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Implementation Of The Last Planner System (On The Construction Project Of Al-Falah Junior High School)

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Abstract
Currently, the construction sector is adopting the theory of production in the manufacturing industry, known as lean construction, to reduce waste and increase value. Last Planner System (LPS) has not been widely used and has good potential because the advantage of LPS is to identify a job along with obstacles to improve performance in a construction project. In the construction of Junior High School (SMP) Al-Falah, it has work obstacles due to erratic weather so that the project is delayed, the author conducts a field survey to analyze the actual progress in the field, LPS has work indicators / work flow to measure the extent to which work indicators can be realized properly, the LPS work flow are Master Plan, Phase & Pull Planning, Lookahead Planning, Constraints Analysis, Shielding Production, and Percent Plan Complete (PPC) as a standard for measuring whether project productivity is realized properly or not. In this study, the results of the implementation using LPS on the Al-Falah Junior High School construction project show that the lowest PPC can be seen in week 7, which is 0% because there is no work achievement so that the work is delayed, while in week 16 it can be seen that PPC has increased dramatically to 96%. Then after averaging the PPC of 51% which means that LPS has not been able to increase the reliability of planning above 70%, (Ballard, 2000).
Keywords: *Lean Construction, Last Planner System, Percent Plan Complete*

Abstrak
Saat ini, sektor konstruksi mulai melakukan upaya untuk mengurangi waste sekaligus meningkatkan value dengan mengadopsi teori produksi pada industri manufaktur kepada industri konstruksi yang disebut lean construction. Last Planner System (LPS) belum banyak digunakan dan mempunyai potensi yang baik karena kelebihan pada LPS adalah untuk mengidentifikasi suatu pekerjaan beserta hambatan guna meningkatkan kinerja dalam suatu proyek konstruksi. Pada Pembangunan Sekolah Menengah Pertama (SMP) Al-Falah Memiliki hambatan pekerjaan dikarenakan cuaca yang tidak menentu sehingga proyek mengalami keterlambatan maka, Penulis melakukan survey lapangan guna menganalisis progress aktual pada lapangan, LPS mempunyai indikator pekerjaan/urutan kerja untuk mengukur sejauh mana indikator pekerjaan dapat terealisasikan dengan baik, Adapun aliran pekerjaan LPS yaitu Master Plan, Phase & Pull Planning, Lookahead Planning, Constrains Analysis, Shielding Production, dan Percent Plan Complete (PPC) sebagai standar untuk mengukur apakah produktivitas proyek terealisasikan dengan baik atau tidak. Pada Penelitian ini hasil implementasi menggunakan LPS pada proyek pembangunan SMP Al-Falah menunjukkan PPC terendah dapat dilihat pada minggu ke-7 yaitu 0% karena tidak ada capaian pekerjaan sehingga pekerjaan mengalami keterlambatan, sedangkan diminggu ke-16 dapat dilihat bahwa PPC meningkat drastis hingga 96%. Kemudian setelah dirata-rata PPC sebesar 51% yang artinya yang artinya LPS belum dapat meningkatkan reabilitas perencanaan di atas 70%, (Ballard, 2000).
Kata kunci: *Lean Construction, Last Planner System, Percent Plan Complete*

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1. PENDAHULUAN

Construction means building, and on the other hand, building means designing or constructing for the benefit of human beings at a certain cost and time. Building construction means a method of constructing a building that is in accordance with the strength of the building, beauty, and in accordance with its function. Every construction will not be free from problems, one of which is waste.

