THE COMPARISON ANALYSIS OF PRECAST AND CONVENTIONAL METHODS OF THE PROJECT WORKING TIME (PROJECT OF FLAT X IN JAKARTA CAPITAL REGION)

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The Jakarta Capital Region is one of the most populous regions with a population of 10.4 million people as of 2017, so the need of residential is very important. The construction of flats with more than 10,000 every year is carried out by the government.
This study aims to: Find out and compare the probability of the project work time in the flats X if the project with the precast method and how if by the conventional methods. The study was conducted at the high-level flats X in Jakarta Capital Region. The tests conducted in this research were carried out by Monte Carlo analysis using the crystal ball software through some stages such as the normal distribution and triangular distribution to get the probability results of the work on each floor.

The results of this research indicate that the conventional method only has a 10% probability to approach the project planning time, while the use of the precast method has a 90% probability. Overall the precast method has the fastest chance or probability in 114 days (10% probability) when compared with conventional methods in 152 days. The results of the mean probability (50%), the precast method has a completion time of 120 working days and the conventional method takes 162 days. In order to get the highest probability of the project completion time (90%), the precast method has a 125 days processing time while the conventional method requires 172 days of completion.

Keywords: Precast Method, Conventional Method, and Time

1. Introduction

The needs for residential are very important for the residence, for example the Central Agency on Statistics (BPS) shows that The Jakarta Capital Region (DKI Jakarta) is one of the most populous regions with a population of 10.4 million people per 2017 and an area of 661.5 km2. Flats are considered able to meet the needs of the residence of DKI Jakarta which always grow every year, so that the construction of flats in DKI Jakarta is always above 10,000 units. One of the contractors in Indonesia, PT BAP, is a contractor trusted by the government to build the high level flats X. There are the differences between the auction drawings and drawings for information that have been obtained, caused by the process of adjusting to the regional plan and changes in the use of some structural components from conventional to precast.

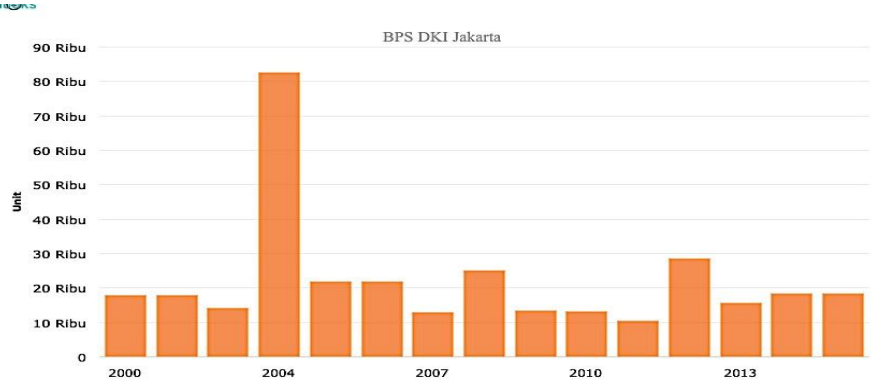


Figure 1. Construction of a residential in DKI Jakarta 2000-2015

El Razek et al (2008) indicated that the modification of the contract as a result of a design change by the project owner and the specifications became one of the causes of the slow project. Whereas the important parameters in the implementation of construction project, which is often used as project target is project performance consisting of budget efficiency, timeliness, and good quality (Messah et al., 2013). Tarigan et al (2019) and Putri et al (2014) indicate that the use of precast method is more beneficial both in terms of the time of the work and the cost of rental of tools therefore the pre-cast method will be more profitable when it is done in the big project because Access to Tower Crane mobilization. Another researcher, Wijaksono et al (2018), showed different things and assumed that precast methods are more efficient in terms of time but cost is not more efficient than conventional methods. But Assaf and Al Heiji (2006) and Sandyavitri (2008) in the results of his research argue that the existence of design changes or methods can trigger the impact of losses in terms of time and also costs.

Project delays can be a domino effect on management, because the impact that can be felt directly from project delays is the increase in costs (Sambasivan and Soon., 2007 and Kaliba et al., 2009). Changes in construction methods are acceptable, but the immediate impact of such changes should be understood the potential consequences of scheduling and costs for each of those changes (Douglas, 2003). Therefore, a construction management is required to analyse and evaluate the alteration of a method to another method.

Problem on the Research: (1) How is the result of a comparative duration of project completion time with the use of conventional methods and precast methods? (2) How is the probability of the use of precast and conventional methods against the time of project work? (3) How is the effect of using precast method when compared to conventional methods?

Research Objectives: (1) Looking for the results of schedule comparison of the plan and the duration of the project using precast and Conventional methods, (2) seeking to know the probability results from the use of precast and conventional methods against the project time , (3) Knowing the impact of using precast method when compared to conventional methods.

2. Literature Study

2.1 Precast Concrete

Precast can be interpreted as a production process of building structures/architectural elements in a location different from the location where the structural/architectural elements will be used. The superiority of precast concrete is the duration of the project can be faster, continuity of the construction process can be maintained, mass production of the manufacturer, can reduce the cost of supervision of supervisor consultants, producing a proven quality of concrete and better. The weakness of the use of precast concrete is the process of moving the precast concrete elements from the production site (factory) to the project location requires additional costs, erection process that also requires a crane tool, to apply the Connect tool or the right level of connection is required a relatively expensive cost (Ervianto, 2006).

2.2 Conventional Concrete

Conventional concrete can be interpreted as a production process of building/architectural elements in a location similar to the location where the structural/architectural elements will be used, conventional concrete in the implementation is planned in advance, all the work of the casting is done manually (Mulyono, 2004). The advantages of concrete with conventional methods are easy and common in field work, easily formed in various sections, calculations are relatively easy and common, the connection of column beams and floor plates is monoliths. The lack of conventional methods is required by the manpower of more workers, the use of relatively more formwork, the job in the development is somewhat prolonged because the workmanship sequentially interdependent with other work, affected by the weather.

2.3 Time Management

The project submission must not exceed the specified time limit, therefore it is necessary to have time management in order for the project to be in accordance with the planning (Gardjito, 2017). Time management means entering all the processes needed in the project to ensure project completion time (PMI, 2000). The main process in project time management is the process of identifying all activities, sorting processes, estimated activity duration, development schedule which means determining when an activity in the project will start and when to complete, schedule control is a process to ensure that the performance is done in accordance with the allotted time allocation.

On the implementation of construction projects, project delays often occur. Abedi et al (2011) shows that delays can cause some negative things, i.e. additional workmanship, additional costs, disputes (between contractors, owner and others), arbitrage (when delays become a problem then it must be resolved by the third party), the court process (when the delay becomes a major problem), and Abandontment. The impact of loss on delays can be shown by Figure 2.1.

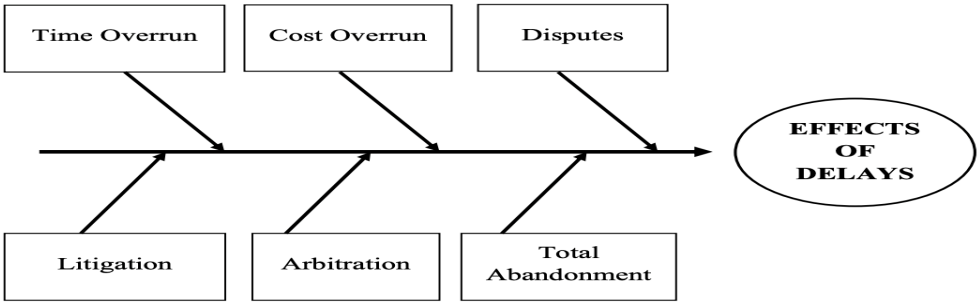


Figure 2.1. Fish bone diagram of six effect of the construction delay

2.4 Time Analysis

Time analysis is important in the implementation of construction work, because the cost that will be issued at the time of implementation is closely related to the execution time of the work as well as the execution time that has a close connection with Expenses incurred (Gardjito, 2017). There are several ways of analyzing the work time of this research project using the Monte Carlo simulation to determine the probability analysis of project execution time when the project is using precast method or when the project uses Conventional methods.

