

CREATING TOTAL PROJECT MANAGEMENT SYSTEM ON APPLYING LEAN CONSTRUCTION

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Abstract

GS E&C had developed construction management system, PMS which is based on EVMS in 1997. Recently, TPMS has developed for effective construction management through applying daily schedule management and JIT on materials, labors, equipments focusing field work. TPMS realizes "Shielding" and "Make-Ready Process" which are the main concept of Lean construction. Through this system, it can manage and plan daily field work, support the field work related material, labor, and equipment planning, and minimizes the non-valuable process. This paper introduces the concept of TPMS, and through established system, it can lead the construction culture and raise the competitive power of construction industry

Keywords : Earned Value Management System, Just in Time, Lean Construction, Total Project Management System

1. Introduction

1.1 History and purpose of the system

In 1997, GS E&C was the first in the engineering and construction industry that used the EVMS(Earned Value Management System) to develop and implement the PMS (Project Management System)which linked progress with profit/loss. In 2003, the schedule management functions were upgraded resulting in PMS+. This in turn was further developed into TPMS(Total Project Management System), which enables schedule management on a daily basis and JIT(Just in Time) material, equipment, and manpower deployment. This enables more effective management of construction project management

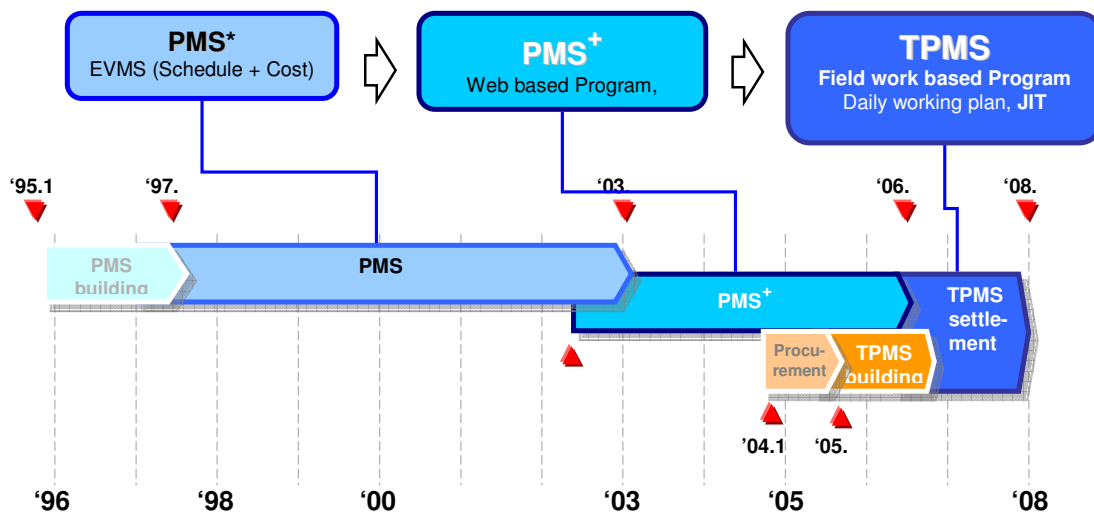


Figure1. TPMS History

GS E&C was able to experience first hand the daily schedule management and JIT by benchmarking the Heathrow Terminal 5 Project on 2005. To enable optimum and accurate JIT delivery, an accurate schedule is the key, but the confidence rate of current master schedules are 50%. In order to increase this rate, the daily schedule management was implemented.

This paper introduces the entire framework of TPMS which is based on Lean Construction and explains further the concept of daily schedule management.

1.2 Current Status

To develop this system, the Heathrow Terminal 5 Project was benchmarked on 2005, and it was inspired for the new systems and TPMS was started development on April of 2006. After pilot testing of 16 sites, it was implemented to all sites as of October 2006. In order to enable JIT material delivery, the Rebar Processing Plant was established on October, 2005 which supplies rebar, a key material, to all sites. This reduces rebar loss by processing rebar to order. The two plants located in Sihwa Industrial Complex and Kyongsang-province processes a total of 280,000 tons.

