



Managing Risks Based Scrum/Kanban Methodologies in Construction Industry

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ABSTRACT

Construction project risk management is one of the managements that receives huge attention in the world. As the success of any project is closely related to the effectiveness of risk management. However, in terms of the construction industry in Syria, there are clear shortcomings and gaps in risk management. So, to assess the actual reality of the Syrian construction industry with all its details (Project Management Methodologies - Software - Risk Management Methodologies - New Technology), this study relied on the descriptive analysis method of data collected through an interview, where the interviews were directed Syrian project management professional engineers over the entire area of the Syrian Arab country. The novelty of this research comes from the fact that it provides a framework for managing the risks of construction projects in Syria with a methodology that combines the strengths of Scrum methodology and the strengths of Kanban methodology. The significance of this study stems from the fact that the proposed risk management framework can be linked in an integrated manner to the development approach of project management, whether predictive or adaptive.

Keywords: BIM, Kanban, Construction Industry, PM Professional, Risk Management, Scrum, Syrian.

1. Introduction

Complexity As a result of the changes that occurred in the concepts of project management since its inception up till now, many professional methodologies have popped up like "PMP" provided by PMI (Project Management Institute) or as "Prince2" provided by Axelos. Even these professional methodologies have been modified in one way or another to cover and meet uncertain and variable requirement environment. To make way for the emergence of Lean, Scrum, Kanban, XP and other Agile management methodologies.

One of the main pillars of managing any project is Risk Management. Risk management is a global issue, and a challenge should be managed effectively in order to meet project objectives and achieve stakeholders' satisfaction. The same applies to AEC industry, with all this urban development all around the world and due to the rapid adoption of BIM (Building Information Modelling) the importance of risk management in the AEC industry is growing day by day. And it is necessary to understand the innovative project

management methods and adopt the more compatible with BIM technology.

BIM based Risk management has become an imperative as a result of the great changes that the industry sector is witnessing every moment, Considering BIM not only allows design and construction teams to work more efficiently, but it allows them to capture the data they create during the process to benefit operations and maintenance activities. Blowing up situation in Syria since 2011 and catastrophic Syria/Turkey February 6th earthquake have irreversible implication for civil and construction legacy. This situation has created the urgent need to assess the current situation of Syrian construction and develop a comprehensive and effective framework to manage issues and risks. This research proposes a risk management framework for the Syrian Architecture, Engineering, and Construction (AEC) industry by integrating Scrum and Kanban methodologies with Building Information Modeling (BIM) as a mitigation strategy. Scrum's iterative and flexible approach, combined with Kanban's focus on workflow visualization and efficiency, provides a comprehensive

framework for managing risks. BIM enhances this framework by offering detailed digital representations of projects, enabling early risk identification, scenario simulation, and improved stakeholder communication. Together, these methodologies and tools aim to address the specific challenges of the Syrian AEC industry, improving risk management through enhanced visibility, coordination, and decision-making.

2. Literature Review

2.1. Concept of Risk Management:

Project Risk Management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project.

2.1.1. Plan Risk Management:

The objectives of the Plan Risk Management process are to develop the overall risk management strategy, decide how the risk management processes will be executed, and integrate risk management with all other activities (PMI,2019)

2.1.2. Identify Project Risk:

Identifying Risks is the process of identifying individual project risks as well as sources of overall project risk and documenting their characteristics.

The main outputs of Identify Project Risk:

2.1.3. Risk Register:

The risk register picks up the details of identified individual risks. risk analysis results, risk response strategies, response implementation, and status. It is used as an effective way to risk management processes.

2.1.4. Perform qualitative Risk Analysis Process:

Is the process of Prioritizing individual project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics. it focuses efforts on high-priority risks (PMI, 2017).

2.1.5. Perform Quantitative Risk Analysis Process:

Perform Quantitative Risk Analysis is the process of numerically analyzing the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives (PMI, 2017).

2.1.6. Plan Risk Response Process:

Once risks have been identified, analyzed, and prioritized, plans should be developed for addressing every risk the project team considers to be sufficiently important (PMI, 2017).