2.5 Probability with Monte Carlo Simulation

Uncertainty in the project can be categorized as risk in implementing the project, a solution that can be done against uncertainty is to implement probabilistic scheduling. Monte Carlo simulation can be used to integrate the time of a project by using randomly selected values from a probability distribution of time that may occur with the aim of calculating the distribution of possible total time from A project. Project Management Institute (2004) explains that in the field of project management, a Monte Carlo simulation is used to calculate or iterate the time of a project using randomly selected values of the distribution Probability of time that may occur with the aim of calculating the possible distribution of total time from a project.

Prior to analysis using the method of Monte Carlo researchers will search for data from some estimates of the duration of the project activity, such as optimistic estimate is the duration used to settle something when everything goes Well, the ideal time estimate is the duration of time used to accomplish something that is most possible, and a pessimistic estimate that is the duration required to complete an activity when everything is in the condition does not support.

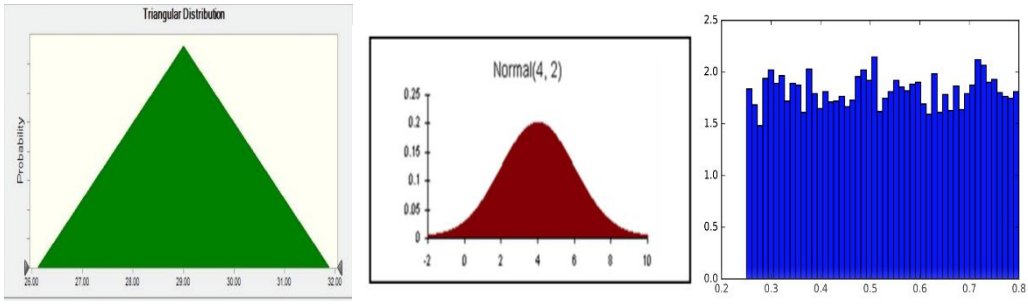


Figure 2.2. Example of Probabilitic Distribution

3. Research Methodology

This study aims to determine the probability of the use of precast methods and conventional methods on the contruction of flat X using the Monte Carlo simulation. This research Model is quantitative descriptive research with survey research used in this research to find out about estimated project implementation time by writing development method change, in this case research Survey by observing the state of the project and get the data directly from the contractor that built the high-level flat X in DKI Jakarta.

3.1 Data

There are some data used in this research such as project completion time planning data obtained directly from the Contracting Party, after which other data is optimistic estimate, ideal time estimate, and a pessimistic Estimate obtained through the questionnaire after all data obtained next the researcher will look for probability with a Monte Carlo simulation through the Crystall ball software which is an add-ins of Microsoft Excel.

3.2 Monte Carlo Simulation project Execution time

The step before performing a Monte Carlo simulation is to determine the number of iterations using Microsoft Excel by looking up the standard deviation, looking for the average data obtained and testing it using the 1000 times trial literation.

The Monte Carlo simulation at the time of the project will be conducted several times by using data derived from the questionnaire data that is spread by researchers, the data to be analyzed is optimistic estimate, ideal time estimate, and Pessimistic estimate. Data obtained from the questionnaire is then input by researchers into the software crystal ball using normal distribution and triangular distribution. Figure 3.1 and 3.2 shows how to choose Normal distribution data and Triangular distribution in crystal ball software.

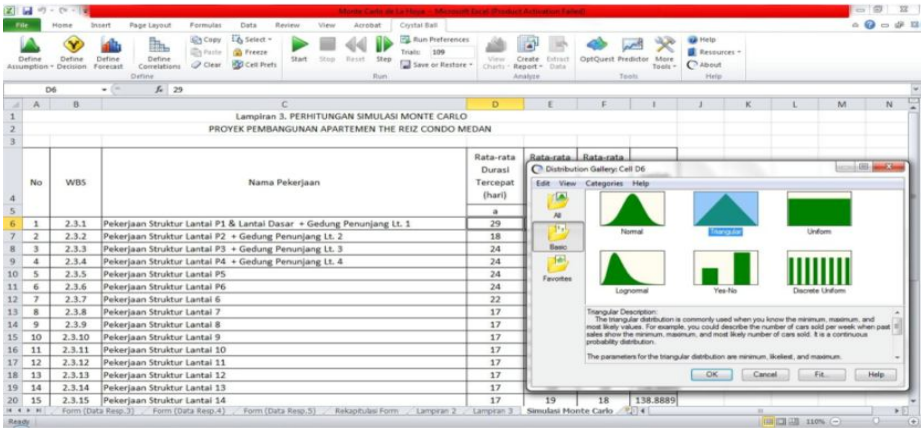
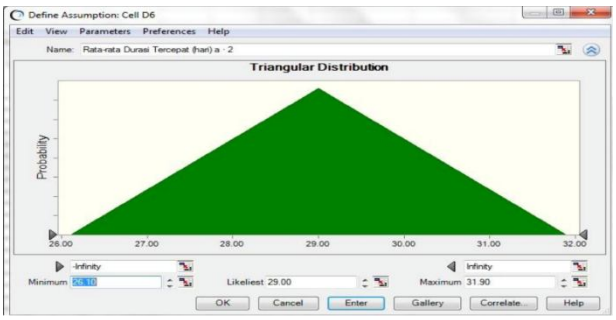


Figure 3.1. Choose Asumption Cells (Triangular distribution and Normal Distribution)

At the stage of Figure 3.1 researchers use Asumption cells then choose triangular distribution to get the mean result and standard deviation from the results of the questionnaire through 1000x iteration.



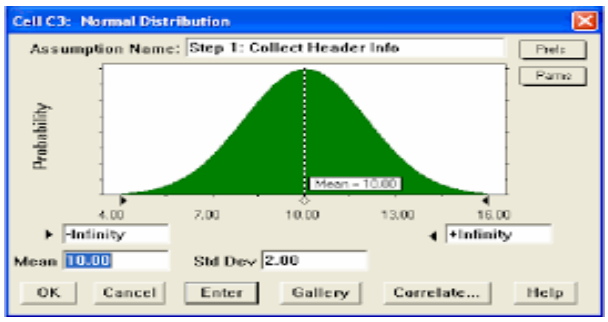


Figure 3.2. Input Optimistic Estimate, Ideal Time Estimate, Pessimistic Estimate and Standard Deviation, Mean Value

In the left image shows triangular distribution where the data used is optimistic estimate, ideal time estimate, and the pessimistic estimate after which the output result will be obtained is the default value of deviation and mean that later will be input in normal distribution on the right image that aims to get the probability results.

