Lean Project Management as a Solution in Overcoming Process Barriers from the Project Life Cycle

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***Abstract*—** Delays in the project management of change (MOC) process result in cost inefficiencies, poor reputation, and poor quality, so it is important to address these delays. This study identifies the factors causing the delay and proposes improvements as a solution. The concept approach is Lean Project Management. The research design is an exploratory sequential mixed method by selecting one sample of the MOC project using the purposive sampling technique. Primary data collection was use Focus Group Discussions (FGD) and observation, while secondary data uses documentation studies. The analysis technique uses value stream mapping (VSM) and why-why analysis. Mapping each work process and time using VSM to find out which jobs are value-added, non-value added, and non-value added but necessary. The results showed that there were communication gaps, poorly controlled plans and time schedules, and unclear RACI (responsibility, accountability, consult, and information) from everyone involved. This results in waste in the form of inappropriate waiting and processing. This is because understanding the concept of modification and detailed design of the MOC cannot be achieved comprehensively. The proposed improvement plan is to use a project charter, develop a realistic and consistent schedule plan, and review and socialize RACI.

***Keywords*—** Lean project management, management of change, value stream mapping.

I. INTRODUCTION

In the operational production system of a petrochemical olefin plant, of course, there can be problems such as inefficiency, ineffectiveness, or low-profit margins.

This is where the technology, engineering, and construction (TEC) division are needed, whose duties include planning, and managing changes or additions to facilities in factory operations, where the process is called management of change (MOC).

The MOC process begins with the process of applying for changes or additions facility, followed by process, and engineering studies, continuing with the implementation /construction process until the testing/ commissioning of the new facility.

The target results of this MOC project are mainly in the context of growth, reliability, cost saving, asset integrity (compliance with government regulations, safety, and insurance), and new business long-term sale-purchase.

The phenomena of research was raised when the general manager meeting that user/ customer complaint about taking long a time to proceed MOC project.

Based on this issue has to explore what factors the MOC project low production (delay) project life cycle work and how to overcome barriers running the project live cycle.

Results of the literature review show that (Womack & Jones, 1997) and (Ohno & Bodek, 2019) explained seven waste concepts related to Project Management and identified the cause of a project can failure mainly due to two reasons, namely failure of estimation and failure of implementation.

The high productivity ratio and the minimum percentage of waste are strategies to improve the quality of construction development (Syahri et al., 2017). Value stream mapping is used as a method to analyze the percentage of waste (time loss) called delay due to workers, equipment, and materials in column work.

(Amran et al., 2019) evaluated a storage tank cap of 10000 L with a Lean Project Management approach and the application of buffer time could save costs by 0.06% and reduce work schedules by 39%.

(Shou et al., 2021) stated that well-organized project management is essential to improve turnaround maintenance (TAM) efficiency by using a systematic lean management framework based on value stream mapping, structured analysis, and validation in the oil and gas industry.

Project management governance such as coordination and communication, work planning, and scheduling is the subject of research (Dasí et al., 2021; Hopmere et al., 2020; KABETO, 2020; Khatib et al., 2020; Turner & Miterev, 2019; Yap et al., 2021) there is an early warning in the achievements of a project.

In addition, after identifying the stakeholder groups participating in the closure phase, responsibilities and roles were proposed as RACI (Responsible,

Accountable, Consulted, and Informed) models by mapping the closure phase of processes and stakeholders. (O'Connor & Mock, 2020) use of the commissioning construction start-up (CCSU) activity flowchart and RACI models will help CCSU managers to better understand the distribution of responsibility and accountability for CCSU activities on their projects and will help them avoid miscues and oversights due to vague or ambiguous assignments.

These phenomena research as above explain that related to some previous journals such as lack of communication among team and arrangement to control of timeline (plan and schedule).

The phenomenon of delays in the life cycle of a project, according to theory (Womack & Jones, 1997), is closely related to poor management governance such as project planning, low labor performance and productivity, inflated budgets, and inappropriate specifications.

Another factor that causes non-value-adding activities is the ineffectiveness of several factors involved in project implementation (man, method, machine, material, and environment), so project completion can be delayed.

Different from previous research is not found the factor of role and responsibility parties involved as found simultaneously in one package of research with another factor. Role and responsibility related to the approved organizational structure of every company.

II RESEARCH METHOD

The research design of this study is the sequential exploratory mixed method. Quantitative and qualitative data are taken in this study.

Referring to the problem formulation and objectives research and mapping of work values (Value Stream Mapping) MOC project progress report of 122 MOC application data yearly is required including the time duration for each process activity in the implementation phase of the MOC project.

One sample case MOC to be a representative sample due to high-cost budget, annual coat saving, and quick return on investment.

Triangulation data sources such as Primary data has been taken through Focus Group Discussion (FGD), especially with the project control engineer as the informant, and secondary data in the form of documentation from the MOC Master List.

The whole data took from Engineering Construction Division of Petrochemical Company in Banten, Indonesia.

