Application of Lean Project Management Method in Environmental Drainage Development Case Study: x Area Bekasi City

S Maulana¹, F D Ariyanti²

¹,²Profesional Engineer Program, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480

Abstract. Drainage systems are infrastructures for runoff water management and flooding in the settlements area. Many factors cause the drainage system not to function properly. This study was conducted on the implementation of an urban drainage system project in the X Area of Bekasi City using the Lean Project Management Method to analyse waste from resources, analyse risks and manage variations on costs, time, and human resources. The results of the analysis of risk responses that are important to note are the lack of supervision of the implementation of OHS in the field, lack of coordination and outreach to the residents, working hours of irregular (ineffective) use of the equipment, and unskilled labor. Based on the estimated cost of the construction project of the urban drainage system in the X Area of Bekasi City, there has been a change of actual cost (addendum contract) of 8.9% greater than the planning cost (initial contract). Based on the calculation, total savings with the CCPM method in the construction of the urban drainage system in the X area of Bekasi City are Rp. 2,894,136,099.

Keywords: lean project management, urban drainage, risk, construction

1. Introduction

In the construction of the drainage system in the Bekasi City Region X in 2019, there has been a 2 times contract addendum relating to additional implementation costs, from an initial contract cost of Rp. 10,060,777,000 to Rp. 10,952,900,000. Therefore, there is non-productivity so that it gives added value to the final product (Non-Value Adding Activities), in construction, namely waste. Therefore, it is necessary to apply the Lean Project Management (LPM) approach. This research is needed related to the implementation of urban drainage system constructions in the X area of Bekasi City with the Lean Project Management approach. This is a mitigation in the construction of other drainage systems, so that the implementation of construction can be in accordance with design planning.

2. Literature Review

2.1. Environmental engineering
2.1.1 Urban drainage system.
[1] Urban drainage system is a drainage that has the functions to control or drain excess surface water in residential areas from local rain, so that it can provide benefits for human activities. [1] In drainage management for planning, operations and maintenance it is necessary to pay attention to factors such as Rain Intensity, Catchment Area, Urban Area Growth, Physical and Environmental Factors.

2.1.2 Types of drainage.
[1] Based on the physical condition, the drainage system consists of primary, secondary, tertiary channels. [2] Based on the history of the formation there are 2 (two) types of drainage system, natural drainage and artificial drainage. [2] Based on the construction, drainage system there are 2 (two) types, open channel drainage and closed channel drainage.

2.1.3 Drainage hierarchy.
Based on the system and function, drainage has several types of channels. The channels are integrated in the work system. [3] Buildings in a drainage system generally consist of collector / tertiary channels, carrier / conveyor / secondary channels, and main drain / primary canals.

2.1.4 Drainage complementary buildings.
Based on the Minister of Public Works Regulation No. 12 / PRT / M / 2014, additional buildings of drainage system consist of culverts, buildings, inlets, pumps and sluice gates

2.1.5 Eco-drainage.
[3] Eco-drainage is a concept that considers environmental and social factors in making decisions about drainage systems. Eco-drainage considers the quantity and quality of runoff, and the service value of surface water in urban ecosystems.

2.2. Project management

2.2.1 Infrastructure criteria.
[4] Performance appraisal can be measured through an assessment of the level of efficiency and effectivenes, according to Prawirosentono [5]. Efficiency shows the minimum ratio between input and output. Small input and large output are the expected conditions. While effectiveness focuses on the level of achievement of organizational goals in providing services.

2.2.2 Construction project implementation performance.
Reference to the concept of construction management, related to controlling time, cost and achievement of physical targets (quantity and quality) as well as administrative order, this is confirmed in Minister of Public Works Regulation No. 45 of 2007, which is divided into several activities in the construction implementation, namely:

a. Evaluate the program of physical implementation activities compiled by the construction implementer.
b. Controlling the physical construction implementation program.
c. Evaluate the program for technical and managerial irregularities that arise
d. Coordinate between parties involved in carrying out physical construction
e. Carry out surveillance activities
f. Prepare a final report on the construction management work

2.2.3 Project monitoring, control and evaluation.
[6] Monitoring is a descriptive assessment procedure to identify and / or measure the influence of ongoing activities without considering the causality relationship. [7] Evaluation is a process to find out or test whether an activity, activity process, output of a program is in accordance with the objectives or
criteria that have been determined. In Government Regulation No. 39 of 2006 states that in monitoring and evaluating a program / activity has objectives that are also different from one another, so there are elements in monitoring and evaluating a program / activity, can be seen in Figure 1.

