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To cite this article: László Soltész and László Berényi 2021 *J. Phys.: Conf. Ser.* **1935** 012003

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Success factors in product development projects: expert opinions

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Abstract. Successful product development is a common challenge for technical and management experts. The increasing pressure on time reduction and cost savings while enhancing product features, requires rethinking project management methods. This paper analyses the opinions of product development experts about the success factors of product development projects. A voluntary online survey was used for data collection in 2020. The study confirms that development engineers, test engineers, project managers, and product development managers have partially different approaches to important success factors. Precise regulation and focus on collaboration are considered essential topics. The results show that knowledge management and collaboration with other organizational units must be improved. Enhancing the interpretation of project success and forcing the better utilization of lessons learned or module information can contribute to sustainable success.

1. Introduction

Careful design and improvement of product development processes are essential to reduce lead times of product development and make better and more valuable products to customers [1]. Otherwise, companies can minimize the risk of development and market introduction through well-made product development processes [2] [3]. A particular emphasis should be given to these projects because product development is riskier than other projects of the companies, and it has a spillover effect on investments and production. However, a well-managed product development project also has several extra risk factors, especially related market reaction to new products. It is difficult and uncertain to predict business factors, like how customers will welcome new products, is the pricing correct, is the target customer group found [4] [5].

Nevertheless, the lead time of a new product largely depends on industrial characteristics. Generally speaking, customers clearly tend to require more contemporary products much faster, than before. This expectation requires changes to projects; which give additional risks for companies and product development professionals; to speed up the lead time of a product to market sooner, while continuously providing some new features, services, or solutions to market, [6] through a complex approach to individual projects [7]. During development projects, there are different types of interests and reactions of the project stakeholders. Usually, the project team is stressed by the pressure of timing, cost limitations, and delivery of the specified products and services. There are different views in a complex



product development process by different company functional units; including manufacturing, technical assistance, and product development. Diverse levels of managerial roles, also see a project from different perspectives [8]. These different approaches of project members and stakeholders provide an opening for misunderstanding, disagreement, and conflicts within the project team. The main task of the project manager is to be aware of these different interests and views. He or she has to reduce conflict by these disparate short-term interests and set the project team on a common ground according to problem-solving of project issues [9].

Every company dealing with product development, must understand the main areas of these diverse foci, interests, and views by team members. These areas are inevitable, to deliver successful products onto the market [10]. One of the most critical success factors of product development are the people who are managing; doing product development projects. Suppose product development responsible managers cannot understand clearly, where the main conflict areas by a different interests in development are. In that case, they cannot manage the improvement of processes and handle this topic. Suppose the participants of the project and especially project managers become too upset and cannot feel full support from company management easily. In that case, they will be unmotivated, causing the reduction of product development project effectiveness and reducing creativity and teamwork [11] [12].

2. Materials and method

2.1 Research goal

The study aims to contribute to a better understanding of the specific characteristics of product development projects. The investigation's scope is limited to the evaluation of the success factors in the participants' opinions. The justification of focusing on the managerial aspects of a technical effort is given by the uncertainty and unpredictability of new product development. The goal of the study is to describe the experts' opinions about the success factors by different grouping factors.

2.2 Survey design

Corporate professionals of product development were contacted with a survey about their experience with the success factors of a product development project. Based on literature review and expert interviews, a list of success factors were compiled. The respondents were asked to evaluate the items on a five-point scale between not important and very important.

The grouping criteria include experience in project development, job function within the projects. The items of the success factors are organized around four critical topics (Table 1).

Table 1. Survey questions by success factors

Topics of success factors	Survey item
Regulation	Available written internal standards and regulation Regular inspection of written standards Clear, written project goal Compliance with previously defined objectives and targets
Information for the future	Project feedback meeting, collection of project lessons Lessons-learned database Module database
Collaboration	Regular project meetings Cooperation within the project team Involvement of sustaining engineering experts into the project Involvement of manufacturing experts into the product development project
Focus of project manager	Active focus on project team by the project manager Active focus on project deliverables by the project manager

A voluntary online survey was designed, and an anonymous reply was assured. The data collection method was convenient, using the snowball method. This method was necessary due to the particular target group of the research; even if this is a limiting factor in general findings.

