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AN EMPIRICAL EVALUATION OF SCRUM-RELATED COMPONENTS FOR RISK MANAGEMENT IN AGILE PROJECTS

Breno Gontijo Tavares [1]

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A B S T R A C T

This exploratory survey examines practitioners' perceptions of the relevance of Scrum-related components and the sufficiency of Scrum across five risk management activities: planning, identification, analysis, response planning, and monitoring. A structured questionnaire was administered to a purposive sample of 36 experienced Scrum practitioners. Component selections were summarized using frequencies, while sufficiency ratings were analyzed using descriptive statistics, the Friedman test for related samples, Kendall's W, and Holm-adjusted Wilcoxon signed-rank tests. The Friedman test identified statistically significant differences across the five activities, $\chi^2(4) = 120.05$, $p < .001$, with Kendall's $W = .834$. Pairwise comparisons identified higher perceived sufficiency for identification and monitoring, intermediate sufficiency for response planning, and lower sufficiency for risk management planning and analysis. These results describe phase-specific perceptions rather than observed risk management effectiveness. The study distinguishes the relevance attributed to individual components from judgments about the sufficiency of the framework and derives practical considerations for complementary risk management support. The non-probability sample, preliminary instrument evaluation, and self-reported measures limit generalizability and require replication.

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1. INTRODUCTION

Risk management remains a central concern in traditional project management but is less clearly defined within agile frameworks such as Scrum. Standards like the PMBOK® Guide (PMI, 2021) and PRINCE2 prescribe structured procedures for identifying, analyzing, and mitigating risks, while Scrum emphasizes self-organization, iterative planning, and short feedback cycles (Schwalbe, 2018).

Although these adaptive characteristics inherently support risk identification and mitigation, they are not typically recognized as formal risk management practices. Prior studies emphasized that, despite the importance of risk management, agile methods often lack explicit, structured practices to handle risk effectively (Chaouch et al., 2019; Niazi et al., 2016).

Nevertheless, research indicates that agile teams may neglect explicit risk handling if they rely solely on adaptability (Olechowski et al., 2016). This may result in unrecognized gaps, particularly in high-risk or complex projects. Moreover, the absence of formal risk-tracking mechanisms may create challenges for systematically

[1] Corresponding author: Breno Gontijo Tavares
Email: breno.tavares@eldorado.org.br

monitoring and documenting project risks (Hillson & Simon, 2020).

This study uses the Project Management Institute's risk management framework (PMI, 2021) as a conceptual reference. For the purposes of the survey, risk management is organized into five analytical categories: risk management planning, risk identification, risk analysis, risk response planning, and risk monitoring. These categories represent the operationalization adopted in this study rather than an exhaustive reproduction of the processes described in the reference framework. Qualitative and quantitative risk analysis are not assessed separately, nor is the implementation of risk responses. This operationalization provides a structured basis for examining how Scrum-related components may support different risk management activities.

Recent empirical work suggests that certain Scrum events and artifacts, such as the Sprint Retrospective and Product Backlog, play key roles in revealing risks associated with technical debt, scope creep, or team dynamics (Tavares et al., 2019b). However, limited quantitative evidence exists regarding the specific contribution of these components to formal risk management.

This study examines two related but distinct perceptions: the relevance attributed to individual Scrum-related components and the sufficiency attributed to Scrum as a framework across five risk management activities. A component may be considered relevant without respondents regarding the framework as sufficient for the corresponding activity. The study contributes an exploratory, phase-specific characterization of these perceptions and derives practical considerations for complementary risk management support. These considerations are implications of the findings, not interventions evaluated in this research.

2. THEORETICAL FRAMEWORK: RISK MANAGEMENT IN SCRUM

Traditional project management frameworks, such as PMBOK® and PRINCE2, conceptualize risk management as a structured and formal process involving identification, analysis, response planning, and continuous monitoring (PMI, 2021). These models are supported by risk standards like ISO 31000, which emphasize a proactive, organization-wide approach to uncertainty (International Organization for Standardization [ISO], 2018; Tavares et al., 2019a). In contrast, agile methodologies, including Scrum, tend to embed risk management implicitly within iterative cycles, team interactions, and feedback loops rather than through formal documentation. Risk management planning concerns the approach, responsibilities, criteria, and procedures for managing risk. It is conceptually distinct from planning the work to be performed during a Sprint.

Scrum is designed to reduce uncertainty through time-boxed iterations, regular inspection, and adaptation mechanisms (Schwaber & Sutherland, 2020). Scrum events such as the Daily Scrum and Sprint Retrospective provide opportunities for risk identification and team-level reflection. The Product Backlog artifact and the Definition of Done commitment provide transparency concerning planned work and the quality conditions required for an Increment (Schwaber & Sutherland, 2020). Tavares et al. (2020) further emphasize that effective risk management in Scrum requires intentional use of agile mechanisms to surface impediments early and incorporate risk-related considerations into Sprint Planning and Product Backlog management.

