

# DECISION-MAKING PROCESS IN SOFTWARE PROJECT MANAGEMENT

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## Abstract

This research seeks to evaluate the cases when context and individual factors influence how decision-making works, leading to ineffective decision-making in the process. The central question for this study is: What facts influence software project managers in making decisions? The elements that impact the discoveries of the software project managers and their possible results demand concentration because project status (delays, success, or failure) mainly results from a series of bad decisions. The major intent of this research is to identify how these categories of factors influence decision-making: contextual factors (members of the team, stakeholders) and individual factors (previous experiences, feedback received, risk management) to increase the efficacy of project management. To obtain insights on how is functioning the decision-making process, in this paper, we conducted a practical study by investigating the results of a survey developed to catch the experiences of software project managers. Based on the study's findings, we concluded that one of the factors with the highest impact on the decision-making process is the feedback received by project managers from their team. In the second place, with lower influence, the factors are placed in the category of contextual factors (members of the team and stakeholders), which have an equal significance in decision-making. The last category of elements has the lowest impact on the decision-making process: previous experiences and risk management. In terms of risk management, most project managers are not afraid to assume risk, which has a negligible impact on making a decision.

**Keywords:** Software Project Management, Decision-Making Process, Cognitive Biases, Decision-Making Styles, Risk Management, Contextual Factors, Individual Factors, Feedback

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## **1. Introduction**

“Decision-making is a complicated process that begins with the perception of the need for change and has its end in choosing and implementing a course of action among several viable ones.” (KIRKWOOD, 1997) [5]

A significant part of decision-making concerns exploring a limited set of choices related to evaluative benchmarks. Simon [4] states that we cannot obtain a whole image for all possible alternatives in most circumstances, or the time and cost of targeting this scope are too expensive. Unlike any other project, the requirements are subject to frequent changes in software development, as stated by Cunha [1]. As a result, many decisions must be made with high uncertainty, making software projects more unpredictable. As the author presents “software projects involve dealing with trade-offs between characteristics, preferences, and quantities while maintaining a balance between requirements”.

Ruhe [12] concludes that decision-making impacts all project phases. Considering this fact, the efficiency of each decision should be of utmost importance at every stage in the developing process. Therefore, a formal evaluation process should be done before making all the decisions. For example, one process consists of the following steps: designate procedures for decision investigation, specify the criteria, determine alternative explanations and solutions, choose evaluation methods, consider options, and elect the final solutions.

When selecting the right solution, it is known that decision-makers tend to depend on infrequent judgmental rules or heuristics to facilitate challenging decision concerns. Tversky and Kahneman [13] have classified these cognitive biases into behavioral biases, probability and belief biases, perceptual biases, memory biases, and social biases.

These biases can conduct to extreme and systematic errors in decision making, thus making them causes of failures in making efficient decisions. By acknowledging the impact, some techniques, such as bottom-up planning, burndown charts, product demos, flexible planning, daily meetings for the team, and stakeholder feedback, may be used to defend against considerable biases.

In software project management, these biases can be reflected in errors such as the ones mentioned in “*Cognitive Biases in Software Engineering: A Systematic Mapping Study*” [11]. The first possible bias is that project managers tend to bypass requirements analysis. In this case, the overview of the situation can be superficial and incorrect, which can lead to an inefficient estimation of time and resources for the project. The PM's overconfidence can lead the project to failure. The second could be that miserly information processing causes specialists to accept client prerequisites uncritically.

Another bias can be that project managers often underestimate the value of their time, cost, and effort and anchor to the initial value, which is low. This underestimation and not evaluating/renegotiating introduce a distortion on software product assessment, making it

contesting to revise project plans. For example, project managers often overestimate software productivity by landing on the lower side's conventional project completion time estimate. Software developers then sense the pressure to perform to get the project back on track. Finally, PMs achieve extra help, surpassing the project's funding and agenda.

In the case of memory biases, project managers can irrationally allocate more resources in a case like a previous case where a more increased investment has been made.