2.3 Sample

The online surveys were filled in by 112 experts, all of whom have been involved in product development projects. 92 of them defined product development related tasks in their work, and 8 experts marked that they have other duties. The research sample consists of these respondents (n=100). The sample characteristics are as follows:

- Education level: 4% of the respondents do not have a degree. 35% of them have a bachelor's, and 57% of them a master's degree. 4% of respondents have a PhD.
- Normal Responsibilities: 32% of the respondents work as development engineers, 30% are primarily project managers, 23% are product development managers and finally 7% are test engineers.
- Experience: 34% of the sample have 5 years or less experience in product development. 20% of them have 6-10 years, 33% have 11-20 years, and 13% have more than 20 years of product development experience.

Although the sample cannot be considered representative, the size and structure of the research sample allow for conclusions to prepare further investigations.

2.4 Analysis methods

The survey results are processed by statistical analysis, using the following methods:

- The results by sub-samples are presented with the mean values of the evaluations on the five-point scale.
- The non-parametric Kruskal-Wallis test checks the differences between samples.
- The correlation between the survey item was checked by the Spearman method.
- A cluster analysis was conducted to explore the patterns of the responses. The hierarchical clustering procedure was selected with Ward-method for ensuring the minimal variance within the cluster.
- Crosstabulation for checking the composition of the cluster membership patterns (significance was tested by chi-square value)

The statistical analysis follows the instructions of [13] [14]. The confidence level of the statistical tests was 95% for each case.

3. Results and discussion

3.1 Overall assessment

There are three items of the survey to highlight based on the mean values. Clear written project goals (4.89) are considered the most important success factor of a product development project. That is followed by the cooperation of the project team (4.83) and the active focus of the project manager in the project team (4.65). According to the topics of the success factors, items related to regulation and collaboration are usually considered more important than others. The least important items are using a module database (3.68) and lessons learned database (3.80). The involvement of sustaining engineering experts into the project (3.94) or the regular inspection of written standards are also at the bottom of the list. The results confirm that emphasizing the management factors and human issues is considered decisive in product development success. At the same time, the results indicate a short-term approach to the project success of the experts. However, the items considered the least important go beyond the boundaries of the given project; they are essential inputs for future projects. In other words, the key

factors of sustainability are undervalued. Based on the correlation matrix (Table 2), these items are considered essential by respondents who also considered the involvement of sustaining and manufacturing experts important.

Table 2. Correlation matrix of selected survey items (significant results marked by ‘**’)

		Available written internal standards and regulation	Regular inspection of written standards	Project feedback meeting, collection of project lessons	Cooperation within the project team	Involvement of sustaining engineering experts into the project	Involvement of manufacturing experts into a product development project
Lessons-learned database	Correlation Coefficient	.161	.354*	.319*	.127	.317*	.340*
	Sig. (2-tailed)	.110	.000	.001	.208	.001	.001
Module database	Correlation Coefficient	.219*	.284*	.134	.203*	.324*	.282*
	Sig. (2-tailed)	.029	.004	.185	.043	.001	.004
Involvement of sustaining engineering experts into the project	Correlation Coefficient	.209*	.366*	.260*	.210*	1.000	.441*
	Sig. (2-tailed)	.037	.000	.009	.036	.	.000
Involvement of manufacturing experts into product development project	Correlation Coefficient	.223*	.377*	.214*	.338*	.441*	1.000
	Sig. (2-tailed)	.025	.000	.033	.001	.000	.

3.2 Evaluation of success factor groups

According to the questions about the project regulation, the experts considered clearly defined project goals, as the most important (Figure 1). Written standards and their regular inspection are found to be more important by development engineers, than by other stakeholder groups of the sample. Experts who are involved in product development projects, but their job description is not categorized especially for this purpose; value the importance of standards and regulations higher than other respondents. However, compliance with previously defined expectations is the least important for these experts. The differences in the evaluations do not show significant differences (Table 3).

Comprehensive lessons-learned and module databases are pieces of evidence for long-term thinking. Information collected in the databases

