

Integrating Project Management Information System and BIM for Inspecting and Coordinating In All Phases of Construction

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Abstract - The Construction industry has been transformed through the adoption of digital technologies, particularly Building Information Modeling (BIM) and Project Management Information Systems (PMIS). It explores the benefits of integrating these systems in all phases of construction, from pre-construction to post-construction, including improved project efficiency, reduced costs, increased quality, and enhanced collaboration. The challenges that need to be overcome, such as data management, software compatibility, and stakeholder resistance, are also addressed. The abstract concludes by highlighting the need for a coordinated approach among stakeholders to fully realize the potential of these technologies and improve project delivery in the construction industry.

Key Words: Project Management Information System (PMIS), Building Information Modeling (BIM), Improved project efficiency, Reduced cost, increased quality

1. INTRODUCTION

The construction industry has increasingly adopted digital technologies to improve project delivery, communication, and collaboration while reducing costs and errors. Among the most popular digital tools are Project Management Information Systems (PMIS) and Building Information Modeling (BIM). PMIS manages project information, resources, schedules, and costs, while BIM offers a detailed 3D model of a building's design and construction elements. The integration of these systems offers numerous advantages, including better coordination and communication among project teams, improved decision-making, and reduced project delays and errors. This paper aims to explore the integration of PMIS and BIM for inspecting and coordinating throughout all phases of construction. The paper examines the benefits of integration and addresses challenges such as data management, software compatibility, and the need for standardization. Additionally, the paper presents case studies and best practices from industry leaders to provide insights on successful integration. Overall, this paper provides a comprehensive overview of integrating PMIS and BIM for inspecting and coordinating in all phases of construction, including the benefits, challenges, and best practices.

2. METHODOLOGY

- Literature study about PMIS and BIM
- PMIS and BIM Integrated Case studies
- Comparative analysis
- Base line scheduling for monitoring the project
- Comparative Analysis
- Results
- Recommendations
- Conclusion

3. PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

A Project Management Information System (PMIS) is an essential tool in the construction industry due to the complexity of construction projects. With multiple stakeholders, large volumes of data, and various interconnected activities, construction projects require a centralized platform to manage project information, resources, schedules, and budgets efficiently.

PMIS plays a critical role in construction project management by enabling project managers to monitor and control all aspects of the project. Using PMIS, construction project managers can effectively manage communication among project team members, stakeholders, and clients, optimize resource utilization, control project costs, manage project schedules, identify, assess, and mitigate risks, monitor quality control, and generate reports and analytics on project progress, resource utilization, budget performance, and other key project metrics.

4. BUILDING INFORMATION MODELING

In the architecture, engineering, and construction industry, Building Information Modeling (BIM) is utilized as a collaborative tool to create and manage digital representations of physical and functional characteristics of buildings or infrastructure. This involves using 3D modeling software to generate digital representations enriched with

information such as material properties, energy consumption, and maintenance requirements.

BIM provides a platform for visualization, simulation, and analysis of building designs and performance, improving communication and collaboration among project stakeholders. It also enhances construction project quality and efficiency by reducing errors and rework, improving cost estimation and project scheduling, and fostering communication among stakeholders.

Autodesk Revit, ArchiCAD, Bentley MicroStation, and Tekla Structures are some of the popular BIM software tools used in the industry. Due to its potential for reducing costs, improving construction quality, and ensuring better project outcomes, BIM's use in the AEC industry is increasing.

5. PROCESS IN INTEGRATING PMIS & BIM

1. Identify project goals and requirements
2. Select PMIS and BIM software
3. Integrate PMIS and BIM
4. Train project team members
5. Monitor and evaluate performance

6. ADVANTAGES

Integrating Project Management Information System (PMIS) and Building Information Modeling (BIM) in the construction industry offers several advantages, including:

1. **Improved Collaboration:** Integrating PMIS and BIM allows project teams to work collaboratively, share information, and make informed decisions in real-time.
2. **Enhanced Visualization and Simulation:** BIM provides a 3D model of the building, allowing project teams to visualize and simulate construction activities and identify potential issues before construction begins.
3. **Improved Cost Control:** PMIS and BIM integration enables better cost control by providing real-time information on project costs, resource utilization, and budget performance.
4. **Better Quality Control:** PMIS and BIM integration allows project teams to monitor project quality, track performance metrics, and identify areas for improvement.
5. **Reduced Risk:** PMIS and BIM integration allow project teams to identify and mitigate project risks,

reducing the likelihood of project delays and overruns.

