# MODELING THE DECISION-MAKING PROCESS IN ORDER TO ASSESS THE RISKS OF AN IT&C PROJECT

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*This paper develops a business process model, based on which can be determined whether an IT&C project is likely to succeed or not. The result of applying this model is assisting the decision related to start or abandon the project. The criteria on which the model is based is: user involvement in generating specifications and their type, user involvement in certain phases of the project life cycle, the existence of effective communication processes to be implemented and the involvement of users in these processes in different ways, project manager recruitment criteria, software development methodology and the number of key employees.*

**Keywords**: user involvement, specifications, project life cycle, effectiveness, communication processes, project manager recruitment, software development methodology, key employees.

## 1. Introduction

Software projects are high-risk activities that generate variable performance [1]. International surveys suggest that only about a quarter of all software projects are successful (i.e. finalizing according to planning, budgeting and specifications) and billions of dollars are lost annually on failing projects or projects that do not deliver the promised benefits [2].

Problems involving risks are often difficult to differentiate and misunderstand by those who make vital decisions for organizations and projects. The risk is not tangible or visible and therefore the perception of risks in a particular project varies according to the characteristics of the risk, respectively to the internal and external environment of the project.

The general belief is that, in order to reduce the likelihood of an unwanted result of a project, all potential risk factors of the project should be identified. The

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risk exposure for each factor is then estimated and exposures are prioritized to identify the risks that represent the greatest threat to the project. Attention is then focused on high risk factors to minimize the likelihood of their occurrence (and / or the magnitude of their impact) through control measures such as mitigation strategies and / or emergency plans. Risk factors are progressively monitored to detect as soon as possible when they may occur. The materialization of a risk factor is often recognized by triggering a predefined risk or reaching a predetermined risk threshold. At that point predefined emergency plans are activated to minimize impact.

Managers tend to be more concerned about the extent of the risks than the likelihood of them happening. In addition, they tend to prefer verbal representation of risk to its probabilistic formalization [3]. In practice, it is very difficult to estimate the probability of several risk factors happening. Probability can only be significantly determined for repetitive activities, in controlled circumstances. The unique character of many software design activities attenuates this. In practice, a common answer to this problem is the general view of a risk in terms of uncertainty and its qualitative assessment. Risk factors are evaluated and ranked on a relative scale, such as small, medium and high risk, for each of their dimensions – i.e. probability and impact.

March notes that, according to classical decision theory, risk is generally defined as the distribution of possible outcomes, their probabilities and subjective values [3]. The risk in software projects is usually defined as the probability of a loss or a negative impact on the outcome of a project [4].

The definition of risk includes only known or foreseeable threats. It does not recognize unforeseen threats. This limitation is usually solved in practice by iteratively identifying risks rather than through specific processes that manage unforeseen threats within risk management methodologies. In practice, variables can materialize unexpectedly and quickly, threatening the integrity of a project. Some organizations are concerned about these threats (which are often managed less formally, at a lower level, with a smaller priority comparing to known risks and less visibility to management) through independent problem management or through crisis management processes. As a result, traditional risk management is linked to other important management processes, such as problem management and crisis management, but this relationship is rarely officially recognized in risk and project management methodologies or is rarely explicitly explained.

Each of the IT&C project management activities can be a risk factor for the project. Thus, identifying requirements, communicating and managing the relationship with the stakeholders, budgeting and time framing and building an efficient team are all risk factors of varying magnitude.

## 2. Identifying requirements

61.3% of the papers studied in this article identify user participation as a contributing factor to the correct generation of system specifications, which leads to the creation of a relevant architecture and gives users a sense of ownership of the results (Table 1).

*Table 1*

**User activities that influence success in IT&C projects**

| | Defining system requirements | Quality assurance | Providing support during and after the implementation | Communication and research | Development and design |
|---|---|---|---|---|---|
| Frequency of studies that consider the activity important for the project success | 61.3% | 61.3% | 29% | 12.9% | 16.1% |

The relatively high level of user involvement is necessary for the project success, along with the management of their expectations [5]. Table 2 presents recommendations on the level of involvement of users from the point of view of all the studied papers.

