The Integration between Building Information Modelling and Scrumban. Case Study: FD3 Commercial Building in Damascus

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Abstract

Construction Project Management is one of the most significant processes that require meticulous organization and coordination to ensure the successful project implementation, meeting various criteria. Currently, the need for using modern technologies and methodologies became of utter necessity, in particular with the sophisticated advancements in technology and the emergence of the contemporary project management methodologies. This should be done to achieve the best results when implementing such projects Existing literature underscores the importance of Agile project management in projects. This is due to its effectiveness in achieving the project deliverables. Agile project management proved to reduce rework and provide assistance in dealing with possible changes that might have an influence on the project progress in the future. This is particularly evident in the current situation in Syria, where a company would take responsibility of the rework costs due to various unexpected uncertainties or risks, resulting in stopping the work on ongoing projects. Rework is considered of the most noticeable problems in the construction industry in Syria, and as a result, the industry is losing efficiency and effectiveness. All such hardships urged the need for more sophisticated methodologies and technologies, such as Building Information Modelling (BIM), where BIM proved to be time-, quality-, and cost-effective. This study sheds the light on the application of the Scrumban methodology, the most recent Agile project management methodology, and its integration with the BIM environment in the execution phase in construction projects. This research was based on the experimental research methodology, in addition to exploring the existing literature to provide final results supported by previous experience and the application section to reach optimal recommendations to apply Scrumban in BIM-Based construction projects in Syria in the light of the current practices.

Keywords: Agile Project Management; Building Information Modelling (BIM); Scrumban, Kanban; Sprint; Scrum; BIM Execution Plan

1.0 Introduction

The construction sector in Syria is a pivotal economic domain, particularly when considering the post-war recovery period. The significance of this sector not only lies in rebuilding what have been destructed, but also in encouraging displaced people to return to their homes and actively participate in the socioeconomic recovery in the country. Despite the significant socioeconomic influence of this sector, it still grapples with several challenges, including schedule and cost overruns, and quality issues. To effectively address these issues, modern management methodologies and technologies should be adopted to achieve thorough waste-free construction practices [1].

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Agile project management set free the project manager from the constraints of conventional methods, including routine and bureaucratic processes and operations, where in Agile project management, the project management model requires the project manager to demonstrate leadership skills to board the final product safely, meaning achieving both efficiency and effectiveness [2].

One notable approach is Scrumban, which emphasizes collaborative work and team participation. And this aligns with the fundamental characteristics of BIM-based projects [3]. This is because the most essential aspect to make a project successful is the interdisciplinary collaboration and continuous communication to avoid clashes and solve them before reaching the execution phase [4].

The integration between BIM and Scrumban enhances planning and coordination between teams and tasks, and enables the determination of clear objectives and the prioritization of operations and processes, leading to effective timely project execution. Therefore, this research focused on exploring the efficiency of integrating between BIM and Scrumban to achieve an optimal project management framework for BIM-based projects, in particular in the execution phase.

This research will focus on how Scrumban will be of benefit in the execution phase in BIM-based projects, focusing on raising awareness about this modern methodology, and showing how it can contribute to the present and future of the construction industry in Syria.

2.0 Literature Review

2.1 Background

2.1.1 Agile Project Management

Agile Project Management is a contemporary concept that aims at enhancing work efficiency and increasing productivity in organisations. In the light of this concept, the Project Management Institute defined Agile Project Management as a methodology that focuses on achieving targeted objectives and works effectively through enhancing work processes, and coordinating efforts among teams and individuals [5].

Agile project management is featured by various characteristics, including the concentration on added value to meet the clients' requirements in the least costly way, where it underscores the idea of improving the product or service quality [6]. Also, mitigating waste until reaching nearly zero waste, where agile project management concentrate on the removal of any unnecessary activity or item that might have an influence on the work process. Therefore, leading to improving workflow and reducing wait times and delays [7].

In addition, agile project management empowers teams through assigning roles and responsibilities required to make responsible decisions, encouraging collaboration and interaction between team members and promoting collective effort principle [8].

Furthermore, continuous improvement is a key concentration in agile project management, depending on the principle of PDCS (Plan, Do, Check, Act) to manage processes and analyse data to implement continuous improvements. Finally, agile project management reduces the time needed to react with the client requirements and changes in the industry, thus, it ensures flexibility and adaptive ability with the never-ending challenges. The following diagram shows the agility attributes [9].

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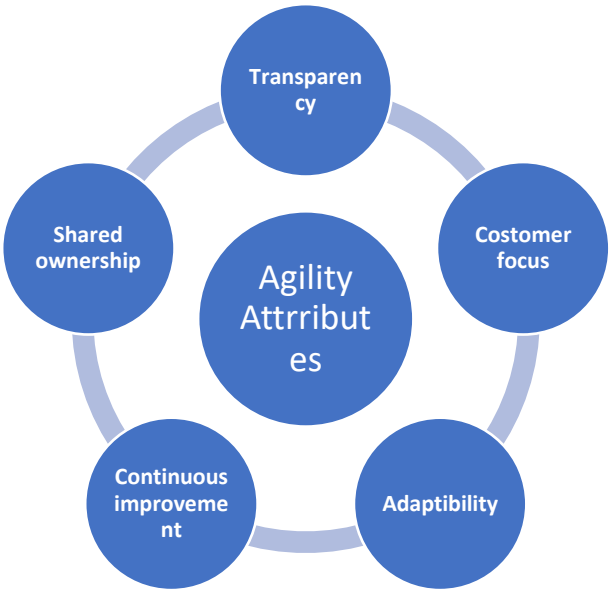

Figure 1: Attributes of Agile Project Management (The authors, 2023).

2.1.2 Scrum

2.1.2 Scrum

Developed as a means to update and develop modern technologies that focus on collaboration and autonomous motivation of teams, Scrum dates back to the early 21st century. In Scrum, work is divided to time-box iterations called "Sprints," for which roles and responsibilities are assigned among team members. It is based on the idea of "Product Backlog" to define the list of objectives to achieve the project, then this backlog is divided into "Sprint Backlog" to determine on what specific items to focus during each sprint [10].

2.1.3 Kanban

Kanban focuses on completing the work in a continuous and visual way, where it uses a visual board to show the different work phases and the number of tasks in each phase. Items are moved within the board based on their changes in status. This method is more flexible than Scrum, where tasks can be added and removed freely without time constraints [11].

2.1.4 Scrumban

Scrumban combines features of both Scrum and Kanban, where it uses a visual board showing phases and tasks in each phase, and uses sprints to divide work into defined time periods, therefore, it helps allocate roles and define objectives in an effective way. Scrumban is more flexible than Scrum, where tasks can be freely added and removed during the sprint based on work progress. Also, Scrumban allows defining clear limits to the expected work during each sprint, and provides a visual representation for work progress and achievement of objectives [12].