According to Schwalbe [8], each project will be limited by the scope, time and cost or commonly called the Project Constraint Triangle.

2.2.4 Drainage construction project.
[1] In the construction of drainage systems, the activities include:
1. Provision of design drawings
2. Pre-construction work
3. Diversion channel and dewatering
4. Earthwork and foundation
5. Works on water structures, canals and complementary buildings
6. Electrical mechanical works (flood pumps, flood gates, automatic garbage filters, electrical panels, power supply / substations / generators)
7. Closure of Diversion Channel
8. Field testing of drainage system functions and quality testing
9. Making as built drawing
10. Provisional Hand Over
11. Maintenance period
12. Final Hand Over

2.3. Lean Project management concept

2.3.1 Implementation of lean project management.
[9] Lean is a continuous improvement effort to eliminate waste, increase product value added (goods and / services) and provide value to customers. This concept can be applied to manufacturing or service companies, because basically the concept of efficiency will be a target to be achieved by the company. There are 5 (five) basic principles of lean, namely:
1. Identifying the value of products (goods and / services) based on the customer's perspective, where customers want products (goods / services) of superior quality, with competitive prices on timely service.
2. Identifying the value stream process mapping for each product (goods / services).
3. Eliminating waste that does not add value from all activities along the value stream.
4. Organizing so that material, information, and products flow smoothly and efficiently throughout the value stream process using a Pull system.

5. Looking for various techniques and tools to achieve excellence and continuous improvement.

[10] Stages in the lean thinking approach, namely:
1. Understand waste
2. Set goals
3. Understanding Big Picture
4. Detailed Mapping
5. Involving suppliers and customers, and
6. Review the plan made

2.3.2 Waste.
[9] Waste can be defined as any work activity that does not provide added value in the process of transforming inputs into outputs along the value stream (the process of making, producing, and delivering products, both goods and or services to the market). There are 9 (nine) wastes that can be identified in a company as E-DOWNTIME, namely:
1. Occupational Health, Safety and Environmental (OHSE)
2. Defects
3. Overproduction
4. Waiting
5. Not Utilizing employee’s knowledge, skill and abilities
6. Transportation
7. Inventory
8. Motion
9. Excess Processing

2.3.3 The role of lean project management.
[11] The role of Lean Project Management (LPM) in construction projects is to identify waste (Non-Value Adding Activities) and obstacles (risks) that have the potential to arise during project implementation, as well as estimating the needs of project implementation (time, cost, resources). The principles of Lean Project Management are Project Systems, Leading People, Chartering, Right solutions, Managing Variations, Project Risk Management, Project Plans and Execution.

3. Method

3.1. Research approach
This research uses descriptive methods are used to explain and analyse the identification of problems in the form of waste in the construction of drainage system, while the qualitative approach is used to measure the results of waste analysis, risk assessment and managing variations in accordance with the principles of Lean Project Management for the formulation of follow-up on handling waste and saving that can be done on the project.

3.2. Research framework
In the development of drainage systems there are problems that occur that can affect the operational sustainability and maintenance of drainage systems. This can be seen in the status of implementation of construction whether it is in accordance with the design plan in terms of quality, cost and time. Based on the Lean Project Management concept to analyse waste from resources, analyse risks and manage variations on costs, time and human resources, an analysis of the implementation of project activities should be produced. If the results of the analysis are appropriate to answer the initial problem, then subsequently arrange efforts and mitigation measures so that the implementation of drainage construction works effectively and efficiently according to existing plans, especially in terms
of financing through the formulation of recommendations and follow-up improvements in the implementation of construction projects, especially another drainage construction.

3.3. **Method of collecting data**

3.3.1 **Data source.**
Based on the source of research data can be grouped into two types, primary data and secondary data.

