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Evaluation of Maturity Levels and Recommendations for Improvements to the Implementation of the Scrum Method Case Study: SSM Transport and SSM QC Teams in Indonesia National Single Window Agency

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Abstract

This study examines the implementation of Scrum within INSWA's national program, SINSW, focusing on two key projects, SSM QC and SSM Transport. Despite adopting Scrum, deviations from its principles, such as unclear sprint end-dates, have hindered timely development. Using the Scrum Maturity Model (SMM), this research evaluates Scrum maturity through mixed methods, including KPA ratings and qualitative insights from observations, interviews, and document analysis. Results indicate both teams are at Maturity Level 1 (Initial), with SSM QC scoring 71.12% and SSM Transport 64.7%, classified as Largely Achieved. Recommendations for advancing to Level 2 include defining clear sprint timelines, enhancing project management, quantitative metrics, team capabilities, and stakeholder involvement. Grounded in the Scrum Guide 2020 and SBOK V4, these strategies aim to refine Scrum practices, fostering more efficient project development at INSWA.

A. Introduction

Indonesia National Single Window Agency (INSWA) plays a pivotal role in supporting Indonesia's national work program through the Sistem Indonesia National Single Window (SINSW). This initiative aims to streamline and enhance the efficiency of administrative processes across sectors by leveraging modern technology [1]. However, INSWA's adoption of Agile methodologies, particularly Scrum, for project development has encountered significant challenges. Internal evaluations have highlighted gaps between expected outcomes and actual Scrum practices, indicating deviations from the framework's core principles.

A major issue identified is the inability to achieve 100% completion of sprint goals, resulting in task backlogs that directly impact project schedules for applications such as SSM QC and SSM Transport. Interviews with stakeholders revealed that these backlogs disrupt project timelines, causing a ripple effect on overall deliverables. These challenges are categorized into four key domains influencing the maturity of Scrum implementation: Project, People, Process, and Product [2],[14].

In the Project domain, external disruptions, undefined end-date parameters, and non-compliance with Scrum indicators were observed. Within the People domain, stakeholders often underestimate significant issues, such as simultaneous task assignments across multiple projects. For the Process domain, overlapping responsibilities among team members hinder task completion, while in the Product domain, mid-sprint backlog additions and unresolved carryovers from previous sprints further complicate development efforts.

In this context, previous research provides a conceptual basis for evaluating the maturity of Scrum practices in various organizations. For example, Abimaulana et al. [3], Arifin et al.[4],Ismed[5] and Kurniawan et al [6] evaluated the maturity of software development using a combination of the Scrum Maturity Model (SMM) and Agile Maturity Model (AMM). Other studies, such as those by Setiyawan et al. [7] and Ridha & Hegarini [8], assessed Scrum maturity in telecommunications and media companies, offering improvement recommendations. Furthermore, Zelfia et al. [9] and Panjaitan & Legowo [10] compared Scrum maturity levels between internal and external organizational contexts.

However, no studies have assessed Scrum implementation in government institutions, particularly in large-scale national system integration initiatives. Therefore, this research contributes novelty by evaluating Scrum maturity in the SSM QC and SSM Transport projects using the Scrum Maturity Model (SMM). The study addresses two primary research questions:

1. What is the maturity level of Scrum implementation in the development of the SSM QC and SSM Transport applications at INSWA?
2. What recommendations can be made to improve the Scrum implementation process for these teams?

By assessing Scrum implementation maturity, this study aims to provide actionable insights for practitioners and policymakers to enhance project management effectiveness in the public sector, ultimately supporting the achievement of national strategic goals.

B. Research Method

The research employed a mixed-methods approach to comprehensively evaluate the maturity level of Scrum implementation within the Indonesia National Single Window (INSW) framework. Qualitative insights were gathered through on-site observations within the organization, providing contextual understanding of the Scrum processes and practices. Additionally, quantitative data were obtained by administering questionnaires to two distinct Scrum teams involved in the development phases of Project SSM QC and Project SSM Transport. These teams comprised specific roles, with the SSM QC team consisting of one Scrum Master, one Product Owner, and five Development Team members, and the SSM Transport team consisting of one Scrum Master, two Product Owner, and seven Development Team members.