Each alternative of any decision should be evaluated by software project managers using a set of factors, which can be divided into two categories: situational factors and individual factors. For the first one (situational factors) it can be considered: iterative planning, client involvement, continuous feedback, initiatives for transfer of the know-how, the autonomy of the SPM, the flexibility of the process, the technical capacity of the team, or even the task complexity. On the other hand, individual factors are SPM's leadership style and SPM's experience. Both categories are equally affecting the decision-making process [1].

One of the prior responsibilities of management is decision-making. Still, it alters based on the individual's dissimilarities because everyone has a distinct consideration and knowledge processing style that influence how they decide. In addition, the decision-making style for everyone depends predominantly on how they think about and assesses information. Vroom and Yetton have identified five decision-making styles that can be shown in any challenging circumstances [6]. Their research was performed on 500+ people with leadership roles, participants in management development programs, who were asked to provide noted reports of a company problem they had experienced lately. The final descriptions collected were between one paragraph to several pages. Ultimately, each supervisor answered the questions concerning the selected problem. The identified decision-making styles are conferred as under:

- Autocratic Type 1 (AI) - a stringent process where the supervisor completes their conclusions based on readily known knowledge.
- Autocratic Type 2 (AII) - supervisors utilize this style to gather the necessary facts from their subordinates and then determine the problem's answer. The role of the subordinate is exclusively to provide data rather than generic alternatives.
- Consultative Type 1 (CI) - The supervisors transmit the problem to each employee and take their recommendations and thoughts. Supervisors' decisions can (or cannot) mirror the input received from their subordinates.
- Consultative Type 2 (CII) - Separate group members can confer with each other and disseminate potential options. The supervisor does not commit to using the intake obtained.
- Group-based Type 2 (GII) - Unanimity decision-making technique where the supervisor disseminates the problem to the group of employees and finds a solution through brainstorming. The supervisors do not attempt to control the group's ideas and perceptions.

## 2. Previous work

### 2.1 Studies based on classical factors

Mc Kinsey's study [7] tries to assess the various factors influencing decision-making at work. Executives often refer to wrong causes of inefficient decisions, which lack scientific rigor. Just because one strategy works for a particular organization may not be equally effective for other enterprises.

According to Kinsey, the following five factors influence managers in decision making:

1. Budget preparation – decision-making is strongly related to budget allocation, also known as environmental factors.
2. future development - strategic plans and long-term commitment are usually expected to influence the organization's prosperity and decisions. Future development is also referred to as the organizational factor.
3. orientation – decision-making must keep in view the competition existing in the market. Sometimes organizations must face non-price competition [14]. (Social factor)
4. factors of environment – changes constantly influence decisions in the background. Managers should act by external or internal changes. (Environmental factor)
5. risk – the plans should be able to tackle the risks which may appear. Risk and uncertainty are two essential aspects that must be considered when making a decision. (Personal factor)

Atmosudirjo [8] expressed two critical aspects that impact the process of decision-making: the type of the organization and the personal abilities of decision-makers. In some cases, the personal factor (sometimes mentioned as the individual factor) is deemed the most challenging to handle or anticipate in the decision-making process because many variables can influence this.

In [7], Arroba noted five factors influencing the decision-making process, connected to the person who makes the decision. These factors are:

1. data that was known regarding the definite problem which needs to be cracked
2. the level of education
3. the personality
4. coping - adaptation to the problem
5. culture

The personal factors correspond to the psychological aspect of the people that make the decision, whereas the organizational factor trades more with the environment or the conditions in the organization. Likewise, organizational behavior and dynamics are multi-determined and somewhat tricky. Thus, it needs a manner of studying and comprehending the circumstances in an organization. Syamsi [10] identified four factors that influence the process of decision-making:

1. the condition of the organization;
2. availability of data/information;
3. external circumstances;
4. personality and skill of the person in charge.

The first three factors correspond to the organizational factors, which influence the decision-making process, whereas the last identified element corresponds to the individual or psychological aspect.