4. Finding and Discussion

4.1 Precast

The results showed that the standard value of deviation and mean through triangular distribution in the use of precast method of each job floor is:

Job	Standart Deviation	Mean
Floor 1	1.41	9,42
Floor 2	1.25	9,43
Floor 3	1.02	9,33
Floor 4	0.97	9,31
Floor 5	1.18	9,50
Floor 6	0.89	8,66
Floor 7	0.94	9,21
Floor 8	1.11	8,96
Floor 9	1.25	9,42
Floor 10	0.94	9,27
Floor 11	1.16	9,07
Floor 12	1.20	8,89
Erection	1.31	9,44

Table 4.1. Result Triangular Distribution (Standard Deviation and Mean)

The result of standard deviation and mean is then used in this study to conduct a normal distribution analysis:

Jobs	-1 Standart Deviation	Mean	1 Standart Deviation
Floor 1	8,04	9,42	10,80
Floor 2	8,15	9,43	10,70
Floor 3	8,29	9,33	10,36
Floor 4	8,32	9,31	10,31
Floor 5	8,33	9,50	10,68
Floor 6	7,80	8,66	9,52
Floor 7	8,29	9,21	10,14
Floor 8	7,78	8,96	10,13
Floor 9	8,14	9,42	10,69
Floor 10	8,33	9,27	10,21
Floor 11	7,88	9,07	10,25
Floor 12	7,67	8,89	10,11
Erection	8,16	9,44	10,73

Table 4.2. Result Normal Distribution Precast (-1 $\leq 0 \leq 1$)

The other result is the probability of normal distribution, the probability graph can be seen from the graph 4.1 to 4.13