Despite these embedded practices, Scrum does not offer explicit guidelines for structured risk management, which can lead to inconsistent practices and underutilization of risk-related opportunities (Niazi et al., 2016). Additionally, recent developments propose risk management tools specifically designed for agile contexts that retain agility while providing structure, such as the Rm4Am framework (Tavares et al., 2020).

Recent studies have examined the integration of risk strategies into agile contexts. For example, Conforto et al. (2014) argue that agile teams often rely on tacit knowledge and informal communication to manage risks, which may be effective in small, co-located teams but less so in distributed or complex projects. Fernández et al. (2022) highlight that agile methods can benefit from incorporating lightweight but deliberate risk management techniques. These include early identification of uncertainties during Sprint Planning or the incorporation of risk burndown charts in project tracking.

As organizations increasingly adopt hybrid models that combine agile and traditional practices, the need to reconcile agility with risk formalism becomes evident (Conforto et al., 2014). Theoretical efforts are emerging to map traditional risk components like probability, impact, and mitigation strategies onto agile Scrum events and roles. These frameworks propose that agile teams can maintain adaptability while introducing sufficient discipline to ensure that risks are not ignored or inadequately managed.

The growing prevalence of hybrid project environments calls for further investigation into how Scrum-related components interact with traditional management structures. By mapping Scrum-related components to formal risk management constructs, organizations may identify where complementary risk management practices could be integrated while preserving agile responsiveness. This dual lens provides a fertile foundation for future models of agile risk management that are both adaptive and auditable. Against this background, the study examines the relevance attributed by practitioners to Scrum-related components and their perceptions of the sufficiency of Scrum across five risk management activities. It does not assume that perceived relevance establishes effective risk management.

Recent advances in agile management emphasize the growing need to integrate risk-specific roles and practices into agile frameworks (Niazi et al., 2016;

Tavares et al., 2020). While traditional models such as PMBOK® and ISO 31000 provide explicit risk protocols, they often lack adaptability for dynamic software environments (Conforto et al., 2014). Conversely, Scrum offers adaptive mechanisms that implicitly support risk control, yet these are frequently underutilized. The concept of "agile risk responsiveness" has emerged to bridge this gap, promoting the view that agile teams can manage risks systematically through structured yet lightweight practices (Conforto et al., 2014). The present study examines these issues through an exploratory survey of component relevance and framework sufficiency, without measuring the effects of these components on project outcomes.

3. OBJECTIVES

This study aims to investigate the perceived relevance of Scrum-related components to five risk management activities: risk management planning, risk identification, risk analysis, risk response planning, and risk monitoring. It also examines the extent to which practitioners perceive the Scrum framework itself as sufficient to support each activity.

Accordingly, this study addresses the following research questions:

- RQ1. Which Scrum-related components are perceived by experienced Scrum practitioners as relevant to the different phases of project risk management?
- RQ2. To what extent do experienced Scrum practitioners perceive the Scrum framework itself as sufficient to support the different phases of project risk management?

Based on these research questions, the study aims to identify the Scrum-related components most frequently associated with different phases of project risk management and to examine whether practitioners perceive the Scrum framework itself as sufficient to support each phase. The findings may inform consideration of complementary risk management practices by distinguishing the perceived relevance of individual components from the perceived sufficiency of the Scrum framework.

4. METHODOLOGY

This study adopted a quantitative exploratory survey design to examine practitioners' perceptions of the relevance of Scrum-related components and the sufficiency of Scrum across five risk management activities in agile software development. A survey was used to collect judgments from experienced practitioners. The design did not assess the effectiveness of the selected components or measure project outcomes.

Participants were selected using purposive, non-probability sampling. The sample comprised 36 practitioners with at least five years of professional experience in software development projects using Scrum. The participants included Scrum Masters, software developers, and Product Owners. Role-specific counts were not recorded. While individual role-specific metrics were not separately recorded, all respondents were actively engaged in hands-on software delivery using Scrum, and the majority held industry-recognized agile certifications (e.g., PSM, CSM, PSPO).

This recruitment procedure was designed to obtain responses from practitioners with substantial practical experience using Scrum in software development projects. Because the study employed purposive, non-probability sampling, the findings should be interpreted as exploratory and should not be assumed to be statistically representative of the broader population of Scrum practitioners.

A structured questionnaire was used to investigate practitioners' perceptions of the relevance of Scrum-related components to different risk management activities and the sufficiency of the Scrum framework for those activities. The questionnaire and its operational definitions are described in Section 4.1.