The choice of the Scrum Maturity Model (SMM) as the primary evaluation framework was informed by its established effectiveness in assessing Scrum maturity across various organizational contexts. Integration of SMM with the Agile Maturity Model (AMM) was undertaken to provide a broader perspective, encompassing agile principles beyond Scrum, thus ensuring a more holistic assessment of agile maturity [3],[4],[5],[6]. This selection aligned with the objectives and preferences of the National Single Window Agency (INSWA), emphasizing the importance of adopting agile methodologies to enhance project efficiency and effectiveness. By agreeing to utilize SMM and AMM as part of the research methodology, INSWA demonstrated its commitment to fostering continuous improvement and innovation in project management practices.

The evaluation process involved the utilization of detailed questionnaires categorized into different levels and specific goals. Responses obtained from the questionnaires underwent calculation through the AMM method to gauge the maturity of individual process areas, represented by Key Process Area (KPA) ratings [11]. These ratings were interpreted based on established criteria, categorizing them into four levels: Fully achieved, Largely achieved, Partially achieved, and Not achieved. This structured approach ensured a thorough evaluation of Scrum maturity within the INSW framework, contributing to enhancing project management practices in alignment with INSWA objectives.

$$\frac{\sum(Yn) + 1/2\sum(Pn)}{\sum(Tn) - \sum(Nan)} * 100$$

Yn = Amount of Yes
Pn = Amount of Partially
Tn = Total questions
NAn = amount of N/A

Based on the formula, KPA rating interpretation the response from questionnaires and get the value presented by the following:

1. Fully achieved (86%-100%), all key practices identified in the KPA have been implemented and can be proven by organizational unit
2. Largely achieved (51%- 85%), many of the key practices identified in the KPA have been implemented and can be proven by organizational unit

3. Partially achieved (16%-50%), some of the key practices identified in the KPA have been implemented but in some aspects, it can't be proven by the organizational unit
4. Not achieved (0%-15%), key practices identified in the KPA not implemented

The Scrum Maturity Model assessment outlines distinct objectives at each level to evaluate the maturity of Scrum implementation within an organization, with detailed specifics provided in Table 1. At Level 2 (Managed), the focus is on foundational Scrum adoption, including establishing roles, artifacts, meetings, and sprints (19 questions total), alongside effective requirement management through clearly defined backlogs and successful sprint planning. Level 3 (Defined) emphasizes process refinement, with goals such as establishing a clear "Definition of Done," regular product demos, and iteration management through sprint backlogs, timeboxing, velocity tracking, and burndown charts (21 questions). At Level 4 (Quantitatively Managed), the aim is standardized project management practices (1 question), ensuring consistency and predictability. Finally, Level 5 (Optimizing) targets continuous performance improvement through effective daily scrums, retrospectives, and tracking positive performance indicators (12 questions), fostering an environment of excellence in Scrum methodology [12],[13].

Table 1. The Number of Questionnaires for Each Level

Level	Goal	Specific Goal	Number of Question
2 Managed	Basic usage of scrum methodology	Scrum role exists	3
		Scrum artifacts exist	9
		Scrum meeting exists	5
		Scrum sprints are correct	2
	Requirement Management	Product owners define requirement clearly	4
		Product owner brings product backlog as a requirement	6
		Have successful sprint planning meetings	6
3 Defined	Customer relationship management	Have a clear definition of done	2
		Product owner exists	1
		The team have demo happens after each sprint	2

	Iteration management	Sprint backlog defined	7
		Timeboxed of each iteration	4
		Celerity measured	3
		Having sprint burndown chart	2
4 Quantitatively Managed	Standardized Project Management	Standardized Project management	1
5 Optimizing	Project performance management	Have a successful daily scrum	6
		Have a successful retrospective after ever sprint	3
		Positive indicators	3