Data analysis using the value stream analysis tool (VALSAT) and seven tools will be used to analyze these wastes.

Determination of suitability is done by multiplying the average score of each waste with the value stream mapping suitability matrix

Value stream mapping (VSM) with the largest total score according to the VALSAT results will be used as the selected mapping to identify waste in detail.

This selection is since the VSM with the largest value is most suitable for identifying waste in the value stream.

VSM Stage 1 conducts current state stream mapping select service/process, establish mapping and data collection ground, map process flow, map material flow, indicate time pulse, map information flow, identify value added (VA), non-value added (NVA), and non-value added but necessary (NNVA).

Stage 2, the current state VSM with opportunities, identifies opportunities through waste analysis, and why-why analysis takes one sample of MOC that has a higher budget cost.

Finally entered Stage 3, future state stream mapping where there is an improvement plan that will cut the MOC project process time effectively and efficiently.

III RESULT AND DISCUSSION

A. RESULT

The MOC process will be described as a workflow diagram as illustrated in Figure 1 which describes of matrix between MOC Workflow against parties who are going to involve in the MOC process.

Before conducting VSM, a detailed review of the progress of each work process in the year 2021 is illustrated in Figure 2. In Table 1 and Figure 2 there is a gap between Phase 2 of 122 MOC and the completed work stage of 69 MOC.

This means that there is a gap of 122 – 69 = 53 MOC or if 122 MOC is the basis then only 69/122 = 57% of MOC construction was completed and there are 43% whose construction was not carried out.