2. TPMS To be Image

TPMS uses the two key factors of Lean Construction, Shielding and Make-Ready Process (Ballard, 1994) which enables the planning and management of activities on a day-to-day basis, the planning and deployment of material, manpower, and equipment related to the activities, thus reducing factors that are of no value to the project. In order to facilitate real-time sharing of information, mobile technology is used and the information is also shared with the subcontractors.

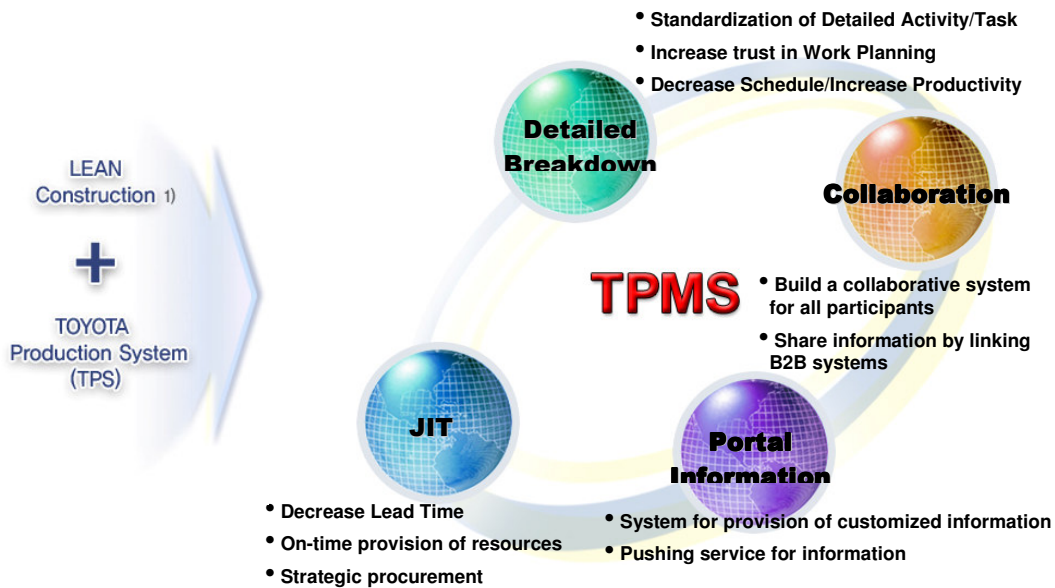


Figure2. TPMS To Be Image

2.1 Daily schedule management

The module that provides the ability to keep track of and manage the daily works is the “Daily schedule management” and is the core of TPMS. The activities that are managed

are called Tasks and this is linked to the needed materials and associated costs. When the Task is completed, the consumed materials and the costs are automatically calculated, which enables cost analysis and thus the summary of revenue and cost at a daily basis. This can be expanded into automatic schedule creation and performance analysis.

2.2 Material JIT

In order to realize Material JIT, 7 item groups have been classified according to their characteristics and the means to manage them planned. To solve the 3 issues of JIT, the right amount at the right time at the right place, a company was established called Estec which calculates the material amount according to the tasks and deliver them accordingly. For delivery at the right time, the Daily schedule management enables the automatic request the materials according to the schedule. Finally for the right place, it is using Bar Code to manage the arrival and departure of the materials. To enable the timely delivery of steel rebar, the Rebar Processing Plant have been established and operating.

2.3 Manpower and Equipment

For manpower management, RFID have used to accurately manage worker status in addition to their experience which enables the increase of construction quality by enabling the hiring of skilled workers. This is in addition to managing safety issues by managing the black list of workers with safety issues. By using mobile technology, subcontractor managers can view the status of workers by Task and thus can manage productivity according to the work area. As for equipment, instead of managing just the operation rate, the past records and safety issues are also managed.