2.1.7. Implement Risk Responses Process:

It ensures that agreed-upon risk responses are executed as planned in order to address overall project risk exposure, minimize individual project threats, and maximize individual project opportunities (PMI, 2017).

2.1.8. Monitor Project Risks Process:

Track identified risks, monitor residual risks, identify new risks, ensure that risk response plans are executed at the appropriate time, and evaluate their effectiveness throughout the project life cycle. Also the effectiveness of all of the Project Risk Management processes should be reviewed and audited. (PMI, 2017)

2.2. Concept of Project Management Professional:

2.2.1. Scrum

Scrum Focus on delivering the highest business value in the shortest time frequently through short iterations known as sprints. This gives visibility to the work that's being done and creates opportunities for feedback. (Sutherland, et al. 2020)

2.2.2. Kanban

Kanban: is a popular framework method to implement agile and software development. It requires communication of capacity and full transparency of work. Work items are represented visually on a kanban board, allowing team members to see the state of every piece of work at any time. Using cards, physical or electronic boards can track work as it progresses. (Damanellore Karthik, et al. 2021)

2.3. Concept of Building Information Modelling

Building Information Modeling (BIM) is the foundation of digital transformation in the architecture, engineering, and construction (AEC) industry. Building Information Modeling has great benefits such as:

- Promote design and engineering creativity and ensure coupling between the design, construction and operation of the built environment (Ahmed O. S., 2018)
- As Construction risk could affect badly project's feasibility. (Shibani, et al. 2022) BIM Provides analytical capability to enhance project and enterprise level functions such as risk management.
- Cooperation between all departments and avoiding problems that were previously occurring. (Alzoubi,2022)
- Enhance performance through effective involvement of all parts of the project. (Salamah, et al. 2023)
- Higher productivity as it reduces waste and time loss, reduces costs, and improves quality. (Ahmed S. D. et al. 2018)
- Allocate more effective resources and reduce wasted materials in the project.
- Reducing planning defects (Ganbat, et al. 2020)
- Reduce information loss and reducing human errors. (Ahmed O. S., 2018)
- Integration between the analysis / design model and the construction model (Lepkova, et al. 2019)
- Simulating the stages of the project from the beginning of excavation at the site to the end and facilitating communication between all parties. (Shaban, et al. 2018)
- Detecting conflicts during design and avoiding re-work. (Ganbat, et al. 2020)
- Improve risk management as the updated construction model with all changes made during construction provides an accurate source of information (Ganbat, et al. 2020)

3. Research Methodology

Analysis Methods were used in this research As a systematic, arranged method supports collecting research-related data and serves clarifying the relationship between the research variables in the form of questions or hypotheses, this method also enables using statistical analysis tools that suit the nature of the research data. The main research method in this study was interviews. The most important part of this process is the creation of questions that accurately reflect the opinions and experiences of the respondents. The questions are adopted from previous studies with some modifications to suit the context of this study. The structure of the questions is divided into four main themes: (1) Demographic and company information. (2) Agile Project management: (3) Scrum risk management (4) BIM in Construction. The interviews were conducted via Zoom meeting and team meeting applications, and a direct face- to- face approach.

The Community in this research Construction industry companies in Syria that are interested in applying new technologies. The chosen Samples are from professionals’ engineers with experience on Syrian construction projects are selected as the sample in this study. The respondents come from various departments that could generally be classified as a research department, design come from various levels of non-executive to management level since they are directly involved in a business unit, function, or process in organization.

4. Results and Data Analysis

4.1. Development Risk management Framework

Based on the results of the questionnaire and analysis of the results, a proposal for Risk Management Framework was developed based on three Pillars: 1. Risk Management Office (RMO); 2. Risk Processes and 3. Roles.