*Table 2*

**Recommendations regarding the level of user involvement in successful IT&C projects**

| | Low level | Moderate level | High level |
|---|---|---|---|
| Frequency of studies that recommend it to increase the chances of a project success | 27.8% | 33.3% | 38.9% |

Usually, in software projects it is recommended to define the requirements before the start of the project or in the planning and design phase. However, only 20% of the studies presented in this paper consider that the user involvement before starting the project is important, while another 20% think user involvement during the planning and design phase is characteristic for successful IT&C projects. A high level of customer engagement is the best predictor of project success [6, 7]. Many other studies indicate that user involvement is greater when limited to certain phases. Thus, 44% of the research studied considers beneficial the continuous involvement of users throughout the life cycle of the project (Table 3).

*Table 3*

**Best practice in involving users who define the success of an IT&C project**

| | Before starting the project | Planning and design phase | Continuous involvement |
|---|---|---|---|
| Frequency of studies that considers it to be defining for the project success | 20% | 20% | 44% |

As computer systems purpose is to support users, the latter have to define the functions and the way they are used. Several user satisfaction measurements are included to analyze how users perceive performance in terms of different dimensions. The Multiple Factor User Satisfaction (MFUS) model includes the division of project requirements into functional requirements and presentation requirements [8]. The positive impact of users is higher on functional specifications (99%) than on presentation specifications (91%) and, consequently, on project success (Table 4).

*Table 4*

**User involvement impact on proposed activities in the MFUS model**

| Activities influenced by user involvement | Positive influence level |
|---|---|
| Functional requirements | 99% |
| Presentation requirements | 91% |
| Quality assurance | 61% |
| Project management | 72% |

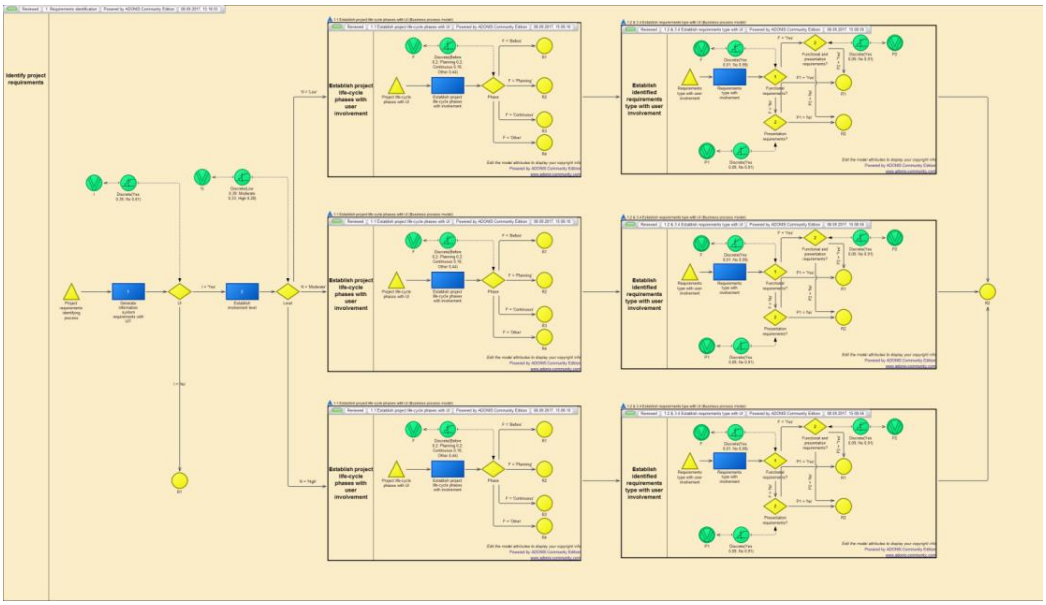

Fig. 1. Risks in requirements identification process according to the proposed mode

### 3. Communication

On average, 20% of IT&C projects fail due to inefficient communication. Communication is important due to the need to share the user's vision on the computer system so that the final product does not surprise the client. Communication is critical for success in large organizations [9]. Only 12.9% of previous studies identify communication and research activity indispensable for users, thus becoming a contributing factor to the success of the project (Table 1).

Some research on large software projects has suggested that both types of communication with users – direct, with high frequency and by specific processes – influence the success of the project (Table 5) in almost equal measures.