2.1.5 Building Information Modelling

Given the challenges and issues in the Architecture, Engineering, and Construction (AEC) industry, particularly cost and schedule overruns [13], especially in large-scale projects [14], there's an immediate need for a new approach to tackle these problems, and Building Information Modelling (BIM) is the suitable solution. BIM is a system that encompasses all relevant information about a building, including engineering dimensions, quantities, and properties, has emerged as a solution [15]. BIM is defined as an effective platform where all stakeholders collaborate to deliver a more innovative project. Over the past few decades, the adoption of BIM has surged significantly [14], due to its proven efficiency and effectiveness in the AEC industry [16], enhancing project performance [17], mitigating risks [18] and leading to increased demand for BIM implementation in projects. This has prompted academic researchers to incorporate BIM into educational curricula and courses [19].

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Countries are at various stages of BIM implementation and adoption [20]. Developing countries, for instance, are in the early stages of BIM implementation, primarily due to a lack of BIM awareness [21] and absence of engineering training and qualifications [19]. It's been noted that BIM is seldom adopted at the governmental level, particularly in less industrialized countries [22]. For example, in Syria, most public administration employees are unaware of what BIM is [23]. Furthermore, the majority of AEC project work is still carried out using traditional methods [24].

Therefore, it's been proposed to establish standards for engineering education and training [19]. Also, It's been demonstrated that the environment during the training process is crucial for making education and training more effective [25]. However, training alone is not sufficient for BIM application and adoption; there must be clear and detailed procedures based on a robust methodology and standards [26]. Once BIM adoption is complete, the maturity of BIM should be assessed [27]. It's been suggested that governments should support BIM adoption and implementation by enacting mandatory regulations requiring the use of BIM [28]. This requirement has been emphasized from the perspective of educational institutions through the creation of educational programs that support the BIM adoption process [29] [29].

2.1.6 BIM Execution Plan (BEP)

The most important element when using BIM is the BIM Execution Plan. The goal of creating a BEP is to facilitate information management in BIM-based projects. Also, it can be defined as the plan that facilitates the way the BIM part is implemented in the project. BEP contains various phases and procedures that would help achieve the best results when using BIM in construction projects. These include defining objectives and requirements, defining tools and software applications, defining responsibilities, creating the schedule, education and training, the implementation of the plan, monitoring and evaluation, and continuous improvement [30].

2.1.7 BIM and Scrumban

While Scrumban is an agile method that proved its efficiency in various aspects, it still shows weaknesses in construction projects due to the scope creep issues. This is because Scrumban, as being an agile method, is based on continuous change, accepting change orders as part of the project with notable variations [31]. BIM, in this scenario, provides a clear picture of the project phases and work in an early stage in the project, leading to less change orders in the execution phase [32].

The shared features between BIM and Scrumban can be summarized as the following [33]

1. Continuous improvement: Both BIM and Scrumban support continuous improvement of processes and operations, where plans are regularly updated to guarantee both effectiveness and efficiency.
2. Communication and Collaboration: This is done by regular meetings to provide feedback and exchange information.
3. Quality control: frameworks and procedures are established to monitor and control quality in both BIM and Scrumban, where the quality of services and products are checked. Also, Both methodologies ensure meeting quality criteria that are defined for each project.
4. Effective resources allocation: both methodologies optimize resources based on the priorities and requirements of the project.
5. Added value: one of the major concentration points in both methodologies is providing added value to customers and end-users. Goals and objectives are defined mainly based on customers' expectations to achieve maximum satisfaction.
6. Adapting with changes: changes and updates are continually considered in both methodologies, with taking into account balance and flexibility to avoid scope creep and cost and schedule overruns.

2.1.8 Advantages of Scrumban

2.1.8.1 For owners

Scrumban increases the quality of the project, mitigates risks, and reduce costs. When the project is divided into smaller tasks, the owner can easily and effectively monitor progress, leading to early

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detection of problems to deal with them the right way. This should be with continuous communication between all parties. In this case, the owner is continually informed with any changes in design or used materials, therefore, rapid intervention can be done to avoid any additional costs [12].

2.1.8.2 For Engineers

Scrumban promotes interaction and collaboration between team members. When the project is divided into short time-boxes, project engineers can define clear goals for each period of time, thus, they have more concentration on the project tasks, leading to the achievement of tasks effectively and timely. Thanks to the continuous communication, engineers can exchange information and learn from each other's expertise. This is crucial in enhancing performance and promoting innovation in the project. Furthermore, this lead to the exact determination of what elements will be modelled in the next time-period, in order to review and verify the completion of modelling the defined elements with no problems [12].

2.1.8.3 For Contractors and Suppliers

Scrumban improves the project execution, and reduces waste and costs. When the project is divided into short time periods, contractors and suppliers can accurately specify required resources, and organize the supply processes. Continuous communication can help them also meet the project requirements more quickly and effectively, leading to customer satisfaction and the increase in the chance of contracting other projects in the future [12].

2.1.9 Scrumban Lifecycle

Scrumban goes through four phases: 1. Initiation; 2. Planning; 3. Execution; 4. Delivery and Feedback. Scrumban is implemented in five steps. At first, a meeting with the owner is done to understand their requirements, then the five steps can take place are Product Backlog, Scrumban board, Daily Meeting, Review, and On-Demand Retrospectives [33].

2.2 Related Work

Sakikhales, M. and Stravoravdis, S. summarized the potential benefits of using Agile methodologies in the AEC industry, in particular the Design Phase. This research shed the light on the constraints that the conventional project management methods lay on projects, and proposed and iterative workflow that aligns with the principles of agile management. This study suggested that the application of BIM promotes the application of agile management in construction projects. Also, this study indicated to the ability of agile project management in improving the customer participation through regular feedback and comments during the project lifecycle, leading them to become an integral part of the decision making, thus, their requirements and preferences can be more easily understood. The authors in this study relied on literature review to assess agile project management in construction. The major result of this research was that using agile improved project success rate three times the performance in the traditional methods through a comparison between the two methods in a project [34] as figure 2 shows:

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Figure 2: Comparing success rate in agile and waterfall projects adapted from Measey and Radtac

Source: [34]

Radan and Kalinichuk explored the integration between BIM and agile in construction. Authors suggested a hybrid scheduling method that features both methodologies, focusing on the economic benefits of this integration, and showing BIM as a technical source for construction projects. By using Agile and BIM together, the hybrid scheduling approach allows for overlapping activities, where the main long project lifecycle is divided into smaller groups of sequential activities. This overlap in activities allows for the synchronization of work, where design and construction stages can be run simultaneously, leading to schedule compression and faster project completion. Also, the integration of Agile and BIM allows for continuous collaboration between the investor, designers, and the general contractor throughout the project. This collaboration helps improve detailed design specifications and address any issues early in the project development process. While the specific tools used in implementing the hybrid scheduling approach were not mentioned in the article, it can be inferred that BIM tools and agile project management tools can be used to support the integration of Agile and BIM methodologies in construction projects [35].