## 2.2 Recent studies

Cunha's study [1] tries to comprehend how the decision-maker evaluated the decision established by analyzing their knowledge in the workplace and recognizing precursors and outcomes of those judgments to boost project management efficacy. In his study, he considers that for software project management, the decision-making is ruled by experience, negotiation, communication, level of self-control, and point of view, which are individual factors. However, they are not the only ones because contextual factors can also appear: the autonomy of the manager and team members' technical abilities.

Jingdong Jia identified in May 2016 [3] a set of 237 environmental factors that influence the decisions pipeline in software projects. These factors were extracted through a methodical literature review of 40 related papers. The factors are discussed in his article "*The environmental factors influencing individual decision-making behavior in software projects: a systematic literature review*". Based on this study, Jingdong realized in October 2017 an analysis of this data. In his research "*Grouping environmental factors influencing individual decision-making behavior in software projects: a cluster analysis*" [2], he proposes a classification of these 237 environmental factors by using a k-means clustering algorithm to group all these factors. The resulted categories of factors, along with the number of factors included in each category, are:

1. Challenging work - 38 factors
2. Goal - 34 factors
3. Appropriate physical conditions - 24 factors
4. Company support - 23 factors
5. Characteristics of the task - 20 factors
6. Distributed team - 20 factors
7. Feedback from the job - 20 factors
8. Organization - 20 factors
9. Technical competence - 18 factors

10. Development - 11 factors

11. Peer commitment - 9 factors

### **3. Proposed approach**

The paper identifies characteristics that impact the decision-making process in software project management. The research was devised using the survey method. All the data was gathered by disseminating questionnaires. The survey is conceived to use as a variable for studying two categories of factors:

- contextual factors (members of the team, stakeholders)
- individual factors (previous experiences, feedback received, and risk management)

The reason for using these factors as examination variables was that these elements commonly influence an organization's decision-making process.

To study the decision-making process, a form was created and distributed. The form answers will reflect the way of thinking of different software project managers, based on their previous experiences.

To determine the candidate's experience, they will be asked to state how long they've been working as a software project manager and say how big the company they work in is. Also, they will note how many teams they coordinated to find out how many different decisions they made.

After determining how much work experience, they have, they will specify their opinion on what they consider a complex decision to identify the decision-making factors that make a decision complex.

### **4. Study results**

The form was sent to 115 candidates to examine their decision-making as software project managers. A set of questions was created to see the decision-making process in different companies and circumstances.

The research is focused on software project managers. Most of our candidates were selected from LinkedIn profiles who indicated work experience in project management in the IT industry. The main reason for targeting this category is because project managers are the ones who must assume the majority of the decisions in the software development cycle.

The participants in our research were asked about the number of years of experience in the field, and it resulted that 70% of the respondents have less than 5 years of experience. The research was conducted on a group having an average of 4.84 years of experience in the field, with a standard deviation of 3.60.

Almost 55% of the participants stated that they are working in companies with more than 1000 employees, and another 25% of them said to be working in companies having between 100 and 1000 employees.

For more insight into the level of experience of the respondents, they were asked the number of different teams they have worked in as project managers. 53% of the respondents answered that they have worked in more than 3 teams, and only 12.2% of the respondents have worked only in 1 team as project managers.

A meaningful subject of study in the research conducted was identifying the factors that make project managers consider a decision complex. The factors analyzed by this question were stakeholders (decisions that imply talking to the client), team members (decisions that require summoning the whole team), previous experiences and risk management (decisions that only mean your judgment for the most part), and feedback (decisions that you must make based on some feedback). The results show that the percentages are almost equally distributed between these factors, although the decisions which require summoning the whole team have the highest rate of 33%.