2.4 Information Link

Although information needed by the site is available, their utility rate is low. The reason being that the information is hard to find or of no use at all. In TPMS, information regarding SEQ, technology, and knowledge is linked to the standard Tasks with the aim of reducing accidents and quality issues. Departments in charge of the information (Quality, Safety, Environment, Technical Info., KM, etc) are gathering the information needed by the sites and in TPMS they are classifying and linking them. Thus the information according to Task will be provided to the site engineers, even through mobile devices.

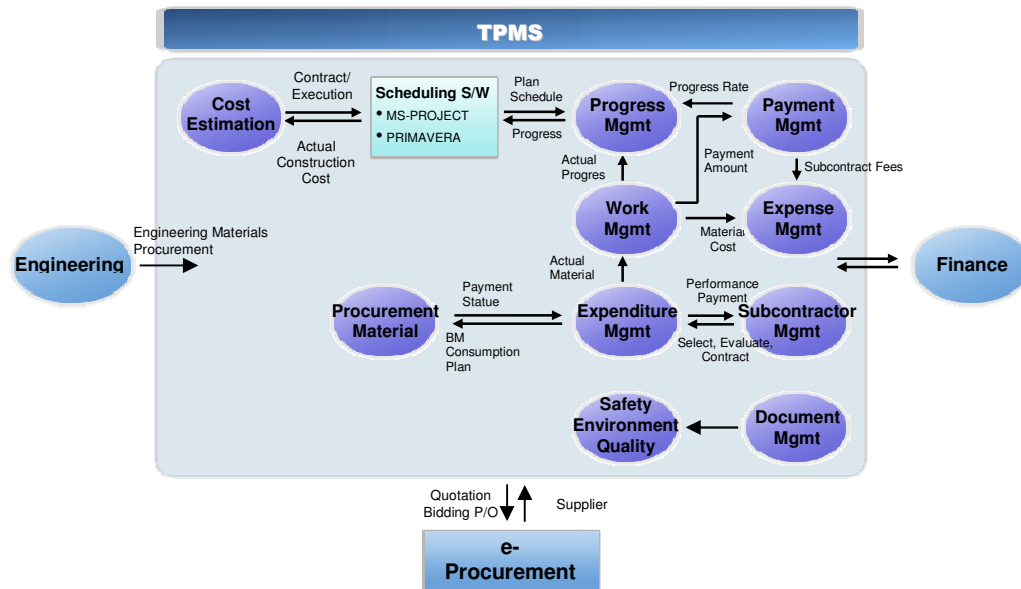


Figure3. TPMS Functions

3. TPMS Development

Daily schedule management is currently under pilot testing in 16 construction sites with the aim of improving and stabilizing it. Material JIT and manpower, equipment and knowledge link is currently under development. After stabilization and training, the work processes will be improved and implemented on 2007.

3.1 Daily schedule management

3.1.1 Daily schedule management Implementation Status

On April 2005, the SPS, United States company, supported the GS E&C as a project manager, the Daily schedule management was previously tested at 3 sites. Using experience from this, TPMS was developed as an own system from of Oct. 18th 2005, and it was implemented at 18 sites. These pilot-tests were for proving the effectiveness of the system and feasibility of the standard Tasks. On April, 2006, problems were overcome and implemented at 19 sites. The system was perfected via three more pilot tests and has thus become an easy to use system.

