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Analysis of Employee Performance with Presence Implementation Using Radio Frequency Identification (RFID) Systems in Construction Companies

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Abstract*: At the initial stage, the construction phase will begin on the project site. Person on Board (POB) data is very needed by the site management team. This aims to determine the number of workers in the area and if there is an emergency, calculation can be carried out accurately. So that this research can solve some of the problems that are usually faced by construction companies. So with this research and innovation a new method will be formed, namely changing the attendance method with the Radio Frequency Identification (RFID) system. Radio Frequency Identification (RFID) also has a function to detect lost working hours caused by the indiscipline of workers. In addation. It can be used to increase worker productivity in each work item. The research methodology uses primary data (loading manpower data, Person on Board calculation data & lost working hours. In this study, an evalation was obtained in the form of actual productivity using the RFID method, the result were greater, such as concrete pavement work. Actual productivity was greater than the targeted productivity because there were some materials that out of stock (rebar & concrete), this affected the progress of the work. For other jobs, the productivity is in accordance with the standards set by management, some are even smaller.*

Keywords*: Productivity, Person on Board (POB), Radio Frequency Identification (RFID) and Lost Working Hours.*

I. Introduction

The world of construction is currently developing very rapidly, especially construction in infrastructure and oil & gas. Even though in conditions like today (pandemic covid-19) construction services are urgently needed by the private sector and the government. When will the start of the construction phase on the site the Person on Board (POB) project data is really needed by the site management team. However, in several ongoing project sites, Person on Board (POB) calculations are still done manually or using paper attendance so that it requires accurate accuracy in data recording. So that with some of the problems that occur during the initial phase of construction work in a project, there will be research conducted, namely making an innovation to solve these problems by changing the attendance method with the Radio Frequency Identification (RFID) system. For example in this study, with the existence of an RFID system in the construction of a construction project, it can save resource requirements to be used, know & monitor the productivity results of workers and equipment used and can view & evaluate maintenance schedules for these equipment, especially in buildings / buildings general. In addition to the problems above, there is also the problem of lost working hours caused by workers leaving the work area before the time to go home. This problem is very detrimental to many parties because there is no tool used to detect it. So that with this Radio Frequency Identification (RFID) system, besides being able to be used for calculating Person On Board (POB) systematically, it can also be used to detect lost working hours that occur in each stakeholder. When workers leave the work area by passing through the queue line at one of the gates, it will be detected that the worker left the project site at what time and second so that it will make it easier for stakeholders to deduct the worker's salary and need to be verified using CCTV that will be installed in each rfid gates.

So this study aims to use the Radio Frequency Identification RFID system for calculating Person On Board (POB) and lost working hours in construction companies. The method that will be used to obtain Person On Board (POB) data is that each employee/worker who will work at the project site will be given a Chip-based card with High Frequency (HF) after carrying out the Medical Check Up (MCU) and Induction stages.

The challenges in implementing RFID in this study were when during the initial application it had to be socialized to all construction project stakeholders. It aims to introduce stakeholders to the use of this new technology. Apart from that, another challenge is during the maintenance process, this process is very useful for system reliability in terms of the accuracy of the data produced. This maintenance phase also aims to repair devices that have been damaged for the life time of the product or device that has been installed and has been enabled. And also because project sites are usually located in remote areas, the electrical system also needs to be considered.

II. Design Model

The following is the architectural design that will be used for the Radio Frequency Identification (RFID) system