For each risk management phase, participants were presented with a predefined list of Scrum-related components and were asked to select all components they considered relevant to that phase. Participants could select zero, one, or multiple components for each phase. The resulting quantitative data represent the frequency with which each component was selected by participants for each risk management phase.

In addition to the component-selection questions, participants were asked to assess the extent to which the Scrum framework itself provided sufficient support for each risk management phase. Responses were collected using a five-point ordinal scale ranging from 1 (Highly insufficient) to 5 (Highly sufficient). The scale was designed to assess whether the Scrum framework itself was perceived as sufficient to support the respective phase or whether additional tools, methods, or approaches might be necessary.

For each selected Scrum-related component, participants were also asked to provide an open-ended justification explaining why they considered that component relevant to the corresponding risk management phase. These justifications were reviewed to provide contextual support for the interpretation of the quantitative findings. No formal qualitative coding, thematic analysis, or independent qualitative categorization was performed. Therefore, the open-ended responses were used as contextual information rather than as a separate source of formally analyzed qualitative results.

The instrument was aligned with PMI's risk management framework and the official Scrum Guide (Schwaber & Sutherland, 2020).

Data analysis comprised descriptive and inferential statistical procedures. First, frequencies and percentages were calculated to identify the Scrum-related components most frequently selected for each risk management activity. Second, the perceived sufficiency

of the Scrum framework was assessed using a five-point ordinal scale, ranging from Highly Insufficient (1) to Highly Sufficient (5). Responses were summarized using frequency distributions, medians, and first and third quartiles (Q1 and Q3).

To examine whether perceived sufficiency differed across the five risk management activities, the Friedman test was applied. This non-parametric test was selected because the same 36 participants evaluated all five activities using an ordinal response scale, resulting in a repeated-measures design. Kendall's coefficient of concordance (W) was calculated to assess the magnitude of the overall differentiation across activities.

Following a statistically significant Friedman test, pairwise comparisons were performed using Wilcoxon signed-rank tests. The Holm correction was applied to adjust p-values for multiple comparisons and control the family-wise error rate. Statistical significance was established at $\alpha = .05$.

Before the main data collection, the questionnaire underwent expert review and pilot testing with two experienced Scrum Masters who also had project management experience. Their feedback informed wording revisions before the final questionnaire was administered. Neither reviewer participated in the main sample of 36 respondents. The procedure is described in Section 4.1. Additionally, qualitative comments provided by participants were reviewed to support the interpretation of quantitative findings and identify potential inconsistencies in the responses.

4.1 Research Instrument

The survey instrument was developed based on two primary sources: the Scrum Guide (Schwaber & Sutherland, 2020) and the Project Management Institute's risk management framework (PMI, 2021). The instrument was designed to examine the perceived relevance of Scrum-related components and the perceived sufficiency of Scrum across five risk management activities: risk management planning, risk identification, risk analysis, risk response planning, and risk monitoring.

The questionnaire included Scrum accountabilities, events, artifacts, the Definition of Done commitment, and selected concepts or practices associated with Scrum implementation. The collective term “Scrum-related components” is used in this study to refer to these heterogeneous items and does not imply that all of them are mandatory or formally defined elements of Scrum. The Burndown Chart is treated as an associated practice rather than as a formal Scrum artifact, while Sprint Timebox represents a characteristic of the Sprint rather than an independent event. The survey assessed the perceived relevance of these items rather than the effectiveness of a standardized risk management intervention.

For each phase, participants were asked to select all Scrum-related components they considered relevant from a predefined list. The same list of components was presented for each of the five phases. Participants could select zero, one, or multiple components for each risk management phase. Selecting no component indicated that the respondent did not consider any of the listed components relevant to that phase.

The predefined list included Daily Scrum, Sprint Planning, Sprint Review, Sprint Retrospective, Sprint, Sprint Backlog, Product Backlog, Burndown Chart, Increment, Scrum Master, Developers, Product Owner, Definition of Done, and Sprint Timebox.

After selecting a component, participants were asked to provide a written justification explaining why they considered that component relevant to the corresponding risk management phase. These open-ended justifications were reviewed to contextualize and support the interpretation of the quantitative results. Because no formal qualitative coding procedure was applied, the open-ended responses were not analyzed or reported as an independent qualitative dataset.

For the assessment of the perceived sufficiency of the Scrum framework, a five-point ordinal scale was used for each of the five risk management phases: 1 (Highly insufficient), 2 (Insufficient), 3 (Partially sufficient), 4 (Sufficient), and 5 (Highly sufficient). The question was designed to assess the extent to which the Scrum framework itself provides sufficient support for each risk management phase and whether complementary tools, methods, or approaches may be necessary. The complete questionnaire, including these assessment questions, is provided in Appendix A to improve transparency and support replication of the study.