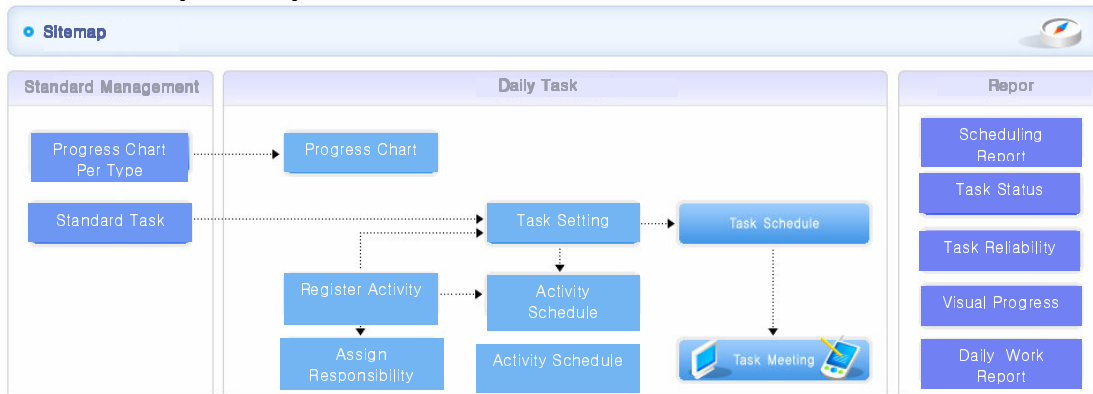


Figure4. Daily schedule management Work Flow

3.1.2 Defining Standardized Task

To set up a standard for work process and to improve the productivity of the site workers, detailed activities and tasks were standardized according to 19 construction sites by a panel of experts. The period of standardization was from September 2005 to February 2006 and was participated in 200 people. 8,700 detailed activities and 46,000 tasks were standardized and registered in the system. In terms of business division, architecture has 4 types(detailed activity : 2,600 task : 11,600), civil engineering has 5(detailed activity : 2,300 task : 13,500), housing has 2 (detailed activity : 700 task : 2,000) environment has 3(detailed activity : 800 task : 6,000) and plant has 5 construction types(detailed activity : 2,000 task : 12,700). The site engineer can select the construction type and create a master schedule for the selected type.

3.1.3 Task Setting

In Lean Construction, discussing and fixing work processes using post-its have been included in the system. Thus, one month before the work, the work process is discussed with the subcontractor and if it is fixed a schedule is automatically created and checked via the system. The core of Daily schedule management is Task Setting and this is what enables site management.

