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Implementation of Agile Project Management for Digitalization in the Oil & Gas Industry: A Case Study of Gas Stations in Indonesian Company

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ABSTRACT

Agile project management has been extensively utilized in software development, but its application in IoT installation and integration projects remains relatively uncommon. This study aims to enhance the implementation of agile project management practices within the context of gas station digitalization, which faced a target completion shift three months early. This acceleration was driven by business-critical factors, including compliance with government regulations, subsidy reimbursements, and operational efficiency improvements. Using a case study and the Design Science Research Methodology (DSRM), the research focuses on an oil and gas company undertaking gas station digitalization to comply with regulatory requirements. The project was managed using agile principles and the Scrumban framework. By adopting agile project management and Scrumban, the company achieved faster deployment cycles, improved real-time data accuracy and coverage, and enhanced coordination between stakeholders, leading to 50% faster integration time per station. As a contribution, the study introduces a project management model tailored for agile adoption and an application of Scrumban to large-scale IoT-based infrastructure projects, particularly in a highly regulated industry such as energy distribution. Unlike previous studies focusing on agile methods in software development, this research extends the methodology to a multi-site, hardware-integrated digital transformation, addressing both technical and operational challenges in real time to facilitate the effective execution of digital transformation initiatives within the oil and gas industry.

KEYWORDS *IoT Installation Integration; Agile Project Management; Project Management; Gas Station Digitalization; Scrumban.*

INTRODUCTION

Digital transformation has become a crucial component across various industries, including the energy and fuel distribution sectors, to enhance operational efficiency and transparency (McKinsey & Company, 2020; Wijayanti & Sutrisno, 2021). According to McKinsey & Company (2020), digital transformation projects in the oil and gas industry face a failure rate of approximately 70%, with delayed implementation being one of the primary contributing factors (McKinsey & Company, 2020; Tan & Siahaan, 2021). Furthermore, Gartner (2021) reported that 85% of digital transformation initiatives in highly regulated industries fail to meet their original timeline targets, resulting in significant financial losses and compliance risks (Gartner, 2021; Choi & Song, 2022). In the context of IoT-based infrastructure projects, research by the International Energy Agency (2022) indicates that delays in digitalization deployment can result in revenue losses of up to $2.5 million per month for large-scale energy distribution companies (International Energy Agency, 2022; Suryani et al., 2021). The criticality of implementation speed (time-to-market) becomes even more pronounced in regulated industries, where non-compliance penalties and subsidy

reimbursement delays can compound financial impacts (Liu & Chen, 2022; Kumar & Sharma, 2021). A study by Deloitte (2023) emphasized that successful digital transformation in the oil and gas sector requires not only technological readiness but also adaptive project management methodologies capable of responding to accelerated timelines and regulatory pressures (Deloitte, 2023; Zhang et al., 2022).

The implementation of digitalization in companies aligns with government regulations as stipulated in BPH Migas Regulation No. 6 of 2013, which mandates the use of Information Technology Systems (ITS) for the accurate, targeted, and well-measured distribution of fuel to consumers. Furthermore, BPH Migas Decision of 2020 requires companies to record and report consumer data and fuel volumes accurately to prevent subsidy misuse. Additionally, new regulations mandate that detailed transaction data recorded in a company's data center must be verified and serve as the basis for subsidy and compensation payments, as governed by PMK No. 159 of 2021 and PMK No. 166 of 2023. Delays in digitalization projects for gas stations could disrupt a company's cash flow, as discrepancies between the transaction data recorded in the digital system and actual distributed data may arise (Bhimani, 2021; Borowski, 2021; Hapsatou, 2022).

To comply with regulations that mandate the digitalization of gas stations, the first batch of gas station digitalization (Digi-1) was initiated in 2021, encompassing 5,518 gas stations. Several technical and operational challenges have emerged, including resistance to change, limited technological skills, and the complexity of integrating gas station facilities such as dispensers, underground tanks, hardware systems (controllers), and software. Issues identified in managing digitalization projects include delays in achieving daily integration milestones during project execution, which subsequently lead to missed targets. These delays are often attributed to a lack of coordination among teams, slow decision-making processes, and technical challenges encountered on-site.

To enhance the incremental value of gas station digitalization, the second phase of digitalization for 958 gas stations, known as Digi-2, was launched in 2024. However, the Digi-2 project faced a significant challenge when the target completion was advanced by three months due to business-critical factors, including compliance with government regulations, subsidy reimbursements, and operational efficiency improvements. This acceleration required an adaptive project management approach to handle the condensed timeline without compromising quality or operational stability.