Before the main data collection, the questionnaire underwent expert review and pilot testing with two Scrum Masters who also had experience as project managers. Both had more than ten years of experience in Scrum and risk management. They completed the questionnaire through an online form and reviewed all questions and response options. Their assessment addressed clarity, relevance, coverage of the topics, and the appropriateness of the listed components. Feedback was exchanged by email.

The reviewers’ recommendations primarily concerned question wording rather than changes to the underlying concepts or structure of the instrument. These recommendations were incorporated before the questionnaire was administered to the main sample. The two reviewers were invited exclusively for this preliminary stage and were not included among the 36 survey respondents. No additional reviewers assessed the instrument. This procedure provided preliminary evidence concerning clarity and content appropriateness, but did not establish comprehensive psychometric validity or measurement reliability.

Component selection was interpreted as perceived relevance, not as evidence of actual use, frequency of use, or effectiveness. Similarly, sufficiency ratings represented respondents’ judgments about the support provided by Scrum, rather than an objective assessment of compliance with a risk management standard or improvements in project outcomes. These measures were

therefore treated as distinct perceptions: the relevance attributed to individual components and the sufficiency attributed to Scrum as a framework.

5. RESULTS

The results are presented as frequencies of selection. For each risk management phase, participants could select zero, one, or multiple Scrum-related components. Therefore, the values reported in Table 1 represent the number of participants who selected each component as relevant to a particular risk management phase. Because the sample consisted of 36 participants, a frequency of 36 indicates that all participants selected that component for the corresponding phase.

The results show that the Daily Scrum, Developers, and Sprint Planning were among the Scrum-related components most frequently selected across the five risk management phases. The selection frequencies represent the relevance attributed to each component by respondents, not its observed use or effectiveness in managing project risks.

Table 1 presents the selection frequencies for each Scrum-related component across the five risk management phases. The results allow the identification of components that were more frequently associated by participants with specific risk management activities.

For Risk Management Planning, the total number of component selections was lower than the number of participants because some respondents did not consider any of the listed components relevant to this phase and therefore selected none. The frequencies represent component selections rather than the number of respondents who answered the question.

Table 1. Frequency of Scrum-Related Components Selected by Risk Management Phase

Scrum-Related Component	Planning	Identification	Analysis	Response Plan	Monitoring
Daily Scrum	2	36	18	24	36
Sprint Planning	16	30	24	18	12
Sprint Review	3	24	6	12	24
Sprint Retrospective	0	18	6	6	24
Sprint	0	0	6	12	6
Sprint Backlog	0	30	18	18	12
Product Backlog	0	24	24	6	0
Burndown Chart	0	18	0	6	12
Increment	0	12	0	0	12
Scrum Master	6	18	18	24	24
Developers	1	24	30	24	30
Product Owner	1	18	30	12	12
Definition of Done	0	18	6	6	0
Sprint Timebox	0	12	6	0	12

Note. Respondents could select zero, one, or multiple components per phase. Consequently, the sum of selection frequencies within a phase may be lower than, equal to, or higher than the number of participants.

The selection frequencies describe the relevance attributed by respondents to each component within the sample. They do not measure observed use or effectiveness in managing project risks.

5.1 Perceived Sufficiency of the Scrum Framework Across Risk Management Phases

In addition to identifying the Scrum-related components associated with each risk management phase, the questionnaire assessed the extent to which participants perceived the Scrum framework itself as sufficient to support each phase. Responses were collected using a five-point ordinal scale ranging from 1 (Highly insufficient) to 5 (Highly sufficient). Table 2 presents the frequency and percentage distributions, together with the median and first and third quartiles (Q1 and Q3) for each risk management phase.

Table 2. Perceived Sufficiency of the Scrum Framework by Risk Management Phase

Risk Management Phase	Highly insufficient n (%)	Insufficient n (%)	Partially sufficient n (%)	Sufficient n (%)	Highly sufficient n (%)	Median	Q1–Q3
Risk Management Planning	10 (27.8%)	22 (61.1%)	3 (8.3%)	1 (2.8%)	0 (0.0%)	2	1–2
Risk Identification	0 (0.0%)	0 (0.0%)	2 (5.6%)	20 (55.6%)	14 (38.9%)	4	4–5
Risk Analysis	6 (16.7%)	24 (66.7%)	6 (16.7%)	0 (0.0%)	0 (0.0%)	2	2–2
Risk Response Planning	0 (0.0%)	14 (38.9%)	18 (50.0%)	4 (11.1%)	0 (0.0%)	3	2–3
Risk Monitoring	0 (0.0%)	0 (0.0%)	0 (0.0%)	21 (58.3%)	15 (41.7%)	4	4–5

Note. Q1 and Q3 denote the first and third quartiles, respectively. Percentages may not sum to exactly 100% because of rounding.