Chart 4.1 Analysis probability of execution time on the 1st floor

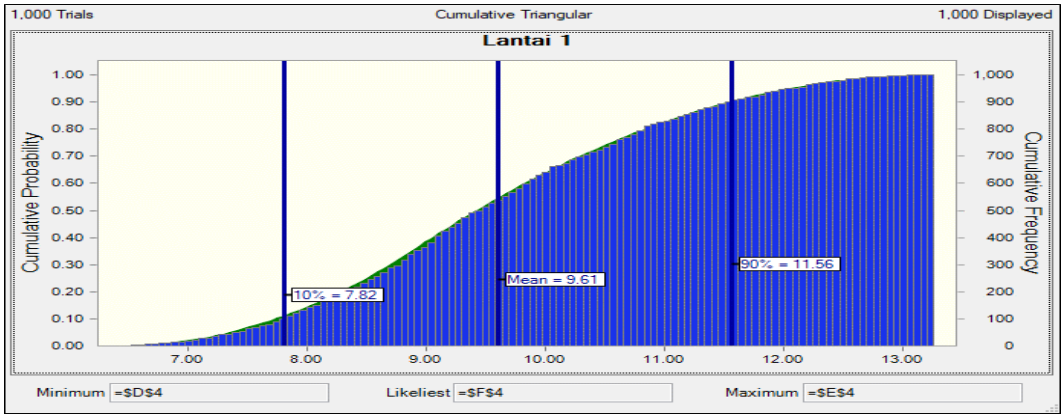


Chart 4.2 Analysis probability of execution time on the 2nd floor

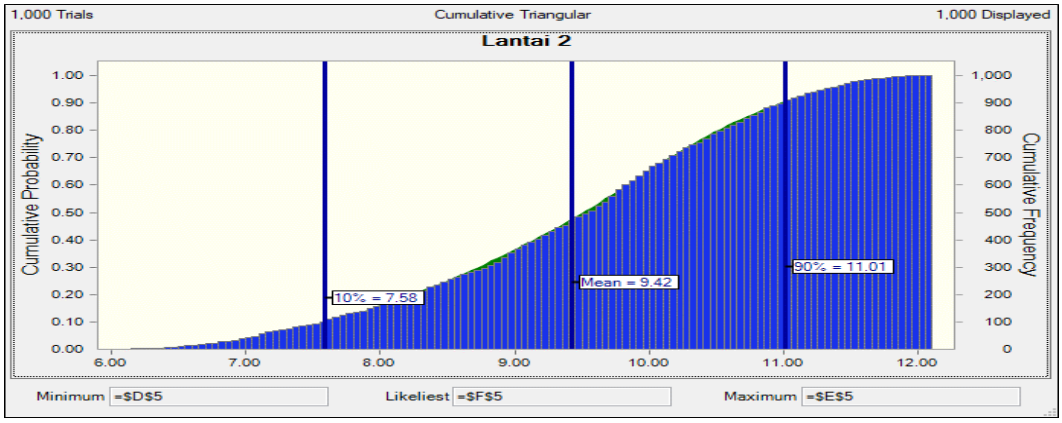


Chart 4.3 Analysis Probability Of Execution Time On The 3rd Floor

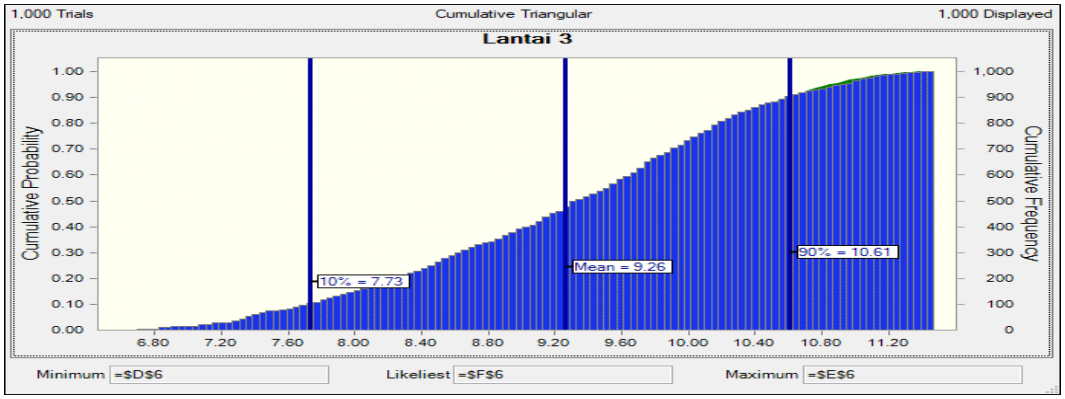


Chart 4.4 Analysis probability of execution time on the 4th floor

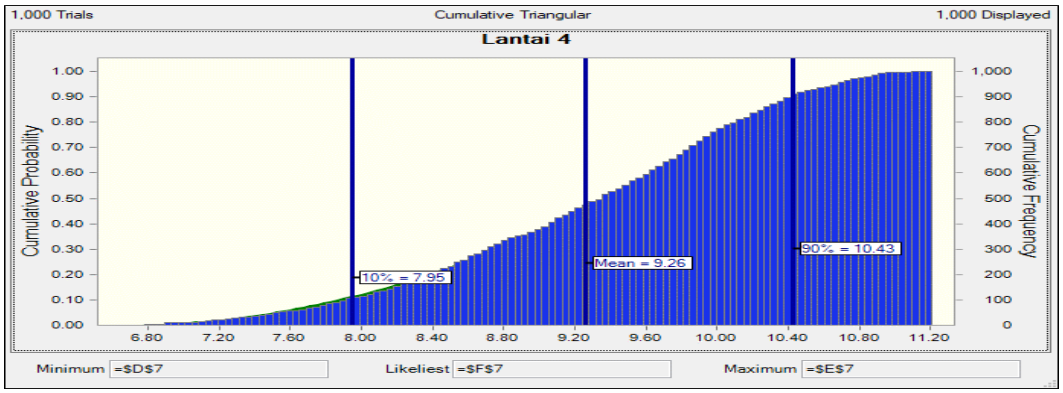


Chart 4.5 Analysis probability of execution time on the 5th floor

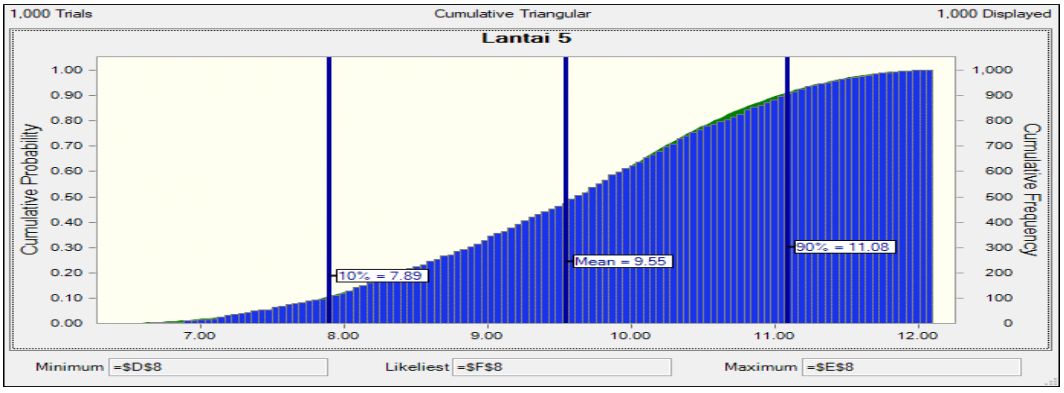


Chart 4.6 Analysis probability of execution time on the 6th floor

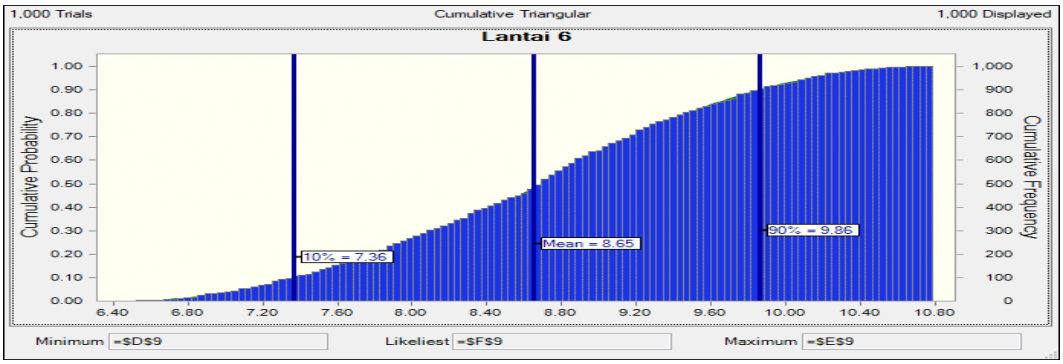


Chart 4.7 Analysis probability of execution time on the 7th floor

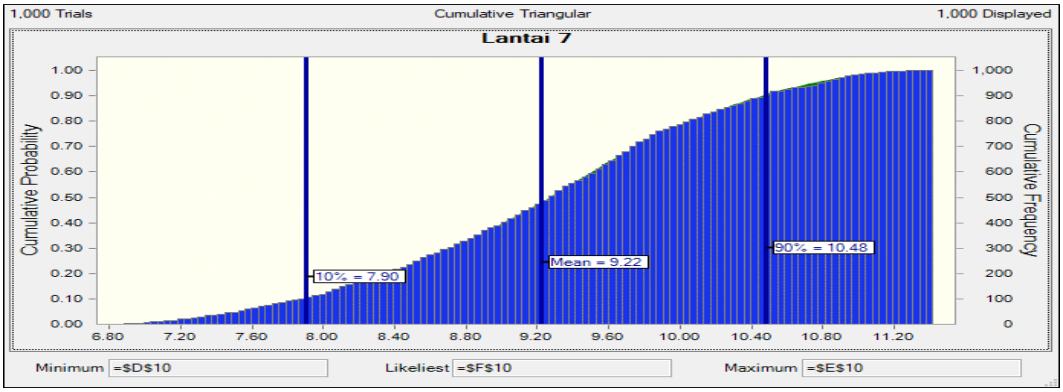


Chart 4.8 Analysis probability of execution time on the 8th floor

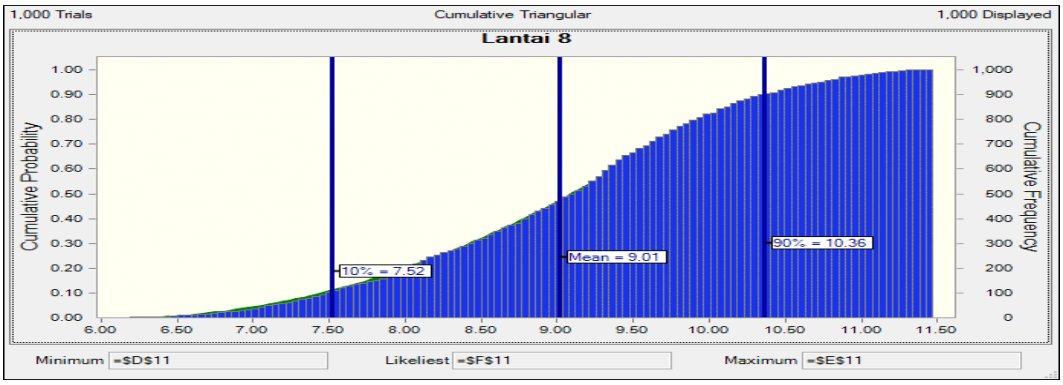


Chart 4.9 Analysis probability of execution time on the 9th floor

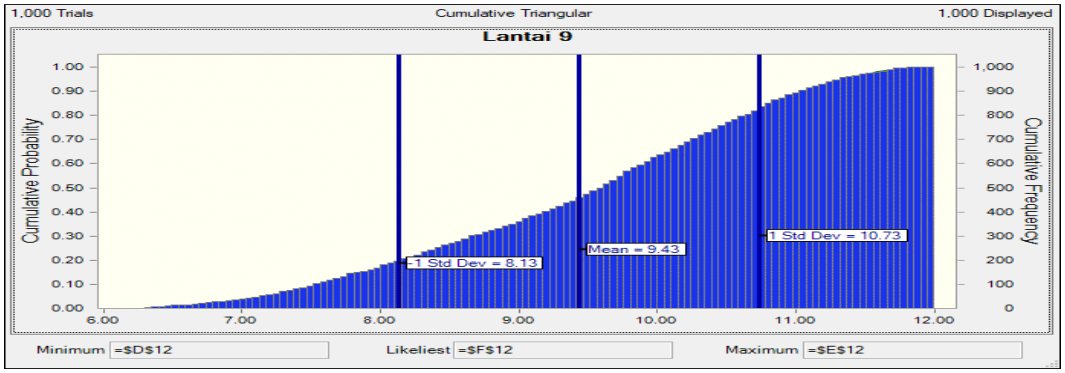


Chart 4.10 Analysis Probability of execution time on the 10th floor

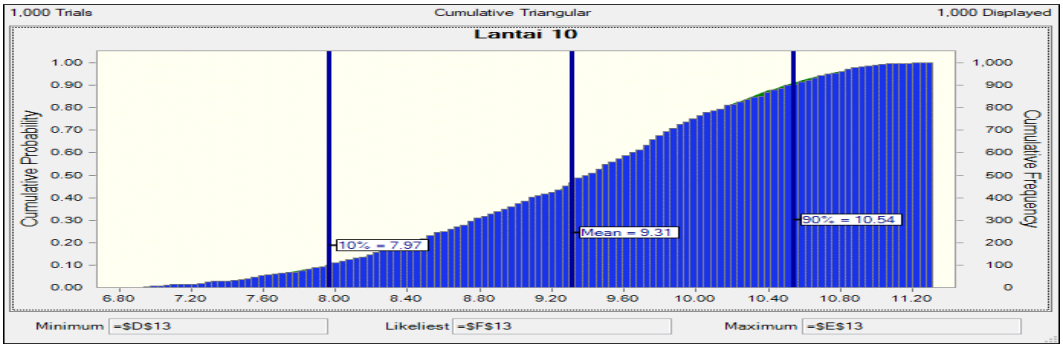


Chart 4.11 Analysis Probability of execution time on the 11th floor

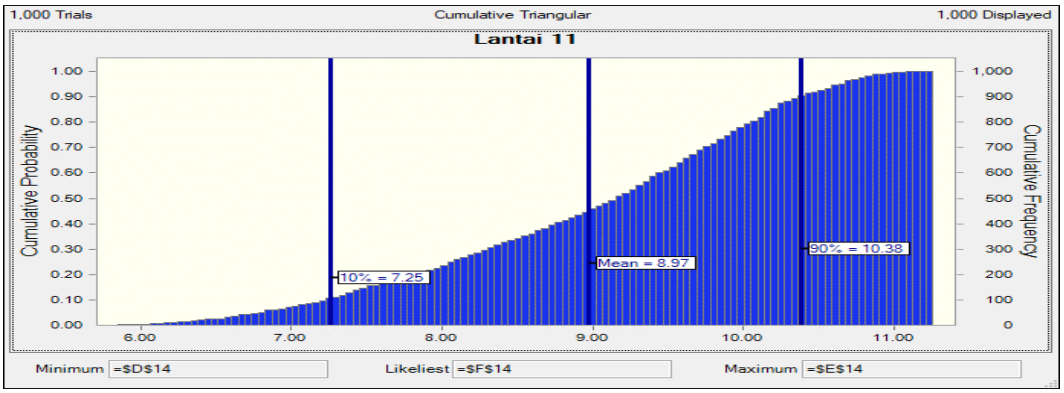


Chart 4.12 Analysis Probability of execution time on the 12th floor

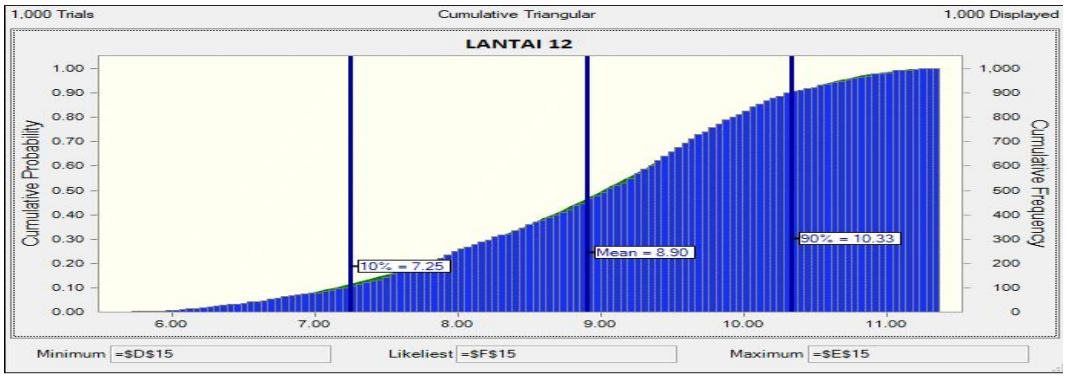
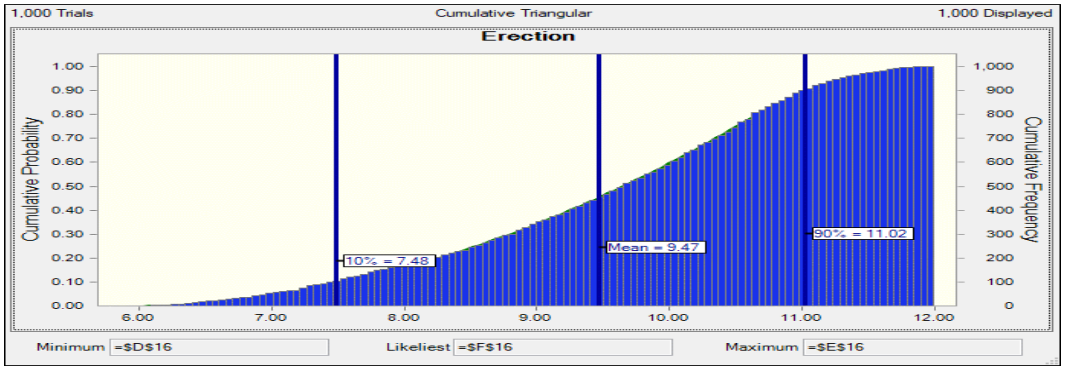


Chart 4.13 Analysis of probability of execution time on Erection work



From the chart results can be concluded in table 4.3

Probability	10%	50%	90%
Floor 1	7,82	9,61	11,56
Floor 2	7,58	9,42	11,01
Floor 3	7,73	9,26	10,61
Floor 4	7,95	9,25	10,43
Floor 5	7,89	9,55	11,08
Floor 6	7,36	8,65	9,56
Floor 7	7,90	9,22	10,48