Waste will always exist and is inherent in every construction, so what can be done is to minimize the amount. The effort to minimize waste by only doing activities that add value to the final product is known as lean construction. This is supported by (AlSehaimi et al., 2009), who state that through lean construction, it is expected to reduce the waste of time, material, and labor so that maximum work can be produced. Lean construction is a method to minimize inefficiencies in materials, duration, and efforts to create maximum output (Koskela et al., 2002). Construction managers should consider all aspects that can cause inefficiencies from the early stages of the project, such as delays, costs, quality, safety, and wrong management decisions (Koskela, 1992). Lean construction aims to maximize value and efficiency by avoiding non-value-added activities and incorporating lean manufacturing principles for continuous improvement in design and construction (Abd Elhamid & MJ Deen, 2008). Further interpretation of lean construction is not a rule in the planning process but serves as a basis for common thinking and behavior at every stage of the construction process (Forbes & Ahmed, 2011). One of the existing methods in lean construction is the Last Planner System (LPS) method.

Last Planner System is a project management system that controls production in terms of schedule implementation or time scheduling of project implementation, so as to improve the relationship between work, performance and productivity of a construction project (Human & Zuldi, 2018). The advantage of Last Planner is to identify a job along with obstacles to improve performance in a construction project.

The implementation of LPS is still rarely applied in construction. According to Glenn Ballard in 2000 that LPS can improve construction performance by more than 70%. In connection with that, this study applies the concept of LPS to construction projects and evaluates the progress of construction project work through a case study of Al-Falah Junior High School.

(Heizer et al., 2009) identified seven concepts of waste, they are over production, motion, processing, transporting, inventory, waiting, and defects, all of which result in inefficiency and additional costs in the production process. To overcome these wastes, it is necessary to implement measures such as appropriate production scheduling, reducing unnecessary movements, using appropriate technology, reducing product movement, managing inventory well, avoiding waiting time, and reducing product defects.

The objectives of this research are:

Analyze the implementation of the Last Planner System concept compared to the actual progress to get the Percent Plan Complete results on the Al-Falah Junior High School Surabaya project.

2. RESEARCH METHODS

In this system, there are performance indicators that are used to measure the extent to which the work flow can be achieved properly, as for the Last Planner System work flow control, which is:

2.1 Master Plan

Master plan here is a general plan and analyzes all the work for the whole project by showing the main, sequence, and duration.

2.2 Phase& Pull Planning

The purpose of Phase Planning is to prepare a detailed schedule covering each stage of the project, serving as the basis for further planning, structural framework, and completion (Ballard & Howell, 2004). This planning stage, which benefits from team collaboration, outlines a section of work from the beginning to the end of the project. Planning sketches can be done as part of workflow control analysis, focusing on overcoming delays in work details.

2.3 Lookahead Planning

Lookahead planning has a conceptual interpretation of activities for the next 2 to 6 weeks. Creating a lookahead plan is attempted by pushing the work breakdown agenda from the beginning of the second project time span to the next 6 weeks. The lookahead planning in this research assumes that there is no accumulation of activity duration until the end of the project implementation era or milestone. The lookahead concept takes 5 weeks. The steps to create a lookahead plan are as follows:

a) Lookahead planning is made using lean tools in the shape of a sticky note and flip paper made of manila paper with columnar lines. The shape and illustration of the sticky note filling of the lookahead concept can be observed in Figure 1.

(a) (b)

b) Analysis of estimated work delays is made. This analysis refers to the progress of the work of each day or person. The use of this information is due to the movement of workers along the floor at a particular time. After that, calculations were attempted with similar methods as in table 1.

Date n1	Date n2	Date n3	Date ni
Progress until n1	Progress until date n2 = Progress date 1 + Progress work/people/day x amount of work	Progress until n3 = Progress date 2 + Progress work/ people/day x amount of work	Progress until date ni = Progress date ni + Progress work/people/day x amount of work

2.4 Weekly Work Planning

WWP carries out programming by looking at the concept of lookahead in a week as a result the concept of activity is more focused on the week under review. In this research, because the work examined is small in a relatively short duration to add a designation (DWP) is to look at the profession on the day or coincide on the reviewed.