*Table 5*

**Summary of studies in the field of communication with users**

| | High frequency of the communication with users is a critical success factor of the project | Specific formal / informal or internal / external communication processes are sufficient for the success of the project | Another way of communicating with users |
|---|---|---|---|
| Frequency of studies that consider the influence of the communication method on the success / failure of the project | 40% | 47% | 13% |

The ability to communicate at multiple levels is of particular interest when it comes to choosing a project manager in the IT&C industry. While the presence of communication, as a desired attribute for project manager effectiveness, is well documented in literature, the specific ability to communicate not only with team members but also with stakeholders and different levels of management is a specific type of communication that is estimated differently by 48.7% of the recruiters from the industry [11].

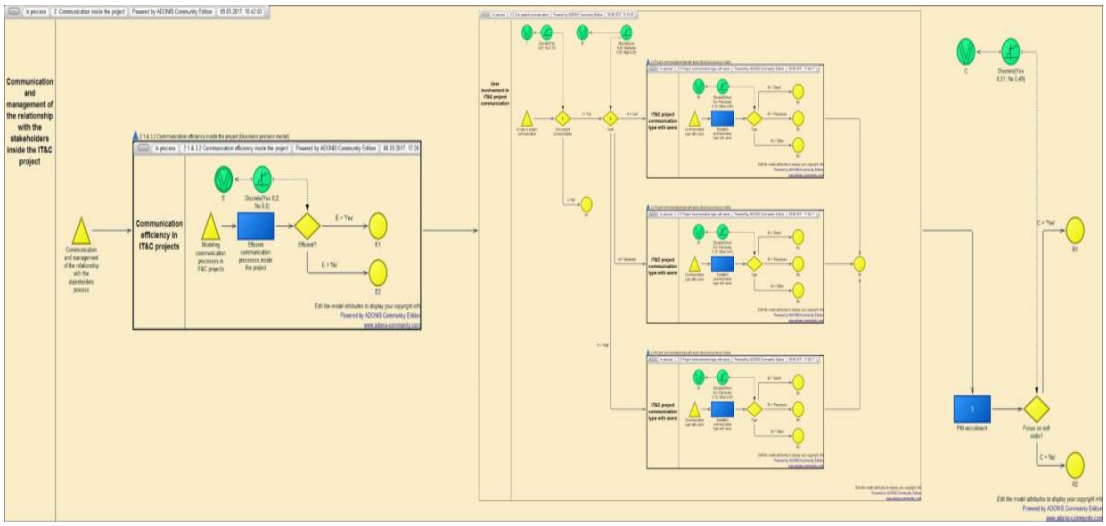


Fig. 2. Risks during communication inside the project according to the proposed model

## 4. Budgeting and time framing

The MFUS model indicates that the task creation activities positively influence a project delivery by 76.2%, i.e. budgeting and time. The data collected reveals that the activities of creating presentation requirements have a negative impact on the satisfaction of users in terms of project design under optimum conditions, this decrease being by 55.3% [8].

Statistically, it is possible to provide insight from the patterns observed in the data obtained from Team Software Process (TSP) methodology or any other agile methodology results. The average of reported values indicate a considerable difference from projects that do not use such a methodology – 6% versus 33%, i.e. a performance improved by 5.5 times regarding initial planning deviation, in terms of costs and time (Table 6).

*Table 6*

**Overview of the results obtained following the implementation of the TSP methodology**

| TSP results category | Results obtained without using TSP methodology | Results obtained using TSP methodology |
|---|---|---|
| Estimated effort precision | 84% | 96% |
| Initial planning deviation | 33% | 6% |
| Number of defects confirmed during tests against one thousand lines of code (KLOC) - defect density | 2,75 | 0,4 |
| Test Duration (in days / KLOC) | 4,35 | 0,6 |

Inefficient communication leads to fewer successful projects [10]. IT&C organizations that are the most efficient communicators report significantly more projects falling within the time frame (71%) and respecting the budget (76%). IT&C organizations that do not benefit from effective communication processes report fewer projects that fall within the timetable (37%) and respect the budget (48%).