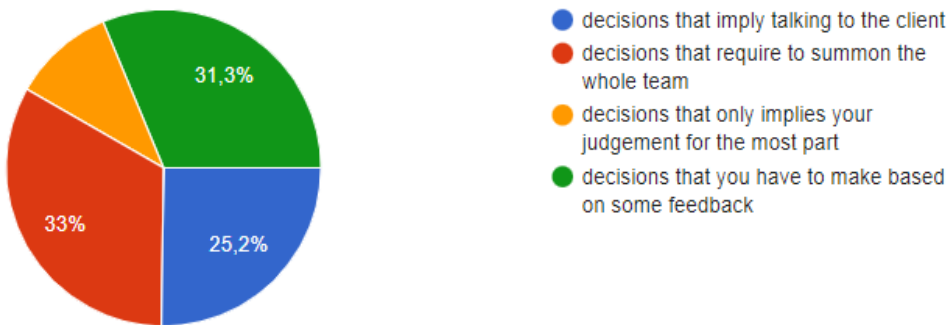


Figure 1. Which of the situations considered makes you consider a decision complex?

One top feature of agile software development is the team members' engagement and involvement in making decisions. To determine how much a PM involves the team in this process, they were asked, "How often do you summon the whole team to decide for the team?". Half of the respondents (52,2%) answered "most of the time", 13,9% "always", 27% "sometimes," and only 7% said "rarely", indicating that most of the managers take into consideration the team's opinion.

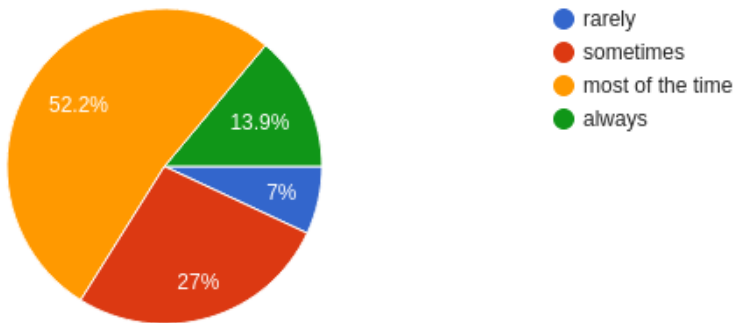


Figure 2. How often do you summon the whole team to decide for the team?

The second question that highlighted the team's importance in making decisions in a software project was "How much does the team's opinion usually impact the final decision? Choose the answer that fits you the best". The results show that, in total, 67% of PMs that answered the questionnaire prefer to let the final decision be made democratically, giving a last word to the team. From this total, 60% of them address a more open decision-making process which implies brainstorming with the team, listening to every opinion, and then deciding, whereas 7% prefer to come up with some final, personal options and then get the team involved. A high number of respondents (32,2%) also indicated that they would instead consider the opinion of a more senior member, and more than half of the PMs that chose this option are the ones conducted as project managers with 3 or more teams.



Figure 3. How much does the opinion of the team usually impact the final decision?

By asking candidates about how stakeholders influence their decision-making process, it was discovered that the majority (76.1%) consider the opinion of the stakeholders equally crucial to all the other factors in making a decision. Another significant percentage of the respondents (17.7%) stated that the idea of the stakeholders is primary in every decision they make.





Figure 4. What do you think is the influence of project stakeholders on project decisions?

Also, candidates were asked how often they contacted the project stakeholders for an opinion. Almost half of the respondents answered that they get the stakeholders most of the time, whereas only 8% responded that they always ask the stakeholders for an opinion.

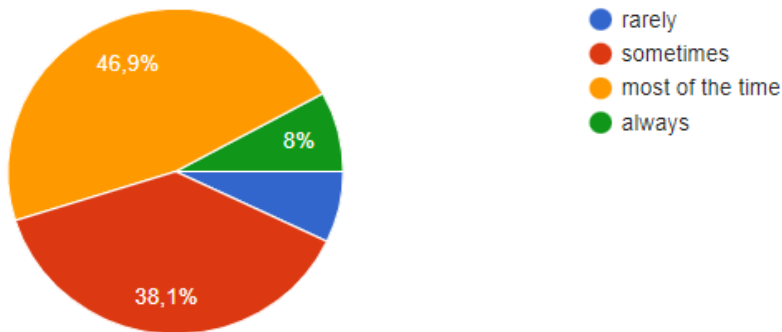


Figure 5. How often do you contact the stakeholders of the project for an opinion?