Overall, integrating PMIS and BIM in the construction industry improves project efficiency, reduces costs, and enhances project quality, resulting in better project outcomes.

7. DISADVANTAGES

While integrating Project Management Information System (PMIS) and Building Information Modeling (BIM) offers many benefits, there are also some potential disadvantages to consider:

1. **High Initial Cost:** Implementing PMIS and BIM integration requires significant investment in software, hardware, and personnel training, which can be expensive.
2. **Technical Challenges:** The integration process can be complex and challenging, requiring technical expertise and experience. Integration issues can lead to delays and increased costs.
3. **Resistance to Change:** Integrating PMIS and BIM may require changes to traditional project management practices, which can be met with resistance from project teams and stakeholders.
4. **Security Concerns:** Integrating PMIS and BIM requires sharing sensitive project information among project stakeholders. This can raise security concerns related to data privacy and intellectual property protection.
5. **Limited Adoption:** Not all organizations in the construction industry have adopted PMIS or BIM, making it challenging to integrate these systems into project management processes.

It is important to carefully evaluate the potential drawbacks of PMIS and BIM integration and implement strategies to mitigate them to ensure successful integration and maximum benefits.

8. CASE STUDIES

1. Mass transit : Stations south chennai
2. Mass transit : Stations north chennai
3. Mass transit : Stations east chennai
4. Island Development – Saudi Arabia
5. Island Development – Saudi Arabia-Spa and Retreat space
6. Island Development – Saudi Arabia-All day dinning space

8.1. MASS TRANSIT : STATIONS SOUTH CHENNAI

Conventional Method

TIME	COST	SCHEDULE
Days are increased by around 40 -50 days.	Project budget is increase 2.5%	Proper time allotment for the project process will take longer time
Delay in material delivery by 12 days	Wastage of material -17%	Fixed schedule of the project will be changed due to delay in material supply
Lack of communication between clients & contractors	Affected the work process	The work cannot be separated or altered on time of execution
Update of project schedule couldn't be managed properly	Project days and budget increased by 3%	Scheduled dates will vary
Site management issues	Amount of man power increased by 7%	Site management issues can cause variation in the assigned schedule.
Lack of working process among the workers	Project days and budget increased by 3%	-
Recalculating of project will take longer time	Budget details will vary due to manual recalculation	-

Table 1:- Project status using conventional method

Risk management	Data entry	Site issues
Few safety checklist can be missed on site	Missing of points while entering data manually.	Very hard to maintain a large set of data update
Architectural plans and details cannot be handled manually.	Cannot provide proof or backup for missed data	Every data cannot be accessed by everyone.
Lack of equipments can cause delay in work process.	Digital photos and data cannot be updated	Proper quality image cannot be saved.
Safety measures for workers cannot be updated on time.	Need huge inventory to store data files.	