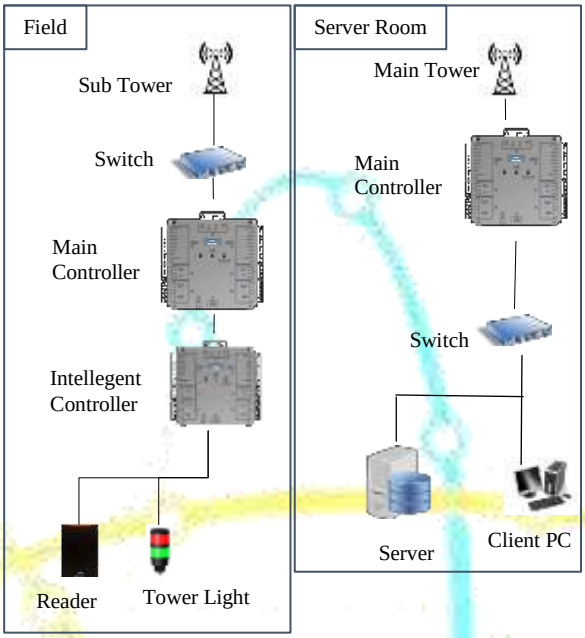

Figure 1 Architectural System

Based on the architectural system, it can be explained that the RFID gate located on the field site must be equipped with a main controller, intelligent controller, switch, reader, light tower and sub tower. When workers or staff tap on one of the readers at the RFID gate, the result of reading the data and verifying it is through the tower light. The parallel data will be sent to the intelligent controller with the help of a Cat6 UTP cable. From the Intelligent controller the data will be transferred to the Main controller. The tapping data must first go through the main controller and then be transferred to the sub tower. The sub-tower has special requirements regarding the distance to the server room, namely that the sub-tower must not be obstructed by buildings that are taller than the main tower. This is because this research does not use cables. So that the data transfer uses electromagnetic waves. Data that has been sent to the main tower will be sent to the main controller in the server room. The data will be refined on the server so that the tapping data of workers who have gone through the filtering and verification stages at the RFID gate will appear on *the client PC* and the output of this data processing is in the form of excel data so that it can be used by stakeholders who need it.

2.1 Research Stage

The stages of the research are as follows:

2.1.1 Literature Study

In this stage the method used for data collection using primary data. And the following is an explanation of the data retrieval. The method used to get the data is Primary Data. Primary data in this study was obtained from several methods as follows:

1. Data Loading Manpower
   This data is obtained from the results of calculating the number of BQ, *schedule* and *productivity* of each department. This data will be used to determine the number of gates and the number of RFID gate lines. This aims to reduce the queue for the tapping process in each RFID gate line

2. Person on Board (POB*)* calculation data and lost working hours
   This data is obtained from the tapping process for each worker who already has access in the form of a card equipped with a chipset. The data retrieval process, namely the worker's identity is inputted into the RFID system and then when the worker taps on one of the RFID gate readers, the data will be verified and sent to the RFID server so that the data can be converted in the form of excel

2.1.2 Problem Identification

In a construction project, in addition to the application of safety aspects, accuracy is also needed in the completion according to the target. To get optimal results in completing the construction work, it is also necessary to have the discipline of workers to work every day because with the discipline of the workers (direct workers), target achievement can be completed according to a predetermined schedule. However, in several construction projects there are several items that have not been implemented in increasing productivity, namely attendance issues. Presence itself is very useful for disciplining workers by considering the results of the work they get. The following are the problems that occur in the indiscipline committed by workers:

1. Coming to the construction project site late
   Every company has implemented a working hours system. In its implementation, this is usually also informed to the workers when at first you handed over the work contract. But indeed not all workers can follow these rules so that it has an impact on the work (productivity) that is obtained. Delays or employee indiscipline can cause losses to the company, such as delayed project completion progress and financial losses
2. Undisciplined workers
   Workers who do not apply discipline at work can also hinder the completion of construction projects. The intended indiscipline is leaving the project site during working hours. This is because the results of the work produced are not in accordance with the targets that have been given by the company to workers.
3. Workers come to the project site but do not produce work products
   There are some problems this can happen but rare. This can happen if the worker only intends to do the job if there is a boss, even though the worker has already made attendance. However, this can be anticipated by disciplining workers every time and their superiors must always check on their workers.

From the various problems that arise above due to the indiscipline of the workers which have an impact on work results or productivity that are not in accordance with the target and will also have an impact on the company's financial losses, a solution is obtained, namely in the form of applying attendance to workers using Radio Frequency Identification (RFID). By implementing attendance using this system, it is hoped that construction project workers can reduce worker indiscipline which harms many groups and aims to be able to complete construction projects according to the targets that have been given and always prioritize work safety.

III. Research Result

3.1 Results of Data Processing

In a project there is always a completion target, you can use a predetermined schedule reference or the results or productivity that has been obtained. In the completion of construction projects usually use the target productivity per day that must be achieved from each stakeholder. Stakeholders here are subcontractors, contractors and clients. Where the subcontractor is a third party involved by the main contractor to carry out certain obligations arising from the construction contract, work which is carried out by the subcontractor for and on behalf of the main contractor. Contractor is the use of one main contractor who carries out a construction project work. Client is the main executor who runs a construction job. Of the three stakeholders, a construction project can be carried out in accordance with what has been targeted.