4.1.1. Risk Management Office

The Risk Management Office (RMO) is an organizational structure linked directly to the General Manager of the organization or contracting company. The office is headed by the Risk Manager and consists of the following departments:

- The Consult Office, headed by a Risk Expert
- Risk Follow-Up Office, headed by Risk Owner
- Logistics Support Office, headed by Logistics Support Officer which consists of: Internal & External Relation Unit; Internal & External Reports Unit and Documentation Unit as shown in Figure 1.

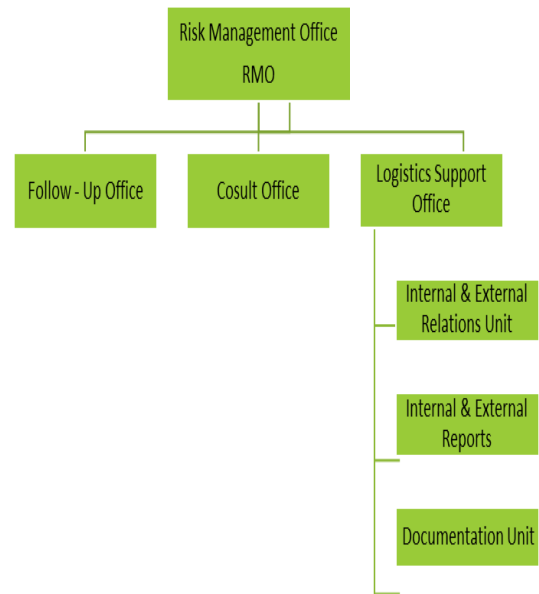


Figure 1. Risk Management Office (RMO) Organizational Structure (Author, 2023)

The responsibilities of an RMO can range from providing a consultative role to projects—such as supplying templates, best practices, training, access to information, and lessons learned from other projects—to taking on a monitoring role. The RMO serves as a repository for project risks and acts as an auditor of risk management processes. It may make recommendations, lead knowledge transfer efforts, and support Risk Owners in various ways, including coaching, mentoring, training, and oversight. Additionally, the RMO monitors compliance with risk management standards, policies, procedures, and templates through project audits. It also develops and manages project policies, procedures, templates, and other shared documentation (organizational process assets) and coordinates communication across projects.

4.1.2. Risk Processes:

The outcome of construction Projects is accomplished through the applicable and integration of three phases:

1. Design
2. Implementation
3. Operation.

In this proposal, it was considered each phase is a project with five processes (Initiating – Executing – Monitoring and Controlling – Closing). With separate Risk Processes in each phase. Kanban Methodology with Scrum Ceremonies are applied in this proposal to manage project risks. So it was named each phase by an iteration or sprint.

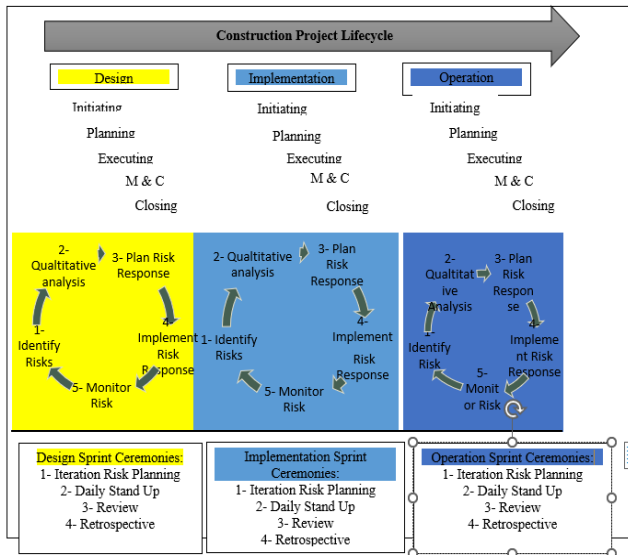


Figure 2. Shows Risk Management Process Based on Scrum/Kanban (Author, 2023)

4.1.3. How does Risk Process Works?

4.1.3.1. Identify Project Risks:

Risk Owner with Risk Experts are responsible to identify project risks and to document all project risks in Risk Register (Sousa Neto, et al. 2023).