2.5 Constrains Analysis

Constraints Analysis intends to recognize obstacles before an obligation is completed. In this research, constraints analysis is conducted every morning. The benchmark limits of this research are as follows:

a. Submittals : requests or submissions for the application of work
b. Materials : the availability of materials used in the implementation
c. Space : the availability of a place to do work
d. Equipment : the availability of equipment to do work
e. Workers : the availability of the most important activity power of helpers or workers to do work.

Conducting a constraints analysis requires cooperation with all parties. If this boundary analysis is not done, it tends to be too reactive when something unexpected happens during project implementation (Steven et al., 2013).

2.6 Shielding Analysis

The purpose of the Shielding Production analysis is to sort out the quality termination and recognize the trigger of the obstacles described earlier. In this research, it was also tried to analyze the creation of shielding traps in the morning after completing the barrier analysis.

2.7 Percent Plan Complete (PPC)

PPC is the number of completed assignments divided by the number of all planned assignments, and is written as a percentage. (Ballard, 2000). The equation is as follows:

$$PPC = \frac{amount\ of\ work\ plans\ that\ were\ successfully\ executed}{total\ work\ plan} \times 100\%$$

PPC is a measure of the extent to which the commitment to carry out the planned work has been realized. PPC can be used as a standard to control production units, determine project schedules, implementation strategies, and others. A high PPC indicates that more work is being done with available resources, productivity is high and progress is accelerating. (Ballard, 2000).

3. RESULT AND DISCUSSION

This research was conducted with a case study on the construction project of Al-Falah Surabaya Junior High School (SMP) located at Jalan Darmokali No.62, Surabaya. The construction of Al-Falah Junior High School was carried out in 2022 with general work components including structural work.

The SMP 2 Al-Falah Surabaya project was carried out from December 22, 2022 to the contract limit on November 22, 2023. While the research was conducted for eleven weeks, namely from week 7 to week 17. In the initial week of observation, the work progress that has been achieved is 21.76%. Therefore, the observation in this study is limited to the beginning of the work, namely earthwork, foundation, and structure. The following are the results of the method that has been implemented.

3.1 Master Plan

The master schedule is a schedule that contains the main works of the project. From this master schedule it is obtained that the project started on December 22, 2022 and is planned to be completed on November 22, 2023. This study was conducted in the period from February 2, 2023 to April 18, 2023 and the project was delayed due to weather factors so that work stopped when it rained.

3.2 Phas Planning

Phase plan is the planning of sub-works from the beginning to the end of the project. Planning sketches can be carried out as part of the work flow control analysis, this research focuses on the analysis to overcome delays due to weather so that work is stopped when it rains and there are puddles of water that reduce productivity performance on earthworks, foundations, sloofs, and columns so that it hampers the performance of the work itself.

3.3 Lookahead Planning

The weekly work progress of each assignment is determined until the reviewed date. There are color differences in each work area such as yellow shared ground area, dark blue foundation, light blue ground floor, kiein 1st floor, light green 2nd floor, orange shared 3rd floor. After the percentage weight above, the researcher then calculates the difference between the percentage weight of the plan and actual and obtains the results of work achievements and work delays.