C. Result and Discussion

Scrum maturity level 2 encompasses two overarching objectives: 1) Fundamental Scrum Management and 2) Requirement Management. The evaluation of specific goals within Basic Scrum Management reveals KPA ratings outlined in Table 4, with an average value of 71.12% for SSM QC Project. This denotes the complete attainment of these general goals. Conversely, for SSM Transport Project, the average value only attains 64.70%, indicating a predominantly achieved status, as detailed in Table 2.

Table 2. Recapitulation of KPA Rating Basic Scrum Management

No	Specific Goal	SSM QC	Average	SSM Transport	Average	
1	Scrum roles exist	92,85%	71.12% Largely Achieved	90%	64.70% Largely Achieved	
2	Scrum artifacts exist	58,19%		56.05%		
3	Scrum meetings exist	68.57%		57.78%		
4	Scrum sprints are correct	64.88%		55%		

Table 3 evaluates Sofware Requirement Engineering by comparing SSM QC and SSM Transport on the goal: Product Owners Define Requirements Clearly. SSM QC achieved an average score of 82.85% for the specific goal, with an overall average of 78.01%, categorized as Largely Achieved, demonstrating effective collaboration with Product Owners to ensure clarity in requirements. In contrast, SSM Transport scored 68.94% for the goal, with an overall average of 73.82%, also categorized as Largely Achieved, though the lower score highlights room for improvement in ensuring requirement clarity and communication. While both teams show progress, SSM QC performed better in aligning with Scrum practices for Requirement Management.

Table 3. Recapitulation of KPA Rating Sofware Requirement Engineering

No	Specific Goal	SSM QC	Average	SSM Transport	Average
1	Product owners define requirement clearly	82.85%		68,94%	
2	Product owner brings product backlog as a requirement	73,80%	**78**.01% Largely Achieved	71,06%	73.82% Fully Achieved
3	Have successful sprint planning meetings	77,38%		81,46%	

Scrum maturity level 3 comprises three key objectives: (1) Customer Relationship Management and (2) Iteration Management. The assessment of specific goals under Customer Relationship Management, as outlined in Table VI, reveals that SSM QC has successfully met the objective, achieving an average score of 86.10%, indicating full accomplishment. Conversely, SSM Transport has reached a status of largely achieved, with an average score of 74.30%, highlighting progress while indicating areas for further improvement.

Table 4. Recapitulation of KPA Rating Customer Relationship Management

No	Specific Goal	SSM QC	Average	SSM Transport	Average
1	Have a clear definition of done	83.33%		76.66%	
2	Product owner exists	85.71%	86.10% Fully Achieved	67,50%	74.30% Largely Achieved
3	The team have demo happens after each sprint	89.28%		78,75%	

The table highlights specific goals within Scrum maturity level 3, focusing on Customer Relationship Management, with notable differences between SSM QC and SSM Transport. SSM QC demonstrates strong performance with an average achievement of 86.10%, indicating full accomplishment of having a clear Definition of Done (DoD). However, the DoD is not consistently applied across all activities, and the Product Owner (PO)'s involvement is insufficient in key Scrum ceremonies, such as Sprint Planning, Sprint Review, Daily Scrum, and Sprint Retrospective, limiting their ability to effectively guide the team. Similarly, SSM Transport achieves a largely accomplished status with an average of 74.30%, but faces challenges in consistently implementing a clear DoD and ensuring adequate PO participation. These shortcomings hinder both teams' ability to align product objectives with development efforts fully. To enhance Scrum maturity, both teams should focus on strengthening adherence to the DoD and ensuring active, consistent PO involvement across all Scrum practices.

In another general goal, Project Management as shown in Table 5, both SSM QC and SSM Transport just reach Largely Achieved with average value 63,64% and 63,26%.