Table 1. Risk Register (John Wiley & Sons, 2017)

ID	Risk Description	Risk Category	Risk Action	Risk Analysis	quantitative	Response Strategy	Risk Trigger	Risk Status
1	-	-	-	-	-	-	-	-

In this process all identified risks should be categorized and risk action owners should be stated for each one those identified risks, to perform qualitative risk analysis later. Every risk and corresponding risk responses should have been allocated to a risk action owner as part of the Identify Risks process. (Project Management Institute, 2019). Risk Identification should depend on stakeholder collaborative and business environment. (Esteki *et al.*, 2020).

4.1.3.2. Perform Qualitative Risk Analysis

Risk Owner and Risk Experts are responsible for this process, Risk Action Owner could help. In this process all identified project risks are prioritized and rated from High Priority – Medium – Low to Nil Priority. The outcomes of this process should be stated in the risk register. After that Risk Owner should Prepare and Refine Risk Backlog, Risk owner documents all identified project risks in the Risk Backlog then he refines the risk backlog through Refinement Meeting in order to prioritize and rate risks from most high priority to nil priority (Marle, 2020), according to outputs of Perform qualitative Risk Analysis Process as following and according to other risk assessments parameters (Urgency – Proximity – Dormancy – Manageability – Controllability – Connectivity – Strategic impact and Proximity).

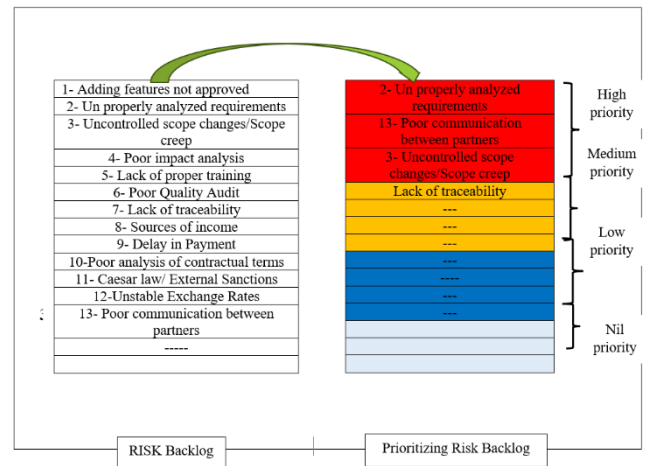


Figure 4. Risk Backlog and Risk Backlog Prioritizing (Author, 2023)

The Risk Owner, Risk Experts and Risk Action Owner are responsible for this Process. The output of this process which should be documented in the risk register:

- o Agreed-upon response strategies.
- o Specific actions to implement the chosen response strategy.
- o Trigger conditions, symptoms, and warning signs of a risk occurrence.
- o Budget and schedule activities required to implement the chosen responses.
- o Contingency plans and risk triggers that call for their execution.
- o Fallback plans for use when a risk has occurred and the primary response proves to be inadequate.

4.1.3.3. Plan Risk Response Strategy

The Plan Risk Response strategy, when integrated into the risk processes using Kanban with Scrum, ensures that risks are systematically identified, prioritized, and managed throughout the project. In this approach, the Kanban board visualizes the flow of risks, enabling the team to focus on high-priority issues and track their progression. Scrum ceremonies, such as sprint planning and daily stand-ups, are utilized to regularly assess and adjust risk responses, ensuring that the team remains responsive to emerging challenges. This combination of Kanban's visual management and Scrum's iterative processes enhances the team's ability to proactively address risks, improving overall project outcomes.

4.1.3.4. Preparing to Implement Risk Response Strategies

Risk Action Owners are responsible for this process. Based on the urgency and priority of project risks in the risk backlog, they pull high-priority risks and place them in the Risk Progress implementation list.

4.1.3.5. Implement Risk Response Strategies

The most priority risks and risk that appears its trigger should be implemented first. The risk owner is responsible for ensuring that the risk response is effective and for planning additional risk responses if required. The risk action owner is

responsible for ensuring that the agreed-upon risk responses are carried out as planned, in a timely manner.