3.3.2 **Data collection technique.**
There are 2 (two) techniques used in data collection, namely interview techniques and literature study techniques.

3.3.3 **Target respondent.**
Data collection by depth interview and questionnaire. The questionnaire used consisted of open-ended questions that gave respondents the freedom to give answers according to their own perceptions. The types of questions in this questionnaire relate to the implementation of urban drainage construction in terms of the concept of project management, especially the 5M resources (man, money, machine, method, material). The respondents involved in this study, namely:

1. Technical Directorate of PPPWJM Work Unit
2. Supervising consultant,
3. Contractor

3.4. **Method of data analysis**

3.4.1 **Activity mapping.**
Mapping of work activities by grouping project activities using Work Breakdown Structure (WBS). WBS is done by checking the activities from the whole project to the lowest sub-variables. [12] In project planning, WBS as a basis for making work schedules, calculating costs, determining the resources needed, calculating work risks, including the use of project monitoring and control activities.

3.4.2 **Waste identification.**
Waste analysis using the Root Cause Analysis (RCA) method so that it can identify the root causes of the risks in the implementation of construction activities. RCA is a method to identify the root cause of an undesired outcome and the steps needed to prevent the recurrence of an undesired outcome. The work steps in implementing this RCA method include:

- Step 1: Define the Problem
- Step 2: Collect Data
- Step 3: Identify Possible Causes
- Step 4: Identify the Root Causes

3.4.3 **Risk identification.**
The process of risk identification by interview survey techniques, brainstorming with experts, to literature studies. The factors identified involve both external and internal factors to determine the sources of risk and their indicators.

3.4.4 **Risk priority number mapping analysis.**
After the source of the risk and its indicators are known, a Risk Priority Number calculation step is taken to assess the risk by completing a risk assessment form using the Failure Mode and Effect Analysis (FMEA) method with the formula below:

\[
FMEA = \text{Possibilities} \times \text{Impact} \times \text{Difficulty} \tag{1}
\]
3.4.5 Managing variation analysis.
Variation in a project is defined as uncertainty. Therefore, the party implementing the activity needs to manage variations by estimating before project implementation in terms of the costs, time, and resources used. The goal is that project management can predict or estimate the time, cost and resources needed when implementing a project.

3.4.6 Critical chain project management (CCPM) scheduling.
[13] Critical Chain Project Management (CCPM) is used for scheduling projects, by looking at scheduling existing projects. In determining the critical chain, and cutting safety time on each project activity comes from the reduction between the duration that has safety time in each activity.

4. Results and analysis

4.1. Identification of construction project activities
The following is information about activities in the construction of urban drainage system in X Area Bekasi City, in the description below:

| Location of Activity | Jatibening Sub-District, Pondok Gede District, Bekasi City |
|----------------------|----------------------------------------------------------|
| Scope of Activities  | ● Construction of Channels with Box Culvert of 140x140x100 length 265 m ' with a storage capacity of 519.4 m$^3$  
● Construction of a Retention Pond with a storage capacity of 1,300 m$^3$  
● Construction of Modular Tank as water absorption into the ground with a storage capacity of 350 m$^3$  
● Mechanical and Electrical Installation, a pump with a capacity of 2 x 300 liters / second and the installation of a generator with a capacity of 80 kV |
| Execution time       | Implementation of activities for 161 Calendar Days, starting from 24 July 2019 to 31 December 2019 |
| Benefit Output       | Drainage can handle floods of 20.47 Ha but for implementation in 2019 it can only reduce the problem of flooding of 11.38 Ha in X Area. |

4.2. Mapping Work Activity (Work Breakdown Structure)
Details of activities carried out in the construction of the urban drainage system in X Area Bekasi City can be seen in Figure 2.

4.3. Waste identification and analysis

4.3.1 Waste identification.
The cause of waste is analysed with the if-then formulation, to find out the actions taken so as to minimize or eliminate waste, it can be seen in Table 1.