Table 2:- Project status using conventional method

Using PMIS Software Method

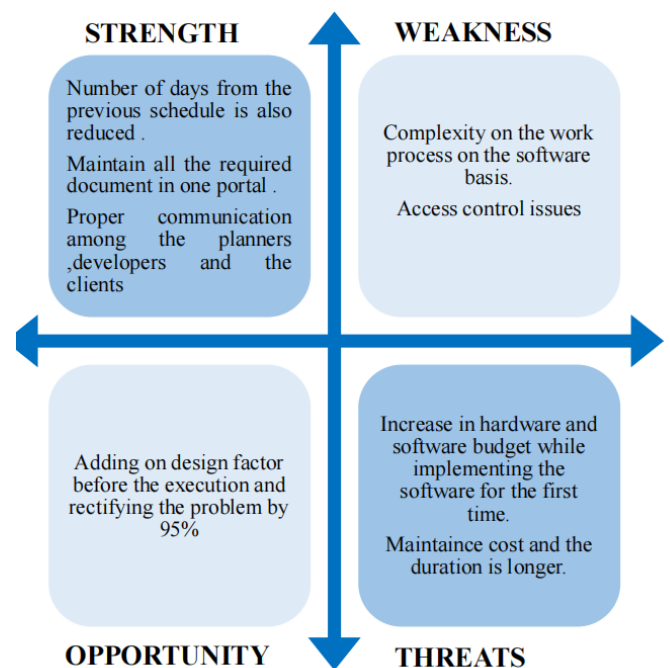
Risk management	Data entry	Site issues
Few safety checklist can be missed on site thereby uploading in portal helps	Missing of points while entering data manually can be resolved	Very easy to maintain a large set of data update
Architectural plans and details cannot be handled manually thereby can be updated in portal and checked	Can provide proof or backup for missed data	Every data can be accessed by everyone.
Lack of equipments can cause delay in work process , therefore the need of the equipment can be updated using the pmis portal	Digital photos and data can be updated	Proper quality image can be saved.
Safety measures for workers can be updated on time.	Does not require huge inventory to store data files.	Live update on PMIS portal of the photos using drone and cameras in the site

Table 3:- Project status using PMIS Software method

TIME	COST	SCHEDULE
Days will decreased by around 40 -50 days.	Project budget will decrease by 1.2%	Proper time allotment for the project process will take less time
No delay in material supply .	Wastage of material is controlled 6%	Fixed schedule of the project will maintained properly on the PMIS portal
communication between clients & contractors are very effective.	Work process is not affected	The work can be separated or altered on time of execution
Update of project schedule can be managed properly	Project days and budget is decrease by 2%	Scheduled dates will maintained properly
Site management issues are rectified as early as possible	Amount of man power decreased	Proper site management will maintain the work schedule and the work can be finished as early as possible
Proper understanding of the work among workers and the contractors	Project days and budget is decreased by 2%	-
Recalculating of project will take very less time	Budget details will be constant by using the software	-

Table 4:- Project status using PMIS Software method

SWOT ANALYSIS



8.2. MASS TRANSIT : STATIONS NORTH CHENNAI

Conventional method

TIME	COST	SCHEDULE
Days are increased by around 35-45 days.	Project budget is increase 2.7%	Proper time allotment for the project process will take longer time
Delay in material delivery by 16 days	Wastage of material -18%	Fixed schedule of the project will be changed due to delay in material supply
Lack of communication between clients & contractors	Affected the work process	The work cannot be separated or altered on time of execution
Update of project schedule couldn't be managed properly	Project days and budget increased by 3.5%	Scheduled dates will vary
Site management issues	Amount of man power increased by 12%	Site management issues can cause variation in the assigned schedule.
Lack of working process among the workers	Project days and budget increased by 3.5%	-
Recalculating of project will take longer time	Budget details will vary due to manual recalculation	-

Table 5-: Project status using conventional method

This passage highlights the challenges faced in a construction project related to time, cost, schedule, safety, and management. The delay in material delivery and poor communication between clients and contractors resulted in a significant increase in the project timeline and budget. Safety measures were not updated regularly, and individual safety issues could not be analyzed correctly. Site management issues led to variations in the assigned schedule, and a lack of working process among workers caused further delays. Recalculating the project is a time-consuming process, and the budget details can vary due to manual recalculation. The passage emphasizes the importance of proper time allotment, effective communication, and efficient site management to complete a construction project successfully within the set budget and schedule.

Risk management	Data entry	Site issues
Few safety checklist can be missed on site	Missing of points while entering data manually.	Very hard to maintain a large set of data update
Architectural plans and details cannot be handled manually.	Cannot provide proof or backup for missed data	Every data cannot be accessed by everyone.
Lack of equipments can cause delay in work process.	Digital photos and data cannot be updated	Proper quality image cannot be saved.
Safety measures for workers cannot be updated on time.	Need huge inventory to store data files.	

