Just in Time on Mechanical and Electrical Implementation in Leedon Hotel Surabaya

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Abstrak

Pekerjaan Mekanikal, Elektrikal dan Plumbing merupakan pekerjaan setelah semua pekerjaan Konstruksi dilaksanakan. Penggunaan material pada saat pelaksanaan pekerjaannya merupakan bagian yang berpengaruh penting terhadap penentuan besarnya biaya proyek karena sisa material akan banyak terjadi apabila tidak dikontrol penggunaannya. Tujuan dari penelitian ini adalah mengidentifikasi Penerapan JIT pada pekerjaan mekanikal dan elektrikal di proyek Hotel Leedon Surabaya. Dari hasil yang didapat, teridentifikasi bahwa ada sisa material dalam pelaksanaan proyek tersebut. Hal ini disebabkan oleh perubahan desain, kurangnya koordinasi antara lapangan dan kantor, serta penggunaan metode inventory atau persediaan yang tidak sesuai dengan kondisi Gudang yang berukuran kecil. Dengan diterapkannya konsep just in time yang berfokus pada eliminasi pemborosan dengan perencanaan – kebutuhan – penggunaan di lapangan, kondisi gudang yang terbatas masih dapat dilakukan pengendalian material tanpa menggunakan persediaan material berlebih yang berdampak pada meminimalisir timbulnya pemborosan

Kata Kunci: *Inventory, Just In Time, Material, Waste*

Abstract

Mechanical electrical and plumbing (MEP) is an activity in construction project after structural activity is conducted. The use of materials during projects implementation has an important part of project total cost because waste will be happened if it is used uncontrollable. The aim of this study was identifying JIT application to electrical work in Leedon Hotel Surabaya. The result of the study is identified that there are waste in Leedon Hotel project. It was caused by design change, lack of coordination between project and Head Office, and inventory method that not fit with the size of small warehouse. With applying just in time concept had a focus on waste elimination by planning - needs – use, Limited warehouse conditions can still be controlled without using excess material inventory which has an impact on minimizing the emergence of waste

Keywords: *Inventory, Just In Time, Material, Waste*

1. Introduction

Projects are activities with a limited period and resource allocation to obtain outputs according to the criteria. It is associated with the life cycle project, from the beginning until the end of the project. Project management grows and develops along with the needs in the modern industrial world as coordination is followed by control [1]. Project are also defined a temporary effort which is conducted to create unique product, services and result [2].

A mechanical electrical and plumbing (MEP) system is a system that includes plumbing, firefighting, MVAC (Mechanical Ventilation Air Conditioner), consisting of plumbing and sanitation systems, fire prevention, air conditioning/ventilation, lighting, telephone, CCTV, lightning rods, sound system in buildings or buildings designed on the building project. Industry players, especially those in the construction sector, realize that the supply of products or materials that will later be used in projects is a product of high quality, fast, and especially cheap. Coordinating on mechanical system design

planning, MEP work is very important in project success because the completeness of the facilities in the building greatly supports the achievement of elements of comfort, health, safety, ease of communication and mobility in buildings.

Considering the large proportion of the use of these materials, waste is usually found. To reduce waste, it is necessary to optimize the use of materials, the application of effective and efficient methods and estimates and orders must be matched [3]. In the lean production concept that has been adopted into lean construction, there is a just-in-time (JIT) method, which is a method that focuses on eliminating waste and trying to deliver materials in the right quality, quantity, and time to increase productivity to get quality and reduce waste.

In the world of MEP contractors, production with the Just-In-Time (JIT) concept is the main thing that must be fulfilled, namely production with the concept of producing only when needed. So, it is necessary to analyze the application of the Just-In-Time (JIT) concept in material storage management at the Leedon Hotel's Surabaya project. the importance of material management in the Leedon Hotel's Surabaya project needs to be carefully planned, especially on the material on-site, in accordance with stakeholder satisfaction. For example, in terms of functional requirements, material durability, safety, and timeliness. Satisfaction is measured from execution, such as finishing, conformity of design to specifications, and timeliness of delivery and cost.