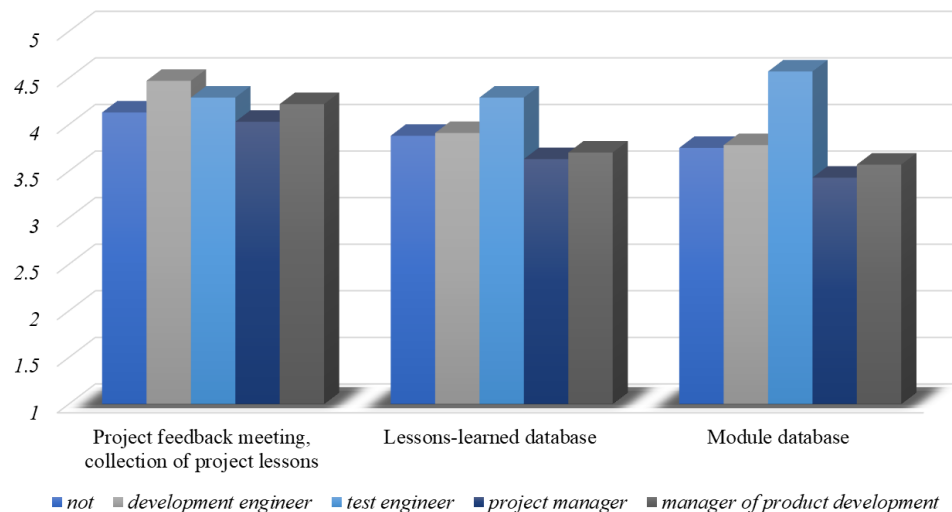
Managing the experience and lessons by project feedback meetings is rated higher than the databases by the respondents. The ratings are similar for this question while building a lessons-learned, or a module database, showing a more scattered picture (Figure 2). Test engineers rated these issues remarkably higher than others. Of course, they can use the databases as a direct information source in their jobs, but listening to the voice of the test engineers is better. It is beneficial for the corporation. Ratings by the project managers are the lowest in this question group. The result confirms that the project boundaries designate the responsibility of the project manager. Notwithstanding, this is obvious, and with a more

comprehensive responsibility of the project managers; more can be achieved, if this is formed by corporate management as an expressed requirement. The results of the module database show a statistically significant difference (Table 3).

Figure 1. Evaluation of regulation topic (mean values on a five-point scale)



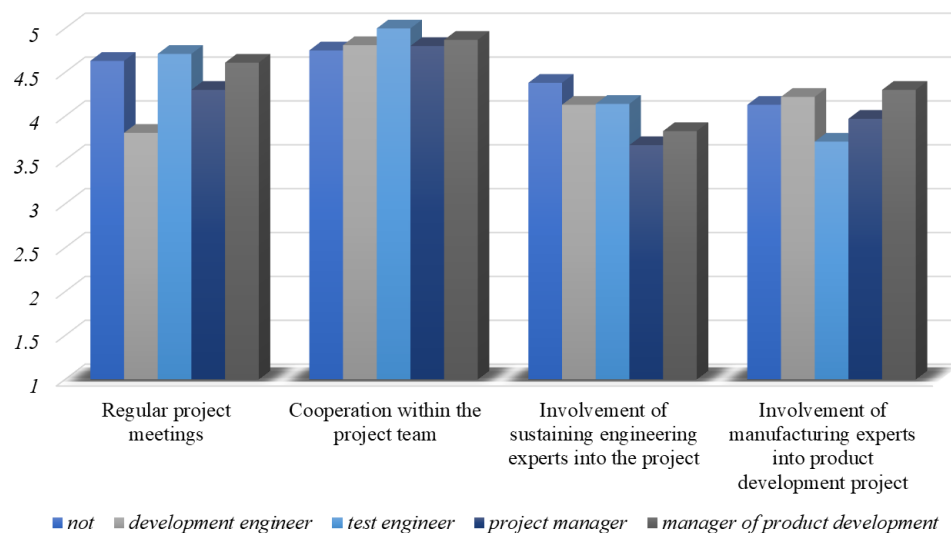
Figure 2. Evaluation of information for the future topic (mean values on a five-point scale)



Collaboration and teamwork include project-level information flow, internal cooperation, and the involvement of other departments. Project level collaboration shows the highest and most balanced ratings (Figure 3). Regular project meetings are rated low by the development engineers (the differences are significant, as marked in Table 3). Ad hoc participants, test engineers, and product development management consider the regular meetings the most important. The involvement of manufacturing

