

# An Application of PDA in Building Construction Project for Enhancing Productivity

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## Abstract

**Objectives:** The construction industry is trying to adopt the rapidly improved information and telecommunication technology. The construction manager should coordinate each construction operation toward the maximization of the productivity. **Methods/Statistical Analysis:** The systematic management in site is critical for the prevention of the potential interference between various processes, which results in more efficient schedule management of construction projects. This study examines the utilization of Personal Digital Assistants (PDA) as one of mobile devices for the enhancing the level of construction management. It applies the PDA-based system to the building construction projects and presents the benefit in the productivity of PDA-based system. **Findings:** The study intends to offer the system that could be helped construction engineers to set a reasonable PDA-based system in building construction project through the minimization of waiting time for more efficient schedule management. Furthermore, based on an assessment in productivity, it was found that the PDA-based system is more reasonable than the existed system owing to the advantages of the PDA-based system, such as reduced reworking, faster response to changes. **Improvements/Applications:** The proposed PDA-based system should be estimated in the productivity of PDA-based system using the computer simulation methodology which can provide quantitative number in productivity.

**Keywords:** Building Construction, Personal Digital Assistants, Productivity, Sharing Framework, Task

## 1. Introduction

Recently, construction industry is developing with the rapidly improved information and telecommunication technology. Especially, the multi-story building construction projects ongoing world widely may need the complicated construction methods and highly advanced equipment. Thus, the construction manager should coordinate each construction operation consisted of various unit processes toward the maximization of the productivity. In order to do so, the systematic management in site is critical for the prevention of the potential interference between various processes, which results in more efficient schedule management of construction projects. However, in general, construction managers use a pile of paper and/or field report<sup>1</sup>. That makes them still have many typical

jobs in construction field including the collection of construction data and the inspection. A difference between the outdoor site and the office can lead to low efficiency. The mobile computing system can eliminate and/or reduce this difference by using digital input with mobile computing device on construction field effectively. As an each activity is strictly scheduled, construction manager (CMr) must revise the schedule and make decision within time<sup>1</sup>.

According to prior study<sup>2</sup>, the waiting time should be minimized in schedule management so that the following process can get started right after the preceding process is finished. However, the crew performing each process is not identical in most cases, so, if the completion of preceding process is not well-informed, the following process cannot be initiated on time. It means there can

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be a time gap between two consecutive processes by the absence of immediate communication, which results in the productivity loss in time; thus the construction management by the communication without delay between two consecutive processes is very important. In order to eliminate the reiterated waiting time resulting from it, the application of mobile device is explored. This study examines the utilization of Personal Digital Assistants (PDA) as one of mobile devices for the efficient schedule management of processes in a queue. Furthermore, it applies the PDA-based system to the building construction projects and presents the benefit by calculating differences in the productivity of PDA-based system over existed system.

The articles related to the PDA on site application have been appeared in recent years. The purpose, the concept based on End User Computing, and the component of the mobile system as well as the structure of system and outline of subsystems were described<sup>1</sup>. And a paradigm 'distributed product information' from the supplier point of view was proposed<sup>3</sup>. 'Distributed' no longer means 'sent to many clients' but rather 'accessed at many providers'. The first article dealt with how to use PDA in site for construction manager, the second one was how to increase the utilization in the given information that was from the construction site.

The PDA can collect information in real-time and the data can be analyzed by the site team the next day<sup>4</sup>. And, the PDA was developed for controlling system of harbor terminal<sup>5</sup>. Also, the mobile computing could eliminate and/or decrease delay between outdoor site and indoor office<sup>6</sup> and could be used in building defect management system<sup>7</sup>. CMr can utilize digital data input device with mobile computing on construction site effectively. So, those articles emphasized how the mobile devices can contribute to minimize the gap between outdoor and indoor.

Most of the previous articles have emphasized how the recent developed IT can help the construction projects and how effectively IT can activate in construction sites. But, there is no research in information sharing view, and how accurately the mobile devices can help the construction projects. Therefore, this paper is the aim for showing how to use the mobile device, especially PDA, in information sharing to all participants and what exactly the mobile device can improve the productivity compared to the conventional system.