The next factor analyzed in the survey is previous experience and how it affects the decisions of project managers. The results indicate that most of them consider previous experiences necessary but not crucial. Another 18.6% of the candidates stated that they analyze their decisions independently from their previous experiences, which leads to the conclusion that previous experiences do not influence decisions. Also, 8.8% of the candidates responded that they base their decisions on similar past experiences, which leads us to conclude that less than 10% of the project managers consider their previous experience a significant factor in making a decision.

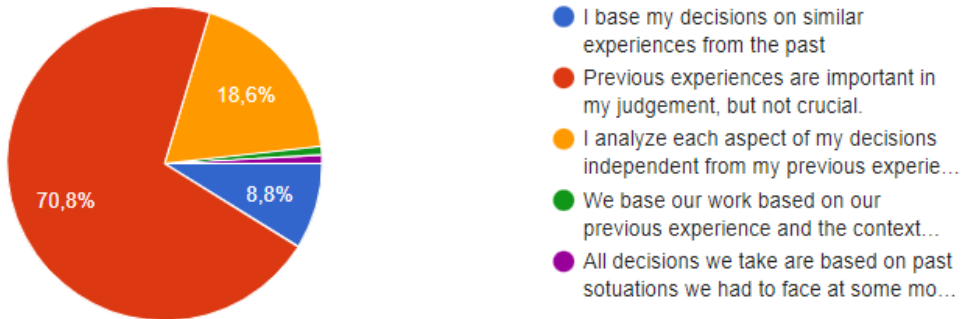


Figure 6. How do previous experiences influence your decisions?

When asked: “How often did it happen to you to be in a situation similar to an experience?” 68.1% of the candidates responded “sometimes”, and only 24.8 responded with “most of the time”. There is also a percentage of 7.1% of the candidates who answered that they are rarely in situations similar to past experiences. The results of this question drive to the conclusion that past experiences are not frequently reliable for PMs when making decisions because it is not so common to be in situations similar to past experiences.

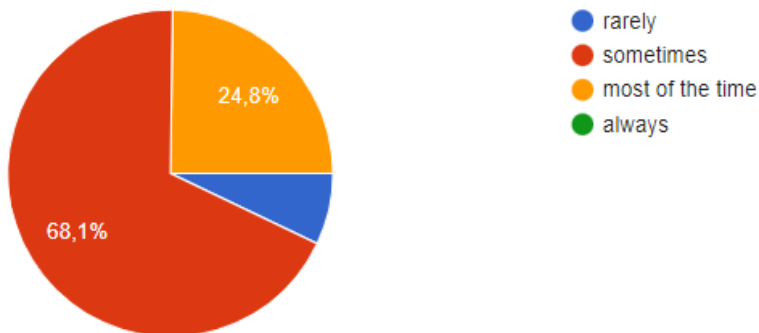


Figure 7. How often did it happen to you to be in a situation similar to an experience?

Another factor involved in the analysis with the help of the questionnaire is feedback, more specifically, how receiving feedback influences PMs in making decisions. The majority (96,5%) answered that they generally like to “consider all the feedback received to improve their future decisions”. Only a few (2,7%) said they “consider only feedback from their superiors”. Also, we aimed to find out how often PMs ask for feedback and consider it when making a decision. If at the previous question there was a majority, at this one, the answers were almost divided between “I ask for feedback only when I consider it needed” (58,8%) and “I always add feedback forms and read the feedback at a certain period” (40,4%). Thereby, the majority of PMs concentrate on making and revising decisions in an ongoing feedback loop, the difference being made only by the periodicity that one might ask for feedback: some prefer to ask for it with regularity, whereas others reach for it usually when they consider it is needed.

