a startup but also helps predict its future development, identifying risks at early stages and making timely adjustments to the team's direction. This is especially important for startups with high levels of uncertainty, where decision-making requires precision and comprehensive analysis.

Thus, the proposed method for evaluating technology startups opens new horizons in project management, minimizing risks and enhancing process efficiency. It can be effectively applied not only to startups but also to large technology companies that require optimization in managing complex projects. Additionally, the OMG Essence framework serves as a valuable tool for venture investors, particularly during due diligence and in the search for promising startups. With its structured approach, it enables investors to gain deeper insights into a project's viability, assess its current maturity, and identify critical areas that need improvement. A key feature of the framework is its ability to analyze startups at the level of fundamental elements, such as the team, technology, and market. This provides a comprehensive view of potential risks and growth opportunities. Such an approach not only enhances

the quality of analysis but also supports more informed investment decisions focused on long-term success.

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