Of the 3 stakeholders, usually at the beginning of the contract process there is already an agreement on targets or productivity that must be achieved together. Where productivity is one aspect that determines the success of a company in increasingly fierce competition in the business world. So that the main reference besides the schedule is also the productivity target of each construction department. Each construction department has the opportunity for values on productivity that have been agreed upon. The intended construction department includes the Civil, Mechanical, Piping, Electrical and Instrument Department. Each department has its own responsibilities and productivity targets, but this is still based on or refers to the target completion schedule for construction projects. In addition to the schedule and target productivity, there is also something that needs to be made a concern in construction projects, namely the Strategy Construction Execution Plan (CEP). Where the content from CEP contains Site organization chart, Direct Indirect & Equipment mobilization plan, Subcontractor management plan and work procedure installation. So that from the preparation before executing a construction project the planning must be really thorough, because it will affect

the completion target, the quality of the work and the productivity that must be achieved. The following is an example of productivity in construction projects in each department that has been targeted by management

Table 3. 1 Target productivity of each department

No	All Department	Productivity Targets	Units
1	**Civil Department**		
	Precast Drainage	3	Mh/m'
	Concrete Pavement	8.6	Mh/m3
	Steel Structures	60	Mh/ton
	Building	140	Mh/m2
2	**Mechanical Department**		
	Static	40	Mh/ton
	Rotating	51	Mh/ton
	Mechanical Packages	60	Mh/ton
3	**Piping Department**		
	Underground Pipe – Carbon Steel	10.2	DI/day
	Aboveground Pipe – Carbon Steel	10	DI/day
4	**Electrical Department**		
	Cable Way (includes support)	2.5	mh/m
	Pulling Cable (include Termination)	2.3	mh/m
5	**Instruments Department**		
	Cable Way (includes support)	3.5	mh/m
	Pulling Cable (include Termination)	0.3	mh/m
	Field Instruments	6.5	mh/ea

3.2 Data Work Volume

Productivity data on construction projects, work volume data is also very necessary for calculating manpower requirements. The following is an example of the work volume of each department that will be used as a reference for construction project work.

Table 3. 2 Work volume of each department

No	All Department	Quantity	Units
1	**Civil Department**		
	Precast Drainage	9080	m'
	Concrete Pavement	47170	m2
	Steel Structures	4894	tons
	Building	8025	m3
2	**Mechanical Department**		
	Static	8687	tons
	Rotating	1519	tons
	Mechanical Packages	2482	tons

No	All Department	Quantity	Units
3	**Piping Department**		
	Underground Pipe – Carbon steel	91702	DI
	Aboveground Pipe – Carbon steel	90024	DI
4	**Electrical Department**		
	Cable Tray (include support)	34902	meters
	Pulling Cable	204519	meters
5	**Instruments Department**		
	Cable Tray (include support)	34333	meters
	Pulling Cable	730128	Metes
	Field Instruments	5922	Pcs

3.3 Control of Human Resources

Control of labor or human resources aims to create a workforce with special skills needed in the construction project. So the goal is to ensure these workers can reach the expected level of productivity. In increasing productivity, there are many factors that need to be applied, such as work time discipline. The flow of communication coordination to stakeholders can run smoothly and implement work safety aspects according to predetermined standards. The following is the flow of coordination communication needed by teams or workers during construction projects.

Figure 1 Daily Coordination Meeting

In addition to daily meetings, the working hours of all employees working on the construction project must be disciplined regarding effective working hours because with effective working hours, the target productivity results can also be obtained.

All stakeholders will implement normal working hours (Minimum 10 Working Hours) for employees as follow:

- Monday
  06.30 – 07.00 : General Safety Talk
  07.00 – 11.30 : Work
  11.30 – 12.30 : Break
  12.30 – 17.00 : Work
  17.00 – 17.15 : Housekeeping
- Tuesday – Saturday
  06.30 – 06.45 : Contractor TBM
  06.45 – 07.00 : Subcontractor TBM
  07.00 – 11.30 : Work
  11.30 – 12.30 : Break
  12.30 – 17.00 : Work
  17.00 – 17.15 : Housekeeping
- Sunday /National Holidays
  Holidays/ On Call Basis

Based on the schedule of working hours above, all stakeholders will follow these working hours and also if overtime work is required, these stakeholders will adjust according to the needs of work planning.

3.4 Human Resource Requirement & Project Schedule

In carrying out construction projects, competent human resources are needed and have the discipline to work. This is necessary to complete a construction project up to the commissioning stage. As for the human resource needs met, there are other things that must be applied in the work in this construction phase, such as a comfortable attendance process, appropriate duration of working hours and level of effectiveness at work.