The results show a clear differentiation in the perceived sufficiency of Scrum across the five risk management phases. Risk Management Planning was classified as insufficient, with a median of 2 (Q1 = 1, Q3 = 2). Thirty-two participants (88.9%) selected either Highly insufficient or Insufficient, while only one participant (2.8%) selected Sufficient and none selected Highly sufficient.

Risk Identification received substantially higher assessments. The median was 4 (Q1 = 4, Q3 = 5), with 34 participants (94.4%) rating the Scrum framework as either Sufficient or Highly sufficient. Only two participants (5.6%) selected Partially sufficient, and no participant selected either of the two insufficient categories.

Risk Analysis was also classified as insufficient, with a median of 2 (Q1 = 2, Q3 = 2). Thirty participants (83.3%) selected either Highly insufficient or Insufficient, while six participants (16.7%) selected Partially sufficient. No participant rated the Scrum framework as Sufficient or Highly sufficient for this phase.

Risk Response Planning presented an intermediate pattern. The median was 3 (Q1 = 2, Q3 = 3), with 18 participants (50.0%) selecting Partially sufficient. Fourteen participants (38.9%) selected Insufficient, and four (11.1%) selected Sufficient. No participants selected either Highly insufficient or highly sufficient.

Risk Monitoring received the strongest overall assessment. The median was 4 (Q1 = 4, Q3 = 5), with all 36 participants (100%) selecting either Sufficient or Highly sufficient. Twenty-one participants (58.3%) selected Sufficient and 15 (41.7%) selected Highly sufficient. No participant selected any category below Sufficient.

Overall, the results indicate that the perceived sufficiency of the Scrum framework varies substantially across risk management phases. The strongest support was observed for Risk Identification and Risk Monitoring, whereas Risk Management Planning and Risk Analysis were perceived as insufficiently supported by the Scrum framework itself. Risk Response Planning occupied an intermediate position, being perceived as partially sufficient.

5.2 Statistical Comparison of Perceived Scrum Sufficiency Across Risk Management Activities

To determine whether the differences observed in the descriptive analysis were statistically significant, a Friedman test was conducted using the paired sufficiency ratings provided by the 36 participants. The analysis revealed statistically significant differences across the five risk management activities, $\chi^2(4) = 120.05$, $p < .001$. Kendall's coefficient of concordance was $W = .834$, indicating a strong differentiation in perceived sufficiency across the activities.

These results indicate that respondents did not evaluate Scrum's sufficiency uniformly across the five risk management activities. Instead, their assessments varied substantially according to the activity being considered.

To identify which activities differed, post-hoc pairwise comparisons were performed using Wilcoxon signed-rank tests with Holm adjustment for multiple comparisons. The results are presented in Table 3.

Table 3. Pairwise Comparisons of Perceived Scrum Sufficiency Using Wilcoxon Signed-Rank Tests with Holm Correction

Risk Management Activities Compared	Adjusted p-value	Statistical Result
Risk Management Planning × Risk Identification	< .001	Significant
Risk Management Planning × Risk Analysis	.707	Not significant
Risk Management Planning × Risk Response Planning	< .001	Significant
Risk Management Planning × Risk Monitoring	< .001	Significant
Risk Identification × Risk Analysis	< .001	Significant
Risk Identification × Risk Response Planning	< .001	Significant
Risk Identification × Risk Monitoring	.707	Not significant
Risk Analysis × Risk Response Planning	< .001	Significant
Risk Analysis × Risk Monitoring	< .001	Significant
Risk Response Planning × Risk Monitoring	< .001	Significant

Note. Pairwise comparisons were conducted using two-sided Wilcoxon signed-rank tests. Adjusted p-values were calculated using the Holm procedure to account for ten pairwise comparisons. Statistical significance was evaluated at $\alpha = .05$.

The pairwise comparisons revealed a consistent pattern in the perceived sufficiency of Scrum across risk management activities. Risk Identification and Risk Monitoring received the highest sufficiency ratings, with no statistically significant difference between them (adjusted $p = .707$). Risk Management Planning and Risk Analysis received the lowest ratings, also without a statistically significant difference between them (adjusted $p = .707$).

Risk Response Planning occupied an intermediate position, with statistically significant differences compared with each of the other four activities (adjusted $p < .001$). These findings indicate three distinct levels of perceived sufficiency within the sample: higher perceived sufficiency for Risk Identification and Risk Monitoring, intermediate perceived sufficiency for Risk Response Planning, and lower perceived sufficiency for Risk Management Planning and Risk Analysis.

The results provide statistical support for the phase-specific pattern identified in the descriptive analysis. However, they should be interpreted as differences in practitioners' perceptions rather than evidence of the actual effectiveness of Scrum in managing project risks.