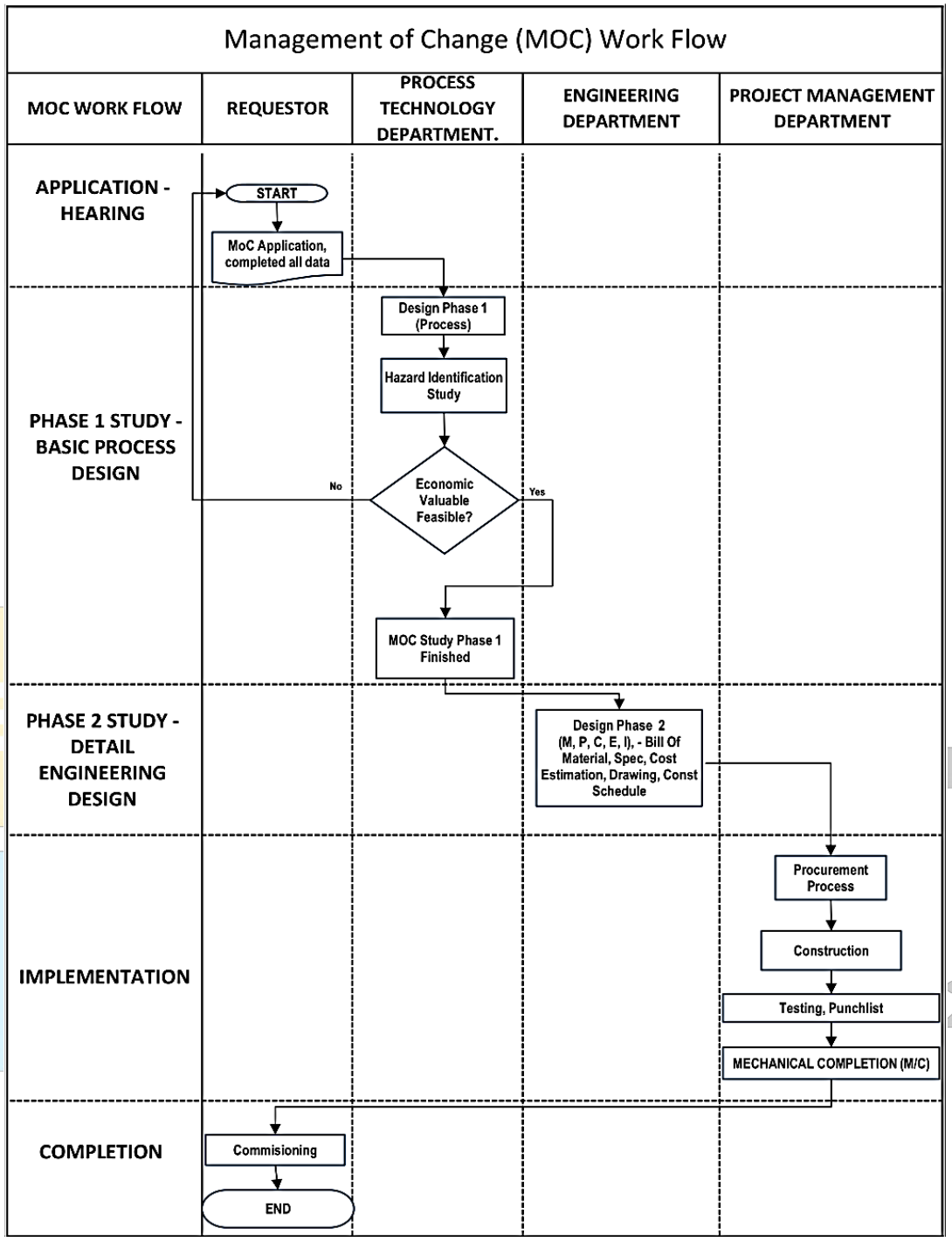

Figure 1: *MOC Process Workflow Diagram (Source: Company Procedure 2021)*

Table 1: *Progress Report MOC Work in 2021*

Activities	Plan/Actual	Number of MOC (unit)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Phase 1	Plan	73	78	89	96	102	113	113	113	113	113	113	113
	Actual	52	57	78	92	92	94	100	108	108	108	113	113
Phase 2	Plan	68	69	72	77	84	88	96	105	113	117	118	122
	Actual	65	68	76	78	84	88	90	116	118	118	121	130
Implementation	Plan	0	2	10	18	25	32	35	46	50	51	66	78
	Actual	0	4	7	19	24	26	29	32	36	55	60	69

Source: Progress Report MOC, TEC Division (2021)

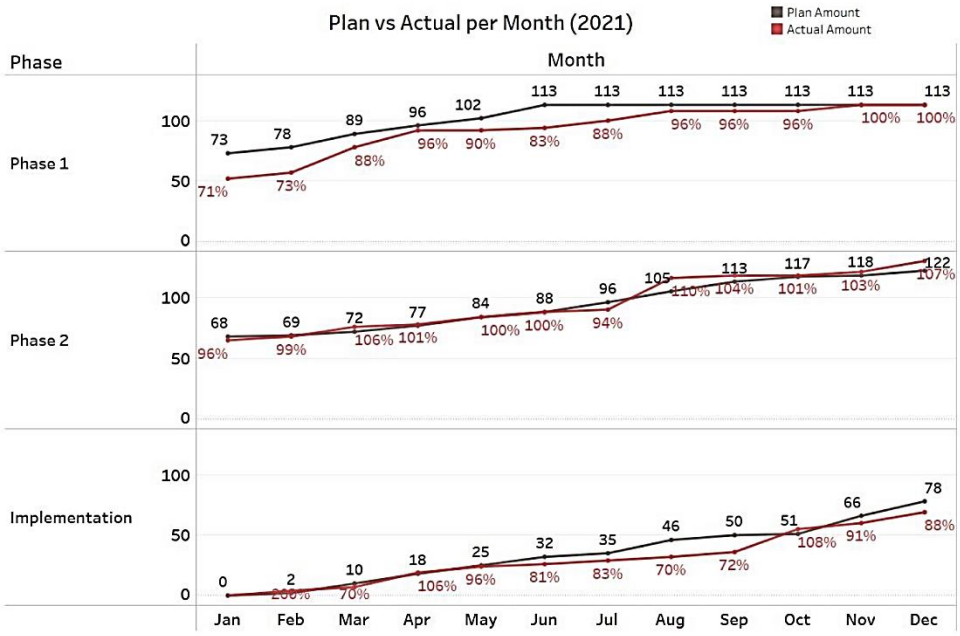

Figure 2: *Plan Versus Actual per Phase per Month in 2021 (Source: Processed data, 2021)*

Figure 2 shows that the implementation phase compares to Phases 1 and 2 indicating low productivity, Phases 1 and 2 can achieve about 100 MOC but the implementation phase can achieve only about 60 MOC. The implementation phase is the focus of research due to the low productivity of completing MOC. The implementation phase consists of the procurement process (material and service), construction, testing, and commissioning.In this research, the initial implementation process, namely the procurement process (material and service) will be the focus of waste analysis. The waste analysis uses the VSM method. Data collection and analysis of data wastage using the Process Activity Mapping tool. Mapping process activities can analyze what work steps are wasteful and the amount of time wasted and can find out whether the waste that occurs is NVA or NNVA.

Stage 1 waste mapping via VALSAT is in Table 2. The number of MOC is 53 MOC are assumed as waiting for waste and 5 MOC as inappropriate processing. It is illustrated that Process Activity Mapping (PAM) is ranked first in waste contribution. Conduct current PAM as of Table 3 that mapped the whole activity starting to prepare an invitation to bid (ITB) until the kick-off meeting (KOM), stated how much time consumed each activity and identify the value of work whether are VA, NVA, or NNVA also identify kind of waste. Summarized process activity mapping in Figure 3 as current state VSM with summary PAM in Table 4.

Based on PAM (Table 3) and the real explanation of VALSAT (Table 5), it shows that there is still waste waiting for 170 hours or 41% in work activity ITB, Quotation, and KOM. Inappropriate processing waste for 244 hours or 59% in work activity ITB, Quotation, TE Material/Service. These two wastes are NVA and NNVA components, which require proper repair to be able to eliminate them and turn them into VA activities.