The function of the just-in-time system can be used in order management to material delivery according to the required quantity and quality. JIT also regulates incoming and outgoing materials to the warehouse in the field so that it will identify when waste occurs. Various specialist contractors, subcontractors, suppliers, and even the manufacturing industry are involved, indicating the division of a construction project work into work carried out by different parties. Using the inventory mechanism, the limitations and scarcity of order/production inventory can be controlled [4]. The application of the JIT concept that has been carried out previously by the contractor can be improved by using the application design proposed in this study, to minimize waste/inventory in construction projects. In addition, the proposed JIT application concept is expected to be able to run an inventory mechanism that can meet the limitations and scarcity of supplies. JIT developed by Toyota Motor has also succeeded in making the Japanese electronics and automotive industry an industry that can work efficiently with good quality, starting from analyzing the condition of the material storage area to adjust each material, analyzing problems, to evaluating it with JIT. The success of JIT in the manufacturing industry has encouraged the construction industry to use it. The Just In Time concept requires several adaptations by carrying out some modifications to the JIT principle so that it can be applied in construction projects [5].

The most important problem in management and inventory is determining when to place an order and how much material to order [6]. In determining the right time to place an order, there are things that must be considered, one of which is the lead time of each ingredient. Several factors affect the lead time of a material, namely the schedule for the use of materials that lead to the schedule for implementing the master schedule project, the distance, and transportation from the material source to the project location, the availability and capacity of the warehouse and storage facilities. Another influencing factor is the availability of storage facilities and the project location (related to the determination of material procurement policies).

1.1. Just-In-Time

The main goal of Just in Time is to produce products only when they are needed, and to produce as many products as required by the customer [7]. The purpose of implementing Just In Time production is to purchase raw materials on time for the production process, as well as for produce and deliver goods. Quick sale time. This can be achieved by reducing waste, reducing inventory, building relationships good relations with suppliers, increase employee engagement and make consumer-centered program.
There are 2 benefits that can be obtained: found from Just In Time, namely: 1) Tangibles Benefits Increase the turnover rate of procurement of raw materials/spare parts, improve delivery accuracy, reduce delivery lead times, reduce the delivery of goods, and shorten the time for suppliers to implement changes; 2) Intangible Benefits Improve product quality, and successfully encourage suppliers to

achieve the required quality, increase productivity, improve production progress, reduce incoming goods inspection, improve efficiency, improve competitive position, improve product design, improve production ethics, increase contacts, and maintain personal relationships with suppliers and reduce work clerical.

If the Just In Time production system is determined in the production system, then the application of Just In Time production can be resolved through the following process: a) First reschedule the production plan to a smaller batch. b) Re-improvement of quality by implementing TQC, and making workers more aware of the importance of quality. c) Increase production factors including workers. In general, implementation timely manner accompanied by employee participation in decision making decision. d) Applying production technology in units to shorten distance of moving raw materials and spare parts from machine to machine other

2. Method

This research focuses on mechanical and electrical work on the Leedon Hotel's Surabaya project. Based on the results of a preliminary survey, an interview with an estimator with 4 years of experience in the MEP field as a contractor at the Leedon Hotel's Surabaya project, it is said that MEP work, especially electrical, has complications in terms of supplier selection due to the large number of suppliers who offer relatively cheap prices and in terms of storage as well as the use of materials with specifications determined by the building owner. Figure 1 is the process of the research.