4.1.3.6. Monitor Project Risks

This process is achieved by these three ceremonies:

i. Daily Stand – Up Meeting

After ending the process of Plan Risk response Strategies, a Daily Stand – Up Meeting should be held by risk action owners every day in the same place at the same time and they should answer three questions?

- 1- What Risks we Encountered yesterday?
- 2- What Risk should we deal with today (any triggers)?
- 3- Any problem with risk response strategies?

These 15 minutes every day meeting provides transparency to risk processes flow and also provides which is risks is outdated and if new ones appear.

ii. Review Meeting

This meeting is held periodically to track identified risks, monitor residual risks, identify new risks, ensure that risk response plans are executed at the appropriate time, and evaluate their effectiveness throughout the project life cycle. Risk Action Owners should keep the Risk Owner informed of the status of the response actions so that the Risk Owner can decide when a risk has been effectively addressed or whether additional actions need to be planned and implemented. It is the responsibility of the Risk Action Owner to ensure that trigger conditions are effectively monitored and that the corresponding actions are carried out as defined, in a timely manner. Risk Managers should ensure that periodic risk reassessment, including risk identification, analysis, and response planning, is conducted in response to project events. Therefore, in the review meeting, two essential aspects should be given attention. Risk Reassessment: in order to (1) Identify new risks, (2) Reassessment of current risks and (3) Closing of risks that are outdated.

- Risk Audit: in order to (1) Examine and document the effectiveness of risk responses in dealing with identified risks and their root causes and (2) Examine and document the effectiveness of the risk management process.
- Status Reviews: here an agenda should be prepared by risk owner in order to document these following:
 - * Top priority risks at present (Are there any changes?)
 - * Risks or trigger conditions that have occurred (What is the status of the actions?)
 - * Risks responded to in the last period (Effectiveness of actions taken & are there any additional actions required?)
 - * Risks closed in the last period (Impact on the plans).

iii. Retrospective Meeting:

This meeting is held after closing any risk and during the closing process of the project. Risk action owners review their work, identify opportunities for improvement risk processes

in subsequent sprints and document lessons learned and review of the risk owner's feedback about the last iteration. They will discuss, What worked well?; What didn't work well? and What can we improve upon for next time?

To Do	On Progress	Audit	Done
2- Un properly analyzed requirements	Risk 2 Risk 7	Risk 13	Risk 3
13- Poor communication between partners	Limit the Progress		
3- Uncontrolled scope changes/Scope creep			
7- Lack of traceability			

All Prioritized risks are listed by Risk Owner in the (To Do) List	Risk Action Owners pull the high priority project risks and put it in (On Going) List		Risk Owner decides what Risk is Closed according to Review meeting
Risk Refinement Meeting: - Risk Owner Responsibility - Rating Risks from the most high priority risk to nil risk	Risk Planning Meeting: - Risk Action Owners Responsibility - Pulling the most urgency risks from To Do list to On Progress List	Risk Review Meeting: - Risk Reassessment - Risk Audit - Risk Reviews	Risk Retrospective Meeting: - What worked well? - What didn't work well? - Improvements? - Lessons Learned
Daily Stand-Up Meetings - Held by Risk Action Owners	Daily Stand-Up Meetings - Held by Risk Action Owners	Daily Stand-Up Meetings - Held by Risk Action Owners	

Figure 5. Risk Processes Based on Kanban Boards and Scrum Ceremonies (Author, 2023)

4.1.4. Roles

4.1.4.1. Risk Manager

Responsible for The effectiveness of the risk management processes. Ensuring periodic risk reassessment, including risk identification, analysis, and response planning, is repeated in response to project events.

4.1.4.2. Risk Owner:

Responsible for Identify project risks, Prepare Risk Backlog and prioritize Risk Backlog, Risk Reassessment, Risk Audit, Status Reviews and Decides which risk is closed.