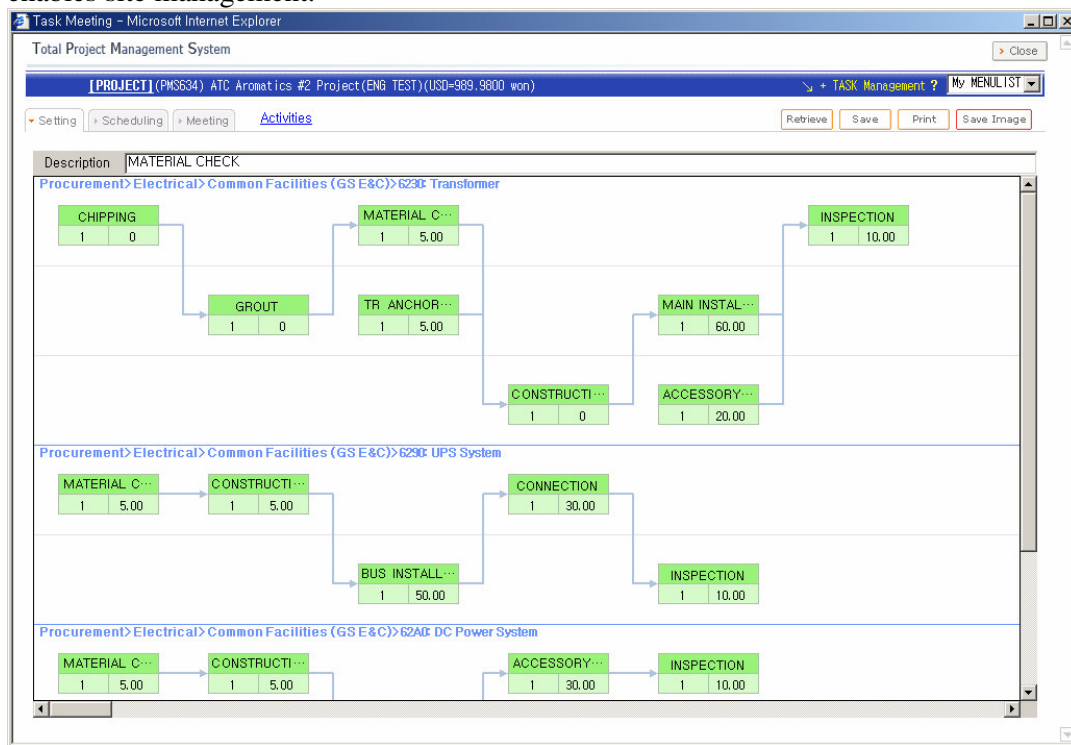


Figure5. Task Setting Screen

The boxes at the top are the name of the Task, the one at the lower left is the period, and the one on the right is the weight value. All the tasks in the Activity have a combined weight value of 100%, and the combined weight value for a single task is the progress rate for a detailed activity. This is linked to payment and thus is a very important data.

3.1.4 Task Meeting

After the work process is fixed at the Task Setting, we have created an environment where Gs E&C employees can meet with the subcontractors and enter the results of the completed and ongoing works while planning the next works. Most of the input is done by Gs E&C employees but the subcontractor foreman is responsible for entering the data for the Daily schedule management with the input tool being a mobile device. The subcontractor selects Completed, In Progress, Not Completed for today's assigned Task and in case Not Completed is selected the reason has to be entered. For tomorrow's work meeting, only the designated task for the next day can be carried out and as for the next work the exact work plan will be made.

The screenshot shows a web-based interface for task management. At the top, there's a header with project information: "[PROJECT] (PMS634) ATC Aromatics #2 Project(ENG TEST)(USD-989.9800 won)". Below this are filters for dates (Base Date: 2006-11-30, 2006-11-27, 2006-12-03) and task status (This Week, Today, Tomorrow, All Tasks, Interference, Completed, OnGoing, NotStarted, Delayed). A navigation bar includes options like Setting, Scheduling, Meeting, Gantt, List, and various action buttons (Instruction, Confirm, Retrieve, Save, Print, Download).

No.	Work Description	Progress Status	Access	Today Work	Tomorrow Work	Duration	Start	Finish	Days	Plan Start	Plan Finish	Start Delay	GS S/V	Subcon S/V	Manpower	Equip
1	Construction>Painting>Aromatic	0				16	11-20	12-07					김병규			
2	SURFACE PREPARATION	Not Started	0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	7	11-30	12-07	0	11-20	11-27	0	김병규		0/0	0/
3	INSPECTION			<input checked="" type="checkbox"/>	<input type="checkbox"/>	7	11-30	12-07	0	11-20	11-27	0	김병규		0/0	0/
4	PROTECTION(TAPING)			<input type="checkbox"/>	<input type="checkbox"/>	7	11-30	12-07	0	11-20	11-27	0	김병규		0/0	0/
5	PRIMER COATING			<input type="checkbox"/>	<input type="checkbox"/>	7	11-30	12-07	0	11-20	11-27	0	김병규		0/0	0/
6	INSPECTION			<input type="checkbox"/>	<input type="checkbox"/>	7	11-30	12-07	0	11-20	11-27	0	김병규		0/0	0/
7	COLOR CODING			<input type="checkbox"/>	<input type="checkbox"/>	7	11-30	12-07	0	11-20	11-27	0	김병규		0/0	0/
8	Construction>Painting>Aromatic	0				9	11-30	12-09					김병규			
9	MAT'L CARRY'G IN SHOP(348M2)			<input checked="" type="checkbox"/>	<input type="checkbox"/>	7	11-30	12-07	0	11-30	12-07	0	김병규		0/0	0/
10	SURFACE PREPARATION			<input type="checkbox"/>	<input checked="" type="checkbox"/>	7	12-01	12-08	0	12-01	12-08	0	김병규		0/0	0/
11	INSPECTION			<input type="checkbox"/>	<input type="checkbox"/>	7	12-02	12-09	0			0	김병규		0/0	0/
12	PROTECTION(TAPING)			<input type="checkbox"/>	<input type="checkbox"/>	7	12-02	12-09	0			0	김병규		0/0	0/
13	PRIMER COATING			<input type="checkbox"/>	<input type="checkbox"/>	7	12-02	12-09	0			0	김병규		0/0	0/
14	INSPECTION			<input type="checkbox"/>	<input type="checkbox"/>	7	12-02	12-09	0			0	김병규		0/0	0/
15	COLOR CODING			<input type="checkbox"/>	<input type="checkbox"/>	7	12-02	12-09	0			0	김병규		0/0	0/
16	Construction>Painting>Aromatic	0				7	11-30	12-07					김병규			
17	MAT'L CARRY'G IN SHOP(486M2)			<input checked="" type="checkbox"/>	<input type="checkbox"/>	6	11-30	12-06	0	11-30	12-06	0	김병규		0/0	0/
18	SURFACE PREPARATION			<input type="checkbox"/>	<input checked="" type="checkbox"/>	6	12-01	12-07	0	12-01	12-07	0	김병규		0/0	0/
19	INSPECTION			<input type="checkbox"/>	<input checked="" type="checkbox"/>	6	12-01	12-07	0	12-01	12-07	0	김병규		0/0	0/
20	PROTECTION(TAPING)			<input type="checkbox"/>	<input type="checkbox"/>	6	12-01	12-07	0			0	김병규		0/0	0/
21	PRIMER COATING			<input type="checkbox"/>	<input type="checkbox"/>	6	12-01	12-07	0			0	김병규		0/0	0/
22	INSPECTION			<input type="checkbox"/>	<input type="checkbox"/>	6	12-01	12-07	0			0	김병규		0/0	0/