Table 5. Recapitulation of KPA Rating Iteration Management

No	Specific Goal	SSM QC	Average	SSM Transport	Average
1	Sprint backlog defined	83.93%		81.11%	
2	Timeboxed of each iteration	54.76%	63.64%	59..72%	63.26%
3	Celerity measured	64.29%	Largely Achieved	55.36%	Largely Achieved
4	Having sprint burndown chart	51,58%		56.87%	

Table 6 illustrates the evaluation of Standardized Project Management, revealing that both SSM QC and SSM Transport achieved a "Largely Achieved" status. SSM QC attained an average of 62.49%, while SSM Transport scored 52.58%, indicating moderate implementation of standardized project management practices. Both teams require improvements to reach higher maturity levels in project management consistency.

Table 6. Recapitulation of KPA Rating Standardized Project Management

No	Specific Goal	SSM QC	Average	SSM Transport	Average
1	Standardized Project Management	62.49%	62.49% Largely Achieved	52.58%	52.58% Largely Achieved

Table 7 evaluates Project Performance Management, highlighting strengths and areas for improvement. Both SSM QC and SSM Transport are "Largely Achieved," with SSM Transport scoring slightly higher for successful retrospectives (58.71%) compared to SSM QC (51.78%). This indicates a stronger focus on reflective practices in SSM Transport, which could foster continuous improvement. Positive indicators are encouraging, with SSM QC at 65.64% and SSM Transport at 75%, suggesting both teams have established effective practices contributing to project success. However, the lower retrospective scores reveal an opportunity to enhance collaboration and adaptative processes post-Sprint to ensure lessons learned are effectively implemented. By strengthening retrospective practices, both teams can further align with Scrum's iterative improvement principles and achieve higher maturity.

Table 7. Recapitulation of KPA Rating Project Performance Management

No	Specific Goal	SSM QC	Average	SSM Transport	Average
1	Have a successful retrospective after ever sprint	51.78%	58.71% Largely Achieved	61.98%	68.49% Largely Achieved

Upon reviewing the KPA Rating recapitulation for all general goals assessed across various levels, as presented in Table 8, it is evident that both the Scrum Team in SSM QC and the Scrum Team in SSM Transport are currently at Level 1, indicating that both teams are still in the initial phase of their Scrum maturity journey. The Scrum

Team in SSM QC has a maturity rating of 71.12% overall, while SSM Transport has a slightly lower maturity level of 64.70%.

Several factors contribute to this difference, including SSM Transport's team members concurrently managing multiple projects, which leads to a lack of focus on individual projects. Additionally, the team has limited experience in applying Scrum methodology, resulting in an incomplete understanding of Scrum principles. In contrast, the SSM QC team is specifically focused on a single project, with experienced personnel and a dedicated Scrum Master, allowing for better alignment with Scrum practices.

Table 8. Result Interpretation KPA Rating

Level	General Goal	KPA Rating / Interpretation	SSM QC	SSM Transport
	Basic Scrum Management	KPA Rating	71.12%	64.70%
		Interpretation	L	L
2	Software Requirement Management	KPA Rating	78.01%	73.82%
		Interpretation	L	L
3	Customer Relationship Management	KPA Rating	86.10%	74.30%
		Interpretation	F	L
	Iteration Management	KPA Rating	63.64%	63.26%
		Interpretation	L	L
4	Standardized Project Management	KPA Rating	62.49%	52.58%
		Interpretation	L	L
5	Performance Management	KPA Rating	58.71%	68.49%
		Interpretation	L	L

The KPA Rating table indicates that both SSM QC and SSM Transport are at Level 1 maturity, reflecting an Initial Stage of Scrum adoption, with significant room for improvement in various areas. Both teams show challenges in Basic Scrum Management and Software Requirement Management, suggesting that foundational Scrum processes need strengthening. While SSM QC excels in Customer Relationship Management with a higher maturity level (86.10%), SSM Transport lags behind at 74.30%. Both teams face consistent difficulties in Iteration Management, Standardized Project Management, and Performance Management, indicating a need for better iteration processes, project standardization, and performance tracking. The results highlight the necessity for targeted improvements, including role clarification, improved stakeholder communication, and more structured iteration management to elevate both teams to higher maturity levels.