Floor 8	7,52	9,01	10,36
Floor 9	7,244	9,528	11,358
Floor 10	7,97	9,31	10,54
Floor 11	7,54	8,97	10,38
Floor 12	7,25	8,90	10,33
Erection	7,48	9,47	11,02

Table 4.3. Results of a simulation of Monte Carlo Precast method

Probability analysis results indicate that precast method is likely to be faster than the planned work time. Subsequent researchers conducted a probability analysis on conventional methods for the end result compared to the time of the project plan.

4.1 Conventional Method

Table 4.4 shows the results of triangular distribution (standard deviation and mean) of the use of precast method in the project Stacking House X.

Jobs	Standard Deviation	Mean
Floor 1	2.36	17,67
Floor 2	2.06	15,41
Floor 3	2.12	15,40
Floor 4	2.96	17,96
Floor 5	1.94	15,00
Floor 6	1.91	14,79
Floor 7	1.93	15,19
Floor 8	1.88	14,81
Floor 9	2.69	16,23
Floor 10	4.57	15,44
Floor 11	1.92	15,06
Floor 12	1.98	14,74

Table 4.4. Result Triangular Distribution (Standard Deviation and Mean)

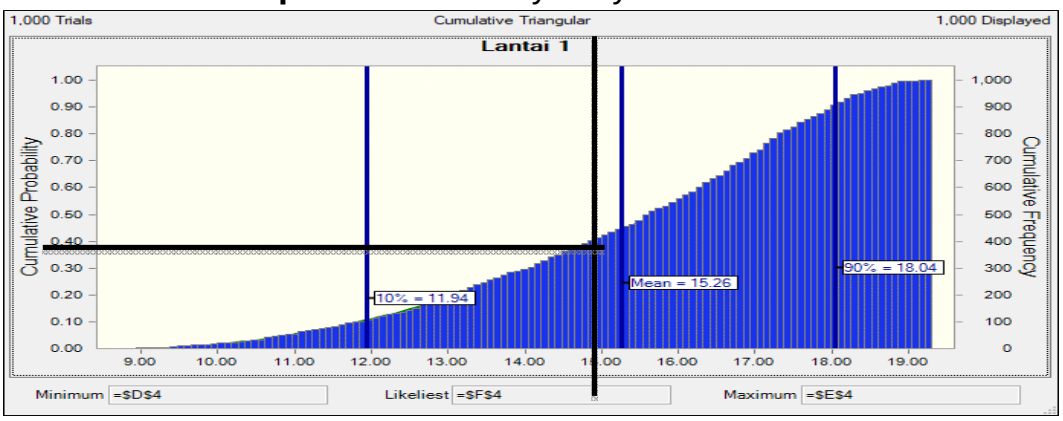
The result of standard deviation and mean is then used in this study to conduct a normal distribution analysis,

Jobs	-1 Standart Deviasi	Mean	1 Standart Deviasi
Floor 1	12,90	15,29	17,67
Floor 2	11,21	13,31	15,41
Floor 3	11,13	13,27	15,40
Floor 4	12,02	14,99	17,96
Floor 5	11,10	13,05	15,00
Floor 6	10,89	12,84	14,79
Floor 7	11,13	13,16	15,19
Floor 8	11,12	12,97	14,81
Floor 9	10,85	13,54	16,23
Floor 10	10,96	13,20	15,44
Floor 11	11,23	13,15	15,06
Floor 12	10,71	12,72	14,74

Table 4.5 Result Normal Distribution Conventional Method ($-1 \leq 0 \leq 1$)

The Output obtained from this result is the probability of 1000x iteration, the probability can be seen in the 4.14 chart up to 4.24,