6. DISCUSSION

6.1 General Observations

The selection patterns indicate that respondents associated different Scrum-related components with different risk management activities. These associations describe perceived relevance, not observed use or effectiveness. The frequent selection of the Daily Scrum for identification and monitoring suggests that respondents regard it as relevant to recurring risk-related communication. However, the study did not observe these meetings or assess whether they improved risk detection or monitoring.

The frequent selection of Developers and the Product Owner for Risk Analysis suggests that respondents associate this activity with technical and product-related perspectives. It does not establish how risk knowledge or decision-making authority was distributed within their teams.

The sufficiency ratings provide a distinct perspective, now supported by inferential statistical analysis. The Friedman test demonstrated statistically significant differences across the five risk management activities, with Kendall's W indicating a strong overall differentiation. The pairwise comparisons revealed three levels of perceived sufficiency. Risk Identification and Risk Monitoring received the highest assessments, Risk Response Planning occupied an intermediate position, and Risk Management Planning and Risk Analysis received the lowest assessments.

Importantly, no statistically significant differences were identified between Risk Identification and Risk Monitoring or between Risk Management Planning and Risk Analysis. This pattern strengthens the empirical evidence that practitioners differentiate Scrum's perceived sufficiency according to the risk management activity being assessed. Nevertheless, these results remain conditional on the participating sample and do not establish that Scrum objectively performs better in activities receiving higher ratings.

The combination of component selections and sufficiency ratings is particularly informative. Respondents may recognize components as relevant to an activity while still considering Scrum insufficient for that activity. The results therefore caution against treating the presence of relevant components as evidence of comprehensive risk management support.

The findings can be interpreted alongside previous research, while recognizing differences in research design and measurement. Tavares et al. (2019a) examined risk management in Scrum software projects through project-based evidence and practitioner interviews, highlighting continuous risk management, feedback, and knowledge reuse. The higher perceived sufficiency of Scrum for risk identification and monitoring in the present survey is consistent with the relevance of these recurring activities. However, this convergence does not establish equivalent outcomes: the present study measures judgments of sufficiency rather than the execution or effectiveness of risk management practices.

Tavares et al. (2019b) identified risk management practices and used the Analytic Hierarchy Process to prioritize Scrum-related components and subcomponents. The prominence of the daily meeting in that study is consistent with the frequent selection of the Daily Scrum for identification and monitoring in the present survey. Nevertheless, the Increment received greater prominence in the earlier prioritization than in the selection frequencies reported here. This difference should not be interpreted as a direct contradiction. The earlier study elicited relative priorities using a hierarchical decision model, whereas the present survey asked respondents to select relevant components separately for each risk management activity. The results therefore suggest that the apparent importance of a component may depend on both the activity examined and the assessment procedure.

Tavares et al. (2020) developed and evaluated a complementary risk management tool, examining performance in risk response planning tasks. That study provides a different type of evidence from the present survey: it evaluates a specific intervention, whereas this study identifies perceptions that may motivate consideration of complementary support. The intermediate sufficiency rating for risk response planning does not demonstrate that a particular tool is necessary or effective. Instead, it identifies an activity for which the value of additional support warrants context-specific evaluation.

Taken together, these comparisons clarify the contribution of the present study. Rather than proposing another set of practices, prioritizing components overall, or evaluating a dedicated tool, the survey distinguishes component relevance from framework sufficiency across five risk management activities. This distinction makes it possible to identify situations in which practitioners recognize relevant Scrum-related components but nevertheless perceive Scrum as insufficient for the activity concerned. The resulting phase-specific characterization complements previous research without establishing causal relationships or replacing evaluations of actual project practices and outcomes.

Lower selection frequencies for the Sprint and Increment should not be interpreted as evidence that these elements are unimportant or that respondents regarded them as outcomes of risk management. The survey did not directly investigate the reasons for their relative position in the frequency distributions.

The findings motivate consideration of complementary practices, particularly for risk management planning and analysis. This is a practical implication requiring evaluation, not evidence that a particular integration approach will improve project outcomes. Likewise, favorable ratings for identification and monitoring do not demonstrate that additional support is unnecessary in those activities.

6.2 Limitations and Threats to Validity

Several limitations should be considered when interpreting the findings. The questionnaire assessed perceived relevance and perceived sufficiency rather than observed risk management performance. Before the main data collection, two experienced practitioners reviewed the questions and response options and completed the online questionnaire. Their feedback informed wording revisions and provided preliminary evidence concerning clarity and content appropriateness. However, the involvement of only two reviewers limits the breadth of perspectives represented in this assessment, and the procedure did not establish comprehensive psychometric validity or measurement reliability. The component list combined different types of Scrum-related concepts and was not exhaustive. For example, the Sprint and its timebox were assessed separately, whereas the Sprint Goal and Product Goal were not included as separate items. These choices may have influenced the selection patterns and limit claims about comprehensive coverage of Scrum. Sufficiency was assessed using one ordinal item per phase, without an independently validated criterion for determining when Scrum should be considered sufficient. Respondents may therefore have applied different standards when assigning their ratings.