To improve the maturity level, particularly for the SSM Transport team, it is crucial to enhance their software development processes and deepen their understanding and implementation of Scrum principles. Both teams should work toward reaching at least maturity Level 3, with aspirations to progress further towards Level 4 or 5.

The recommendations for improvement will be derived from the Scrum Guide 2020 and SBOK V4 [15],[16]. Additionally, insights will be gathered from stakeholders within INSWA responsible for overseeing the projects managed by these teams.. These resources will guide the identification and mapping of key practices and areas for enhancement to support both teams in progressing toward

Level 2 maturity. Table 9 outlines the specific practices and actions that need to be implemented for each team to achieve this goal, focusing on strengthening Scrum fundamentals, such as role clarity, iteration management, and software requirement management. By addressing these areas, both teams can align with the necessary practices and principles to move beyond the initial stage and achieve greater consistency and effectiveness in their Scrum implementation

Table 9. Recommendations for Improvement Target Level 2

General Goal	Specific Goal	Recommendation
Basic Scrum Management	Scrum roles exist	Ensure each Scrum role is clearly defined and allocated, with no overlapping responsibilities. Assign a dedicated **Scrum Master** to focus on facilitation without being involved in multiple projects simultaneously.
	Scrum artifacts exist	Maintain and consistently update **Product Backlogs**, **Sprint Backlogs**, and **Increment Artifacts** as per the Scrum framework. Train team members on the use of collaboration tools like *Lark* to document and share these artifacts effectively.
	Scrum meetings exist	Conduct all required Scrum ceremonies (*Sprint Planning, Daily Scrum, Sprint Review, and Sprint Retrospective*) consistently, ensuring adherence to time-boxing principles. Encourage active participation by all team members.
	Scrum sprints are correct	Ensure sprint durations are appropriate (e.g., two weeks), with deliverable goals that are achievable yet challenging. Clearly communicate sprint goals and emphasize team commitment to them during *Sprint Planning*.
Software Requirement Engineering	Product owners define requirement clearly	Provide dedicated training to **Product Owners** to enhance their ability to define and communicate detailed and precise requirements. Emphasize the importance of gathering comprehensive business needs during initial discussions with stakeholders.
	Product owner brings product backlog as a requirement	Encourage **Product Owners** to collaborate closely with stakeholders to prioritize backlog items based on value and feasibility. Regularly review and refine the backlog to reflect evolving business needs.
	Have successful sprint planning meetings	Facilitate effective *Sprint Planning* by ensuring the backlog is well-prepared beforehand. Use structured formats and clear prioritization criteria to enable the team to commit to realistic sprint goals confidently.

Mapping recommendations for enhancement target maturity level 3 as shown in table 10.

Table 10. Recommendations for Improvement Target Level 3

General Goal	Specific Goal	Recommendation
Customer Relationship Management	Have Definition of Done	Establish a clear and universally understood **Definition of Done (DoD)** for all deliverables. This should include specific quality criteria, testing protocols, and acceptance conditions to ensure consistency and alignment across all team members.
	Product Owner Available	Ensure the **Product Owner** is fully accessible to the team throughout the sprint to clarify requirements, address questions, and resolve ambiguities promptly. Implement tools like *Lark* or *MS Teams* to facilitate seamless communication.
Iteration Management	Timeboxed Iteration	Adhere strictly to timeboxed iterations (e.g., 2-4 weeks). Communicate sprint timelines and deadlines clearly to all stakeholders to avoid interruptions or scope changes mid-

	The team has an effective sprint burndown chart	sprint. Reinforce the importance of respecting time constraints in *Sprint Planning*. Utilize tools like *Lark* or *MS Planner* to generate and display **Sprint Burndown Charts**, ensuring real-time tracking of progress. Educate the team on how to interpret these charts to adjust workflows and identify bottlenecks proactively.