## 2. Building Construction

The building construction is getting complicated than ever due to the improved technology of telecommunication and electrical/mechanical devices. In order to quantify the productivity variation by utilization of the mobile telecommunication technology for efficient schedule management, the building construction project is considered appropriately for this study. Though it depends on, as the most of the building construction projects take more than one year, it is practically hard to measure the productivity variation in all associated construction operations. Accordingly, this study focuses on the concrete and steel structure work in the building construction projects for the productivity variation by PDA application because the structure work of multi-story buildings is performed reiteratively by each floor and the quantitative productivity is relatively feasible to be measured.

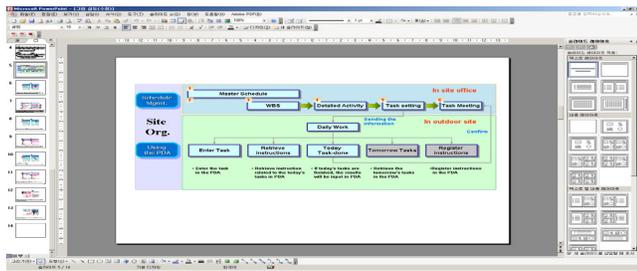
### 2.1 Conventional System

In general, construction project is mainly handled by general contractor (GC). While in construction, GC divides the whole tasks to subcontractors, suppliers, and any other participants through contract. Then, GC draws the entire blueprint for construction and coordinates many subcontractors. All information related to coordination is flawed to GC, however, all tasks are supposed to be done by subcontractors. It means subcontractors may not be delivered the exact information such as the starting or finishing date if GC does not confirm the current situation. Also, the next subcontractor may be in unexpected situation, for example, the previous subcontractor is supposed to clean the site, but he/she does not it as the next subcontractor expected. These information flaws make the schedule delayed.

### 2.2 PDA-Based System

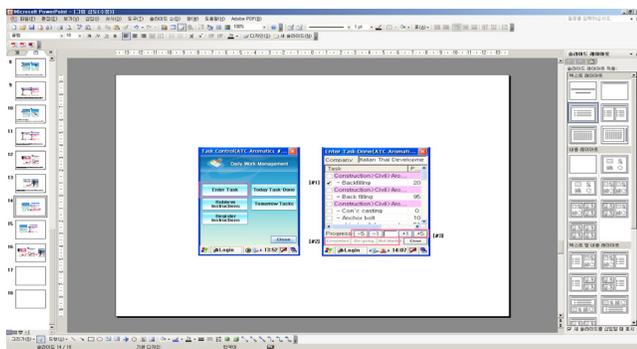
In aspect of information sharing, PDA is not only for construction manager but also the related people, for example subcontractors. However, previous articles have been developed for the unique subject, for example construction manager or inspector, etc., so, there is a limited advantage in using the PDA. The proposed system combined to PDA is both general contractor and subcontractors. PDA is the one of the mobile devices; the range of using PDA depends on how the system is designed.

This paper is focused on the schedule management with PDA, the system architecture as follows (Figure 1);



**Figure 1.** System architecture in schedule management with PDA.

From the master schedule, detailed activities (21 day terms) are to be prepared. Then, the task from a detailed activity is made by GC and subcontractors, and they know when the specific task will be started and done through “task setting”. These tasks are confirmed as today’s work, they are shown through PDA. Then, if the work to be finished is recognized by the GC and subcontractors in task meeting, daily progress payment is confirmed in the system. At last, the finished works are compared with the original plan (i.e. approved list of tasks), and the differences are abstracted and documented.

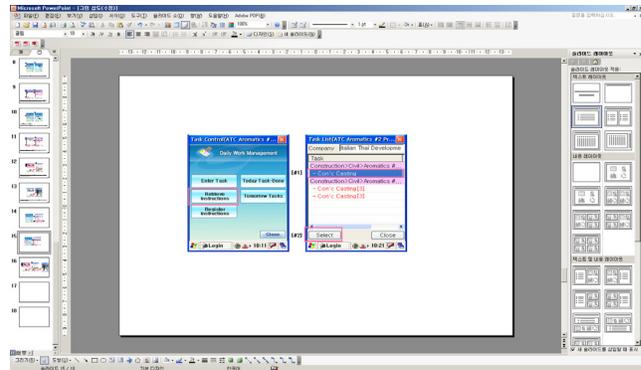


**Figure 2.** Enter Task.

**Step 1. Enter Task:** “Enter task” is for which tasks is supposed to be done today. So, “Enter task” is selected, GC or subcontractors can see a progress status of today’s Task for the company. The Descriptions with the pink background refer to detailed activities, and the others with white background refer to tasks. In order to enter the progress of a task, mark the check box [#1] on the left of the Task Description in Figure 2. Then according to the actual Task progress, choose the one among the progress status which are ‘Complete’, ‘On-going’, and ‘Not started’