Table 2: *Value Stream Analysis Tools (VALSAT)*

Waste	**Quantity**	**%**	**Process Activity Mapping**	**Supply Chain Response Matrix**	**Production Variety funnel**	**Quality filter mapping**	**Demand amplification mapping**	**Decision point analysis**	**Physical Structure a) volume b) value**
Overproduction	1	2	2% x L (1)	2% x M(3)		2% x L (1)	2% x M(3)	2% x M(3)	
Waiting	53	84	84% x H(9)	84% x H(9)	84% x L(1)		84% x M(3)	84% x M(3)	
Excessive transportation	1	2	2% x H(9)						2% x L(1)

Inappropriate processing	5	8	8% x H(9)		8% x M(3)	8% x L(1)		8% x L(1)	
Unnecessary inventory	1	2	2% x M(3)	2% x H(9)	2% x M(3)		2% x H(9)	2% x M(3)	2% x L(1)
Unnecessary motion	1	2	2% x H(9)	2% x L(1)					
Defect	1	2	2% x L(1)			2% x H(9)			
Overall structure	63	100	8,65	7,78	1,13	0,14	2,71	2,7	0,03
Ranking			1	2	5	6	3	4	7
Notes:	H: High correlation and usefulness (9)								
	M: Medium correlation and usefulness (3)								
	L: Low correlation and usefulness (1)								

Source: Focus Group Discussion & Document MOC (2021)

Table 3: *Process Activity Mapping (PAM)*

No.	Work Activity	Time Consumed		Responsible Dept	Operation	Delay	Value			Waste Identification	
		Days	Hours				VA	NVA	NNVA		
I	Invitation To Bid (ITB)	20	160	Project Management Dept (PMD)	O	D	√		●	●	Inappropriate processing
								◊		◊	Waiting
II	PR/PRS	2	16		O		√				
III	Quotation	16,3	154	Contract and Purchasing Dept. (C & P)	O		√		●	●	Inappropriate processing
								◊		◊	Waiting
IV	TE Material	17	136	PMD	O	D	√		●	●	Inappropriate processing
V	TE Service	20	160	PMD	O	D	√		●	●	Inappropriate processing
VI	CCM	14	112	C & P	O		√				
VII	Kick-Off Meeting (KOM)	7	56	C & P	O	D	√	◊		◊	Waiting
	Grand Total	96	794								

Note : VA = Value Added, NVA = Non-Value Added, NNVA = Non Value Added but Necessary | Source : Data Processing (2022)

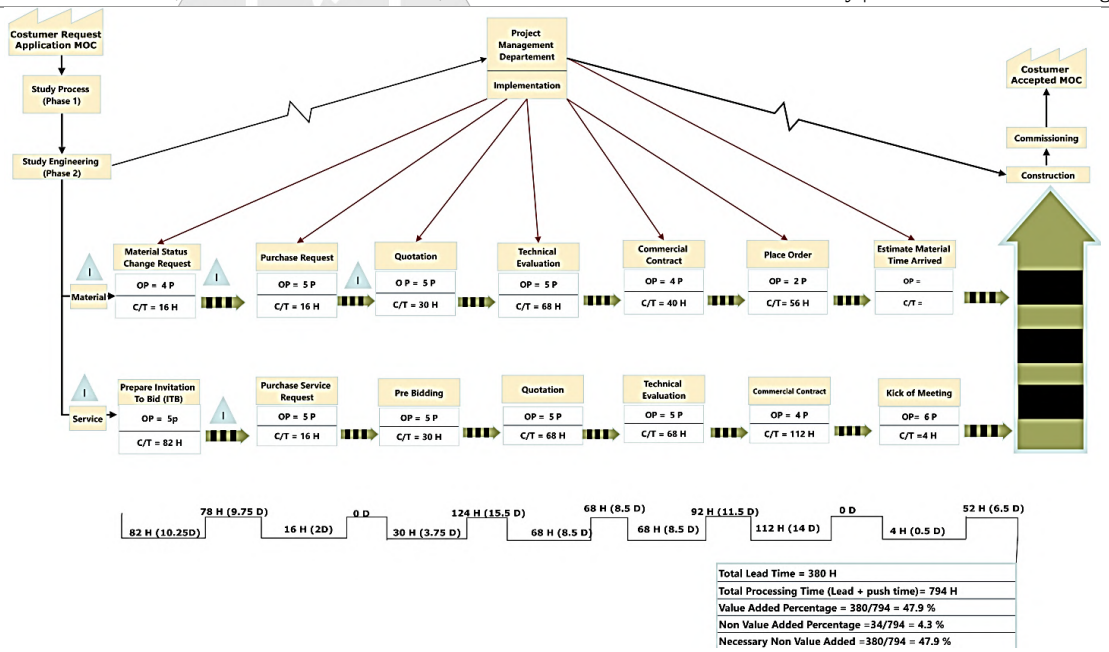

Figure 3: *Current State Value Stream Mapping (Source: Data Processing (2022))*

Table 4: *Summary Current Process Of Activity Mapping*

Work Value	Time Consumed (hour)	PMD (hour)	C & P (hour)	Percentage (%)
VA	380	234	146	47,9
NVA	34	18	16	4,3
NNVA	380	220	160	47,9
Total	794			100