4.1.4.3. Risk Action Owners:

Responsible for Pulling the highest risk from to do list to ongoing list, implement risk response strategies, Ensuring that the agreed-upon risk responses are carried out as planned, in a timely manner.

4.2. Adapting BIM as a Risk Mitigation Strategy:

Considering that most of the construction industry risks come from the fact that the projects do not meet business needs or economic feasibility, and that the design drawings are usually insufficient for construction, and there are risks of wasting the resources used in construction, (PMI, 2017). And considering that resorting to BIM is a good escape from the heavenly problems that may occur in construction industry projects. So as a result of analyzing the results of the questionnaire, and according to previous study (Safour, et al. 2021) it was found that BIM maturity level in Syrian construction industry is in the process of ascending to the level

1. It could be implemented BIM as a risk mitigation response strategy.

Conclusion

In the context of today's rapidly changing environment and the increasing complexity of projects, risk management has become a cornerstone for achieving project success. This research proposes a comprehensive risk management framework that integrates both risk management processes and Scrum ceremonies within Kanban Boards. This approach is designed to provide a continuous and effective method for monitoring risks, ensuring that potential issues are identified and addressed promptly. Additionally, this framework offers ease of application, making it a practical solution that can be seamlessly integrated with any project management methodology. Furthermore, the research suggests that the establishment of a Risk Management Office (RMO) within an organization's structure can further enhance the effectiveness of risk management efforts. The RMO would be responsible for overseeing risk processes and ensuring their alignment with organizational objectives. Moreover, this research advocates for the adoption of Building Information Modelling (BIM) as a strategic approach to mitigate risks in construction projects, offering a proactive means to manage complexities and enhance project outcomes.

Recommendation

1. Promote risk management culture both within the organization and at the national level through intensive workshops and ongoing seminars aimed at introducing effective risk management tools, techniques, and methods.
2. Advocate for the adoption of new technologies as effective project management methods, fostering this culture among engineers from the university stage through to the project site.
3. Prioritize the integration of Building Information Modeling (BIM) within the Syrian Engineers Syndicate.
4. Conduct a thorough analysis of the organization's strengths and weaknesses to identify and address any gaps before implementing the proposed risk management framework.

References

- [1] A., Ramos, F., Albuquerque, D., Dantas, E., Perkusich, M., Almeida, H & .Perkusich, A. (2023, March). Towards a Recommender System-based Process for Managing Risks in Scrum Projects. In Proceedings of the 38th ACM/SIGAPP Symposium on Applied Sousa Neto . 2023.(
- [2] Ahmed, O. S. (2018). *WAY TO BIM*. SPR Agency.
- [3] [Ahmed, S. D. (2018). A. BIM performance improvement framework for Syrian AEC companies. . *International Journal of BIM and Engineering Science*, 1(1), 21-41.
- [4] Alzoubi, H. M. (2022). BIM as a tool to optimize and manage project risk management. *International Journal of Mechanical Engineering*, 7(1).
- [5] Amit Kulkarni 12) .April , 2016 .(Welcome To World of Agile .<https://worldofagile.com/blog/what-is-a-sprint/>
- [6] CMAA Oeners survey 2005, C. I.-R. (2005,2007,2002).
- [7] Damanellor Karthik, D. C. (2021). Role of Kanban System in Construction. *Department of Civil Engineering*.
- [8] Esteki, M. G. (2020). A risk management framework for distributed scrum using PRINCE2 methodology. . *Bulletin of Electrical Engineering and Informatics*, 9(3), 1299-1310.
- [9] Ganbat, T. C. (2020). Mapping BIM uses for risk mitigation in international construction projects. *Advances in Civil Engineering*, 2020, 1-13.
- [10] Higher productivity as it reduces waste and time loss, r. c. (2018).
- [11] Institute, P. M. (2021). *The Standard For Project Management And a Guide to the Project Management Body of Knowledge (PMBOK Guide)*. Project Management Institute.
- [12] John Wiley & Sons, I. (2017). *A PROJECT MANAGER'S BOOK OF FORMS* (Vol. Third Edition).
- [13] Lepkova, N. M. (2019). BIM implementation maturity level and proposed approach for the upgrade in Lithuania. . *International Journal of BIM and Engineering Science*, 2(1), 22-38.
- [14] M., Eldawla, M & .,[15] Zaki, M. (2023). A risk management model for large projects in the construction phase in Egypt. *Journal of Project Management*, 8(1), 25-36 .Habib.(2023) .
- [15] Marle, F. (2020). An assistance to project risk management based on complex systems theory and agile project management. *Complexity*, 2020, 1-20.
- [16] PMI. (2017). *PMBOK GUIDE*. Project Management Insitute, Inc.
- [17] Project Management Institute, I. (2019). *The Standard For Risk Management in Portfolios, Programs and Projects*. Project Management Institute.
- [18] [19] Project Management Institute, Inc. (2017). *Agile Practice Guide*. Project Management Institute, Inc.
- [19] S., Mejri, A & .,[20] Ghannouchi, S. A. (2019). A framework for risk management in Scrum development process. *Procedia Computer Science*, 164, 187-192 . Chaouch..
- [20] S., Mejri, A & .,Ghannouchi, S. A. (2019). A framework for risk management in Scrum development process. *Procedia Computer Science*, 164, Pp 187-192 .Chaouch .
- [21] Salamah, T. S. (2023). Improving AEC Project Performance in Syria Through the Integration of Earned Value Management System and Building Information Modelling: A Case Study..
- [22] Shaban, M. H. (2018). A. Building Information Modeling in Syria: Obstacles and requirements for implementation. . *International Journal of BIM and Engineering Science*, 1(1), 42-64.
- [23] Shibani, A. H. (2022). Financial Risks Management within the Construction. *Journal of King Saud University Engineering*. doi:<https://doi.org/10.1016/j.jksues.2022.05.001>.