Table 6-: Project status using conventional method

Using PMIS Method

Risk management	Data entry	Site issues
Few safety checklist can be missed on site thereby uploading in portal helps	Missing of points while entering data manually can be resolved	Very easy to maintain a large set of data update
Architectural plans and details cannot be handled manually thereby can be updated in portal and checked	Can provide proof or backup for missed data	Every data can be accessed by everyone.
Lack of equipments can cause delay in work process , therefore the need of the equipment can be updated using the pmis portal	Digital photos and data can be updated	Proper quality image can be saved.
Safety measures for workers can be updated on time.	Does not require huge inventory to store data files.	Live update on PMIS portal of the photos using drone and cameras in the site

Table 7-: Project status using conventional method

The given text suggests that a project can be completed more efficiently by reducing the number of days by 40-50 and reducing the budget by 3%. This can be achieved by proper time allotment, daily monitoring, controlling wastage of materials, and maintaining a fixed schedule on a PMIS portal. Safety measures can also be updated daily, and effective communication between clients and contractors can be maintained. The work process and schedule can be altered if required, and individual safety issues can be analyzed properly. Site management issues can be rectified early, and the amount of manpower required can be reduced. With proper understanding of the work among workers and contractors, the project days and budget can be decreased, and project recalculation can be done quickly by using software.

TIME	COST	SCHEDULE
Days will decreased by around 40-50 days.	Project budget reduced by 3%	Proper time allotment for the project process will take less time
Delay in material supply can be rectified easily.	Wastage of material can be controlled	Fixed schedule of the project will maintained properly on the PMIS portal
communication between clients & contractors are very effective.	Work process is not affected	The work can be separated or altered on time of execution
Update of project schedule can be managed properly	Project days and budget will decrease gradually	Scheduled dates will maintained properly
Site management issues are rectified as early as possible	Amount of man power will decrease	Proper site management will maintain the work schedule and the work can be finished as early as possible
Proper understanding of the work among workers and the contractors	Project days and budget will decrease	-
Recalculating of project will take very less time	Budget details will be constant by using the software	-

Table 8-: Project status using conventional method

8.3. MASS TRANSIT : STATIONS EAST CHENNAI

Conventional Method

TIME	COST	SCHEDULE
Days are increased by around 25-35 days.	Project budget is increase 2.1%	Proper time allotment for the project process will take longer time
Delay in material delivery by 10 days	Wastage of material -14%	Fixed schedule of the project will be changed due to delay in material supply
Lack of communication between clients & contractors	Affected the work process	The work cannot be separated or altered on time of execution
Update of project schedule couldn't be managed properly	Project days and budget increased by 3%	Scheduled dates will vary
Site management issues	Amount of man power increased by 8%	Site management issues can cause variation in the assigned schedule.
Lack of working process among the workers	Project days and budget increased by 3%	-
Recalculating of project will take longer time	Budget details will vary due to manual recalculation	-

Table 9-: Project status using conventional method

Using PMIS Method

TIME	COST	SCHEDULE
Days will decreased by around 40 -50 days.	Project budget reduced by 3%	Proper time allotment for the project process will take less time
Delay in material supply can be rectified easily.	Wastage of material can be controlled	Fixed schedule of the project will maintained properly on the PMIS portal
communication between clients & contractors are very effective.	Work process is not affected	The work can be separated or altered on time of execution
Update of project schedule can be managed properly	Project days and budget will decrease gradually	Scheduled dates will maintained properly
Site management issues are rectified as early as possible	Amount of man power will decrease	Proper site management will maintain the work schedule and the work can be finished as early as possible
Proper understanding of the work among workers and the contractors	Project days and budget will decrease	-
Recalculating of project will take very less time	Budget details will be constant by using the software	-

Table 10-: Project status using PMIS method

8.4. ISLAND DEVELOPMENT: SAUDI ARABIA

Name of the project	Red sea development
Total island area	28,000km2
Phase 1 area	2,30,000 sq.ft
Location	Saudi Arabia, red sea islands
Type of building	luxury and hyper-luxury hotelsMarinas, leisure and lifestyle amenities
Master planning and urban planning	WATG and Buro Happold.
Architectural BIM consultants	DLF India.