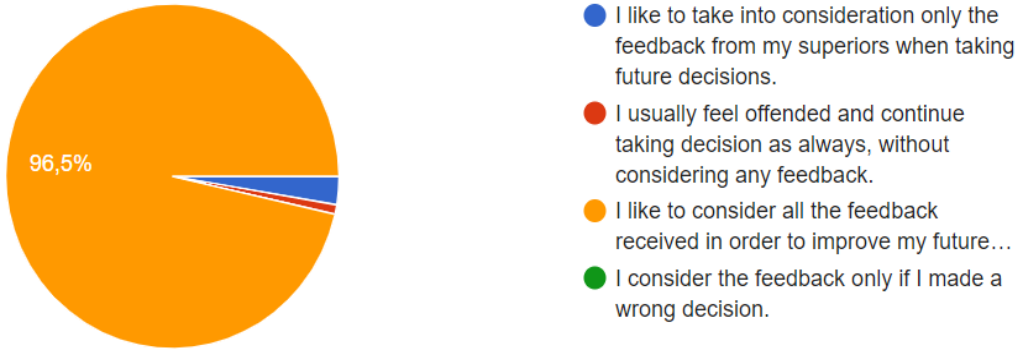


Figure 8. In the past, how have you responded to the feedback received about your decisions?

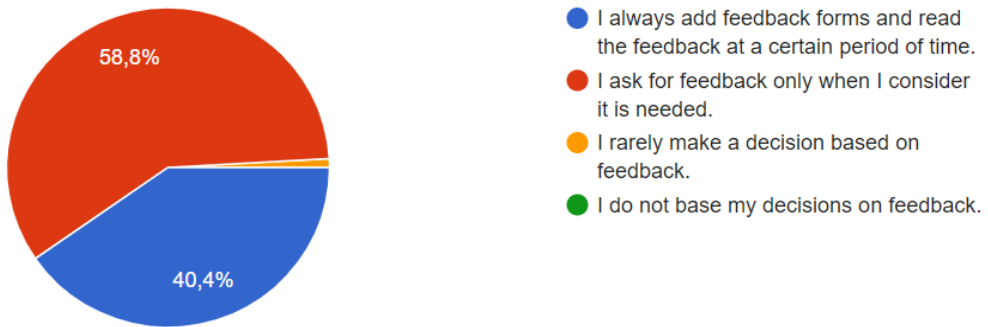


Figure 9. How often do you ask for feedback and consider it when making a decision?

It is well known that the PM is accountable for supporting all the project team members and keeping himself or herself on alert about the potential risks and prospects. By exerting appropriate risk management, the PMs can reach a convenience level within the unknowns in projects. Therefore, the last factor of interest in the research was risk management. The received answers vary at the question “How do you manage risk in making your decision?”. The most common answer is “I like to assume risks, but I always analyze all the possible negative outcomes” (55,3%), highlighting that half of the MPs that took the questionnaire like to take calculated risks.



Figure 10. How do you manage risk in making your decisions?

Another 18,4% answer that they take risky decisions but never over a certain level of risk, and 17,5% tend to choose a safer alternative. The rest of 8,8% are the ones who take the most chances.

The candidates asked the following two paired questions: “Have you ever made a hazardous decision” and “In case you did, which was the outcome”.

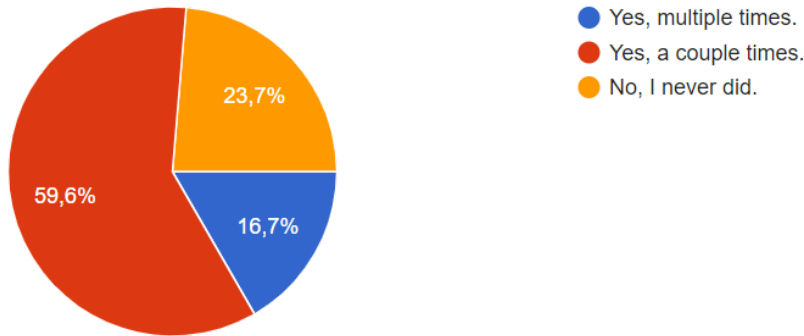


Figure 11. Have you ever made a hazardous decision?