4.3.2 Evaluation matrix.
This evaluation matrix is to find out which solution to choose based on several criteria by weighting the parties involved in implementing the project based on the questionnaire. From the weighting value, we get a score of each solution so that it can be decided which solution is "GO" or "NOT GO". The assessment of each waste of existing solutions can be seen in Table 2 to Table 3.
Table 1. Controlling Waste

| If | Then | When |
|----|------|------|
| Poor PPE availability for workers | Provide PPE for workers according to the type of work | During implementation |
| Lack of application of HSE in the field. | The Technical Directors provide guidance on the application of HSE in the field | During implementation |
| | Implement of HSE planning according to the contract | During implementation |
| Lack of awareness of workers towards the implementation of HSE | The Technical Directors give a reprimand on the implementation of HSE in Construction | During implementation |
| Material that arrived late | Perform other work that does not use material that has not yet arrived at the project site | During implementation |
| | Accelerate the work when the material has arrived | During implementation |
| Delay in payment process so the contractor's finances are not good | Using additional funds for operational activities | During implementation |
| Lack of coordination and socialization to local residents | Coordinate with local people such as RT and RW | Before implementation |
| | Conducting intensive socialization to local people | During implementation |
| Lack of coordination and communication between the contractor and the supervisory consultant | Coordinate with regular meetings (daily or weekly) | During implementation |
| Lack of maintenance on the machine | Perform maintenance tools and repair tools if damaged regularly | During implementation |
| The tool is not used effectively | Using tools according to their abilities and functions | During implementation |
| | Buy a new tool | During implementation |
| SOP of work not implemented | The Technical Directors provide warnings to the implementing contractor and supervisory consultant | During implementation |
| Poor Field Supervision | Technical Directors conduct more intensive supervision in the field | During implementation |
| | Require implementing contractors and supervisory | During |
consultants to provide detailed progress reports of their work on a daily basis

The labor is less thorough
Increase supervision by supervisory consultants and Technical Directors in the implementation of activities
During implementation

Poor working techniques
Adjust the quality of work in accordance with RMK
During implementation

Less Skilled Workers
Improving the ability of workers with training
Before Implementation
Replacing workers with more skilled ones according to their abilities
During implementation

Table 2. Evaluation matrix for poor PPE availability for workers, material that arrived late and lack coordination and socialization to local residents

| Criteria                               | Weight factor | Poor PPE availability for workers | Material That Arrived Late | Lack of coordination and socialization to local residents |
|----------------------------------------|---------------|----------------------------------|-----------------------------|---------------------------------------------------------|
|                                        |               | a      | b      | c      | d      | e | f | a | b | c | d | e | f |
| Cost                                   | 8             | 8 | 64 | 8 | 64 | 7 | 56 | 6 | 48 | 7 | 56 | 8 | 64 |
| Time                                   | 8             | 7 | 56 | 8 | 64 | 7 | 56 | 7 | 56 | 7 | 56 | 7 | 56 |
| Impact on Results                      | 7             | 8 | 56 | 9 | 63 | 9 | 63 | 9 | 63 | 9 | 63 | 9 | 63 |
| Risk                                   | 6             | 8 | 48 | 8 | 48 | 7 | 42 | 7 | 42 | 7 | 42 | 7 | 42 |
| TOTAL                                  |               | 224 | 239 | 217 | 209 | 217 | 225 |

Go/Not Go: Not Go Go Go Not Go Not Go Go

a The Technical Directors provide guidance on the application of HSE in the field.
b Implement of HSE planning according to the contract.
c Perform other work that does not use material that has not yet arrived at the project site.
d Accelerate the work when the material has arrived.
e Coordinate with local people such as RT and RW.
f Conducting intensive socialization to local residents.
g Ranking.
h Weighted Score.