Graph 4.14 Probability analysis on Floor 1st work



Graph 4.15 Probability analysis on Floor 2nd work

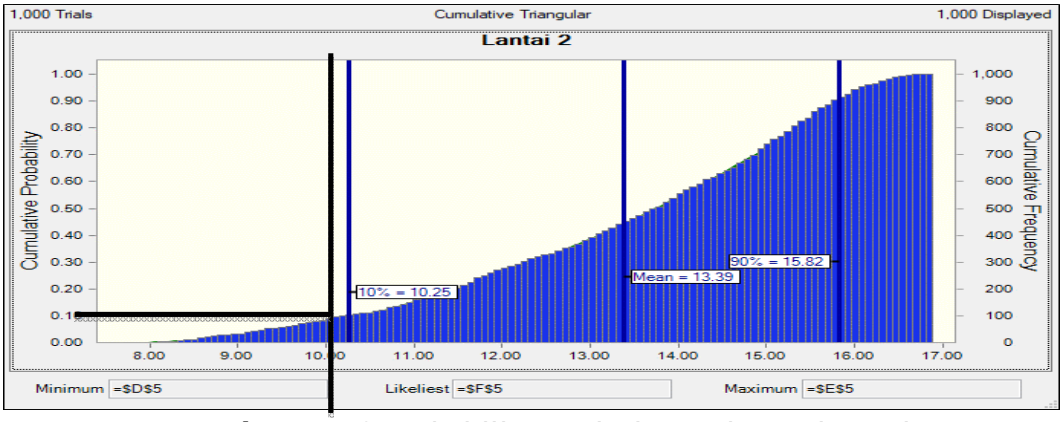


Chart 4.16 Probability Analysis On Floor 3th Work

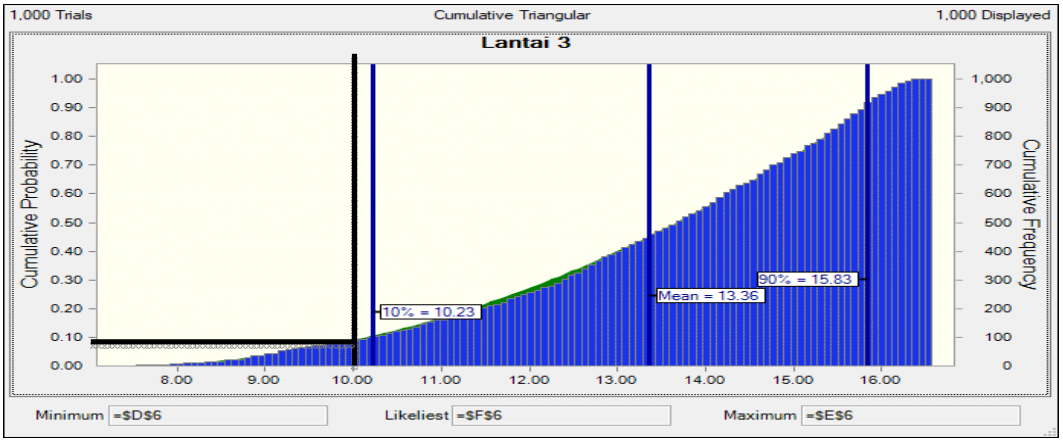


Chart 4.17 Probability Analysis On Floor 4th Work

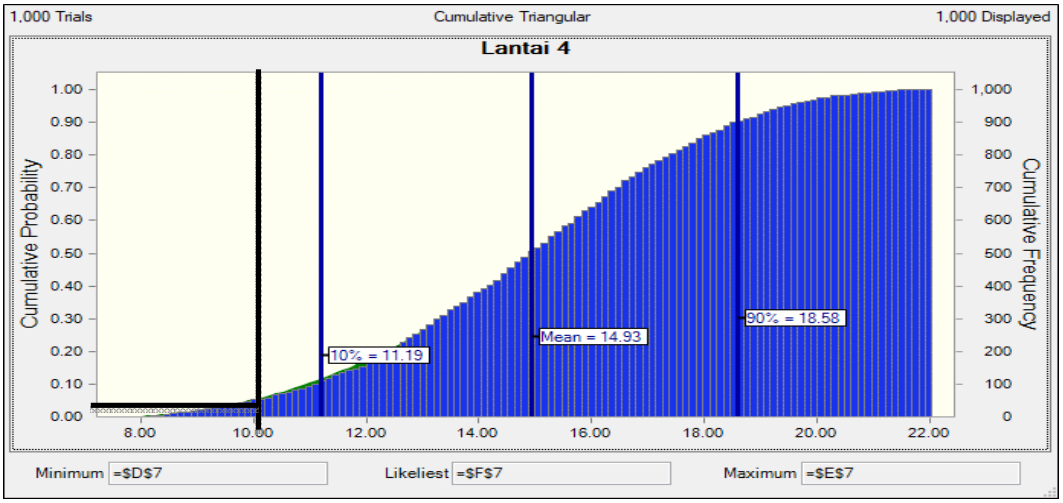


Chart 4.18 Probability Analysis On Floor 5th Work

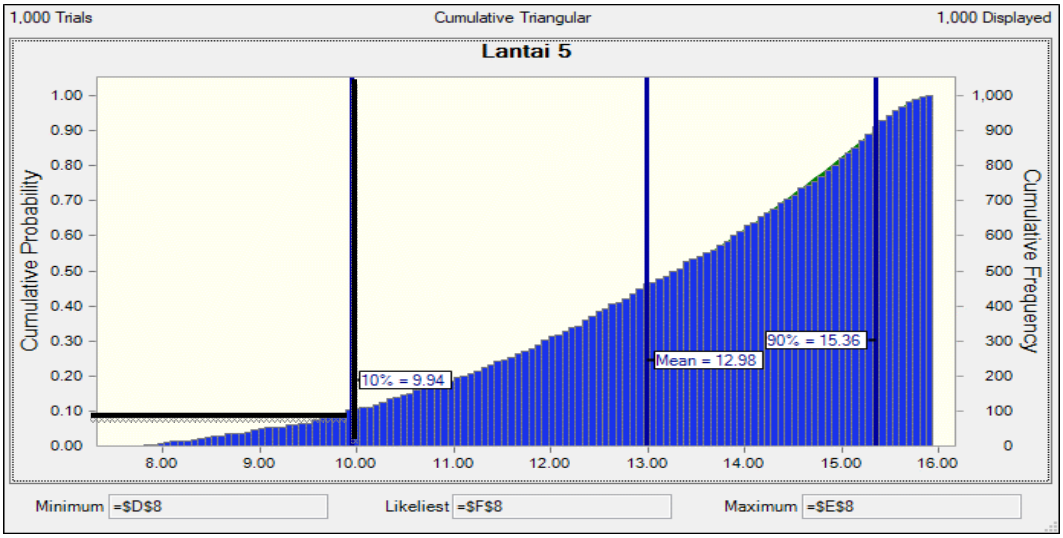


Chart 4.19 Probability Analysis On Floor 6th Work

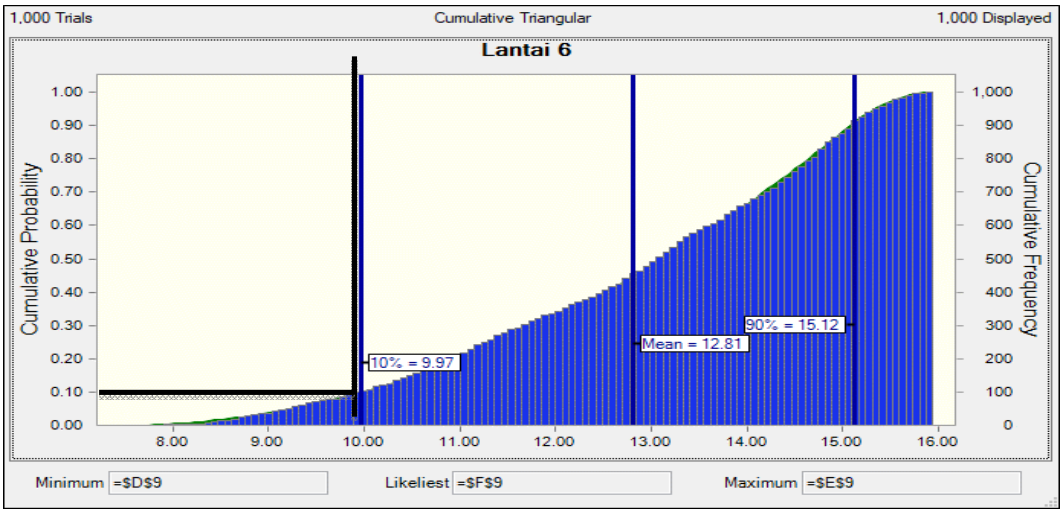


Chart 4.20 Probability Analysis On Floor 7th Work

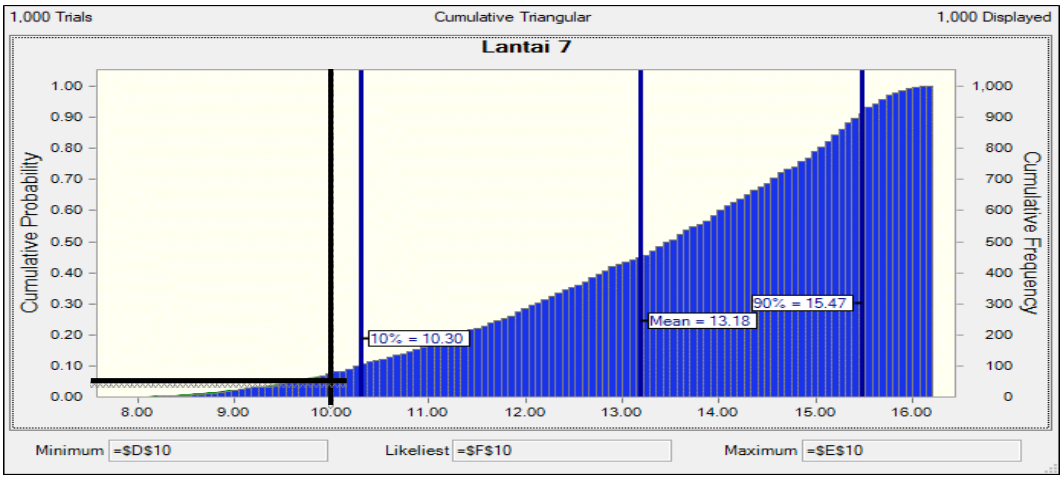


Chart 4.21 Probability Analysis On Floor 8th Work

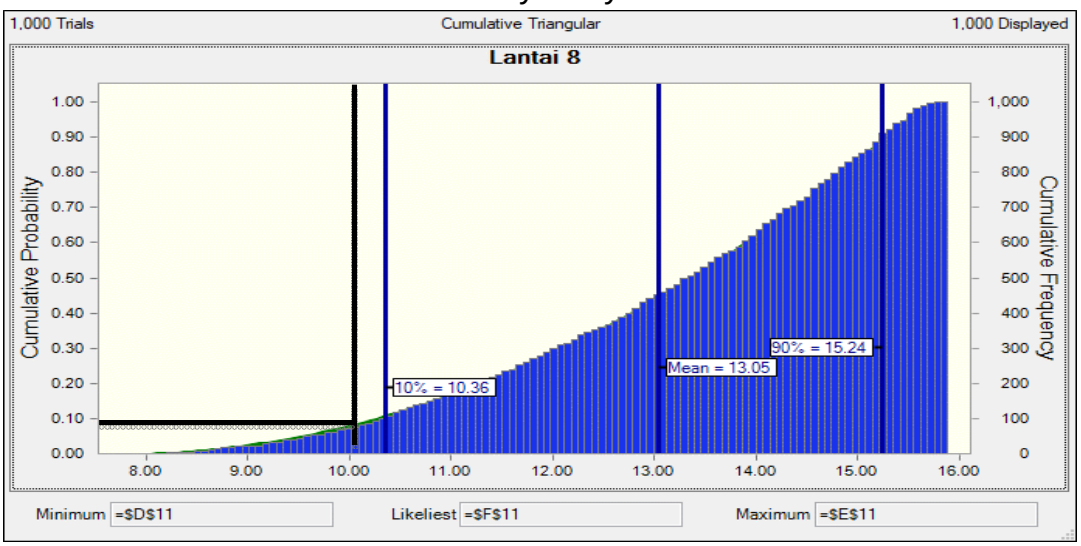


Chart 4.22 Probability Analysis On Floor 9th Work

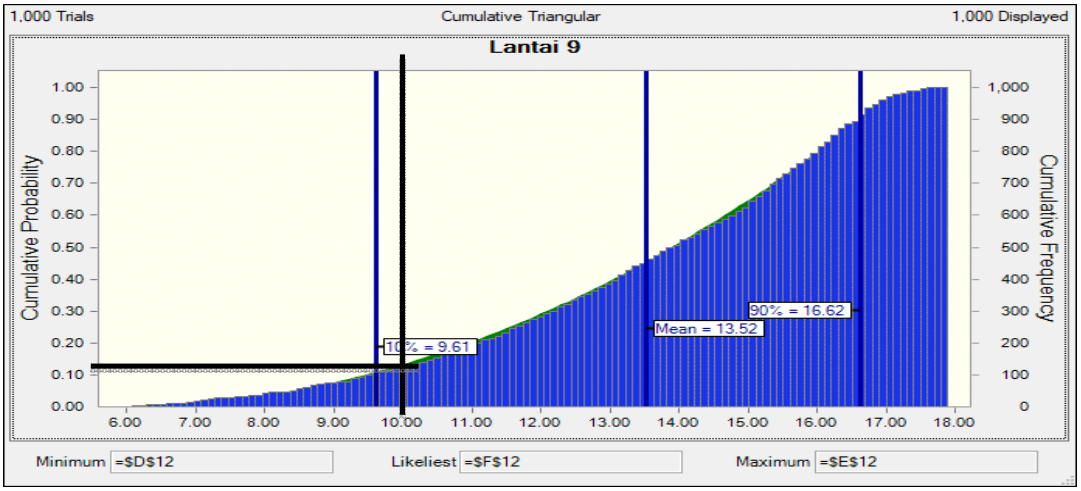


Chart 4.23 Probability Analysis On Floor 10th Work

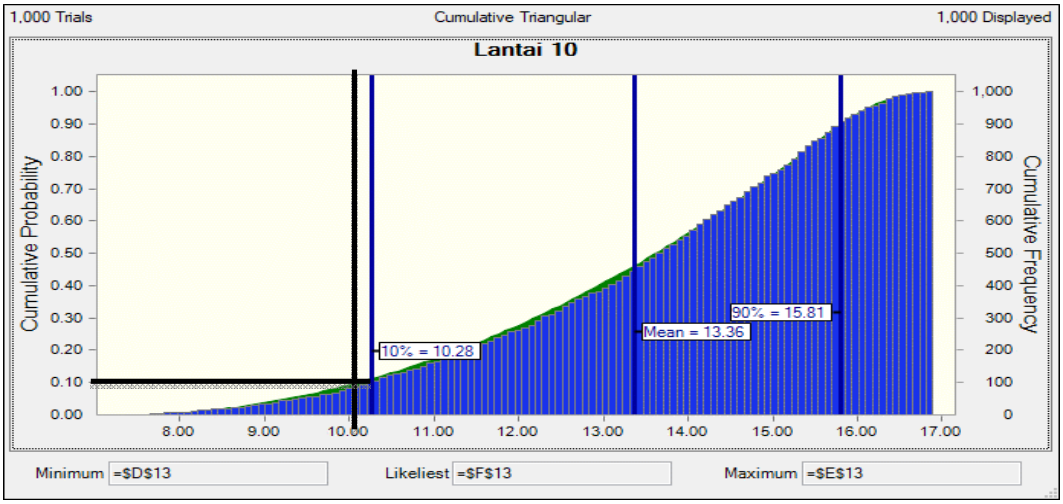


Chart 4.24 Probability Analysis On Floor 11th Work

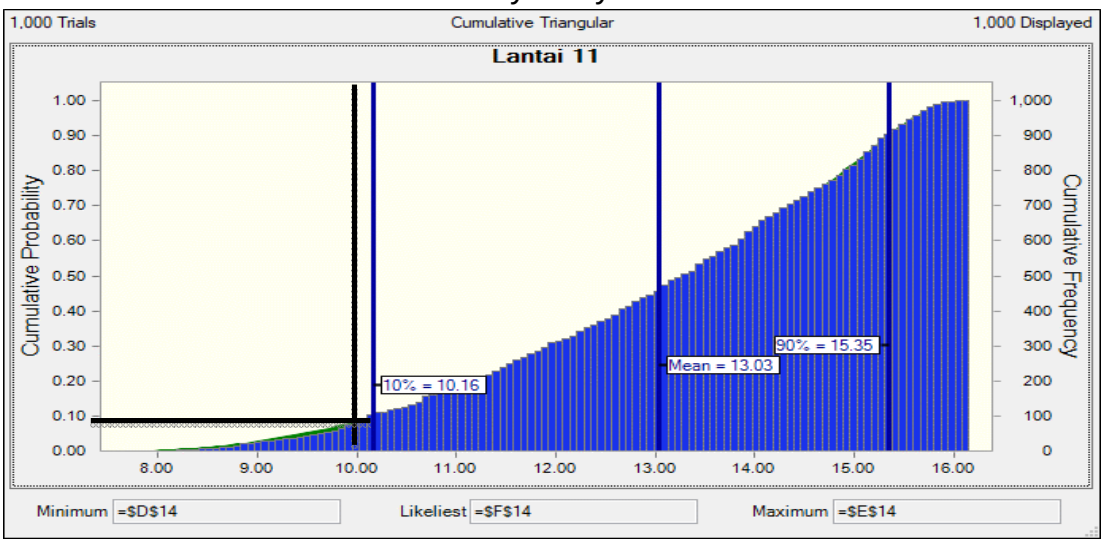
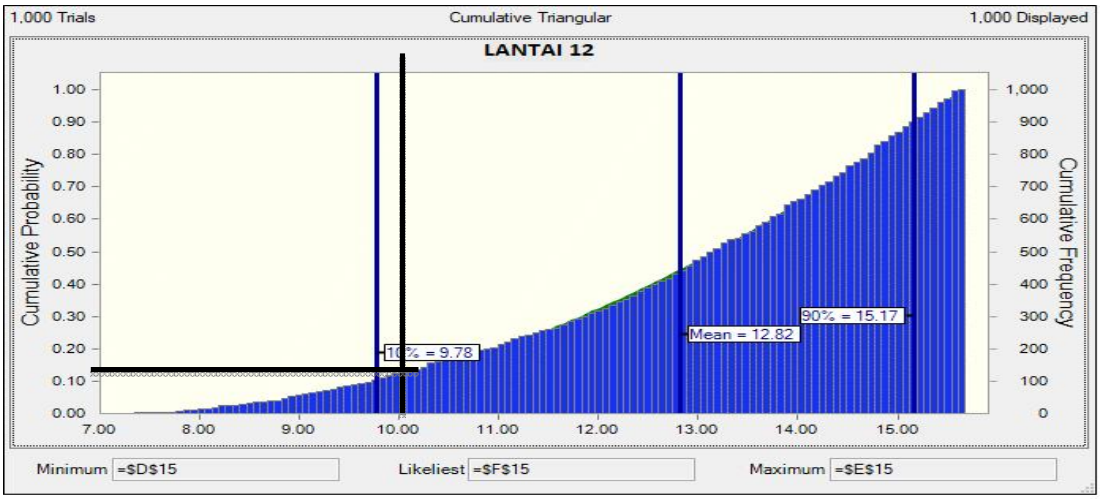


Chart 4.25 Probability Analysis On Floor 12th Work



Probability	10%	50%	90%
Floor 1	11,94	15,26	18,04
Floor 2	10,25	13,39	15,82
Floor 3	10,23	13,36	15,83
Floor 4	11,19	14,93	18,58
Floor 5	9,94	12,98	15,36
Floor 6	9,97	12,81	15,12
Floor 7	10,30	13,18	15,47
Floor 8	10,36	13,05	15,24
Floor 9	9,61	13,52	16,62
Floor 10	10,28	13,36	15,81
Floor 11	10,16	13,03	15,35
Floor 12	9,78	12,82	15,17

Table 4.6 Results of Monte Carlo conventional method simulation

Table 4.6 shows the probability of each job using conventional methods, while the black line on the chart of the probability of conventional methods represents the project planning percentage of projects using conventional methods. Table 4.7 shows the probability on the overall total work on the use of precast and conventional methods.

Percentile	Forecast values Precast	Forecast values Conventional
10%	114.78	151.66
20%	116.47	155.91
30%	117.98	158.15
40%	119.08	160.27
50%	120.12	162.49
60%	121.38	164.40
70%	122.47	166.45