Source: Data Processing (2022))

Table 5: *Real Value Stream Analysis Tools (VALSAT)*

Waste	Q'ty	%	Process Activity Mapping	Supply Chain Response Matrix	Production Variety funnel	Quality filter mapping	Demand amplification mapping	Decision point analysis	Physical Structure a) volume b) value
Overproduction	0	0	0	0		0	0	0	
Waiting	170	41	3,69	3,69	0,41		1,23	1,23	
Excessive transportation	0	0	0						0
Inappropriate processing	244	59	5,31		1,77	0,59		0,59	
Unnecessary inventory	0	0	0	0	0		0	0	0
Unnecessary motion	0	0	0	0					
Defect	0	0	0			0			
Overall structure	414	100	9	3,69	2,18	0,59	1,23	1,82	0

Conduct an improvement plan as described in Table 6 where some NNVA and NVA activities are replaced with an activity in the improvement plan at some row of Table 6. Thereby reducing processing time and increasing the time VA and the results can be seen in Figure 5 as future state VSM.

In Table 6, improvement tasks (in 'after' Colom) that will relate to being carry out some advance activities such as preparing the project charter (understanding of MOC), preparing a realistic timeline project schedule and conducting clarification items to Vendor. This task involves a design engineer, project control engineer, and project engineer who will prepare a project charter, and a realistic timeline.

Improvement work activity will replace previous work activity, hence impact to reduce the consumed of time activity of some activities such as ITB, Quotation, TE Material/Service, and KOM.

Table 6: *Improvement Plan*

	Work Activity		Time Consumed		Responsible Dept	Value			Waste Identification	
	Before	**After**	**Before**	**After**		**VA**	**NVA**	**NNVA**		
I	Invitation To Bid (ITB)		160	126	Project Management Dept (PMD)	√		●	●	Inappropriate processing
	Prepare ITB format									
	Project Eng asks to Design Eng about available time for meeting	Design Engineer to prepare design concept of MOC in format Project Charter & continue to be meeting w/ Project Control Eng, Project Eng and Inspection Eng								
	Prepare invitation meeting w/design engineer	Project Control Eng & Project Eng to prepare realistic time lime Project Schedule								
	Waiting for meeting	Finalization Timeline Schedule subject to approval w/ Section Manager								
	Meeting with Design Engineer									
	Prepare Resume Meeting & approval									
II	**PR/PRS**		**16**	**16**		√				
III	**Quotation**		**154**	**110**	**Contract & Purchasing**	√		●	●	**Inappropriate processing**

					Dept (C&P)			◊	◊	Waiting
I V	TE Mat'l		136	100	PMD	√		●	●	Inappropriate processing
	Engineer request vendor for clarification	Project Control Engineer asks clarification to vendor and if require subject to meeting discussion								
	If still not clear subject to arrange meeting									
V	TE Service		160	116	PMD	√		●	●	Inappropriate processing
	Engineer request vendor for clarification	Project Control Engineer asks clarification to vendor and if require subject to meeting discussion								
	If still not clear subject to arranging a meeting									
V I	CCM		112	112	C&P	√				
V II	Kick Off Meeting (KOM)		56	32	C&P	√				
	Grand Total		794	612						
Note : VA : Value Added, NVA : Non Value Added, NNVA : Non Value Added but Necessary. Source : Data Processing (2022)										

Stage 2 Conduct a 'Why-why' analysis of one sample case of the MOC project described in Figure 4. It has a delay of 42 days, Control Valves purchase process. The why-why analysis describes problems, phenomena, principles, the parameter used, and root causes related to humans, methods, machines, materials, and environment (4M+E). Discussion Why-why analysis involved the manager, engineer, and Corporate Management Organization (who guide & validate these analysis). Refer to Figure 4. There are some unfavorable conditions indicated by NG, where this becomes the basic reference for determining the root cause, described in his findings in Table 7.