The purposive, non-probability sample of 36 experienced practitioners also limits generalizability. Although experience-based eligibility was intended to obtain informed judgments, it does not eliminate selection bias or establish representativeness. The findings should therefore be interpreted as exploratory evidence from the participating professionals rather than as population-level estimates.

The reliance on self-reported perceptions introduces additional uncertainty. Responses may reflect differences in professional experience, organizational context, familiarity with risk management, and interpretations of Scrum. The study did not independently observe respondents' practices or measure project outcomes. Although open-ended justifications were reviewed for context, they were not subjected to a formal qualitative analysis and therefore do not constitute independently analyzed qualitative evidence.

Finally, although inferential statistical analyses identified significant differences in perceived sufficiency across risk management activities, these findings remain subject to the limitations of purposive, non-probability sampling. The Friedman and Wilcoxon tests provide evidence of differences within the participating sample but do not establish population representativeness or causal relationships. Furthermore, the ordinal response scale and the presence of tied observations require cautious interpretation of pairwise comparisons. The practical recommendations derived from the findings were not implemented or evaluated, and their effects on risk exposure, delivery performance, and process overhead remain unknown.

6.3 Managerial Implications

The findings motivate phase-specific consideration of complementary risk management practices. The following recommendations are proposed applications of the results, not practices whose effectiveness was evaluated in this study.

For Risk Management Planning, organizations may define a lightweight approach specifying assessment criteria, responsibilities, escalation rules, and review frequency. For Risk Identification, uncertainties may be recorded explicitly and linked to affected work items, distinguishing the cause, uncertain event, and potential consequence.

For Risk Analysis, a documented assessment procedure may record likelihood, impact, assessment rationale, and priority. For Risk Response Planning, selected responses may be translated into actionable work with an owner, target date, and relevant trigger. For Risk Monitoring, teams may review current exposure, response progress, residual risk, and the need for further action.

Integration should preserve the purposes and timeboxes of Scrum events. The Daily Scrum should not be converted into a comprehensive risk workshop or management reporting meeting. Issues requiring detailed analysis may be addressed in separate follow-up discussions and linked to relevant work items.

These proposals require evaluation in real project settings. The present findings do not demonstrate that the recommendations reduce risk, improve delivery outcomes, or avoid additional process overhead.

From a technological perspective, the findings may inform requirements for software project management support by identifying risk management activities for which practitioners perceive a need for complementary assistance. Candidate capabilities include linking risk records to backlog items, recording assessment criteria and response ownership, and maintaining a history of risk reviews. These are design considerations derived from the findings, not requirements validated with users or capabilities implemented and evaluated in this study.

7. CONCLUSION

This exploratory survey examined the perceived relevance of Scrum-related components and the perceived sufficiency of Scrum across five risk management activities. Among the 36 participating practitioners, median ratings indicated greater perceived sufficiency for risk identification and monitoring, an intermediate assessment for response planning, and lower perceived sufficiency for risk management planning and analysis.

The inferential analysis provided additional support for this phase-specific pattern. Perceived sufficiency differed significantly across the five risk management activities, with a strong overall differentiation indicated by Kendall's W. Pairwise comparisons identified higher assessments for Risk Identification and Risk Monitoring,

intermediate assessments for Risk Response Planning, and lower assessments for Risk Management Planning and Risk Analysis. These findings strengthen the empirical characterization of practitioners' perceptions without establishing differences in actual risk management effectiveness.

The central contribution is the distinction between component relevance and framework sufficiency. A component can be considered relevant to an activity without establishing that Scrum alone provides sufficient support for that activity. Neither measure demonstrates that risks were effectively managed or that project outcomes improved.

The findings motivate phase-specific consideration of complementary practices, particularly for defining risk management procedures and conducting systematic analysis. The proposed integration considerations are practical implications requiring evaluation, not a validated risk management framework.

The conclusions are limited by purposive sampling, preliminary instrument evaluation, and self-reported judgments. Future research should strengthen validity evidence, replicate the survey across documented organizational contexts, and investigate whether practitioner perceptions correspond to observed practices and project outcomes.