Kashikar et al explored the awareness and use of Agile and Lean project management techniques in the construction industry in Mumbai, India. This study highlighted the low level of awareness among project managers, but emphasizes the need for these techniques to increase efficiency and effectiveness. It also discussed the main challenges facing the implementation of Agile and Lean project management in the construction industry in Mumbai, from resistance to change, lack of awareness and training, high levels of dependency among stakeholders, bureaucratic procedures, and the traditional mentality of the workforce. These challenges hinder the acceptance and implementation of these advanced techniques in the construction industry. Surveys were adopted, experts' opinions were taken, and the Nominal group technique was conducted. Experts classified the maturity level of Agile and Lean management in the construction industry as being in the exploratory stage. They also mentioned that Lean construction is more common than Agile project management. In addition, the experts confirmed that these techniques have high growth potential in the future in Mumbai, indicating positive expectations for their maturity and adoption in the industry. The study concluded by suggesting the need for more awareness and adoption of Agile and Lean project management in the construction industry. This research talks about the potential benefits of applying Agile project management methodologies, such as: 1. Cost and time savings: Agile techniques can help reduce waste and inefficiency, leading to cost savings and faster project completion; 2. Competitive advantage: Implementing these techniques can provide a competitive advantage over other competitors in the market; 3. Customer satisfaction: Agile techniques allow for iteration and modifications, leading to products that better meet customers' needs and desires; 4. Effective use of resources: Agile techniques can help reduce waste and improve resource use, leading to improved productivity and profitability; 5. Improved stakeholder relations: Agile techniques can help accommodate the diverse requirements of various stakeholders, leading to better relationships and project outcomes; 6. Reduction in project delays and cost escalation: Agile techniques can help simplify processes and reduce bureaucratic obstacles, leading to reduced delays and cost overruns; 7. Improved project management: Adopting Agile and Lean techniques can lead to improved project management, leading to improved planning, execution, and overall project success [7].

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Paul, A. J. and Rahman, S. K. discussed the use of Agile project management in the construction industry, specifically using the Scrumban methodology. This research highlighted the benefits of Agile management, such as increased customer participation and improved risk management. The researchers explained the principles and framework of Scrumban and how it can be applied to construction projects, and discussed how the Scrumban methodology differs from other Agile methodologies. The methodology used in this article is a review and analysis of existing research and resources on Agile management in the construction industry, where this study relied on information based on a set of studies, articles, and reports. The research concluded that Agile management can help address common project risks and improve project outcomes [12].

3.0 Research Methodology

This research will be based on the experimental approach through a case study using Scrumban in managing the finishing phase of a 10-storey commercial building. In this study, there will be an integration between the elements of the BIM Execution Plan and Scrumban through Teamhood platform. Teamhood is a project management platform that helps project teams collaborate in a more interactive environment. It helps teams create smart plans and control projects to achieve the best results. This platform shows work in the form of a Scrumban board and Ghantt Chart, helping in creating reports with graphical representations. Figure 3 demonstrates the integration of BIM Execution Plan elements with the Scrumban board:

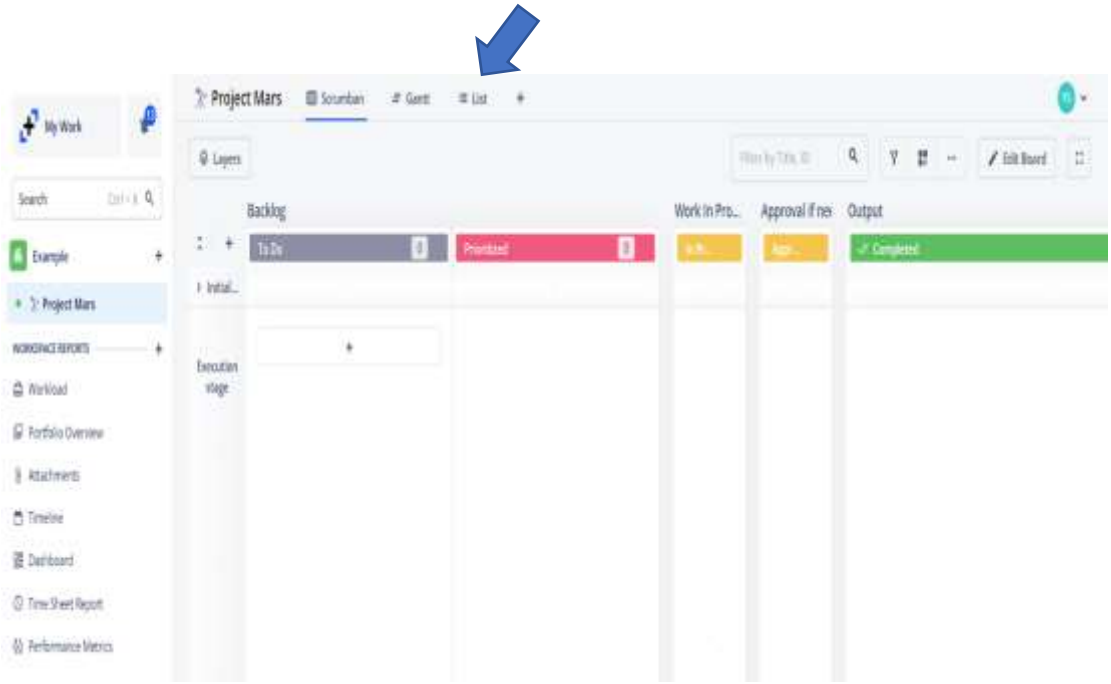

Figure 3: Scrumban board

At first, Scrumban board was created with the following columns:

- Backlog
- Work in Progress
- Approval is needed
- Output

Then, the table was updated to integrate the information taken from the BEP. An example will be shown in figure 4.

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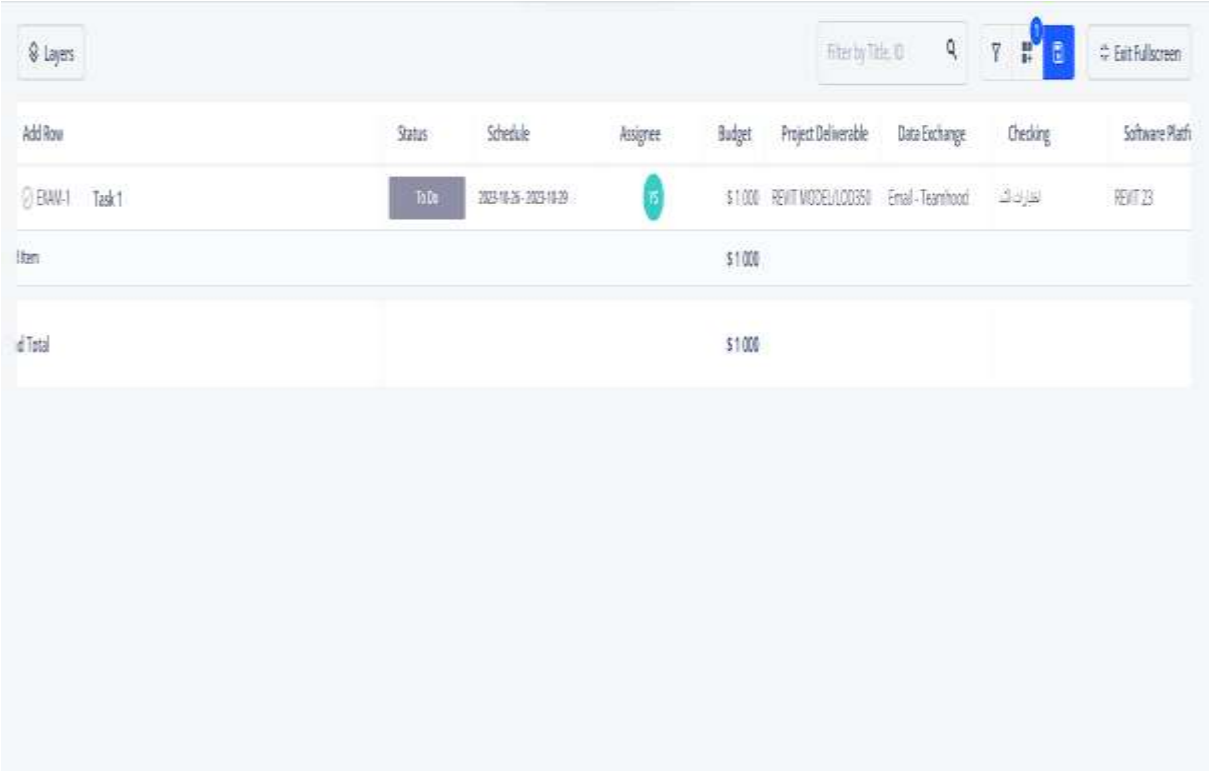