To meet this challenge, Agile Project Management and the Scrumban framework were adopted as key solutions for ensuring the project's success. Agile has proven to enhance collaboration and productivity in various infrastructure and digitalization projects, including the implementation of IoT solutions, by emphasizing rapid iterations and cross-functional team engagement. Agile provides an iterative structure that allows each project phase to be continuously evaluated and adjusted, thereby improving team collaboration and reducing resistance to change. By utilizing this method, companies can enhance responsiveness to changing technical requirements while accelerating project completion through scheduled sprints and regular retrospectives. Additionally, Agile ensures that issues such as daily operational delays can be identified and addressed earlier through consistent monitoring.

A comprehensive review of existing literature reveals the promising yet limited application of Agile methodologies beyond traditional software development. Studies by

Comella-Dorda et al. (2018) and Fitriani et al. (2021) demonstrate Agile's potential in IT infrastructure and software-defined networking projects, noting benefits like reduced deployment time and improved collaboration. However, their research did not address projects involving complex hardware integration or multi-site physical installations, such as those with IoT devices. Further analysis by Moedt van Bolhuis et al. (2023) confirms that IoT projects benefit from hybrid Agile approaches like Scrumban, though their findings are based on small-scale implementations and not on massive, geographically dispersed deployments.

Collectively, these studies identify a significant knowledge gap, as noted by Hurtioi and Avadanei (2020), who highlight the inadequacy of purely Agile methods for projects with extensive hardware and regulatory needs. Specifically, there is a lack of empirical evidence on adapting frameworks like Scrumban for large-scale, hardware-integrated digitalization projects under accelerated timelines and strict compliance requirements. This gap is especially critical in sectors like oil and gas, where projects must simultaneously manage technical dependencies, operational constraints, and regulatory imperatives across hundreds of physical sites.

This research addresses an urgent practical need arising from the compressed timeline of the Digi-2 project. The acceleration of the completion target from mid-December to mid-October 2024—a three-month advancement—created unprecedented pressure to deliver 958 gas station digitalizations while maintaining 100% compliance with government regulations for subsidy reimbursement eligibility. The urgency is further compounded by the financial implications: each day of delay in digitalization results in incomplete transaction data recording, directly affecting the company's ability to secure subsidy and compensation reimbursements from the government. Given that the oil and gas retail sector operates on narrow profit margins, and that subsidy reimbursements constitute a critical component of cash flow for fuel distributors, failure to meet the revised deadline would have cascading financial consequences. Moreover, the regulatory environment is becoming increasingly stringent, with PMK No. 166 of 2023 mandating real-time data verification as the basis for payment, leaving no tolerance for delayed implementation. This convergence of shortened timelines, financial stakes, and regulatory compliance creates an urgent imperative for understanding how adaptive project management can enable successful execution under extreme time constraints.

This study evaluates the implementation of Agile Project Management in gas station digitalization, identifying challenges and opportunities for improvement in these projects. Through a case study on gas stations operated by an energy company, this research provides insights into how Agile can be applied in the energy retail sector to ensure the success of digital transformation initiatives. In addition to enriching the academic literature on Agile adoption in non-technological sectors, the findings of this study are expected to offer practical recommendations for similar organizations to enhance efficiency and alignment with organizational objectives.

METHOD

This study adopted a case study methodology supported by an established theoretical framework, utilizing the Design Science Research Methodology (DSRM). Design Science Research (DSR) aims to improve the digitalization delivery time for gas stations through the six stages defined in the Design Science Research Methodology (DSRM) [11]. (1) Identify the key issues and motivations for implementing gas station digitalization. Use an agile approach

to capture the needs of stakeholders and collaborate with stakeholders (project owner, digitalization execution team, and gas station owners), (2) Define objectives of the solutions, determining and prioritizing the goals based on measurable organizational value (MOV), (3) Design artifacts such as compatibility assessment tools or checklists, IoT prototypes, and integration frameworks. Use sprint planning to break down the digitalization process into manageable increments, (4) Execute iterative cycles focusing on delivering values using the sprint approach, (5) Evaluation to get retrospective and validation between project owner and digitalization execution team. Conduct sprint retrospectives to assess progress and gather feedback, (6) Communicating the results to stakeholders. This step is to create Document lessons learned, refine the backlog for future iterations, and maintain a dynamic backlog of improvements based on findings.