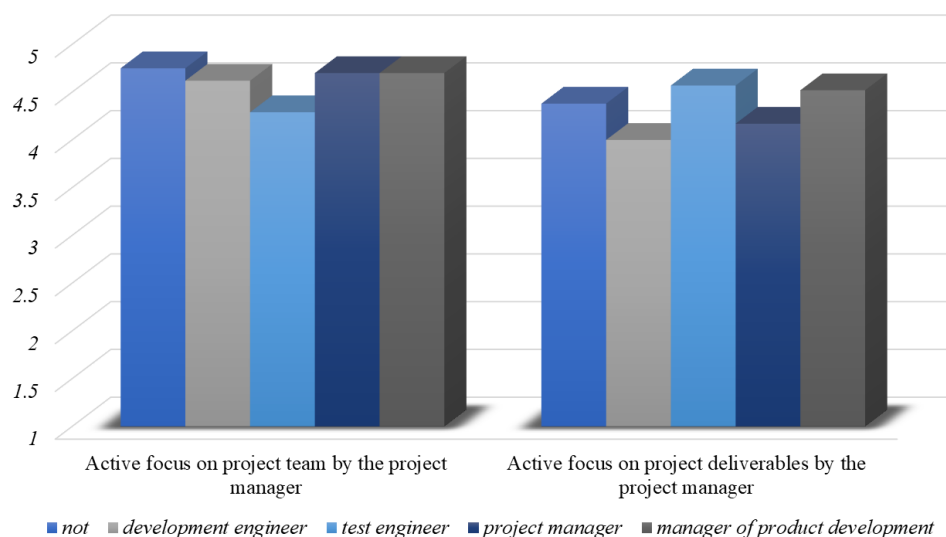
experts or sustaining engineering is subordinate to success based on the evaluations. Project managers show the lowest ratings according to sustaining engineering involvement, while test engineers do not consider it the least important to work with manufacturing.

Figure 3. Evaluation of collaboration topic (mean values on a five-point scale)



According to the focus of project management (Figure 4), project managers found, managing the project team more important, than giving priority to the deliverables. The responses of development engineers showed similar results.

Figure 4. Evaluation of focus of project manager topic (mean values on a five-point scale)



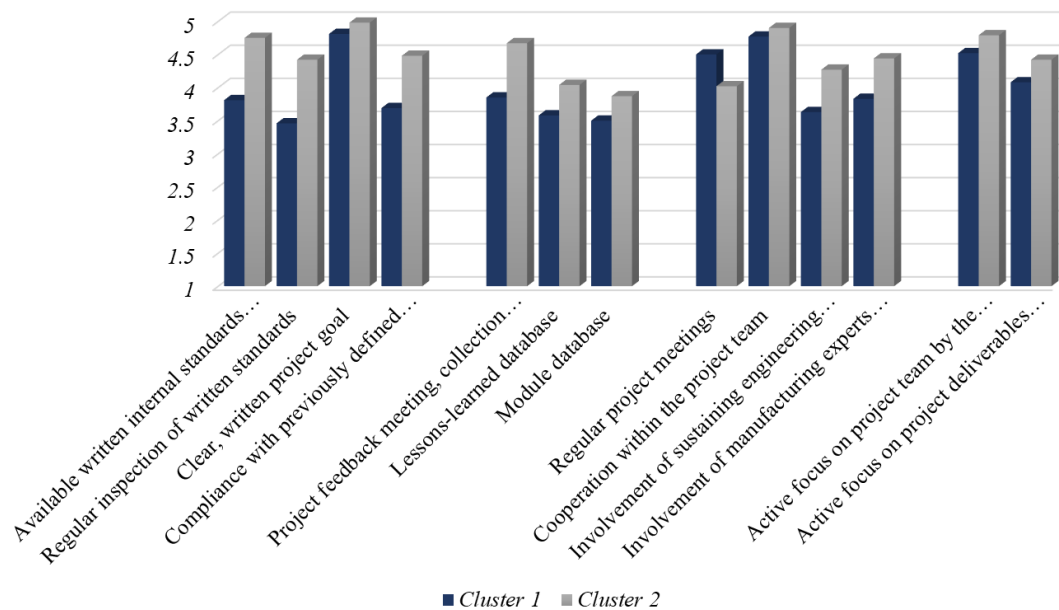
The statistical analysis was conducted with several grouping factors, but noteworthy or significant differences were not found by product development experience or any other aspects. That confirms that understanding project success, primarily depends on the interest represented by the job or position.