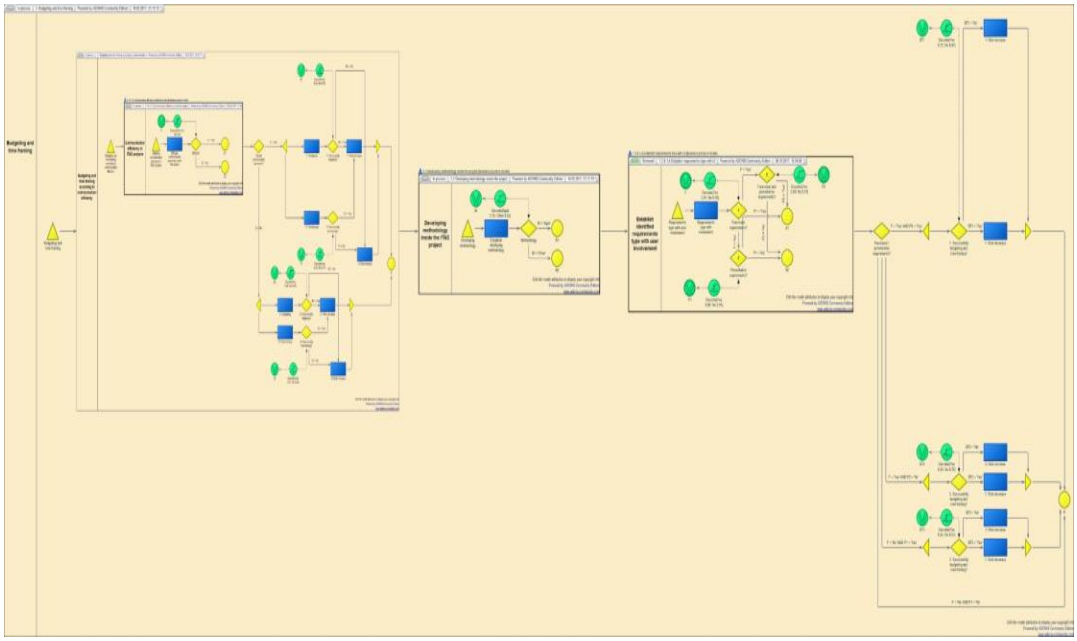

Fig. 3. Risks for budgeting and time framing according to the proposed model

## 5. Building an efficient team

Building an efficient team requires time, and staff fluctuation is a problem that can be noticed over time. If a project depends mainly on a few people, staff fluctuation will be a major risk for the IT&C project if a resignation or replacement occurs as follows: if there is only one key employee, the probability of risk to appear is 29%; adding a key employee reduces the risk of staff transfers to 26.25%, while the existence of three key employees within a team reduces the likelihood of this risk to occur down to 25% [12].