Figure6. Task Meeting Screen

For the measurement standard we use the PPC(Percentage of Plan Completed. Ballard 1999). For example out of 10 works, if 9 is completed then the confidence rate is 90%. PPC is used to evaluate and select subcontractors.

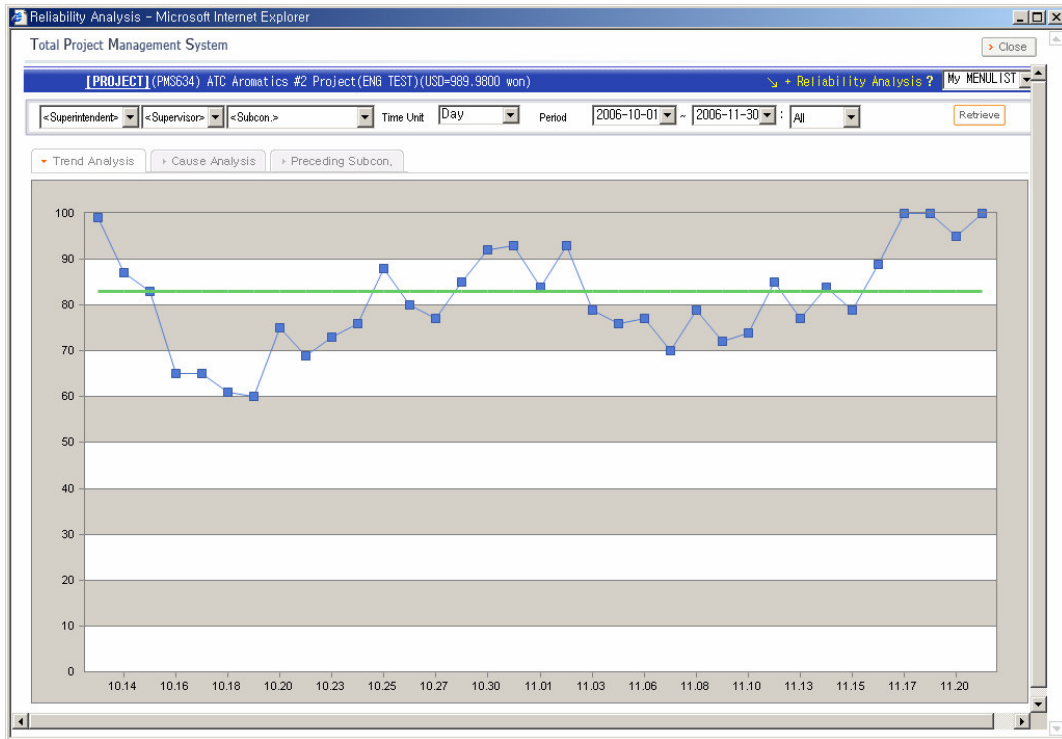


Figure7. PPC Screen

3.2 Rebar Processing Plant

GS E&C has two rebar processing plants in operation. They process rebar for use at the site.