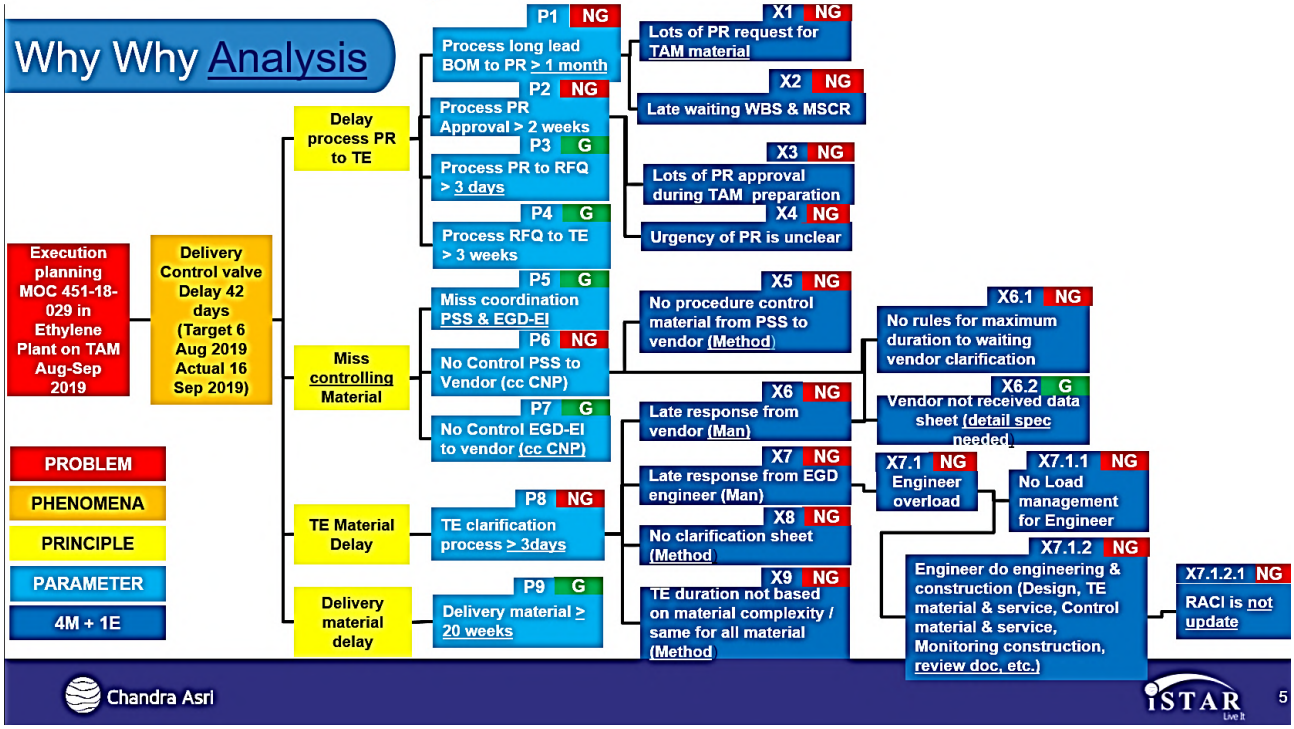

Figure 4: *Why-why Analysis in A Case of MOC | Source: Data processing Why-why analysis TEC team (2022)*

Table 7: *Finding No Good (NG) Condition*

Root Causes		4M + 1E Categories	Waste Categories
X5	No procedure control material from PSS to vendor	Method	Identification Role & Responsibility of each member involved (Inappropriate Processing)

Root Causes		4M + 1E Categories	Waste Categories
X6.1	No rules for a maximum duration of waiting for vendor clarification	Method	Not implemented in terms of control planning & scheduling (Waiting)
X7.1.1	Engineer work overload due to activity out of Role & Responsibility	Man	Identification Role & Responsibility of each member involved (Inappropriate Processing)
X7.1.2.1	Responsibility Accountability Consult Inform (RACI) is not updated	Method	Identification Role & Responsibility of each member involved (Inappropriate Processing)
X8	No clarification sheet	Method	Identification Role & Responsibility of each member involved (Inappropriate Processing)
X1	Lots of PR requests for TAM material	Method	Identification Role & Responsibility of each member involved (Inappropriate Processing)
X2	Late waiting of Work break Down Structure (WBS) & MSCR	Method	Not implemented in terms of control planning & scheduling (Inappropriate Processing)
X3	Lots of PR approval for TAM material	Method	Identification Role & Responsibility of each member involved (Inappropriate Processing)
X4	The urgency of PR is unclear	Method	Identification Role & Responsibility of each member involved (Inappropriate Processing)
X9	TE duration is not based on material complexity, threated same for all material	Method	Not implemented in terms of control planning & scheduling (Inappropriate Processing)

Source: Data processing Why-why analysis TEC team (2022)

Finally, after mapping activities via Current State Value Stream Mapping and Why-why Analysis, they have a dominant pattern of waste activity, namely waiting and inappropriate processing and via Why-why analysis found root causes of Role & Responsibility (RACI) from parties involved. So that after the proposed improvement plan, the Future State VSM forecast can be shown in Figure 5. as Stage 3

Table 8 are summary improvement plan that describes a comparison before and after improvement, VA requirement times are increased from 380 hours to be 412 hours, NVA is reduced from 34 hours to be 0 hours, and NNVA is reduced from 380 hours to be 200 hours. The whole processing time of the implementation phase, especially in the procurement phase (material and service) is reduced from 794 hours to 612 hours. Summarized can be described in Figure 6.