To be able to get the results of manpower requirements, complete data is needed, such as:

- Productivity targets from management, details for this data can be found in sub-chapter 3.1
- Bill of Quantity, details for this data are in sub-chapter 3.2
- Project duration, the duration of normal working hours is at least 10 working hours per day. For details on the duration of the construction project attached
- Duration of working hours, for details on normal working hours, the details are in sub-chapter 3.3
- Manhours, for details on the manhours data calculation formula below

Manhour = Productivity * Bill of Quantity

Productivity data, a Bill of Quantity is needed to calculate the duration data for each work item for each department. This is used to be able to calculate the manpower requirements in each work item. The following is the duration obtained from Primavera Project Construction

Table 3.3 Summary Schedule for Completion

No	All Department	Duration Schedule (Days)	Duration Schedule (Hours)	Normal Working Day (Hours)
1	**Civil Department**			
	Precast Drainage	248	2480	10
	Concrete Pavement	192	1920	10
	Steel Structures	374	3740	10
	Building	367	3670	10
2	**Mechanical Department**			
	Static	380	3800	10
	Rotating	181	1810	10
	Mechanical Packages	144	1440	10
3	**Piping Department**			
	Underground Pipes			
	Carbon steel	286	2860	10
	Aboveground Pipe			
	Carbon steel	296	2960	10
4	**Electrical Department**			
	Cable Way (includes support)	356	3560	10
	Pulling Cable (include Termination)	202	2020	10
5	**Instruments Department**			
	Cable Way (includes support)	388	3880	10
	Pulling Cable (include Termination)	208	2080	10
	Field Instruments	162	1620	10

The following is a table of manpower requirements for work in the construction phase according to the work volume and schedule set by management. This data is obtained from the calculation of the productivity table with the formula:

Manpower = Manhour * Project Duration

Table 3.4 Human Resource Needs

No	All Department	Manhour (Productivity * Bill of Quantity)	Duration Schedule (Hours)	Manpower Calculation Needs (people)
1	**Civil Department**			
	Precast Drainage	27240	2480	11
	Concrete Pavement	405662	1920	211
	Steel Structures	293640	3740	79
	Building	1123500	3670	306
2	**Mechanical Department**			
	Static	347480	3800	92
	Rotating	77469	1810	43
	Mechanical Packages	148920	1440	104
3	**Piping Department**			
	Underground Pipe			
	Carbon steel	917020	2860	327
	Aboveground Pipe			
	Carbon steel	900240	2960	304
4	**Electrical Department**			
	Cable Way (includes support)	87255	3560	25
	Pulling Cable (include Termination)	470393,7	2020	233
5	**Instruments Department**			
	Cable Way (includes support)	120165,5	3880	31
	Pulling Cable (include Termination)	219038,4	2080	105
	Field Instruments	38493	1620	24

With the total number of manpower needed for around 2,000 people, special supervision is needed to improve discipline at work. Apart from supervision at work, another thing that is needed is the absence of workers, because it is this absence that can help complete construction work. An innovation that can be used is using system-based attendance. This system-based attendance will really help the workers and admins who process the data. Because in attendance using this system it uses the real time principle.

3.5 Use of RFID-based Presence

In a construction project work, there are many factors that must be applied. For example, the process of recruiting human resources, specification of the needs of skilled and non-skilled workers, the process of increasing the discipline of workers to the use of methods from the attendance process. Because the essence of construction work is an effort to increase the discipline of workers in completing the scope of work. The innovation that can be used is to use a system-based attendance method, which has been implemented in one of the construction projects. From this flow method, some data can be obtained

3.5.1 RFID-based Person on Board Data

This data is obtained from the worker or staff process if the tapping process has been carried out on the RFID gate path. The conditions that are needed so that the data obtained is valid, namely:
With an average number of manpower of around 2,000 people per day, sample data for Person On Board for 2 weeks in June 2021 is obtained as follows:

Table 3.5 Person on Board RFID

No	All Department	units	Company name	Average
1	**Civil Department**			
	Precast Drainage	Person	PT. N	29
	Concrete Pavement	Person	PT. M	193
	Steel Structures	Person	PT. O	49
	Building	Person	PT. P	240
2	**Mechanical Department**	Person	PT. Q	221
	Static			
	Rotating			
	Mechanical Packages			
3	**Piping Department**			
	Underground Pipe	Person	PT. R	483
	Carbon steel			
	Aboveground Pipe	Person	PT. X	287
	Carbon steel			
4	**Electrical Department**	Person	PT. Y	269
	Cable tray m (include support)			
	Pulling Cable			
5	**Department Instruments**	Person	PT. Z	194
	Cable tray (include support)			
	Pulling Cable			
	Field Instruments			

From POB using the RFID presence method, it was obtained from the process of construction project workers. This data collection starts from entering work at 7 am to 5 pm every day for 2 weeks. The POB data details are attached.