Figure 4: "List" Icon interface

From figure 4, some definitions are established to create the link between BEP and Scrumban board terms:

- Assignee: refers to the main contractors responsible for implementing a certain task. In BEP, this is replaced with "Stakeholder."
- Status: refers to the current situation of the task (To Do – In Progress – Done)
- Schedule: the duration each task is allocated.
- Budget: the estimated cost held for the task.
- Project deliverables: the product required to deliver to the clients when finishing the task (files, documents, plans, etc.)
- Data Exchange: The method of exchanging available information about the task.
- Checking: the method of choosing the task to give approval of implementation
- Software platform: the used software applications to do the task.
- Watches: defining accessibility permissions to the task. In BEP, this term is "Data Segregation."
- Meetings: a 15-minute daily meeting is held to show the Kanban table, with only three columns: To Do, In Progress, and Done. In this meeting, there are valuable discussions that serve as "feedback."

4.0 Case Study: FD3 Commercial 10-storey Building in Damascus

This study will concentrate on the internal and external finishing, and the Landscape works of FD3. It is should be noted that the use of BIM in this project was limited, where most of the study drawings were done using 2D CAD, however, the application of BEP was in certain areas, and was significant in the process of managing the project.

Doi : https://doi.org/10.54216/IJBES.070202

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Figure 5: A 3D Model of FD3

4.1 Project Information

Project name: FD3 Building

Owner: Dr. T. S.

Project location: Eighth Gate Complex (Emmar), Yafour, Rural Damascus, Syria

Project description: commercial building that consists of two basements, a ground floor, and seven repetitive floors, with an area of 760 m2. Each floor has seven offices, three bathrooms, and a ktchen.

Contract: Execution in Trust “Where an organisation executes work at its own discretion”

Contract Date: 1-June-2022

Table 1 shows project milestones and estimated durations:

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Table 1: Project Milestones

PROJECT PHASE/MILESTONE	ESTIMATED START DATE	ESTIMATED COMPLETION DATE
PROJECT ESTABLISHMENT	18-7-2022	1-12-2023
CONCEPT DESIGN	Done By Emmar	
PRELIMINARY DESIGN	Done By Emmar	
DEVELOPED DESIGN	1-8-2022	1-9-2022
DETAILED DESIGN	5-9-2022	5-11-2 022
Internal Cladding Works	5-10-2022	1-11-2023
External Cladding Works	20-10-2022	15-11-2023
Landscape Works	15-9-2023	20-11-2023
HANDOVER	20-11-2023	29-11-2023

Table 2 provides the meeting schedule. It contains information on the type of meetings, who should attend the meeting, the frequency of this type of meeting, and the location.

Table 2: Schedule of Meetings

Schedule Of Meetings			
MEETING TYPE:	**Stakeholders**	**FREQUENCY:**	**LOCATION:**
Collect Client Requirement	**Client - PM**	**One time**	**PM office**
Daily Meeting	**Engineering team involve - Subcontractor involve**	**Everyday**	**Online / ZOOM APP / or in project site**
Retrospective Meeting	**PM - Engineering team - Subcontractor involve**	**Every 3 weeks**	**Online/ ZOOM APP / or in project site**

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4.2 Integrating BIM and Scrumban

Table 3 demonstrates the uses of BIM for the project, showing the purposes of using BIM, responsible parties, the name of software application that will be used in the project, and the version of this software application.

Table 3: BIM uses in the project

BIM Uses for the project			
BIM USE:	**RESPONSIBLE PARTIES:**	**SOFTWARE:**	**VERSION:**
Aluminum Details - LOD300	**Aluglass**	**Revit**	**2022**
Landscape Details - LOD200	**Landmart**	**Revit**	**2023**
Coordination	**Nahhas contracting**	**Navisworks**	**2023**

The previous information was taken from the BEP to help manage the project. After this stage, the Scrumban Board creation started. Figure 6 shows the Scrumban board.