- [24] Sliger, M. (2011). Sliger, M. (2011). Agile project management with Scrum. Paper presented at PMI® Global Congress 2011—North America, Dallas, TX. Newtown Square, PA: Project Management Institute.
- [25] Sutherland, K. S. (2020). *The Scrum Guide*.
- [26] Younus, D. A. (2021). The Impact of Agile Risk Management Utilization in Small and Medium (Smes) Enterprises. *International Journal of Scientific Research and Engineering Development*, 4(3).
- [27] Chaouch, S., Mejri, A., & Ghannouchi, S. A. (2019). A framework for risk management in Scrum development process. *Procedia Computer Science*, 164, 187-192.
- [28] Ganbat, T., Chong, H. Y., & Liao, P. C. (2020). Mapping BIM uses for risk mitigation in international construction projects. *Advances in Civil Engineering*, 2020, 1-13.
- [29] Marle, F. (2020). An assistance to project risk management based on complex systems theory and agile project management. *Complexity*, 2020, 1-20.
- [30] Esteki, M., Gandomani, T. J., & Farsani, H. K. (2020). A risk management framework for distributed scrum using PRINCE2 methodology. *Bulletin of Electrical Engineering and Informatics*, 9(3), 1299-1310.
- [31] Younus, D., Muayad, A., & Abumandil, M. (2021). The Impact of Agile Risk Management Utilization in Small and Medium (Smes) Enterprises. *International Journal of Scientific Research and Engineering Development*, 4(3).
- [32] Alzoubi, H. M. (2022). BIM as a tool to optimize and manage project risk management. *International Journal of Mechanical Engineering*, 7(1).
- [33] Ozkan, N., Bal, S., Erdogan, T. G., & Gök, M. Ş. (2022, September). Scrum, Kanban or a Mix of Both? A Systematic Literature Review. In 2022 17th Conference on Computer Science and Intelligence Systems (FedCSIS) (pp. 883-893). IEEE.
- [34] de Sousa Neto, A. F., Barbosa, F., Albuquerque, D., Dantas, E., Perkusich, M., Almeida, H., & Perkusic, A. (2023). Towards a Recommender System-based Process for Managing Risks in Scrum Projects.