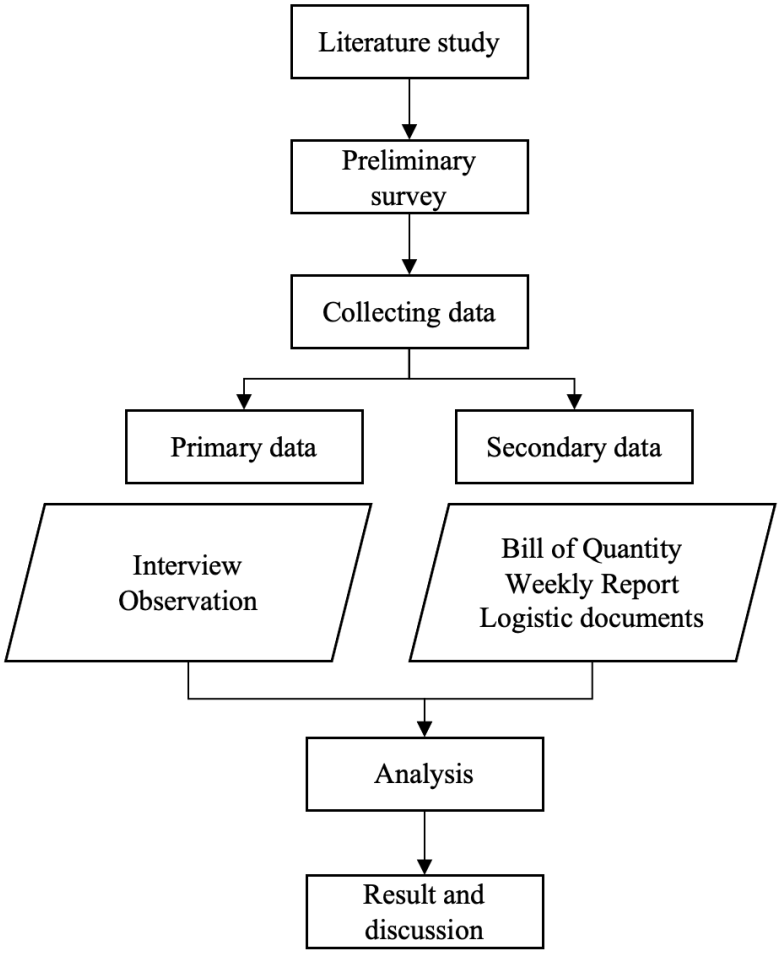

Figure 1. Research stages

In conducting scientific research, systematic preparation techniques must be carried out to facilitate the steps to be taken. Therefore, the author also conducts a literature study on books that discuss construction technology methods and cost analysis, journals, and research on construction management that has been carried out as well as on applicable laws and regulations, to support knowledge about construction management problems that arise.

The next stage is a preliminary survey conducted to obtain information about all necessary aspects of the company so that it can identify problems that exist within the company. A preliminary survey was conducted at PT. Synergy Makmur Sentosa and the Leedon Hotel's Surabaya project aim to obtain information. The stages of the preliminary carried out are as follows: 1) survey time required is one month to get project data in the form of BoQ, logistics documents, RAB, and weekly reports; 2) conduct oral interviews with predetermined respondents to obtain information directly to explain things or situations in the project; 3) prepare research equipment such as stationery, voice recorder/cellphone, etc. as evidence of physical results and documentation.

After conducting the preliminary survey, data was collected, where there were primary and secondary data. For primary data collection, a semi-structured interview method is used to find out the flow of materials/raw materials from ordering to the arrival of products/materials, as well as knowing how decisions are made by contractors. Interviews were conducted using the purposive sampling method, namely the technique of taking data sources into a consideration. For example, the resource person is considered the most knowledgeable about the workflow and the problems that occur so that it can facilitate researchers in taking data sources. The purpose of the interview is to be able to find problems openly, where the researcher records how a work process is carried out and what processes are passed. There were five sources in this study, namely the Foreman, Estimator, Site Manager, Project Manager, and the warehouse or logistics department. Meanwhile, the secondary data in this study are 1) Budget Plan, to find out the details of the work; 2) Bills of Quantities/Material Specifications, and 3) weekly reports.