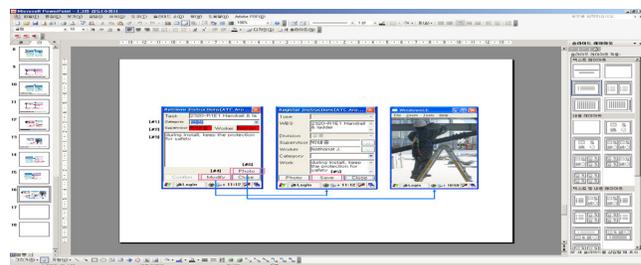
[#2]. If the task Progress status is on-going, GC or subcontractors could enter the progress percent by using the figure button [#3] in Figure 2. Once GC or subcontractors complete marking it, the task disappears from this window and it can be viewed in “Today Task-Done” menu.

**Step 2. Retrieve Instruction:** The “Retrieve Instruction” that is used to give the subcontractor the site instruction. Select a task that you are going to instruct [#1] and click on ‘Select’ [#2] in Figure 3.



**Figure 3.** Retrieve instruction.

Depending on the characteristics of site instruction for the selected task [#1] it can be classified into safety, environment, and quality, [#2] the project Engineer and subcontractors who are in charge of the task [#3] should note the site instructions. If GC or subcontractors need to change it [#4] click on ‘Modify’. After rectifying it and [#5] click on ‘save’ button in Figure 4. GC or subcontractors need to attach a photo of the construction site for the clear understanding of the site instruction. Also, GC or subcontractors can take a picture with PDA and upload it by clicking on ‘Photo’ in site instruction window.



**Figure 4.** Detail contents of instructions.

**Step 3. Today Task-Done:** GC can see the list of subcontractors and select a company from the list [#1], and click on ‘Select’ button [#2] [#3] in Figure 5 then GC can

see the Completed, On-going, and Not started tasks that were filled in on the Enter Task Menu before.

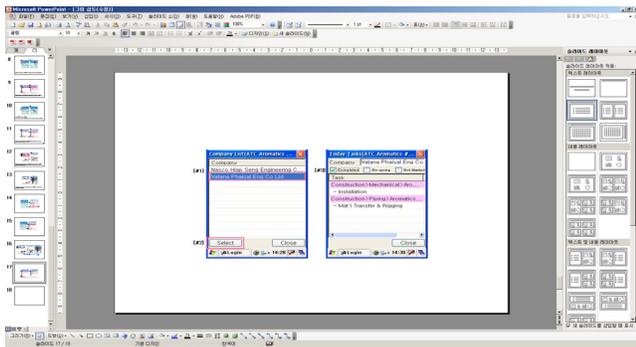


Figure 5. Today Task-Done.

**Step 4. Tomorrow Tasks:** GC and subcontractors can retrieve the tomorrow's tasks in the PDA

**Step 5. Register Instructions:** GC and subcontractors can register instructions in the PDA

Above two functions are similar to "Today Task-Done" and "Retrieve instruction", so they do not need the detailed explanation.

## 4. Discussion the Qualitative Benefit in PDA

The most advantage in using PDA is to enhance the productivity based on rapidity and accuracy. Through interviewing the PDA user, the advantages combined to PDA are investigated as follows;

- To gather the site information, PDA is the most convenience device
- Row data can be easily obtained, because that is not in the office, but in the site
- The information through PDA is directly delivered to site manager, he/she can do timely decision about the dangerous situation
- That device can be used not only schedule management, but also material, manpower, and safety management.

## 5. Conclusion

This research proposed a system in order to help construction engineers to set a reasonable PDA-based system in building construction project for minimization of waiting time for more efficient schedule management.

Based on an assessment in productivity, it was found that the PDA-based system is more reasonable than the existed system owing to the advantages of the PDA-based system, such as reduced reworking, faster response to changes.

From Enter Task to Register Instructions procedures, GC and subcontractors can control construction project in real-time, can do timely decision in dangerous situation, and can get a lot of advantages in project control especially in the future, the proposed PDA-based system should be estimated in the productivity of PDA-based system using the computer simulation methodology which can provide to identify any change in productivity.

## 5. Acknowledgment

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