Table 3. Evaluation matrix for the tool is not used effectively, poor field supervision and less skilled workers

| Criteria                               | Weight factor | The tool is not used effectively | Poor Field Supervision | Less Skilled Workers |
|----------------------------------------|---------------|---------------------------------|------------------------|----------------------|
|                                        |               | g | h | i | j | k | l |
|                                        |               | x | y | x | y | x | y | x | y | x | y |
| Cost                                   | 8             | 8 | 64 | 6 | 48 | 7 | 56 | 7 | 56 | 7 | 56 | 8 | 64 |
| Time                                   | 8             | 7 | 56 | 7 | 56 | 8 | 64 | 7 | 56 | 6 | 48 | 7 | 48 |
| Impact on Results                      | 7             | 9 | 63 | 9 | 63 | 9 | 63 | 9 | 63 | 8 | 56 | 7 | 49 |
| Risk                                   | 6             | 7 | 42 | 9 | 54 | 7 | 42 | 7 | 42 | 7 | 42 | 7 | 42 |
| TOTAL                                  |               | 225 | 221 | 225 | 217 | 202 | 203 |

Go/Not Go: Go Not Go Go Not Go Not Go Go

g Using tools according to their abilities and functions.
h Buy a new tool.
i Technical Directors conduct more intensive supervision in the field.
j Require implementing contractors and supervisory consultants to provide detailed progress reports of their work on a daily basis.
k Improving the ability of workers with training.
l Replacing workers with more skilled ones according.
m Ranking.
n Weighted Score.
4.3.3 Waste analysis.
From the results Waiting factor is the biggest threat in the implementation of the urban drainage construction project, because it is influenced by the many problems encountered such as material that arrives late, delay in payment process to the contractor’s finances are not good, lack coordination and socialization to local residents, lack of maintenance on the machine and the tool is not used effectively. After evaluating waste using the evaluation matrix above, there are recommendations for actions that should be carried out by the construction implementer for the best solution, which can be seen in the Table 4 below. This was stated in the if then formulation which was carried out previously.

| If                                      | Then                                      | When                      |
|-----------------------------------------|-------------------------------------------|---------------------------|
| Lack of application of HSE in the field | Implement of HSE planning according to the contract | During Implementation     |
| Material that arrived late              | Perform other work that does not use material that has not yet arrived at the project site | During Implementation     |
| Lack of coordination and socialization to local residents | Conducting intensive socialization to local residents | During Implementation     |
| The tool is not used effectively        | Using tools according to their abilities and functions | During Implementation     |
| Poor Field Supervision                  | Technical Directors conduct more intensive supervision in the field | During Implementation     |
| Less Skilled Workers                    | Replacing workers with more skilled ones according to their abilities | During Implementation     |

4.4. Risk identification and analysis

4.4.1 Risk analysis.
Based on the results of interviews and questionnaires, a list of events that occurred during the urban drainage construction project in X Area of Bekasi City was scoped based on 4 (four) categories of external and internal risk sources, can be seen in Table 5.

| Concept | Source | Indicator |
|---------|--------|-----------|
| External cannot be predicted | - | |
| External predictable | Material that arrived late | |
| | Delinquent billing so contractor’s finances are not smooth | |
| | Lack of coordination and outreach to local residents | |
| | Lack of coordination and communication between the implementing contractor and the supervisory consultant | |
| | Irregular working hours (not effective) | |
| Internal technical | Lack of maintenance on the machine | |
| | Poor PPE availability for workers | |
| | Lack of application of HSE in the field | |
| | SOP of work not implemented | |
| | Poor working techniques | |
| Internal non-technical | Lack of awareness of workers towards the implementation of HSE | |
| | Poor Field Supervision | |
| | The labor is less thorough | |
| | Less Skilled Workers | |

4.4.2 Risk matrix.
With the FMEA score, the higher the score, the construction implementer must be aware of the risk. The results of the assessment of indicators with risk priority number, can be seen in Table 6.

| N o | Risk (Event) Indicator | Possibility | Impact | Difficulty detection | Total FMEA | When |
|-----|------------------------|--------------|--------|----------------------|------------|------|

9
4.4.3 Risk analysis.
To find out the actions needed as a follow-up or solution to the existing risk, then using a risk response matrix, as can be seen in Table 7.