APPENDIX A. SURVEY QUESTIONNAIRE

A structured questionnaire was used to investigate practitioners' perceptions of the relevance of Scrum-related components to different risk management activities and the perceived sufficiency of the Scrum framework for those activities. The questionnaire covered risk management planning, risk identification, risk analysis, risk response planning, and risk monitoring. For each risk management phase, participants were presented with a predefined list of Scrum-related components and were asked to select all components they considered relevant to that phase. Participants could select zero, one, or multiple components for each phase. Selecting no component indicated that none of the listed components was considered relevant to that phase. In addition, participants were asked to assess the extent to which the Scrum framework itself provides sufficient support for the corresponding risk management phase. This assessment used a five-point ordinal scale ranging from 1 (Highly insufficient) to 5 (Highly sufficient), with 3 representing Partially sufficient.

For each selected Scrum-related component, participants were also asked to provide an open-ended justification explaining why they considered that component relevant to the corresponding risk management phase. These justifications were reviewed to provide contextual support for the interpretation of the quantitative findings. No formal qualitative coding, thematic analysis, or independent qualitative categorization was performed. Therefore, the open-ended responses were used as contextual information rather than as a separate source of formally analyzed qualitative results.

Available Scrum-Related Components

- Daily Scrum
- Sprint Planning
- Sprint Review
- Sprint Retrospective
- Sprint
- Sprint Backlog
- Product Backlog
- Burndown Chart
- Increment
- Scrum Master
- Developers
- Product Owner
- Definition of Done
- Sprint Timebox

Question 1. Risk Management Planning

Which Scrum-related components do you consider relevant to Risk Management Planning?

Please select all components you consider relevant and explain why each selected component is relevant to this phase.

Question 1b. Perceived Sufficiency of the Scrum Framework

To what extent does the Scrum framework itself provide sufficient support for Risk Management Planning?

Please select one option:

1 – Highly insufficient
2 – Insufficient
3 – Partially sufficient
4 – Sufficient
5 – Highly sufficient

Note: This question aims to determine whether the Scrum framework itself is sufficient to support this phase or whether additional tools, methods, or approaches should be integrated.

Question 2. Risk Identification

Which Scrum-related components do you consider relevant to Risk Identification?

Please select all components you consider relevant and explain why each selected component is relevant to this phase.

Question 2b. Perceived Sufficiency of the Scrum Framework

To what extent does the Scrum framework itself provide sufficient support for Risk Identification?

Please select one option:

1 – Highly insufficient
2 – Insufficient
3 – Partially sufficient
4 – Sufficient
5 – Highly sufficient

Note: This question aims to determine whether the Scrum framework itself is sufficient to support this phase or whether additional tools, methods, or approaches should be integrated.

Question 3. Risk Analysis
Which Scrum-related components do you consider relevant to Risk Analysis?
Please select all components you consider relevant and explain why each selected component is relevant to this phase.

Question 3b. Perceived Sufficiency of the Scrum Framework
To what extent does the Scrum framework itself provide sufficient support for Risk Analysis?
Please select one option:
1 – Highly insufficient
2 – Insufficient
3 – Partially sufficient
4 – Sufficient
5 – Highly sufficient
Note: This question aims to determine whether the Scrum framework itself is sufficient to support this phase or whether additional tools, methods, or approaches should be integrated.

Question 4. Risk Response Planning
Which Scrum-related components do you consider relevant to Risk Response Planning?
Please select all components you consider relevant and explain why each selected component is relevant to this phase.

Question 4b. Perceived Sufficiency of the Scrum Framework
To what extent does the Scrum framework itself provide sufficient support for Risk Response Planning?
Please select one option:
1 – Highly insufficient
2 – Insufficient
3 – Partially sufficient
4 – Sufficient
5 – Highly sufficient
Note: This question aims to determine whether the Scrum framework itself is sufficient to support this phase or whether additional tools, methods, or approaches should be integrated.

Question 5. Risk Monitoring
Which Scrum-related components do you consider relevant to Risk Monitoring?
Please select all components you consider relevant and explain why each selected component is relevant to this phase.

Question 5b. Perceived Sufficiency of the Scrum Framework
To what extent does the Scrum framework itself provide sufficient support for Risk Monitoring?
Please select one option:
1 – Highly insufficient
2 – Insufficient
3 – Partially sufficient
4 – Sufficient
5 – Highly sufficient
Note: This question aims to determine whether the Scrum framework itself is sufficient to support this phase or whether additional tools, methods, or approaches should be integrated.

Conflict of Interest Declaration
The author declares no conflicts of interest related to this research.

Ethical Approval and Informed Consent
All procedures involving human participants followed ethical standards for non-invasive social and organizational research. All individual participants provided informed consent electronically before completing the survey. Participation was entirely voluntary and confidential, with all data collected and analyzed in an aggregated, non-identifiable format. Institutional review board (IRB) approval was waived as the study involved minimal-risk, anonymous survey data from consenting adult professionals.

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Breno Gontijo Tavares
Eldorado Research Institute
National Institute of Telecommunications
Brazil
Breno.tavares@eldorado.org.br
ORCID: 0000-0002-4158-7173