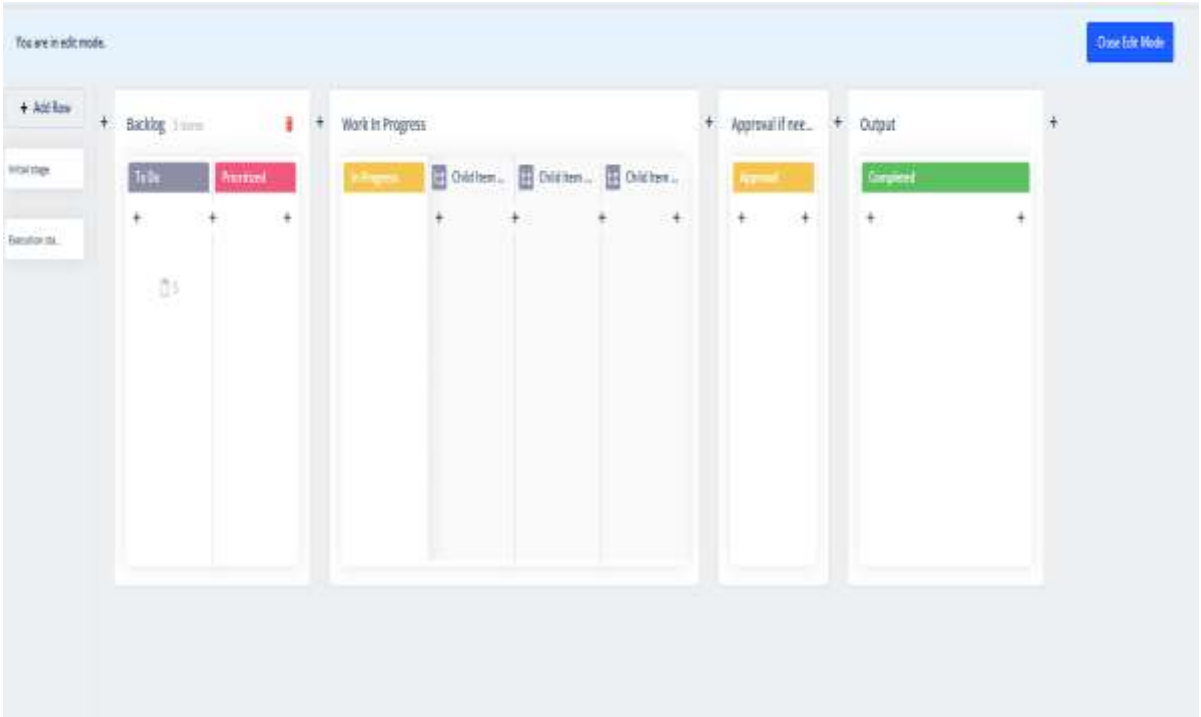

Figure 6: Scrumban Board

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Project tasks will be inserted in the Backlog column. Figure 7 demonstrates an example of the backlog, showing the items in develop design and detailed design, where these items were the major milestones that were previously identified in table 1.

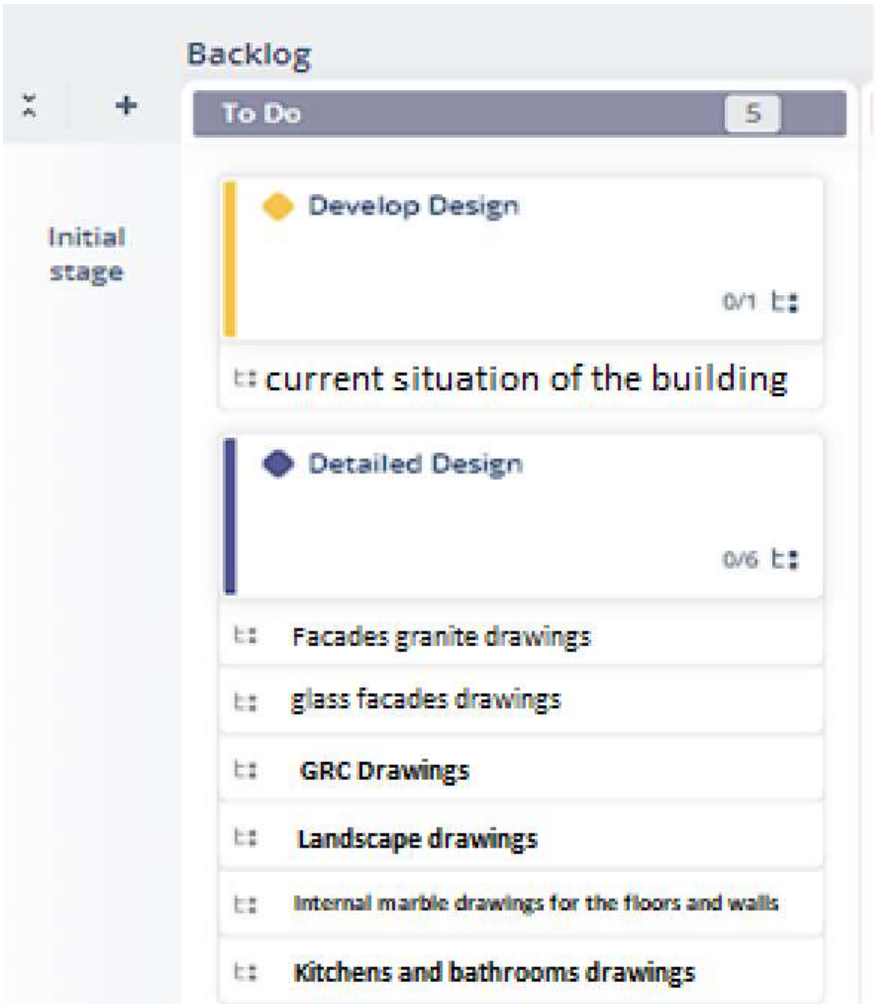

Figure 7: an example of the project backlog

Major and minor tasks are transferred between columns depending on their status. The following are the terms used to describe the task status:

- Prioritized: ready to implement and has a priority
- Work in Progress: ongoing tasks. This column produces three subtasks: 1. Child Item To do; 2. Child Item Doing; and 3. Child Item Done
- Approval if needed: in this column, finished tasks will be included, but put on wait to get the approval of the consultant to make sure they are correct.
- Output: this column includes the tasks that were approved by the consultants.

Figure 8 shows the distribution of tasks on the Scrumban Board.

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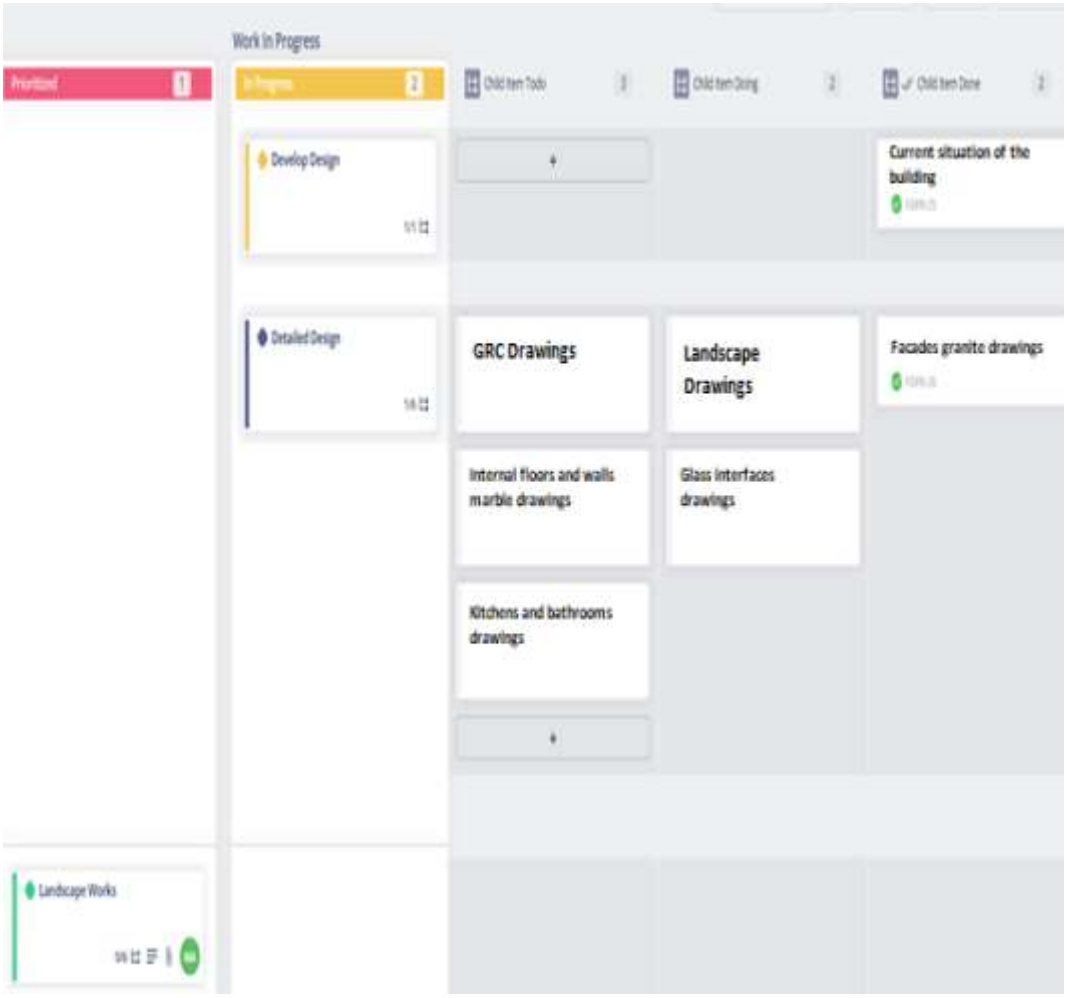