80%	123.69	169.06
90%	125.35	172.03

Table 4.7 Total probability work Precast and conventional methods

Precast method has the most fast time probability of 115 days (10%) and has a mean of 120 days (50%) and has the biggest possibility of completion of 125 days (90%), while the conventional method has the lowest probability of 151 days (5%) and has a mean of 162 days (50%) and has the biggest possibility of completion which is 172 days with probability 90%.

From comparative analysis results can be concluded that precast method has a faster working time when compared with conventional methods. Almost all precast work methods have a day efficiency when compared to project planning while the use of conventional methods has a time difference of 3 days from the planning of the work time. Meanwhile, in the first stage work is the first floor, the contractor has a plan longer than the other work because in its work on the first floor there are advanced foundation and landfill work and has a volume of work Larger than other floors, and at this stage the use of precast method has a time efficiency of up to 5 days while the conventional methods have the possibility of time to match the project plan can occur because There is an acceleration on the work of floor plates, beams and columns. Jobs using conventional methods have the possibility to approach project completion planning but only have a probability of approaching 10%, while the use of precast methods can approach a probability of 80% untill 90% it can Viewed in table 4.8.

Jobs	Time Plan	Probability when using conventional methods	Probability when using Precast Methods
Floor 1	15	42%	117%
Floor 2	10	9,76%	81,74%
Floor 3	10	9,78%	84,83%
Floor 4	10	8,94%	86,29%
Floor 5	10	10,06%	81,23%
Floor 6	10	10,03%	94,14%
Floor 7	10	9,71%	85,88%
Floor 8	10	9,65%	86,87%
Floor 9	10	10,41%	79,24%
Floor 10	10	9,73%	85,39%
Floor 11	10	9,84%	86,71%
Floor 12	10	10,22%	87,12%
Erection	10		81,67%

Table 4.8 Time plan with conventional method probability

5. Conclusion and Recomendation