3. Results and Discussion

3.1. Storing the Material

Based on the project layout as shown in Figure 2 which shows the conditions around the warehouse area and the project conditions, there are entrances/exits for material vehicles not far from the warehouse/material storage and the main road. The position of the warehouse is placed on the layout as shown in the layout image so that it does not interfere with construction work and can be monitored easily, and the transportation process is smooth. Then in the warehouse layout, as shown in Figure 4.2, the material storage warehouse is located on the first-floor basement. The main road elevation is ± 0.00, while the elevation on the second-floor basement is – 2.27. With this elevation, it can be interpreted that the elevation from the main road to the material warehouse decreases. With 11 meters which is not far from the project entrance to the material storage warehouse, when the material arrives at the project, there is a convenience when material drops, material transfers from the material truck to the storage warehouse, thus saving time efficiency when the material arrives.

Figure 2. Project layout

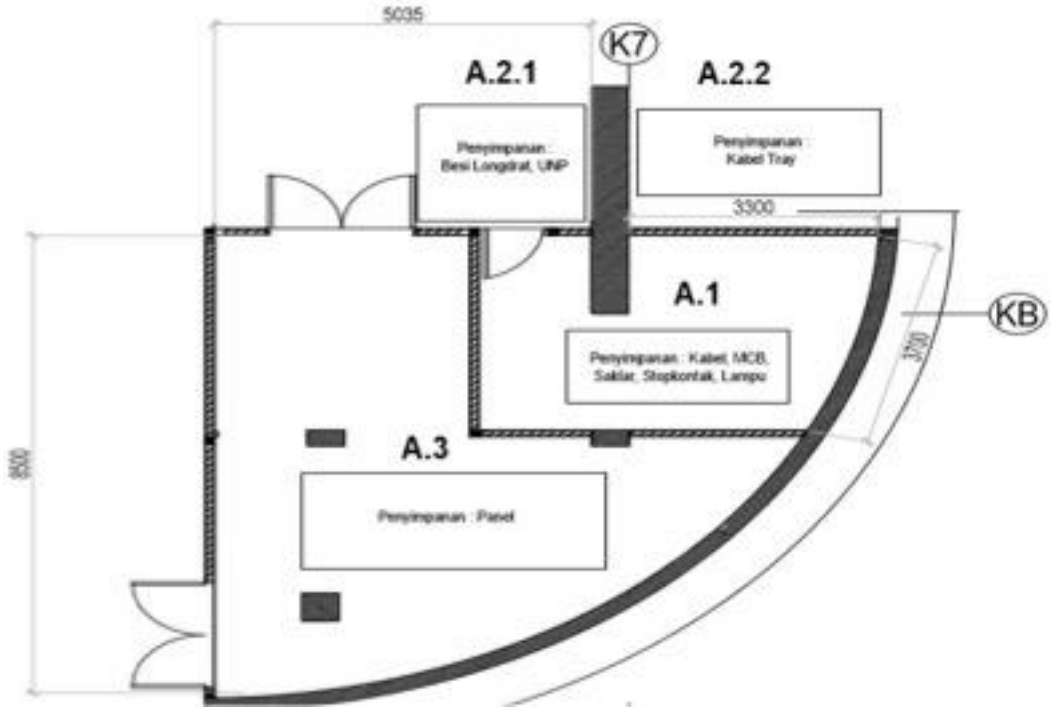

Figure 3. Warehouse layout

With the layout of the warehouse as shown in Figure 3, the placement of materials is distinguished from each other, there are 3 types of storage which can be seen in table 1: 1) closed storage warehouse, used as material storage including cables, MCB, socket switches, lights; 2) open storage, used as material storage for cable trays, longdrat iron, UNP iron; 3) special storage, used as panel material storage. The condition of the warehouse which is in the corner of the room and the size is not

too wide, so the placement of materials in the warehouse is arranged in such a way as to prioritize its use, to minimize repeated material transfers.

Table 1. Inventory condition

No.	Documentations	*Description*
1		Inventory condition, there are some materials: cable, MCB, switches, lamps
2		Open inventory condition, there are some materials: irons, UNP irons, cable tray
3		Specific Inventory, there are some panels

Inventories are material deposits in the form of goods in process and finished goods. In goods products, control is emphasized material control. Inventories in large quantities will cause high costs for storage and purchase of the materials or goods concerned, while excess inventory will also cause many funds to be absorbed in inventory so that it is not efficient. On the other hand, if there is too little inventory, there will be a risk of a shortage of goods or materials. This of course will disrupt the smooth process of work productivity, in addition to that, purchasing costs and inventory costs are also getting bigger.