Figure 8: Distribution of tasks on Scrumban Board

For the Detailed Design and Develop Design, the Revit file will be imported to Navisworks to detect clashes. Using the agile project management, and at the end of each iteration, where in this project sprints were considered to be three-week long, the project will be viewed through the retrospective meetings.

At first, the architectural model will be imported to other disciplines to be developed until the end of the iteration. Then, the model will be discussed in the retrospective to detect clashes and improve the design. Then, at the start of the next iteration, the previous iteration is completed to avoid problems that was present in the previous iterations to find suitable solutions. This process is advantageous to solve design problems as early as possible during the same iteration without moving the occurring issues to the next iteration.

Clicking on “List” icon, project work appears, where in this icon the required columns are added, and in this case, this is the place to add the BEP Information, including Project Deliverable, Data exchange, Software Platform, and Check. Figure 9 shows the “List” column.

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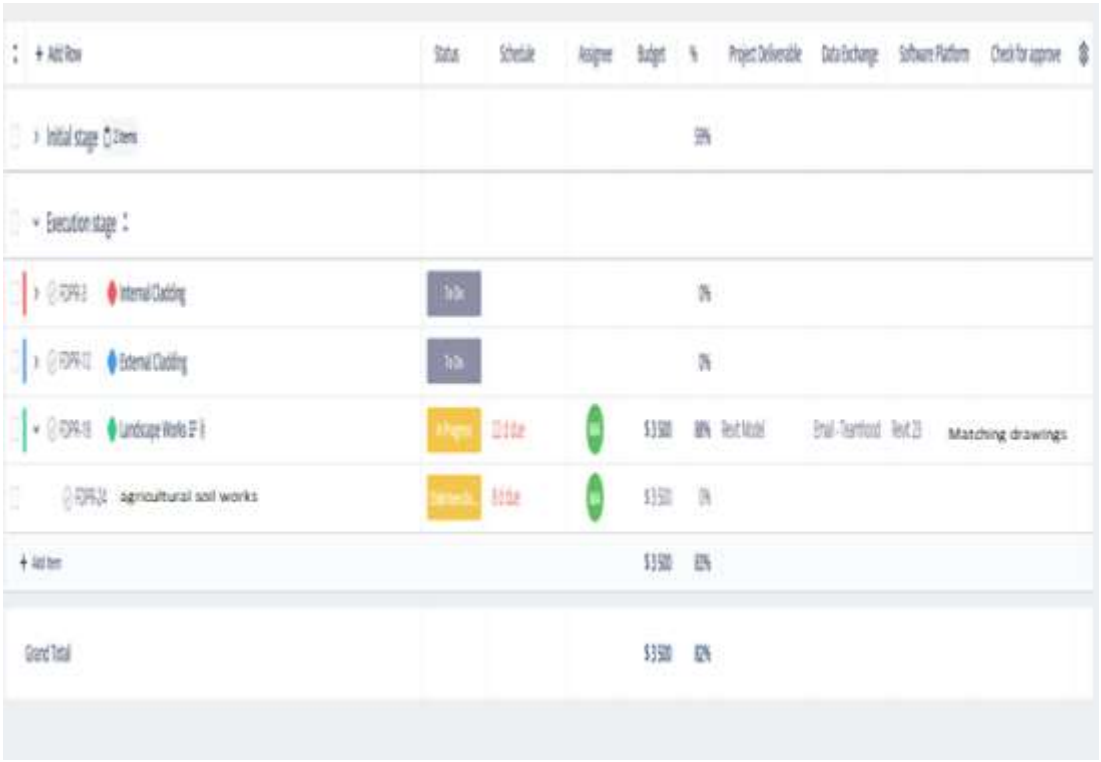

Figure 9: Adding Columns from the "List" icon

Clicking on "Schedule" icon, start and finish dates are defined for each task, then, the button "Gantt" shows the visualization of the schedule in the form of Gantt Chart. Then, to add dependencies, the icon "Dependencies demonstrates each tasks data. Figure 10 shows how dependencies added to the task "irrigation network and electricity for planting beds."

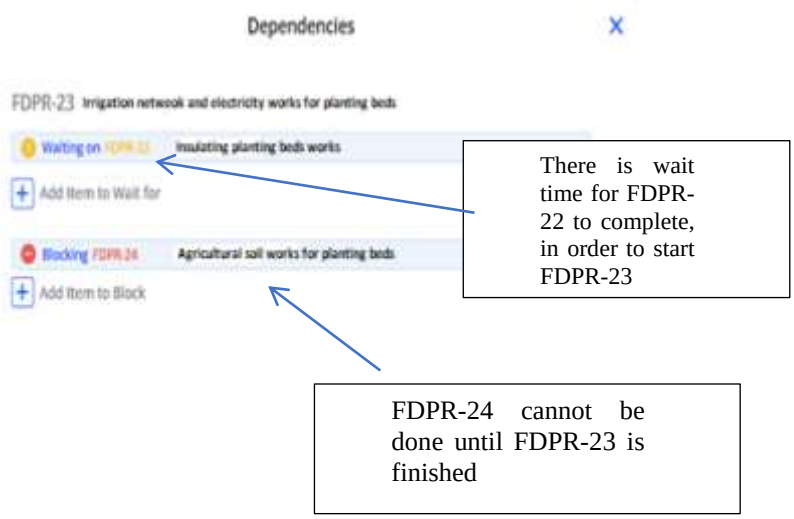

Figure 10: Dependencies window

Going back to the Scrumban Board, Landscape works are demonstrated in figure 11. The status of landscape works is "In progress," not "TO Do."