The analysis results of the comparison of precast methods and conventional methods based on the time of the project is, on the work of the 2nd floor until Floor 12 use precast method has a more efficient work one day from the project planning time while the use of conventional methods on average has a difference of three days longer than the project planning time. The use of conventional methods only has a probability of 10% when wanting to approach the project planning time while the use of precast method has a probability of 80% untill 90%. Overall the use of precast method has the most immediate odds or probability 114 days (probability 10%) When compared to conventional methods 152 days. If you see the mean result probability (50%) Precast methods have a completion time of 120 working days and conventional methods require a time of 162 days. And when it is likely to be the highest probability in project completion time (90%) Precast method has a working time of 125 days while conventional methods require a 172 day completion.

Recommendation for PT BAP, the use of precast method will be ideal in terms of the time of the work Rusun X. With the completion of the time in accordance with the plan or even faster expected to affect other things, such as costs incurred more efficiently than that quality with the use of precast method can also be better because the concrete production process is carried out using the machine in a mass and according to the procedure Careful supervision. Recommendations for the next researcher should not only do comparisons in terms of time but the quality of the project should also be taken into account. In terms of cost would be more expensive to use precast therefore in this study is not examined in terms of costs, other than that the use of comparisons using other parametric statistical methods are worth trying to have comparisons when in analysis using different methods with Monte Carlo mode.

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