Table 11-: Project Description

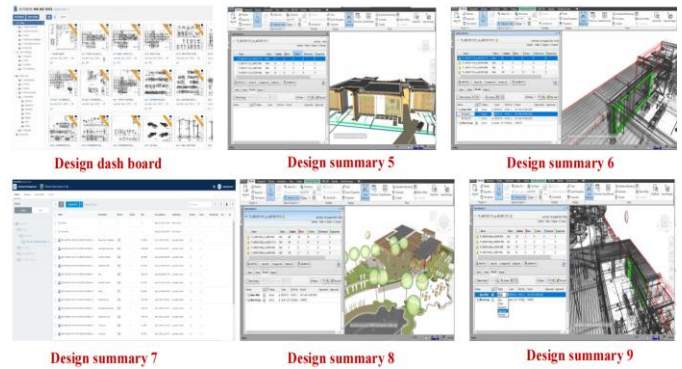


Figure - 1: BIM layout for design analysis

8.5. ISLAND DEVELOPMENT: SAUDI ARABIA - SPA AND RETREAT SPACE

Name of the project	Red sea development
Total island area	28,000km2
Build area	16,580 sq.ft
Location	Saudi Arabia, red sea islands
Type of building	Spa and Retreat
Master planning and urban planning	WATG and Buro Happold.
Architectural BIM consultants	DLF India.

Table 12-: Project Description

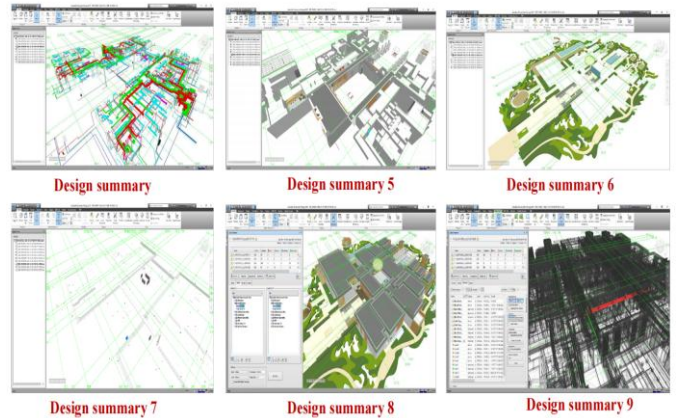


Figure - 2: BIM layout for design analysis

8.6. ISLAND DEVELOPMENT : ALL DAY DINNING

Name of the project	Red sea development
Total island area	28,000km2
Build area	7860 sq.ft
Location	Saudi Arabia, red sea islands
Type of building	All day dinning
Master planning and urban planning	WATG and Buro Happold.
Architectural BIM consultants	DLF India.

Table 13-: Project Description

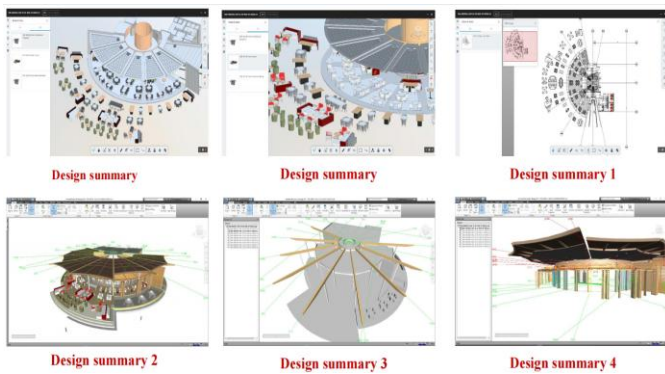


Figure – 3: BIM layout for design analysis

8.7. THE RED SEA DEVELOPMENT COMPANY – INFERENCE

Effective time, cost, schedule, and safety management is critical for construction projects, but various issues can hinder progress. Delays in the design process can increase project duration and costs, while delayed material supply can result in schedule changes and material waste. Daily safety checklist updates may be challenging, and poor communication between clients and contractors can affect work processes. Site management and design issues can also require more manpower and impact safety inspections, while a lack of architect collaboration can cause work clashes and longer project recalculation times.