3.6 Lost Working Hours

Loss of working hours caused by workers or staff who lack discipline is detrimental to each stakeholder. This can occur due to lack of supervision from each field supervisor and lack of discipline among workers. This can be detected by RFID if the worker exits the data from one of the RFID gates. Workers who do the tapping process again after working hours will be able to be tracked and the data can be stored by the data in the RFID system. The consequences or sanctions received by these workers range from reprimands to even deductions from wages. Because this RFID data can be used as the basis for a payroll system for each stakeholder. The following data can be used as a reference for lost working hours and in the future can be used as the basis for an employee payroll system.

3.7 Comparison of Target Productivity with Productivity RFID

Productivity that has been targeted by construction project management can be evaluated by recalculating or proving it using the Radio Frequency Identification (RFID) method. Retrieval of initial data is needed to be the basis when later calculations will be carried out. These data are data on the duration of working hours per day, Person on Board data that has been obtained from the RFID system and actual progress data. that have

been obtained by each stakeholder. From these three data, it is possible to calculate productivity using RFID data. The detailed formula for calculating productivity is as follows:

$$\textbf{Productivity RFID} = \frac{\textbf{POB Data * Working Duration}}{\textbf{Actual Progress per day}}$$

From the calculation formula, the productivity table data is obtained from the RFID system. Productivity data using the Person on Board method will be compared with productivity data that has been targeted by management. This is used to be able to analyze and evaluate the productivity of each work item. The following table is a comparison of the productivity data.

Table 3.6 Comparison of Target Productivity with Productivity of the RFID System

No	All Department	Productivity Targets (Non-RFID)	Units	RFID Actual Productivity
1	**Civil Department**			
	Precast Drainage	3	Mh/m'	2.9
	Concrete Pavement	8.6	Mh/m3	13.1
	Steel Structures	60	Mh/ton	35.4
	Building	140	Mh/m2	80.6
2	**Mechanical Department**			
	Static	40	Mh/ton	23.4
	Rotating	51	Mh/ton	33
	Mechanical Packages	60	Mh/ton	35.8
3	**Piping Department**			
	Underground Pipes			
	Carbon steel	10.2	DI/day	10.2
	Aboveground Pipe			
	Carbon steel	10	DI/day	7.3
4	**Electrical Department**			
	Cable Way (includes support)	2.5	mh/m	2.4
	Pulling Cable (include Termination)	2.3	mh/m	2.0
5	**Instruments Department**			
	Cable Way (includes support)	3.5	mh/m	2.7
	Pulling Cable (include Termination)	0.3	mh/m	0.3
	Field Instruments	6.5	mh/ea	6.4

3.8 Data Analysis

From the data that has been obtained in these calculations, for the basis of manhour calculations, Productivity and Bill of Quantity target data are needed, the construction project. From the manpower requirement data, this will be used as a reference for the subcontracting process. The selection of subcontractors must be adjusted to existing experience because it will affect the quality and speed of the work process in completing construction projects. After obtaining the manpower requirements plan data, the construction project can be started immediately. In this construction process the presence method uses Radio Frequency Identification (RFID) technology. With this system the level of discipline of workers will be increased and also the results of work or productivity can increase as well. In each stakeholder there is always a daily report so that progress can also be controlled so that it is in accordance with the project duration that has been determined.

From this daily report, a summary of the progress and number of POB from the RFID system can be seen so that the POB calculation process becomes faster.

After the POB data and actual progress have been obtained, the productivity calculation for management evaluation in each stakeholder can also be reviewed. Because the evaluation of each work item can help management to be able to execute construction projects according to the budget and schedule that have been determined. In addition, aspects of Quality Control and safety aspects also need to be considered as well. For details on productivity comparisons, see table 3.6 Comparison of Target Productivity and Productivity of the RFID System

From the data table 3.6, an evaluation is obtained in the form of actual productivity using the RFID method, the results are greater, such as concrete pavement work. Actual productivity is greater than the targeted productivity because there are some materials that are out of stock (rebar & concrete), this affects the progress of the work. For other jobs, the productivity is in accordance with the standards set by management, some are even smaller and can be used as evaluation material when there are new projects again.

IV. Conslusion

The conclusions obtained in this study are:

1. In the process of developing construction projects using the application of RFID for attendance, the review results obtained were very effective in being able to increase productivity or work results for each stakeholder and were useful for evaluating the level of discipline of workers in completing work according to a predetermined schedule.
2. With the Radio Frequency Identification (RFID) system, an evaluation of the results of Person on Board data can also be carried out, the level of discipline here can be reviewed from the hours of entry and hours of departure for each worker and its stakeholders. This is also used for efforts to increase productivity in each work item. In addition, in the future this POB RFID data can be used as a basis for the payroll system for each worker every month.

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