Area	Assignments	Feabuari				Maret				April		
		2-8	9-15	16-22	23-1	2-8	9-15	16-22	23-29	30-5	6-12	13-19
Tanah	Galian Alat Berat Tanah Biasa 1-2 m	51,09	58,54	65,98	73,40	80,87	88,38	95,77	100			
	Buang Tanah keluar lokasi	51,09	58,54	65,97	73,40	80,86	88,36	95,75	100			
	Pemadatan Urugan	51,15	58,60	66,21	73,40	81,11	88,70	96,00	100			
	Intrusi Air Semen 10 kg/m2 Lapisan Sirtu	51,08	58,53	65,97	73,40	80,86	88,35	95,75	100			
Pondasi	Soldier Pile (strous pile Ø30cm)	52,83	60,53	68,31	75,82	83,70	91,39	99,09	100			
	Pilot Bor pile Ø 40cm	52,80	60,49	68,28	75,82	83,66	91,35	99,05	100			
	Pondasi Spun pile Ø 50cm, Pemancangan Hidrolis	52,78	60,45	68,13	75,82	83,52	91,21	98,90	100			
	Lantai kerja	59,12	60,64	68,80	75,82	84,32	92,52	100,00				
	Shear Wall	56,58	61,02	69,22	75,82	84,55	92,79	99,96	100			
	PHC	55,71	60,85	72,28	75,82	87,87	96,05	100,00				
	Pile Cap	52,85	60,55	68,17	75,82	83,56	91,37	98,94	100			
Lt. Dasar	Sloof	46,82	52,82	59,43	65,71	72,87	80,14	86,13	93,05	99,45	100	
	Kolom	47,44	52,84	59,30	65,71	72,64	79,88	85,93	92,55	99,25	100	
	Dinding Lift core	50,95	53,18	66,53	65,71	81,24	87,63	94,33	93,09	99,16	100	
	Rabat beton K-300 tulangan Wiremesh M6	53,56	60,87	68,23	75,82	83,60	91,73	99,00	100			
	Plat tangga	73,62	51,87	59,72	65,71	73,05	79,61	79,82	94,55	99,73	100	
	Ground Water Tank Kap. 54 m³	49,71	52,80	60,41	65,71	73,74	80,41	87,26	92,63	100,43	100	
Lt. 1	Balok							30,63	61,39	91,73	100	
	Kolom						15,59	42,31	69,65	96,15	100	
	Dinding Lift core											
	plat tangga										100	
	plat lantai t=12cm								31,55	88,99	100	
Lt. 2	Balok								7,58	57,64	100	
	Kolom								15,33	50,00	85,76	100
	Plat Tangga											100
	Dinding Kolam Renang									38.80	83.33	100
	plat lantai t=12cm									31,58	69,30	100
Lt. 3	kolom										25,21	50,17
	Balok											
	Plat tangga											
	plat lantai t=12cm											

3.4 Weekly Work Planning

WWP is planning by looking at the lookahead plan in a week so that the work plan is more focused on the week under review. WWP in general, the observed works are preliminary earthworks and structures, namely foundation works, sloofs, columns, beams, and floor plates. Table 2 list of work that has been achieved and late work observed from February 2 to March 18 in this study.

3.5 Constrains Analysis

The purpose of constraint analysis is to identify constraints prior to the execution of work. In this study, constraint analysis was conducted every day in the morning.

3.6 Shielding Production

Shielding production analysis to filter out quality assignments and identify the causes of the constraints described earlier. In this study, shielding production analysis was also carried out every morning after completing the constraint analysis.

3.7 Percent Plan Complete (PPC)

From the PPC results, it can be seen that the average weekly PPC is 5l%, which means that LPS has not been able to increase planning reliability above 70% (Ballard, 2000). This is due to the successive delay factors that cause delays, namely the lowest PPC can be seen in week 7 because there is no work capsian so that the work is delayed, but starting in week 16 it can be seen that PPC increases dramatically to 96%.because in the previous week overtime work had also been carried out up to 9 nights so that PPC could be better than before.

4. CONCLUSION

The results of LPS implementation in the Al-Falah Junior High School construction project showed significant variations in PPC achievement, with the lowest value of 0% in week 7 and a drastic increase to 96% in week 16. Despite this, the average PPC remained below the expected target of 51%, indicating that the LPS had not yet achieved planning reliability above 70%. The main factors causing project delays include bad weather and late arrival of materials. To cope with bad weather, several solutions have been proposed, such as preparing special tents, installing tarpaulins, providing raincoats for workers, additional lighting, and thunder protection. By implementing these solutions, it is expected to reduce the impact of adverse weather on the project and increase work productivity.

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