Conventional method

TIME	COST	SCHEDULE
Days will increased for the designing purpose .	Project budget will increase gradually	Proper time allotment for the project process will take longer time
Delay in material supply.	Wastage of material	Fixed schedule of the project will be changed due to delay in material supply
Lack of communication between clients & contractors.	Affects the work process	The work cannot be separated or altered on time of execution
Update of project schedule cannot be managed properly	Project days and budget will increase	Scheduled dates will vary
Design management issues	Amount of man power will increase	Site management issues can cause variation in the assigned schedule.
Lack of working process among the architects	Project days and budget will increase	The issues cannot be rectified before and there can be clashes in work
Recalculating of project will take longer time	Budget details will vary due to manual recalculation	-

Table 14-: Project status using conventional method

Risk management	Data entry	Site issues
Few safety checklist can be missed on site	Missing of points while entering data manually.	Very hard to maintain a large set of data update
Architectural plans and details cannot be handled manually.	Cannot provide proof or backup for missed data	Every data cannot be accessed by everyone.
Lack of equipments can cause delay in work process.	Digital photos and data cannot be updated	Proper quality image cannot be saved.
Safety measures for workers cannot be updated on time.	Need huge inventory to store data files.	

Table 15-: Project status using conventional method

Using BIM 360 software

To achieve successful construction projects, it is crucial to manage time, cost, schedule, and safety efficiently. By reducing the project duration by 60-80 days and cutting down the budget by 3%, proper time allocation for the project process can be achieved more efficiently. Material supply delays can be rectified swiftly to control material wastage.

The BIM 360 portal can be used to maintain the fixed project schedule, and safety checklists can be updated daily. Effective communication between clients and contractors ensures work processes are not affected, and individual safety issues can be analyzed appropriately. The project schedule can be managed efficiently, resulting in a gradual decrease in project days and budget.

Scheduled dates will be maintained correctly, pre-planned safety measures inspected accurately, and site management issues resolved as soon as possible, leading to a decrease in required manpower. Proper site management ensures that the work schedule is maintained, and the project can be completed earlier. An improved understanding of the work among workers and contractors leads to fewer project days and reduced budgets.

Recalculating the project will be quicker, and the software will ensure that budget details remain consistent.

TIME	COST	SCHEDULE
Days will decreased by around 40 -50 days.	Project budget reduced by 3%	Proper time allotment for the project process will take less time
Delay in material supply can be rectified easily.	Wastage of material can be controlled	Fixed schedule of the project will maintained properly on the PMIS portal
communication between clients & contractors are very effective.	Work process is not affected	The work can be separated or altered on time of execution
Update of project schedule can be managed properly	Project days and budget will decrease gradually	Scheduled dates will maintained properly
Site management issues are rectified as early as possible	Amount of man power will decrease	Proper site management will maintain the work schedule and the work can be finished as early as possible
Proper understanding of the work among workers and the contractors	Project days and budget will decrease	-
Recalculating of project will take very less time	Budget details will be constant by using the software	-

Table 16-: Project status using BIM 360 Software method

The use of a BIM 360 portal can help with risk management, data entry, and site issues, which can cause delays in work. By uploading safety checklists and data manually into the portal, missing points and data can be avoided. The portal can also be used to update and maintain a large set of data, including architectural plans and details, which cannot be handled manually. The reason for work delays can be updated in the portal with proper photos and proof, and approvals for any changes can be made quickly. Lack of equipment can also be updated using the BIM 360 portal, and safety measures for workers can be updated on time. Live updates on the BIM 360 portal can be made using drones and cameras on the site, and the portal can be accessed by everyone, making understanding of issues and changes easier. The use of a BIM 360 portal also reduces the need for large inventory to store data files.