To smoothly operate the plants, the Bar bending Automation System is being used to accurately calculate the material amount and to manage the production and delivery of the steel rebar. This is Material JIT at work. This system also enables collaboration between the site, Estec, and the plant.

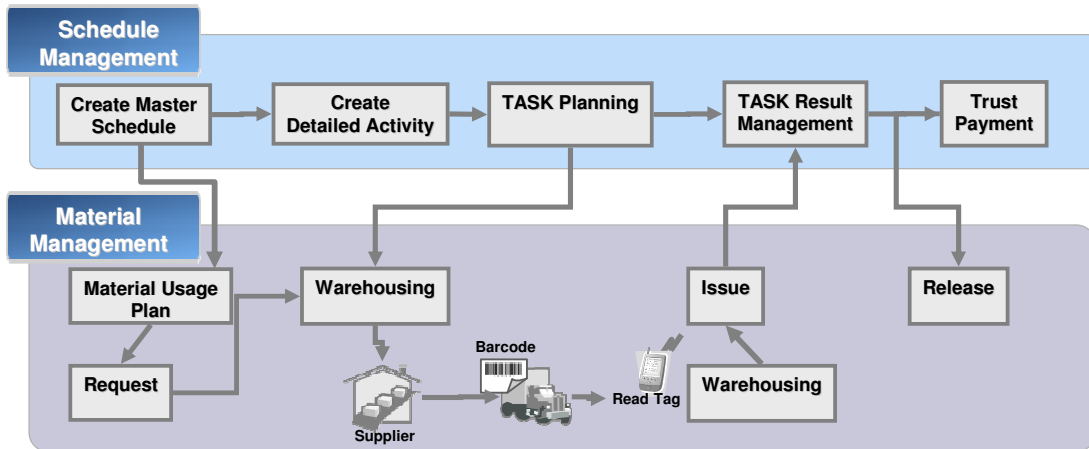


Figure8. The relation between schedule management and material management

3.3 Mobile Technology

Using the PDA, real-time input of production completion, creation of shipping slips, and checking of departure and arrival of rebar is carried out. This enables real-time status check of the entire material management process.

4. TPMS Benefits

TPMS enables real-time information sharing between project members and reduces wastes that result from movement, waiting, and inspection. It also increases subcontractor productivity and reduces project schedule. This in turn enables Cost Innovation. The detailed benefits are listed below;

- 1) GS E&C and its subcontractors are sharing information regarding today's work status, tomorrow's work plan, manpower present, material and equipment in real-time, this increases subcontractor productivity and reduces cost. This leads to increased collaboration with the subcontractors.
- 2) If the Task's completion status is fixed during a Daily Task Meeting, the payment is automatically calculated according to the actual work done, plus the construction progress status, revenue, and profit/loss information can be viewed in real-time. This ensures transparency in management.
- 3) The current planning confidence rate can be increased to 90% from the current 60%, which means accurate schedule planning and in turn leads to increased work efficiency as a result of accurate deployment of material, manpower, and equipment.
- 4) SEQ and technical information is linked with the Task thus ensuring that necessary information is provided at the right time, reducing accidents and quality issues.

5. Conclusion

With IT as a basis, TPMS has increased efficiency and productivity, which has resulted in cost efficiency and increased productivity of the subcontractors. It has enabled transparent management and is playing a part in instilling a new culture in the engineering and construction industry. The implementation of IT is greatly increasing the competitiveness of our company in this highly competitive industry.

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