Mapping recommendations for enhancement target maturity level 4 as shown in table 11.

Table 11. Recommendations for Improvement Target Level 4

General Goal	Specific Goal	Recommendation
Standardized Project Management	Quantitative Project Management	Implement a **quantitative project management system** using metrics such as velocity, sprint burndown charts, and cycle times. Train the team on utilizing these metrics to track progress, forecast outcomes, and improve sprint planning accuracy.

Mapping recommendations for enhancement target maturity level 5 as shown in table 12.

Table 12. Recommendations for Improvement Target Level 5

General Goal	Specific Goal	Recommendation
Project Performance Management	Daily Scrum with success	Ensure **Daily Scrum** meetings remain concise, timeboxed to 15 minutes, and focus solely on the three Scrum questions: What was done yesterday? What will be done today? Are there any blockers? Encourage team discipline and punctuality.
	Successful retrospective	Structure **retrospective meetings** to systematically address successes, challenges, and actionable improvements. Use tools such as the "Start, Stop, Continue" framework to create actionable plans and track their implementation.
	Positive indicators	Establish **key performance indicators (KPIs)** such as team velocity, sprint completion rates, and defect resolution times to monitor progress. Share these metrics in a visual dashboard to enhance team motivation and stakeholder trust.

D. Conclusion

The maturity level assessment of the SSM QC team reveals that the team is currently positioned at Level 1 (Initial), indicating unstructured and ad hoc work processes. While some progress has been made in areas such as Basic Scrum Management and Software Requirement Engineering at Level 2 (Managed), which are largely achieved (LA), the team still requires significant improvements to achieve full consistency and structured Scrum practices. At higher levels, such as Level 3 (Defined) and Level 4 (Quantitatively Managed), areas like Customer Relationship Management and Unified Project Management also show potential, but the lack of fully achieved (FA) goals demonstrates the need for a stronger focus on standardizing and integrating processes. These findings indicate that the SSM QC team must prioritize a holistic adoption of Scrum principles to enhance organizational maturity.

Recommendations for the SSM QC team focus on addressing gaps in Scrum implementation and fostering a culture of continuous improvement. Key suggestions include providing training to Product Owners (POs) to enhance their ability to clearly define requirements and align with business needs. Additionally, the team must

allocate roles more effectively, ensuring that operational tasks such as bug fixing are managed by dedicated support teams rather than developers, to prevent disruptions in development cycles. Regular training and workshops on Scrum practices, combined with the adoption of collaborative tools that support Scrum artifacts and ceremonies, are critical to improving performance and achieving higher maturity levels.

The maturity level assessment of the SSM Transport team also places them at Level 1 (Initial), reflecting similar challenges in structuring processes and implementing Scrum effectively. Despite progress in areas like Basic Scrum Management and Iteration Management at Level 2 (Managed) and Level 3 (Defined), the team exhibits room for improvement, especially in Measurement and Analysis Management at Level 4 (Quantitatively Managed), which remains partially achieved (PA). The need for enhanced quantitative analysis and integration of project management practices is evident. While some practices are largely achieved (LA), they are not consistently implemented across all aspects of the team's operations.

To improve the Scrum maturity level of the SSM Transport team, the recommendations include enhancing the Product Owner's role to better define project goals and align with ultimate business objectives. Timeboxing iterations, improving the use of Sprint Burndown Charts, and integrating quantitative metrics to measure progress effectively are essential next steps. Furthermore, fostering a culture that values disciplined adherence to Scrum principles through training and providing tools that visualize performance indicators will drive improvements. Implementing these strategies will enable the SSM Transport team to transition to higher maturity levels, optimize project delivery, and align better with stakeholder expectations.

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