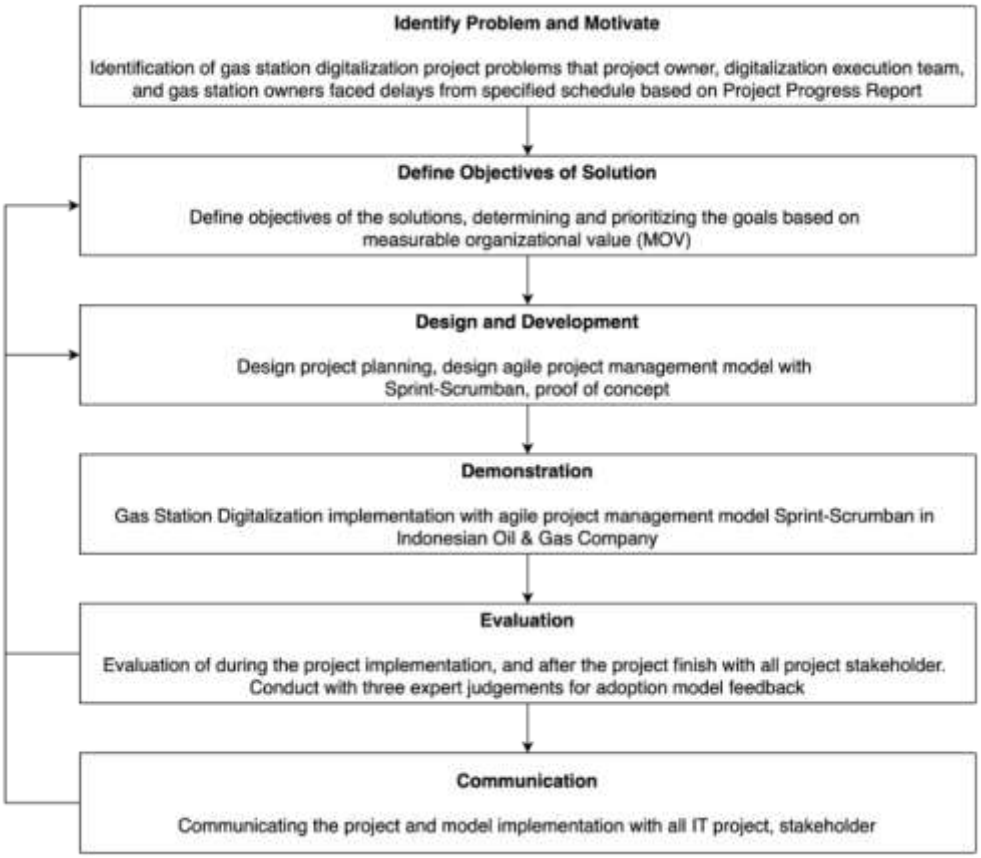

Figure 1. Design Science Research Methodology

RESULT AND DISCUSSION

A. Identify Key Issues and Motivation

A discussion regarding the current conditions was held and attended by the digitalization project vendor and implementation team, stakeholders, and the digitalization project team. The outcome of this discussion emphasized the importance of accelerating and ensuring the accuracy of the digitalization project's implementation, in response to changing stakeholder priorities. The outcome of this stage was a business case that was mutually agreed upon by all parties involved in the project.

B. Define Objectives of the Solutions

The Measurable Organizational Value (MOV) was established by analyzing the business needs. The Digitalization project team explored various options for solutions that could help ensure the project is completed on time, in alignment with these needs.

Table 1. Measurable Organizational Value Digitalization Project

Potential Area	Objectives	Time
Financial	Achieve **100% reimbursement** for subsidy and compensation	12 months
	Achieve **100% accuracy** in subsidy reporting.	6 months
Customer	Increase customer **satisfaction by 10%**.	6 months
Operational	Achieve **99% accuracy** in fuel inventory and transaction records.	3 months
	Enable **100% real-time data** visibility.	3 months
Social	Ensure **100% compliance** with government regulations.	12 months

C. Design and Development

The objective of this step is to build and refine artifacts for each step of digitalization. Agile approach allowing the team to execute iterative cycle with a focus on delivering incremental value to meet the MOV.

Figure 2. Agile Workflow for Digitalizing Gas Stations

From Figure 2, that certain activities can be categorized as Sprints. Table 2 shown the detailed objective, key activities, and deliverable of each Sprint.