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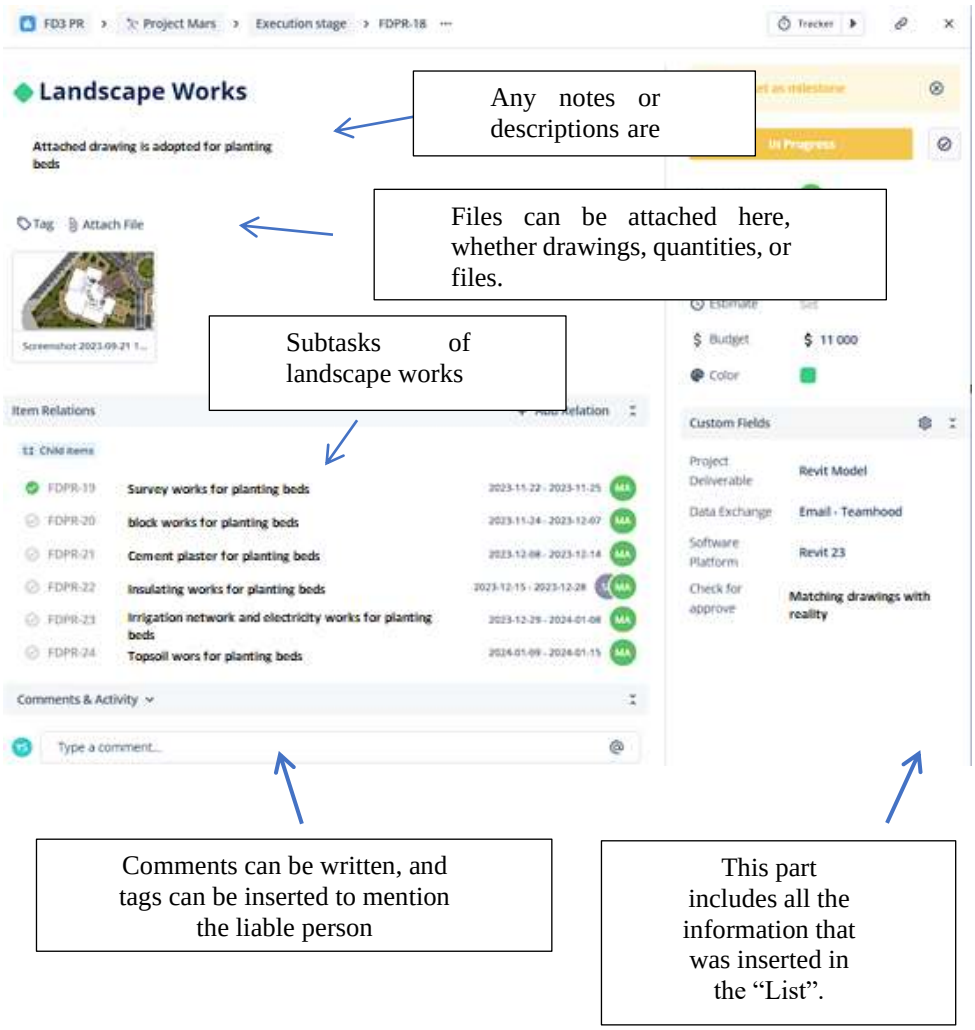

Figure 11: Landscape works in the Scrumban Board

A notification appears when someone comments, or whenever a change in status takes place. Such notification only appears for liable individuals (responsible). In Figure 12, the landscape contractor requesting to move the "insulating planting beds" task to the "Approval" column, and requests to receive the beds works, notifying that there is a problem in the bed number 4 in order to be dealt with.

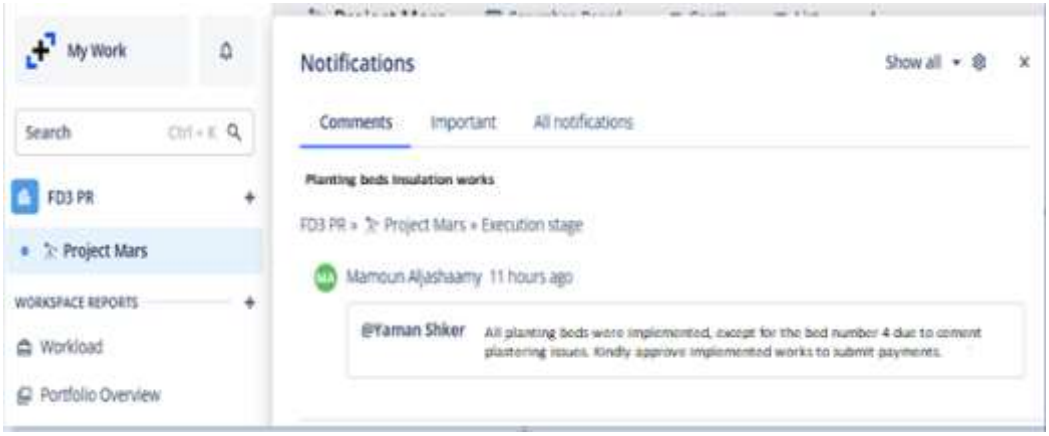

Figure 12: Notifications when a stakeholder comments on a certain task

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All previous explanations present the **Inputs** that helps in managing the project. These inputs serve as the starting point to create the **outputs**, which are generated in the platform depending on the workflow. The following are parts of the outputs generated by the platform.

Project Overview: in this tab, the following information can be found:

- **Cost Performance Index:** Indicates the team effectiveness in managing spending the allocated resources.
- **Schedule Performance Index**: Indicates the team effectiveness in meeting the durations of project milestones.
- **Earned Value:** measures project performance due to its ability to link between the project 3 dimensions; scope, cost, and schedule.

These measures are important to bring the management's attention if any problem is affecting the project progress as planned in terms of cost and schedule. Figure 13 demonstrates the Project Overview Window. In this window, attachments can be found, where all attached files, including photos, drawings, tables etc. can be found.

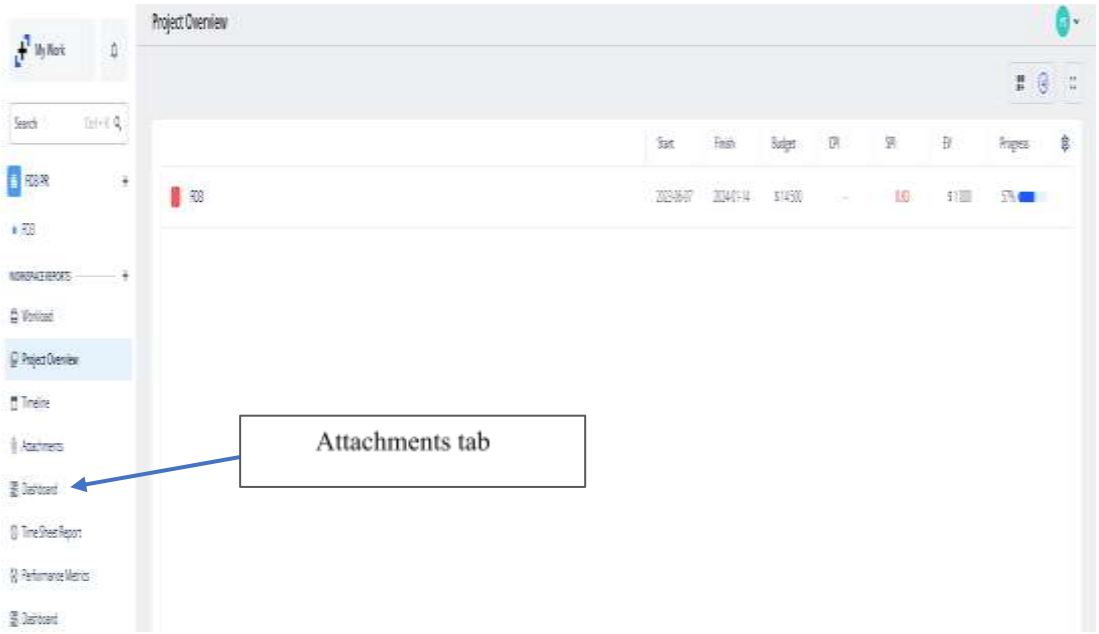

Figure 13: Project Overview Window

Dashboard: This tab can visualize budget progress, item progress, items due to this week, and other forms of project progress reporting. This tab is particularly important for the owner because it enables them to know the exact number of finished and in progress tasks, therefore, they become more aware of how much money is needed to spend in the next iteration. Figure 14 shows the dashboard window.