It can be observed that 59,6% of the PMs made risky decisions “a couple of times”, whereas 16,7% “multiple times”. 76,3% of them had a positive answer, and only 16,7% never took a risky decision. It turns out that for the majority, it had a positive outcome. Some said that the positive note is due to a calculated risk:

*“The outcome was positive because the risk was known and mitigated as much as possible.”*

*“The risk did not materialize as it was closely monitored, and we were prepared with a mitigation plan.”*

*“Risk was communicated and addressed to minimize the impact.”*

*“Everything worked out fine because a risk assessment was done before taking the decision.”*

Some other popular opinions are that even though the outcome was not the one that they expected, they had a lot to learn from that experience.

*“Most of the time, it was worth taking that risk. In the other cases, we tried to learn from experience and help us make a better decision.”*

*“We learned a lot.”*

*“Usually, if I make a risky decision, I know there is no other way (without risk, there may not be gain), but I analyze all possibilities, and I have a backup plan and safety net. Why? there is a team behind me.”*

*“The outcome is not always predictable. Some of the risks taken led to positive outcomes, while others failed. There is no silver bullet or formula that can always be applied in every situation to get the best outcome. However, if you don't try things and take risks, you won't*

be able to improve or have results. Besides, some risks can become opportunities if you play your cards right.”

Also, through the last question addressed, it is demonstrated that PMs tend to be more influenced when deciding by the possible positive outcome than the negative one, as 72% of them stated.

## **5. Discussion**

This material about decision-making in software project management has significantly understood factors that appear to affect effective and ineffective decisions made in software projects. This article introduced the conclusions based on the answers received in the questionnaire addressed to project managers.

We analyzed 2 categories of factors, contextual and individual, and we observed that from the category of individual factors, the most influential one is feedback when deciding on a software project. The research demonstrates that almost all respondents (96%) always consider feedback, and 31,3% of them also consider it the main factor that makes a decision complex, in contrast to the other 2 individual factors: previous experiences and risk management. Most PMs who took the questionnaire admitted that past experiences are essential but never crucial. They do not avoid deciding because there might be risks involved.

When talking about the contextual factors, both factors that we analyzed tend to fill the scales as the highest percentage of respondents (33%) have voted decisions that imply summoning the team members to be the most complex and the second-highest rate (25,2%) voted as the most difficult, decisions that indicate talking to the stakeholders. Also, when being questioned about how often they are asking for an opinion from the stakeholders or the team members (contextual factors), it was demonstrated that they tend to ask the team more often for an idea.

## **6. Conclusion**

The study demonstrated that the feedback received by project managers is the factor that has the highest impact on decision-making. It is also the factor that affects this process most frequently.

Following this factor, the factors are placed in the category of contextual factors (members of the team and stakeholders), which have an equal significance in decision-making. It was proved that project managers tend to assign almost the same importance to the opinion of the stakeholders and the opinion of the team members in decision making.

The last category of factors has the lowest impact on the decision-making process, consisting of previous experiences and risk management. Most project managers consider previous experiences necessary, but not a crucial factor in making decisions, and a significant number of project managers analyze all decisions independent of incidents in the past. Also, in terms of risk management, the study demonstrated that most project

managers are not afraid to assume risks, which makes this factor of risk management one which is not likely to have a high impact on how decisions are made.

## 7. Future work

The research reviewed here does not provide any solutions on how to decrease the negative impact that the factors which influence the decision-making process can have on the outcome. Qualitative studies, including case studies, grounded theory, and protocol studies, are well suited to understanding how to minimize the negative influence. Studying new approaches on this subject and adapting existing ones for software contexts is a valuable study that needs to be undertaken. The models discovered can be evaluated using controlled experiments or action research.

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