Table 2. Mapping Digitalization Steps to Agile Sprint

Sprint 1: Site Assessment	**Objective**	Assess the site's readiness for digitalization and identify any obstacles or compatibility issues.
	Key Activities	Inspect station infrastructure.
		Check compatibility with IoT devices.
		Identify obstacles that require adjustments (e.g., outdated hardware, lack of connectivity).

		Document findings for the next sprint (Civil Work, if needed).
	Deliverable	A report on each station's compatibility and a list of adjustments (if required).
Sprint 2: Civil Work	**Objective**	Address any infrastructure issues identified during the area assessment.
	Key Activities	Perform physical adjustments (e.g., setting up wiring, upgrading infrastructure).
		Resolve major obstacles that prevent IoT installation.
	Deliverable	Fully prepared infrastructure ready for IoT device installation.
Sprint 3: IoT Installation	**Objective**	Install IoT devices and integrate them locally within the station's infrastructure.
	Key Activities	Install IoT devices (e.g., ATG, FCC, EDC, tablets, routers).
		Perform local device integration (e.g., connect devices to the local network).
		Conduct preliminary testing to ensure devices function correctly.
	Deliverable	IoT devices installed and locally integrated.
Sprint 4: Soft-ware Installation	**Objective**	Install and configure the required software to operate the IoT devices and local systems.
	Key Activities	Deploy software on local servers or cloud-based platforms.
		Configure systems to ensure compatibility with hardware.
		Conduct software testing to verify correct installation and operation.
	Deliverable	Fully operational software on-site, ready for system-wide integration.
Sprint 5: Integration	**Objective**	Connect the local systems to the data center and ensure seamless communication.
	Key Activities	Establish connectivity between gas station systems and the data center over the internet.
		Test end-to-end data flow and integration.
		Resolve any data synchronization or communication issues.
	Deliverable	Fully integrated gas station systems, with real-time data exchange with the central data center.

D. Demonstration

This stage is an effort to modernize operational workflows through an agile methodology, specifically utilizing Scrumban. The initiative was divided into distinct sprints, starting with compatibility checks to ensure existing systems meet digitalization needs, followed by civil work to upgrade infrastructure for IoT software installations. Subsequent sprints focus on installing IoT devices, deploying and configuring operational software, and finally integrating systems for seamless operation. Daily stand-ups and using a Kanban board provide real-time visibility and ensure the team stayed aligned with project goals.

Feedback loops were integral to refining testing tools and methodologies at each phase, while the Kanban board helps track progress and identify bottlenecks. The iterative process results in improved scalability across additional locations, as well as enhanced agility, allowing the team to adapt swiftly to challenges and evolving requirements throughout the project.

E. Evaluation

The evaluation of the gas station digitalization project was conducted at two levels: weekly and monthly. Weekly evaluations focus on identifying blockers, reviewing progress, and ensuring alignment with sprint objectives, with updates made to the Kanban board. Monthly evaluations involve project teams and stakeholders to maintain a unified understanding of progress and facilitate strategic discussions. The Scrumban board plays a vital role in visualizing processes and identifying bottlenecks.

To validate project methods, expert judgment was incorporated through input from three key areas of specialization. First, a digitalization expert specializing in technology aspects ensures that the technological solutions, such as IoT implementation and system integration, are robust, scalable, and in line with industry standards. Second, input from digitalization operational users, individuals directly involved in using the digitalized systems at the gas station, provides practical insights into the project's impact and the usability of the implemented solutions. Third, an agile project management expert reviews the project's adherence to agile principles, ensuring effective workflow management, stakeholder collaboration, and iterative delivery. This structured approach fosters enhanced transparency, proactive adjustments, and stakeholder alignment, ultimately driving the success of the digitalization project and laying the groundwork for future scalability across additional sites.

F. Communication

Effective communication is crucial for the successful advancement of the gas station digitalization project. This phase focuses on creating inspection and adoption reports that highlight areas for improvement throughout the project. The result of this phase is an updated progress report, which ensures that the project remains aligned with expectations and is completed and accepted by all project teams and stakeholders. The author has effectively communicated the implementation of the gas station digitalization model to all project members and stakeholders.