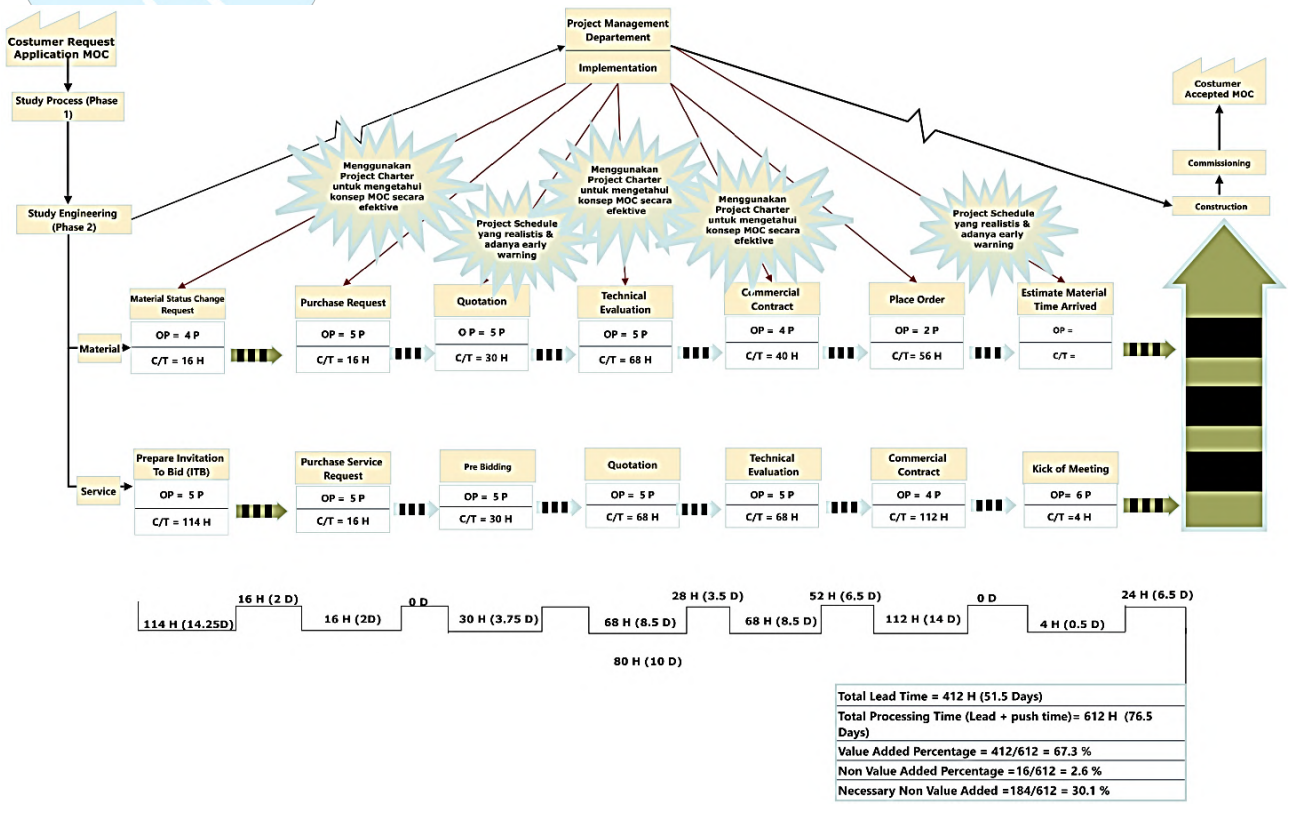

Figure 5: *Future State Value Stream Mapping | Source: Data Processing (2022)*

Table 8: *Summary Improvement Plan*

No	Work Value	Time Consumed		Percentage %	
		Before	After	Before	After
		Hour	Hour		
1	Value Added	380	412	47,9	67,3
2	Non-Value Added	34	0	4,3	0,0
3	Non-Value Added but Necessary	380	200	47,9	32,7
	Total Processing Time	794	612	100,0	100,0

Source: Data Processing (2022)

Figure 6: *Summary after Conducted Improvement Plan (Source: Data Processing (2022))*

Referring to Tables 9 and 10, conduct estimation number MOC project can be achieved at the end of the year based on the increment of VA 19.5% (67.3% - 47.9%). An increment of 19.5% can be used as a constant in linear estimation as follows: Estimation number MOC = (0.195 x Actual complete 2021) + Actual complete 2021

Table 9: *Estimation Number MOC Project Achieved at End of Year*

Work Activity	Plan / Actual	Number MOC (unit in Annual)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Phase II *	Plan	68	69	72	77	84	88	96	105	113	117	118	122
Implemented*	Actual	0	4	7	19	24	26	29	32	36	55	60	69
Estimate after Improvement		0	5	8	23	29	31	35	38	43	66	72	82
Note : *Based on Progress Report in the Year 2021													

Table 10: *Summary of Estimation Increment Number and Percentage MOC Project Achieved at End of Year*

Requirement Time				Number of MOC (Ea.)	Actual Complete until the end of the year (Ea.)	Estimate the number of MOC that can be achieved by the end of the year (Ea.)	Estimate the increasing number of MOC in percentage (%)
Before		After					
Days	Month	Days	Month				
99	4	77	3	122	69	82	19,5