In the flow of goods receipt, the steps taken are logistics starting from checking the incoming material whether it is by the requested SPM (Material Request Letter), in terms of material specifications to the amount of material written on the SPM (Material Request Letter). If the material is following the travel document sent/imported, a stamp will be placed on the material travel document and will be signed by the logistics in the arrival column. Then the check is continued checking the quality of the material that the material is ascertained whether there is the material is damaged. If there are no damaged goods/materials, the logistics will sign on the checked column. Logistics will record incoming goods/materials and archive logistics documents.

In the Goods Storage Flow, logistics performs material management by differentiating material storage locations depending on the characteristics of the type of material. The storage area is divided into 3 places, namely, warehouse, open storage, and special storage. In the warehouse, small materials are stored, easily lost, and/or easily damaged materials such as lamps, sockets, and other small materials. Then in open storage, there are large/heavy materials that are not damaged by open-air such as cable trays, longdrat iron, and U-channel iron. In special storage, it is used as storage of panel material so that when the panel is installed it can be easier without having to move other materials with large panel dimensions. Based on 3 types of storage, it will facilitate logistics when workers

Table 2. Comparation of actual and planning cost

No.	Item	*Units*	*Plan volume*	*Actual volume*	*Price (thousands of rupiah)*	*Waste (thousands of rupiah)*
1	Lighting Instalation					
1.1	DL 9 watt	pcs	2	0	142,8	285,6
1.2	Baret lamp 1x18 watt + baterrey	Pcs	12	0	1.364,5	16.374
1.3	Exit lamp 1x8 watt + baterey	Pcs	3	2	942,2	942,2
1.4	Fuse type 1	Pcs	8	7	34,2	34,2
1.5	Fuse type 2	Pcs	2	0	81,8	163,6
1.6	Hotel switch	pcs	2	0	39	78
	Subtotal 1					17.877,6
2	Cable tray					
2.1	Cable ladder 300 x 100 mm	m	10	0	182	1.820
2.2	Cable ladder 1.000 x 100 mm	M	4	0	323,2	1.292,8
2.3	Cable ladder 700 x 100 mm	M	17	0	272,9	4.639,3
2.4	Cable ladder 500 x 100 + cover	M	5	0	498,1	2.490,5
	Subtotal 2					10.242,6
	Total					**28.120,2**

In table 2 with 2 types of work, each item is used. The BoQ data on two sub-jobs, namely lighting installation, and cable tray, can be compared with the installed material referring to shop drawings and logistics documents which include material usage receipts. It can be seen in table 2, namely the comparison between the planned volume and the field volume, there are differences in terms of the needs that exist in the field, in contrast to the planned volume which from this comparison can be identified as waste / residual material. In table 4.2 it can be concluded that the occurrence of irregularities or the presence of waste for each sub-work that is on the basement floor 2 and basement 1. It can be seen from table 4.2 mentions that waste is in lighting installation work and cable tray work on basement 2 and basement 1 floors with the remaining material items listed and the difference in the plan price is Rp. 30,244,000,00 then at the existing price in the field, namely Rp. 28,120,200.00 where the difference between the plan and field prices is Rp. 2,123,800. From the results of the analysis and identification of the data obtained, waste material items in each sub-work occur due to changes in design, a lack of coordination between the project and the HO (Head Office) where what is included in the HO are project managers, purchasing, and estimators who are still related. with material suppliers.