Risk management	Data entry	Site issues
Few safety checklist can be missed on site thereby uploading in portal helps	Missing of points while entering data manually can be resolved	Very easy to maintain a large set of data update
Architectural plans and details cannot be handled manually thereby can be updated in portal and checked	Can provide proof or backup for missed data	Every data can be accessed by everyone.
Lack of equipments can cause delay in work process , therefore the need of the equipment can be udated using the pmis portal	Digital photos and data can be updated	Proper quality image can be saved.
Safety measures for workers can be updated on time.	Does not require huge inventory to store data files.	Live update on PMIS portal of the photos using drone and cameras in the site

Table 17-: Project status using BIM 360 Software method

9. USING PRIMAVERA SOFTWARE

Primavera software is a project management tool that helps users plan, monitor, and control complex projects efficiently. By inputting project tasks, dependencies, and durations, a network diagram is created to represent the project schedule and the critical path. Using Primavera tools , project managers can optimize the schedule by adjusting task durations, rearranging tasks, or adding additional resources to critical tasks, and the software can calculate the impact of changes and provide recommendations. This process helps identify areas where time can be saved, resulting in a faster completion time and reducing the number of days required to finish the project. Overall, Primavera software facilitates project management and helps identify opportunities to reduce project duration.

9.1 INTEGRATING PMIS AND PRIMAVERA

	Month	Feb-23	Mar-23	Apr-23	May-23
Planned	For the Month	22	22	69	136
	Cumulative	22	44	113	249
Actual	For the Month	0	0	0	210
	Cumulative	0	0	0	210

Table 18-: Project status of mass transit hub for the month feb – may

	Month	Feb-23	Mar-23	Apr-23	May-23
Planned	For the Month	0.52%	1.35%	3.26%	1.98%
	Cumulative	0.52%	1.88%	5.13%	7.12%
Actual	For the Month	0.00%	0.00%	0.10%	0.57%
	Cumulative	0.00%	0.00%	0.10%	0.67%

Table 19-: Project status(in %) of mass transit hub for the month feb – may

9.2. CONSTRUCTION RESULTS USING P6 AND PMIS – TRACKING

Integrating Primavera and a Project Management Information System (PMIS) can streamline project management, provide accurate project forecasting, improve communication and collaboration, enhance risk management, and increase productivity. PMIS manages project documentation, tracks project costs and risks, and

automates project management tasks, while Primavera plans, schedules, and tracks project progress. The integration of these two systems can benefit organizations managing complex projects.

To integrate Primavera and PMIS, you need to ensure that the two systems are compatible. This can be done by using a third-party integration tool or custom developing an integration solution. Once the integration is complete, users can access both systems from a single interface, allowing them to manage all aspects of the project in one place.

10. INTEGRATING PMIS AND BIM

The data from PMIS and BIM models can be made available to project management and owners to understand project progress. The screen shows a plant with work packages divided based on project scope. The PMIS webpage on the left is connected to BIM and provides a list of packages and boxes representing different parts of the works. Clicking on a box provides details of the individual parts. The timeline is also available, filtered by discipline. The portal allows checking other disciplines as well.



Figure – 4: Plug in installation

FINDINGS

The application of PMIS software resulted in a significant improvement in construction efficiency, as evidenced by the completion of a 45 km stretch using the conventional method taking 8 years, whereas integrated PMIS, aimed to complete a 128 km stretch within 5 years, with 85% of the work completed despite a one-year delay. The use of PMIS reduced costs and time by 3 times compared to conventional construction method. The integration of BIM and PMIS with Primavera is currently in progress.

CONCLUSION

In conclusion, integrating PMIS and BIM can bring significant benefits to the construction industry, including streamlined project management, accurate project forecasting, improved communication and collaboration, better risk management, and increased productivity. The use of PMIS and BIM can also help in reducing costs and time, as evidenced by the successful implementation of PMIS in the construction

project. With the ongoing integration of BIM and PMIS along with Primavera, the construction industry is poised to see even greater efficiency gains and cost savings in the future.

RECOMMENDATIONS

Several recommended plugins can integrate BIM and PMIS, such as BIM 360, Revit, Navisworks, AutoCAD, and Synchro. BIM 360 connects BIM models directly to PMIS, while Revit allows users to export BIM models to PMIS. Navisworks helps visualize and analyze 3D project data, while Synchro provides 4D simulation. Using these plugins can improve productivity, communication, collaboration, and risk management, leading to better project outcomes.

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