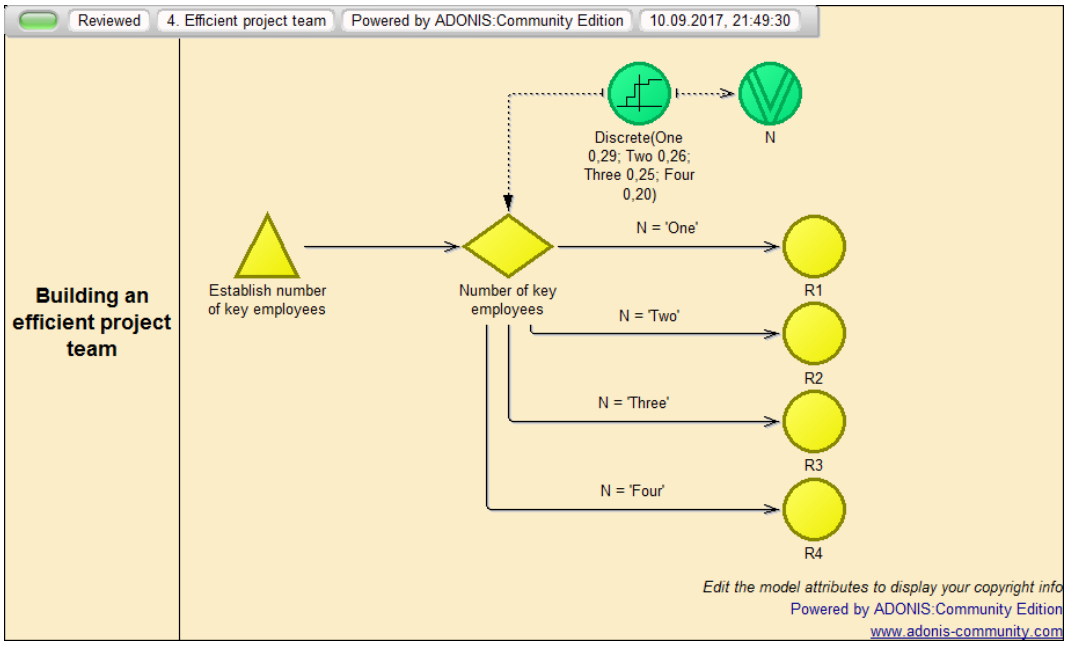


Fig. 4. Risks during building an efficient team according to the proposed model

## 6. Risk factors impact considered in the proposed model

Each of the IT&C project management activities can be a risk factor for the project. Thus, identifying requirements, communicating and managing the relationship with the stakeholders, budgeting and time framing and building an efficient team are all risk factors of varying magnitude. Analyzing some results [10], we can calculate the differences in importance of organizations with high performance, compared to other low-performing competitors of their project management activities. Thus, the following percentage increases are seen in favor of the performing organizations: 20.25% for the identification of the requirements, 36% for the communication and management of the relationship with the stakeholders, 21% for the budgeting and time framing and 28.8% for building an efficient team. Based on these calculations we can adopt a model with 4 levels for the risk factors impact and we can conclude that a classification very close to the truth on a scale of 1 to 100 can be presented in the form of table 7.

*Table 7*

**Risk factors impact considered in the proposed model**

| Risk factors | Impact |
|---|---|
| Identifying requirements | 19 |
| Budgeting and time framing | 20 |
| Communicating and managing the relationship with the stakeholders | 34 |
| Building an efficient team | 28 |

## 7. Conclusions

Risk management is an important function in today's IT&C organizations. Companies are undertaking projects that are increasingly complex and ambitious, and these projects have to be implemented successfully, in an uncertain and often risky environment. A responsible manager needs to be aware of these risks. This does not mean that he should try to address every risk his project can face, because in all but the most critical environments, this can be too expensive, both in terms of time and resources. Instead, he has to prioritize risks. If he does this effectively, he can concentrate most of the time and effort on the most important risks. The impact / risk probability chart provides a useful framework that helps the manager decide what risks needs his attention [13].

The impact / probability risk diagram is based on the principle that a risk has two main dimensions:

1. Probability – a risk is an event that may occur. The probability of this may vary from just over 0% to less than 100%. Probability cannot be exactly 100%, because then it would be a certainty, not a risk, and it could not be exactly 0% because then it would not be a risk.
2. Impact – a risk, by its very nature, always has a negative impact. However, the magnitude of the impact varies in terms of costs and influence on project success or other critical factors.

The risk in software projects is defined as the probability of a loss or a negative impact on the outcome of a project. This means that:

$$R = P \times I, \tag{1}$$

where:

- R is the risk exposure assigned to a particular risk factor;
- P is the probability of the risk occurring;
- I is the impact or magnitude of an unsatisfactory outcome on the project.

To use the impact / risk probability chart, a manager should follow the steps below:

1. List all the risks which the IT&C project may be facing. This list should be as comprehensive as possible.

2. Assess the likelihood of each risk and assign a rating. The probability of this may vary from just over 0% to less than 100%.
3. Estimate the impact on the IT&C project, if the risk occurs, using the scale 0 – 100, for each risk in the list.
4. Show ratings on impact / risk probability chart.
5. Develop a response for each risk, depending on its position in the chart.

Examples of the results obtained by applying the path analysis algorithm the processes modeled in this paper, respectively the impact of each risk factor calculated in table 7 are presented in the following table.