Table 7. Risk response matrix

| No | Risk (Event) Indicator | Posibility | Magnitude Of Contingency | Trigger |
|----|------------------------|------------|--------------------------|---------|
| 1  | Lack of application of HSE in the field | Reduction | Increase commitment to HSE implementation according to HSE Planning in construction projects | HSE is not according to standardization (not according to HSE Planning) |
| 2  | Lack of coordination and socialization to local residents | Reduction | Conduct intensive communication to residents before the implementation, during the implementation and after the construction | Lack of communication to local residents |
| 3  | The tool is not used effectively | Mitigation | Maintenance of tools regularly | Poor field supervision |
| 4  | Less Skilled Workers | Mitigation | Analyzing the needs of workers in accordance with the needs of the work (carried out before construction begins) | Lack of preparation from the implementing contractor for HR readiness |

4.5. Managing variation

4.5.1 Project cost estimation.
Based on the cost of project, it is known that there is an addendum to the contract due to changes in the estimated cost of carrying out the construction of the urban drainage, where the total project cost is Rp. 10,060,700,000.00 in the Initial Contract, Rp. 10,141,500,000.00 in Addendum I and Rp. 10,952,900,000.00 in Addendum II. There has been a change in the estimated price of 8.9% compared to the planning cost (initial contract). This is caused by changes in schedule and human resources at the time of the construction so that the estimated cost of the project for the construction of urban drainage in X Area of Bekasi City is greater than the estimated initial project cost.

4.5.2 Scheduling estimates.
Based on the estimation of the scheduling in the S-Curve, we can see the difference in the achievements of the construction work between the S-Curve of the Initial Contract and the S-Curve of the Final Addendum. For this reason, it is necessary to allocate buffer feeds before foundation work, with the aim that variations of the work interfere with critical activities. The project buffer calculation summary for each job can be seen in the following Table 8.

Table 8. Project buffer recapitulation

| No | Type of work | Buffer Amount |
|----|--------------|---------------|
| I  | Preparatory work | 0 |
| II | Demolition work | 2 |
| III| Drainage and flood gates work | 55 |
| IV | Drainage control box work | 32 |
| V  | Carrier drainage works | 45 |
| VI | Carrier drainage control box work | 22 |
From the calculation for buffering time, it functions to protect work activities from the impacts of waste and risks that have been identified previously so that they can be completed on time and there will be no multitasking, Student's Syndrome, Parkinson's law. The CCPM method will eliminate hidden safety and move it in the form of a buffer behind the project and focus on the final completion of the project.

4.5.3 Resource estimation.
From the results of the calculation it can be seen the total number of workers needed in each type of urban drainage construction in X Area in Bekasi City. On the principle of management, the number of workers used each day, the shorter the duration of work, the number of workers needed will increase.

4.6. Cost savings based on CCPM scheduling and risk reduction
The results of the calculation of cost savings in the construction of urban drainage in Area X Bekasi City can be seen in Table 9.

Table 9. Cost savings recapitulation

| No | Type of work                        | Buffer Amount | Cost     | Total     |
|----|------------------------------------|---------------|----------|-----------|
| I  | Preparatory work                   | 0             | 445,561  | -         |
| II | Demolition work                    | 2             | 21,308,935 | 21,796,498 |
| III| Drainage and flood gates work      | 55            | 4,242,626 | 231,951,758 |
| IV | Drainage control box work          | 32            | 2,137,176 | 68,505,391 |
| V  | Carrier drainage works              | 45            | 5,042,914 | 228,772,731 |
| VI | Carrier drainage control box work   | 22            | 2,033,770 | 45,019,421 |
| VII| Retaining wall lift work           | 7             | 670,331  | 4,692,317 |
| VIII| Genset and mechanical electrical work | 14           | 7,618,618 | 106,660,649 |
| IX | Modular retention pond works       | 30            | 70,448,289 | 2,092,207,443 |
| X  | Road repair work                   | 21            | 3,051,399 | 64,079,370 |

Total     2,894,136,099

Based on the results of the analysis, the modular retention pool work which has the highest cost savings is Rp. 2,092,207,442, - and at the work of raising the retaining wall for the lowest cost savings, Rp. 4,692,317. So that the total savings with the CCPM method in the work of the urban drainage in X Area Bekasi City is Rp. 2,894,136,099,-.