Doi : https://doi.org/10.54216/IJBES.070202

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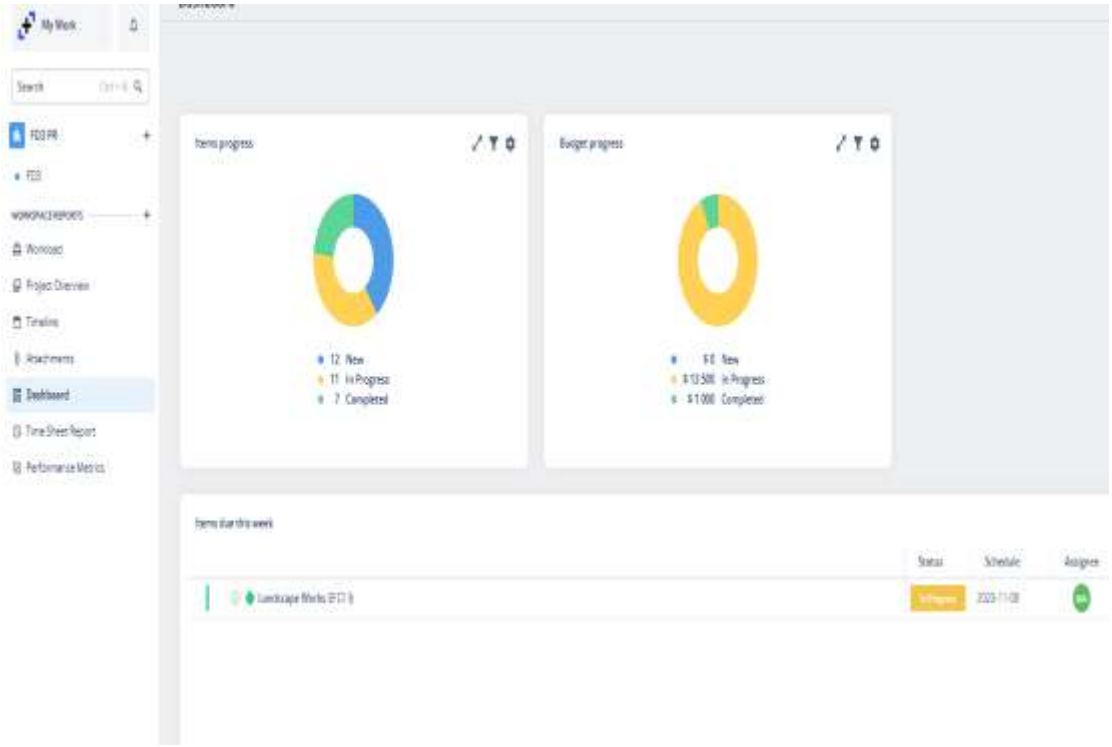

Figure 14: Dashboard window

Daily meetings are 15-minute meetings in which Scrumban board is showed, and the tasks workflow is discussed between the management and the stakeholders. In this phase, the team discusses these issues and take notes about the workflow, where only major ideas are discussed without going into detail, focusing on three major issues:

- What was done yesterday to achieve the current iteration's goals?
- What to do today to achieve this iteration's goals?
- Are there any constraints that hinders achieving this iteration's goals?

Retrospective meetings are a type of meetings that are aimed at providing feedback and solving the current iteration problems. These meetings were set at a frequency of three weeks, and with a duration of 130 minutes. In these meetings, the major task is to identify problems and propose solutions. With BIM, the model in these meetings is navigated through Navisworks to detect clashes, in order to write down any needed change order to consider in the next iteration. These meetings has a significant role in controlling the project processes, enabling the early detection of any possibility of scope creep. It makes the assessment process easier, and promotes collaboration and collective efforts, creating a sense of positive motivation to all stakeholders. This is because this process does not only covers the adverse issues in the project, but also provides indicators about the abiding stakeholders who met the tasks assigned to them efficiently.

5.0 Results and Discussion

This research resulted in the following points:

• The application of Agile management methodologies, particularly the Scrumban methodology, greatly helps in controlling construction projects in terms of predicting risks, dealing with them, and knowing the direction of the project in terms of time and cost commitment.

• The application of Building Information Modeling (BIM) greatly helps in visualizing the project and reducing design errors and resolving conflicts that if discovered during the execution phase, they lead to work stoppage or repetition, and therefore large costs and a lot of time, which must be avoided especially in this stage that Syria is going through.

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• This research showed that continuous communication between stakeholders is extremely important to reach the desired results at the end of the project.

• Dividing the project into short periods and dealing with each period separately leads to ease in dealing with project tasks, managing them, and quickly rectifying errors and problems.

• The participation of Agile management and Building Information Modeling in many points indicates that the best way to manage projects that use Building Information Modeling is Agile methodologies.

• Keeping the owner informed of all stages of the project and showing the reports in a simplified way so that the owner can appreciate how the project is going at any time has a major positive impact on the progress of the project, especially in Syria where most owners are outside the country and far from the project site and its conditions.

6.0 Conclusion

The awareness of using agile methodologies in managing construction and building projects and applying Building Information Modeling (BIM) is still low in developing countries, in particular in Syria, in which it is rare to find engineering companies or contracting companies adopting these modern methods. This is due to several reasons, including resistance to change or finding difficulty in identifying these modern methods and learning to apply them correctly. Therefore, the entities concerned with engineering work and engineering colleges must spread awareness of these methodologies and their benefits and provide training courses to help companies and individuals transition to these methodologies and provide support for them.

This research demonstrated how would the integration between BIM and Scrumban would be of significant importance to address the schedule and cost overruns, in addition to empowering the engineering work environment, which in turn promotes better engineering practices. Such outcomes can help not only promote the construction industry as an industrial aspect, but also qualifies more engineers to become more professional and able to lead the reconstruction phase in Syria. This is significantly crucial for the local economy with all the losses that the country suffered from.

It is important for future research to focus on the best practices to adopt such methodologies in construction companies in Syria, in particular medium-sized companies, which constitute the majority of the companies.

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