*Table 8*

**Examples of results from processes simulation**

| Process | Path | Risk occurring probability | Risk impact |
|---|---|---|---|
| Identifying requirements | 1 | 60.28% | 19 |
| | 2 | 6.36% | |
| | 14 | 0.60% | |
| | 15 | 0.52% | |
| | 16 | 0.44% | |
| | 26 | 0.08% | |
| | 30 | 0.04% | |
| Communicating and managing the relationship with the stakeholders | 1 | 7.10% | 34 |
| | 2 | 6.50% | |
| | 19 | 1.50% | |
| | 20 | 1.40% | |
| | 23 | 1.30% | |
| | 39 | 0.30% | |
| | 40 | 0.20% | |
| Budgeting and time framing | 1 | 19.24% | 20 |
| | 2 | 17.28% | |
| | 26 | 0.28% | |
| | 27 | 0.20% | |
| | 31 | 0.16% | |
| | 44 | 0.08% | |
| | 54 | 0.04% | |
| Building an efficient team | 1 | 28.60% | 28 |
| | 2 | 26.00% | |
| | 3 | 25.24% | |
| | 4 | 20.16% | |

The basic form of the impact / risk probability chart is presented in the figure below.

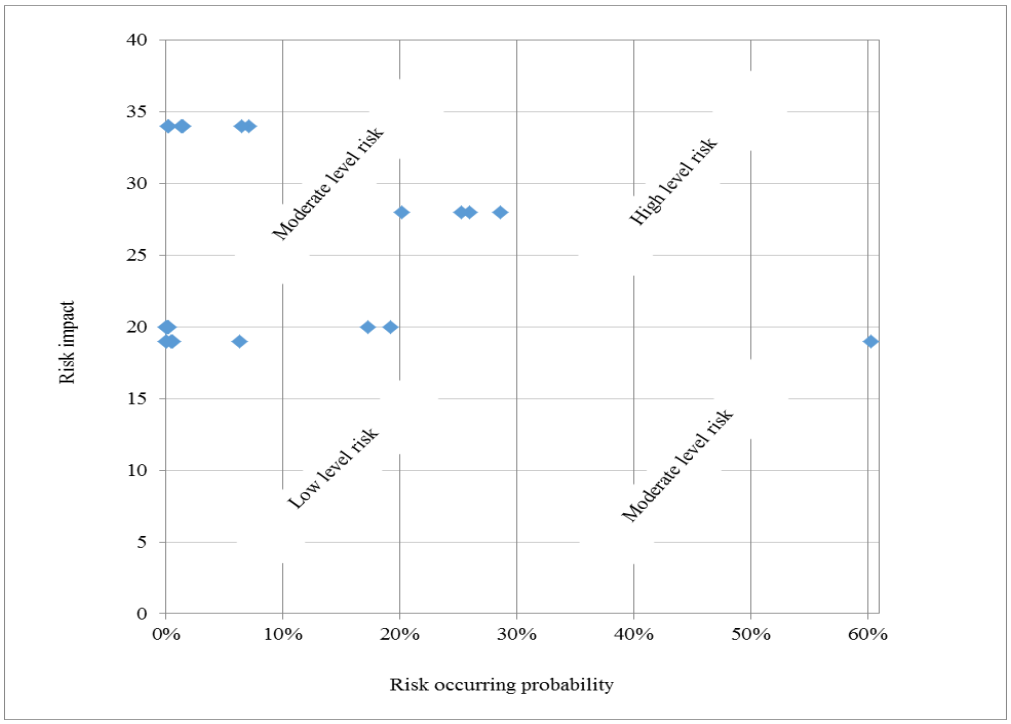


Fig. 5. The impact / probability risk diagram of an IT&C project

The corners of the graph from fig. 1 have the following characteristics:

- Low impact / low probability – risks in the bottom left corner are low and often can be ignored.
- Low impact / high probability – the risks in the upper left corner are of moderate importance. If these occur, the team can cope with them and the IT&C project can continue. However, the project manager should try to reduce the likelihood of these risks occurring.
- High impact / low probability – the risks in the right bottom corner are of major importance if they occur but are unlikely to happen. However, the manager should do everything in his power to reduce the impact these risks will have if they appear and he should have emergency plans for the situation they are doing.
- High impact / high probability – the risks in the top right corner are of critical importance. These are the main priorities of the project manager and are the risks to which he must pay particular attention.

To successfully implement an IT&C project, medium and high level risks need to be identified and studied – otherwise the manager risks spreading too much effort and losing resources for unnecessary risk management.

With the impact / risk probability diagram, the position of each risk determines its priority. High level risks are the most important, and great efforts need to be made to manage them. Risks with low probability and high impact and risks with high probability and reduced impact remain priorities, although different strategies may be required for each.

Low impact and low probability risks can often be ignored.

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