5. Conclusion
Based on the results of the analysis and calculation of the Lean Project Management method for the construction of urban drainage system in X Area Bekasi City at 2019, it can be concluded as follows:

1. From the results of waste analysis, it can be seen that the most influential waste in the implementation of construction is HSE (Health Safety and Environment), Waiting, Defect and Unneeded Process. The following are the factors that cause waste to appear as well as solutions to reduce or mitigate it.
   a. Lack of application of HSE in the field, so the solution is implementing the HSE Planning according to the contract. This is an obligation for all job implementers, in this case the contractor, carries out HSE supervision and control in every work implementation.
   b. Material that arrives late, so the solution is doing other work that does not use material that has not yet reached the project site. This effort was taken to make time efficient by doing other work first without disrupting the sequence or other process units running properly and contacting the material vendor to get the material following the schedule.
   c. Lack of coordination and socialization to local residents, so the solution is making communication with the local resident, in terms of community participation in
construction activities to be a local or other security force. Then, conducting intensive socialization to the local residents during implementation.

d. The tool is not used effectively and is the biggest factor for waste waiting. The solution is making the tools efficient so that they are not easily damaged by using tools in accordance with SOP and specifications of the tools used in the construction.

e. Poor field supervision is the biggest factor for waste defects, the solution that the Technical Directors conduct more intensive supervision in the field. Supervision of the progress of the work and check the suitability of the field with the contract that needs to be fulfilled by the implementing contractor so that the work goes according to existing construction planning.

f. The labor is less skilled is the biggest factor for waste unneeded processes, the solution is to replace workers who are more skilled according to their abilities and need for placement of skilled workers and in accordance with their abilities.

2. Based on the results of risk identification using the FMEA method, the level of risk hazard that may occur at the activity site needs to be anticipated earlier to minimize the risk impact. The results are some risks that are very important to note are lack of application of HSE in the field, lack of coordination and socialization to the local residents, the tool is not used effectively and less skilled workers. Efforts to reduce these risks are carried out with a reduction and mitigation so that the same risk does not occur when carrying out other work.

3. From the estimated cost of the project in the construction of urban drainage in the X Area Bekasi City, there has been a change in the estimated price of 8.9% greater than the planning cost (initial contract). This will certainly affect changes in schedules and human resources used during construction.

4. From the estimation of the scheduling using the CCPM method the acceleration of work results, namely for preparatory work there is no project buffer, we can reduce project buffer all of working details up to 218 days.

5. If the project buffer is not used at all, then we will get cost savings. The total savings with the CCPM method in the construction of urban drainage in X Area Bekasi City is Rp. 2,894,136,099.

References
[1] Directorate of Settlement Environmental Sanitation Development 2016 Technical Basics and Urban Drainage Management (Jakarta: Directorate of Human Settlements Ministry of Public Works)
[2] Ediseno S 1997 Urban Drainage (Jakarta: Gunadarma Press)
[3] Supirin 2004 Sustainable Drainage System (Yogyakarta: Andi Offset)
[4] Rosyidin H P 2016 Operational Performance in the Sanitation and Landscape Service of Bukittinggi City vol 3 no 1 JOM FISIP pp 1-10
[5] Nurmandi A 1999 Urban Management (Yogyakarta: Lingkaran Bangsa)
[6] Wollman N D 2003 Introduction to Public Policy Analysis (Yogyakarta: Gadjah Mada University)
[7] Daryanto 2007 Introduction to Public Policy Analysis (Jakarta: Rineka Cipta)
[8] Dimyati H and Kadar N 2014 Project management (Bandung: CV Pustaka Setia)
[9] Gaspersz V 2007 Lean Six Sigma for Manufacturing and Services. Industries (Jakarta: PT. Gramedia Pustaka Utama)
[10] Hinnes and Taylor 2000 Going Lean, Lean Enterprise Research Center (Wales: Cardiff Business School)
[11] Silvia H S U, Ariestides K T D and Robert J M M 2014 Application of the Lean Project Management Method in Construction Project Planning (Case Study: Construction of the Mantos Building Stage II) vol 2 Static Civil Journal pp 320-329
[12] Hezanita A 2019 *Use of WBS (Work Breakdown Structure) Standards in Building Projects 5 (1)* Infrastructure Journal pp 29-34

[13] Santosa B 2013 *Project Management Concepts and Implementation* (Yogyakarta: Graha Ilmu)