G. Discussion

This study focuses on how the gas station digitalization project, especially Digi-2, aims to enhance operational efficiency and adaptability by implementing modern technologies and agile methodologies, as shown in Figure 6. Following a collaborative initial discussion with stakeholders and the project team, a business case was developed to expedite the project while addressing ever-evolving stakeholder priorities. The project focuses on achieving Measurable Organizational Value (MOV) by exploring various digital solutions to meet defined business needs. Utilizing an Agile approach, the project is structured around iterative sprints, fostering continuous feedback and refining processes, tools, and infrastructure. Key activities include conducting compatibility checks, upgrading IoT infrastructure, installing devices, and integrating systems to ensure seamless operations. Ongoing evaluations, both weekly and monthly, are undertaken to address blockers and align project goals while hile leveraging expert insights to validate the effectiveness of technological and operational strategies.

Emphasizing clear communication and reporting, the project aims to deliver a robust digital solution that aligns with the expectations of all stakeholders, setting the stage for future scalability across additional locations.

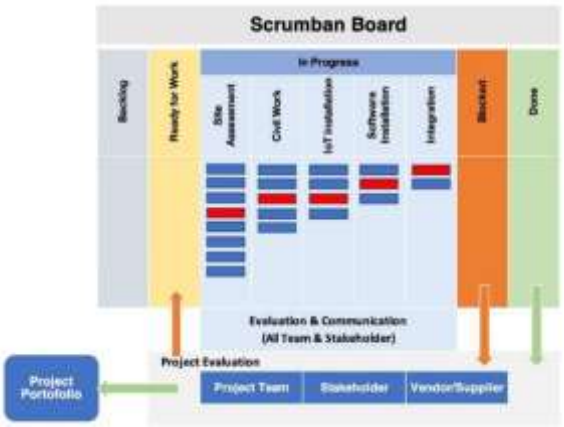

Figure 3. Scrumban Board for Digitalization Project Management

The benefits of adopting an Agile Project Management model using the Scrumban approach include:

a. Agile practices encourage frequent communication between teams, gas station owners, and stakeholders, ensuring that feedback on challenges like infrastructure adjustments or system integration is quickly addressed.
b. Regular retrospectives enable teams to identify bottlenecks in the digitalization process, such as delays in civil work or hardware integration, and make iterative improvements.
c. The Scrumban board provides real-time task tracking, enabling project teams and stakeholders to monitor progress and address issues promptly.
d. The hybrid Scrumban approach allows teams to adapt to changes in project requirements, such as new regulatory compliance needs or technical adjustments, without disrupting the overall workflow.
e. The iterative nature of Agile ensures that potential risks, such as hardware compatibility issues or delayed milestone achievements, are identified and mitigated early in each sprint phase, reducing the likelihood of major project disruptions.

Based on project team's performance report of the gas station digitalization initiative, the project has progressed exceptionally well, achieving the goal of 100% digitalization on schedule despite a revised timeline. Initially set for mid-December, the target was accelerated to mid-October due to stakeholder demands. This change in the timeline required the deployment of manpower earlier and in greater numbers, which impacted the project cost structure.

The addition of cost structure has been communicated with stakeholders, and it was found that the faster the gas stations are digitalized (increment target completion), the more sales transaction data (particularly for subsidized fuel) are recorded. This data recording can provide assurance to the Government for the reimbursement of subsidy and compensation costs.

With the implementation of Agile Project Management and the Scrumban framework, the accelerated schedule was managed smoothly. The framework provided real-time visibility into the prioritized list of gas stations to be digitalized, as well as the allocation of batches and manpower for each sprint.

CONCLUSION

This research demonstrates that the gas station digitalization project, implemented through agile project management and the Scrumban approach, successfully achieved its goals by improving operational efficiency and adaptability in a timely manner. The collaboration among stakeholders and the project team, alongside iterative Agile methodologies, enabled effective communication, swift problem-solving, and continuous evaluations that kept the project aligned with stakeholder expectations. Achieving the 100% digitalization target ahead of schedule not only highlights the project's success but also emphasizes the importance of robust data collection for supporting government reimbursement for subsidies. As the project establishes a strong foundation for future scalability, it illustrates how modern technologies and agile practices can drive substantial improvements in operational processes, service delivery, and competitiveness by responding swiftly to market and regulatory demands in the oil and gas retail sector. However, this research is limited to the adoption of Agile project management using Scrumban for gas station digitalization projects through the Design Science Research (DSR) method. Future research could explore broader applications of Agile project management in gas station digitalization or other digital transformation initiatives, as well as the development of more advanced iterative DSR models. This case study focuses on an oil and gas company in Indonesia, and future research could adopt this model for digitalization projects in other industries or sectors to evaluate the adaptability of Scrumban and agile frameworks.

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