Table 3. ANOVA test results

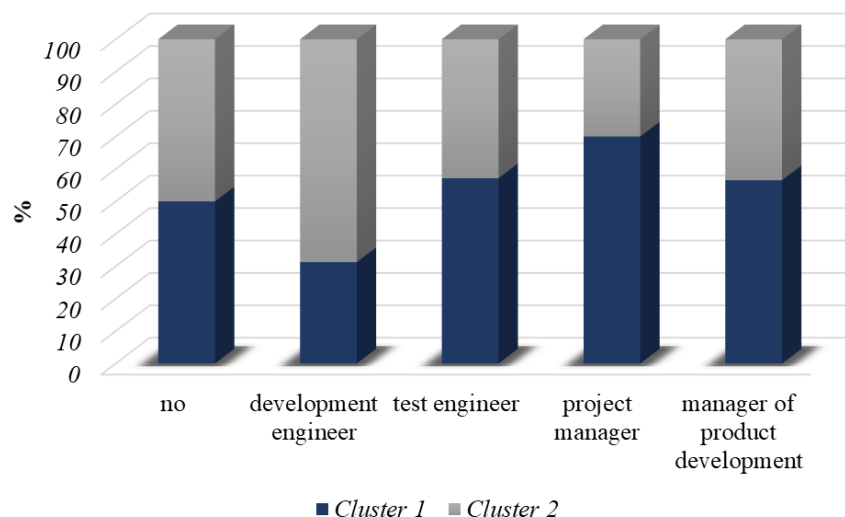
	Kruskal-Wallis H	df	Asymp. Sig.
Available written internal standards and regulation	2.637	4	0.620
Regular inspection of written standards	5.975	4	0.201
Clear, written project goal	4.231	4	0.376
Compliance of previously defined objectives and targets	5.504	4	0.239
Project feedback meeting, collection of project lessons	4.404	4	0.354
Regular project meetings	10.914	4	0.028
Cooperation within the project team	1.395	4	0.845
Lessons-learned database	5.876	4	0.209
Module database	10.968	4	0.027
Involvement of sustaining engineering experts into the project	7.829	4	0.098
Involvement of manufacturing experts into a product development project	4.061	4	0.398
Active focus on project team by the project manager	0.551	4	0.968
Active focus on project deliverables by the project manager	8.250	4	0.083

3.3 Clusters of opinions

However, the results suggest that the evaluations of success factors are mainly based on the job position of the experts; there were few significant results found. Based on the patterns of the responses, a cluster analysis was conducted for exploring groups of experts who think similarly. The analysis allowed two clusters (Figure). Cluster 1 includes experts who considered remarkably less important the need for regulations, the future information generation, and the need for involving experts other than the experts of Cluster 2. The only exception is the item of regular project meetings; this is rated more important by Cluster 1 members.

Figure 5. Evaluations by clusters (mean values on a five-point scale)

Cross-tabulation confirmed the significant differences in cluster membership by the job characteristics (Pearson Chi-Square=9.690, $df=4$, sig.=0.046). The proportion is summarized in Figure 6. Cluster 1 includes the majority of project managers and managers of product development, while Cluster 2 the majority of development engineers. It is to note that based on the analysis, the opinions of most test engineers are closer to the management than to the development engineers.

Figure 6. Cluster membership by jobs

4. Conclusions

Improving performance and enhancing the opportunities for product development is a key area of technical management. Appropriate responses to the market and competitive challenges require identifying and exploiting the success factors in the field. Due to the complexity of the problem, there are no eternal answers. Our study uses experts in product development to find patterns of their thinking. The results confirmed our assumption that the internal project stakeholders in various positions have

slightly different views regarding product development's success factors. Otherwise, some success factors clearly have a strong ranking as a contribution to the success of product development projects.

The main focus areas of further development of product development processes are the following success factors:

- Clear, written project goals
- Cooperation of the project team
- The active focus of the project manager on the project team (managing people and relations)
- Regulation and collaboration
- Lessons learned and module database
- Involvement of sustaining engineering

Consequently, we can define 3 main areas of success factors.

A clearly written set of project goals, as a specification or scope, is really the most important need for projects. That is a clear request from product managers and the participants. According to our experiences and personal discussions with product development experts, this requirement is extremely important in the automotive area. However, in the case of customer products, it occurs quite often that the requirements for delivery time or specification changes during the development project. These situations can be successfully managed by an agile approach, including new technical solutions and communication tools, for the development process [15].

The second area of improvement is people. Cooperation within the project team, as well as the active focus of the project manager on the project team, regulation, and collaboration topics are showing how important people are in the project [16]. Beyond excellent individual performance, the ability to work in groups is essential. A complete team must work together to counteract each other's weaknesses, vacancies with their strengths. Keeping motivation, creativity, problem-solving ability, delivery of new types of solutions; predict the effectiveness of the project.

Finally, a focus area is knowledge management, including lessons learned and a module database. The requirement for boosting the product development process, generates a high level of valuable available knowledge inside the organization, for faster product development. Integrating IT solutions with product development processes, provide useful knowledge database tools such as searching, and transferring knowledge to people. The importance of the involvement of sustaining engineering into product development is also about knowledge transfer. These teams of development engineers are fully aware of the development of product during the life cycle to answer the needs of customers, quality, and manufacturing. This type of knowledge must also be considered in new product development processes as PMI or ISO standards are also required [17].

The conflict of interests about the success factors of product development projects is based on the job positions of the stakeholders. The analysis confirms the approach of managers and development engineers. A better harmonization of the needs and expectations may promote success.

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