Based on the results of the analysis of the data obtained starting from the size of the material storage warehouse with a size of 8.5 x 8.9 meters, the shape of the warehouse is not completely square and is located at the corner of the project so the material storage cannot be maximized, and some materials are outside the warehouse, but can still be overcome by distinguishing the storage of each material item. Then the warehouse layout is affordable because the mobilization when the material arrives, between the entrance and the warehouse location, is not far, and the material drop from the truck to the warehouse is very close, so it still gets time efficient. characteristics and types of materials and also using the material inventory method by providing more material stock so that without realizing it can result in waste. This can be overcome by applying the just-in-time method, which is the opposite of the method previously applied to the Leedon Hotel's project. If previously applied the method by providing more material stock, but this just-in-time method system is the production with the concept of producing only when needed, which means ordering materials according to needs without providing supplies.

3.2. Just-in-Time

The type of contract used in the Leedon Hotel's project is a lump sum fixed price, which means that a contract and the volume of work stated in the contract cannot be changed or re-measured. Regarding problems related to project implementation, efforts have been made to minimize all forms of problems, namely the efforts of the project party and the HO (Head Office) to suppress routine

coordination by holding weekly meetings, crosschecks between the project and the HO (Head Office) to avoid miscommunication and so that all types of work to materials are kept under control about one of the logistics documents that have been archived by logistics. Meanwhile, the coordination that takes place in the field is in the form of coordination carried out by the project team, such as logistics which provides reports to the site manager and supervisor so that they can monitor what materials have been used/installed.

In processing the material flow, before ordering materials is made, first the calculation of material requirements refers to the BoQ (Bill of Quantity), adjusts the existing conditions in the field, to compare with the forcont (For Construction) drawings, then adjusts to the action plan in 1 week there is any work that will be done in that week that has been made by the site manager, then coordinated by the supervisor and compared with logistics documents that refer to the stock card so that when ordering material is more structured with the reference.

After going through the calculation of material requirements, the next step is the stage where material ordering begins with logistics, which will write down what materials will be ordered on the SPM (Material Request Letter) form by the results of joint coordination, then the form is sent to the HO (Head Office) which is addressed to purchasing party. After receiving the Material Request Letter by purchasing, purchasing will first check and coordinate with the project manager and estimator. After passing the checking and approval stage, the material is ordered and scheduled for delivery to the project. When the material arrives at the project, the logistics will re-check the travel document on the incoming material, whether it is in accordance with the SPM (Material Request Letter) ordered, and whether the specifications are appropriate. If there is an unsuitable/defective material at the time of delivery, it will be returned to the material by confirming to the supplier that there is inappropriate/defective material.

If all the materials that have arrived are in accordance with the specifications and travel documents, logistics begins the processing of material warehouse storage where the logistics party has planned the layout of material placement by distinguishing the characteristics of each material. Material storage is divided into 3 parts, namely warehouse, open storage, and special storage to make it easier when taking materials from the warehouse. During the material collection process at the warehouse, the workforce will first be given a material usage bill form and fill out the form stating which materials will be installed or used. Then the logistics will pick up the material according to what has been written by the workforce, then the form that has been written by the workforce will be archived by logistics as a logistics document to control the materials that have been used or installed. Because if logistics do not differentiate from material space, it can affect material warehouse/storage whose conditions are only limited in dimensions for material placement. Using the just-in-time system is a solution when applied to the Leedon hotel's project because the most important thing is that it can be seen from the very limited land area. After all, the project is located right in the middle of the city. This limits material storage so that if you apply material inventory, there will be a buildup of material and cause waste, then the limited land also makes it difficult to mobilize when the material arrives at the project. The implementation of a just-in-time system that produces when it is used means that at the time of ordering the material will be adjusted to the action plan and the material on the field when the material has been used so that in material storage there is only material that will be used without any accumulation of material and reducing waste.

4. Conclusion

From the results of the data that has been obtained, that previously in electrical work in the construction of buildings contained in the Leedon Hotel Surabaya project, it was identified that there was waste in material items. Factors that affect the existence of waste are design changes, lack of coordination between the project and the HO (Head Office), and the use of the material inventory method by providing more material stock where small warehouses cannot be forced by the inventory method. However, if by applying the just-in-time concept to the Leedon Hotel's project and seeing the very limited size of the warehouse for material management, the materials needed will be provided as needed, so that material control can be easier and problems that occur can be avoided, especially material stockpiling.

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