Source: Data Processing (2022))

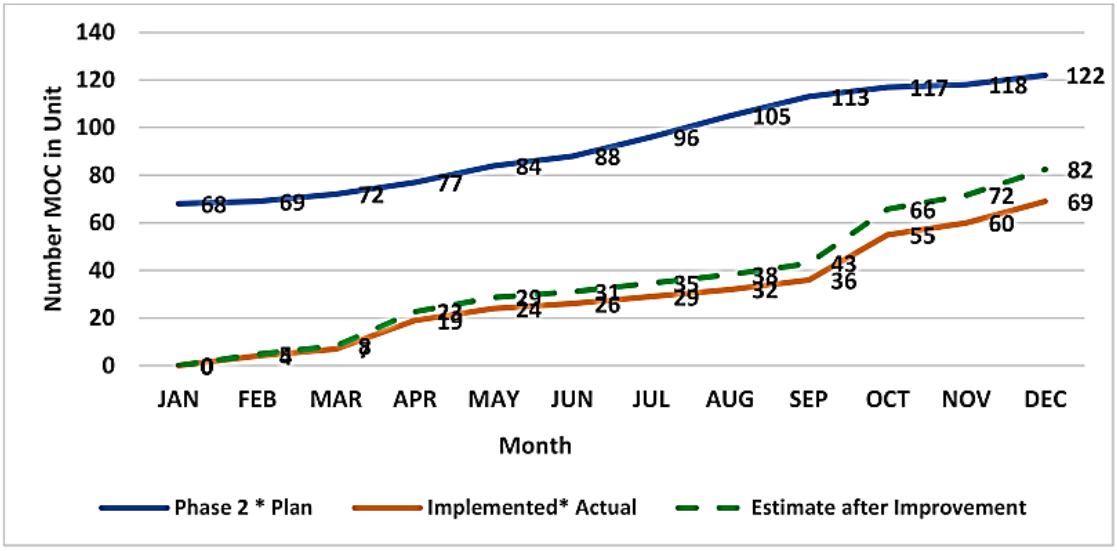

Figure 7: *Estimate Number of MOC Can be achieved until the End of The Year | Source: Data processing (2022)*

B. DISCUSSION

Revisit the problem statement in introduction what factors that MOC project was low production (delay) project life cycle work, Table 5 the current condition indicated waste, first is waiting (41%) this waste from the research findings is due to inaccuracies in the preparation of time planning and schedule, especially for the pre-bidding and kick-off meeting (KOM) processes. This creates time uncertainty in the process of preparing for the pre-bidding and kick-off meeting. Second, inappropriate processing (59%), this waste is from the research findings due to some activities that are time-consuming but necessary. This is because the understanding of the design concept of the MOC cannot be fully understood by the implementing parties, both the owner and the contractor or vendor. Then each party has an ambiguous of understanding who role is responsible to take care of the same activity in project MOC.

Refer to Table 6 improvement plan in which some NNVA and NVA activities are replaced with VA activities, thereby reducing processing time and increasing VA time and the results can be seen in Table 8. Value added increased from 47.9% to 67.3%, NVA decreased by 4.3% to 0%, and NNVA decreased from 47.9% to 32,7%. Simplify diagram after improvement describe in Figure 4, as the future state of value stream mapping is the flow of the work process after an update.

Mapping through VSM by carrying out an improvement plan (Table 6) where in 2021 the plan for 122 MOCs has been completed, and it turns out that only 69 MOCs have been completed. This means that there is a gap of 53 MOC or 43% that has not been completed. After the Improvement plan, as shown in Figure 7, the number of completed MOC will likely increase to 82 MOCs. This means that the gap will be reduced by 32% and productivity will increase by 19.5%.

In principle, the recommendations for improvement in this study have referred to the factors causing delays in the MOC project. However, in addition to management governance, role, and responsibilities factors, it must also comprehensively look at its suitability with the company's organizational structure.

IV. CONCLUSION

Some factors that made low production project life cycles such as poor communication among the team parties involved in MOC work, poor control of plan, and schedule and unclear role and responsibility of each team party also make ambiguities.

How to overcome barriers running a project live cycle.

Improvement suggestions from this research are first to utilize the project charter to get a comprehensive understanding of whole parties that are involved in the content of the MOC project through discussion & socialization. Second, make a realistic plan and schedule in detail with adding buffer time, early warning if unplanned with a prepared recovery plan and then updated, during implementation progress report shall be shown in the progress meeting with highlight issues shall be raised up in this meeting. The third role and responsibility of each team party shall be socialized and implemented consistently and initiated from the managerial level. For whole improvement suggestion, General Manager shall start by appointing a Person in

Charge (managerial level) to run this improvement suggestion and monitor periodically.

The shortcoming of this research is that research does not conduct to find a realistic standard time how long the activity to be done. This research focus on what activity can be improved to be advanced work that can eliminate the activity waste categories. Finally, top management until technician shall strongly commit to eliminating waste.

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