THE IMPROVEMENT OF CONTRACTOR WORKFORCE PRODUCTIVITY PERFORMANCE THROUGH COLLABORATIVE APPROACHES OF THE INTEGRATED PERFORMANCE MEASUREMENT SYSTEM (IPMS) AND LEAN SIGMA PROCESS IN THE "MATURE OIL FIELD" OPERATION (Case Study: Light Oil Operation in Scattered "X" Field)

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Abstract

Now days most of oil fields in Indonesia have been categorized as mature oil field operation and its oil production trend continued to decline. PT. ABC is a multinational oil company that had been operating and managing several oil fields in Indonesia since 50 years ago. The current situation has led to narrowing the company revenue margin since the lifting cost trend tends to increase while the total oil production declines over time and its major component is the contractor cost. Refer to stakeholder's voice indicates that the contractor low productivity level occurs by too much workers showing in-effective manpower usage and in-efficient working time.

The Integrated Performance Measurement System (IPMS) aimed the company to describe the performance measurement system of contractor workforce productivity in "Mature Oil Field" Operation in the form of business level integration that consists of Business Parent, Business Unit, Business Process and Activities. As the result, 3 (three) Key Performance Indicators (KPI) were determined during IPMS implementation in accordance to properly measure the current productivity level of contractor construction workforce in scattered "X" field as expected by the stakeholders. These Key Performance Indicators (KPI) are; Productive Ratio, Supervision Cost, and Schedule Compliance. These KPI's are being applied for both Work-Unit Base and Resource-Hour Base Contractors.

PT. ABC business process improvement tool of Lean Sigma DMAIC roadmap has been successfully applied to provide statistical data baseline, analytical root cause, generate the improved scenario to achieve metrics as defined and sustain its improved process within the next 12 months of control phase. The total financial benefits claimed is **US$ 2.4 MM** by improving ~ 43% working time productivity ratio, supervision cost saving by 10% and sustain effective 8 (eight) hours working of resource-hour base contractor.

The Integrated Process Measurement System (IPMS) and Lean Sigma collaborative approaches have given a platform of common understanding among the parties and measurement of progress towards readiness for the process improvement deployment as well as to ensure its sustainability.

Key words:

Integrated Performance Measurement System (IPMS), Lean Sigma, Contractor Workforce Productivity, Construction

1. Introduction

Company Background

PT. ABC is one of multinational oil company that had been operating and managing several oil fields in Indonesia since 50 years ago through contractual obligations with Government of Indonesia (GOI) which well known as Production Sharing Contract (PSC).

The Indonesian Production Sharing Contract (PSC) applied in the petroleum sector industry for foreign oil and gas companies since 1960s to manage and regulate foreign company to explore, exploitive and develop new oil well program in the oil fields consensus area. As managed by PSC terms, SKKMIGAS' approval should be secured by PT. ABC prior to execute the exploration or exploitation projects in Indonesia. Exploration and exploitation costs borne by the foreign companies are recovered when commercial production is established.

Most of oil fields in Indonesia have been categorized as mature oil fields and its total oil production trend continued to decline over time. Indonesia's crude oil production declined over the last decade due to the natural maturation of producing oil fields combined with a slower reserve replacement rate and decreased exploration initiatives.

The high uncertainty of new oil well development project success through both approaches of exploration and exploitation activities in mature oil fields has put PT. ABC to urgently perform business process performance improvement in order to cut off the high contributor operation cost. The current situation has led to narrowing the company revenue margin since the lifting or operation cost trend tends to increase while the total oil production declines over time.

Base Business Value Stream Mapping (VSM) was performed to investigate and identify the ineffective or inefficient process and as result, the report has generated some findings regarding the major contributors of operation cost was the contractor cost. Refer to stakeholder's voice indicates that the contractor low productivity level occurs by too much workers showing in-effective manpower usage and in-efficient working time

Currently, Scattered "X" Light Oil Operation runs 1,200 oil wells and other 2,000 injector wells in production sharing concession or PSC areas totaling around 2,700 square kilometers. In 2012, PT.ABC employs 1,500 highly skilled personnel stationed in Scattered "X" Light Oil Operation. A number of business partners also support Scattered "X" Light Oil Field and they employ around 2,000 workers.

The total of active contract values which are currently managed by PT. ABC is more than USD 1 Billions that cover several long term and short term contracts to accommodate business activities such as construction, operation and maintenance, drilling, well work, pumping unit, engineering and etc. The following graphic is showing the baseline data of PT. ABC Active Contract values;

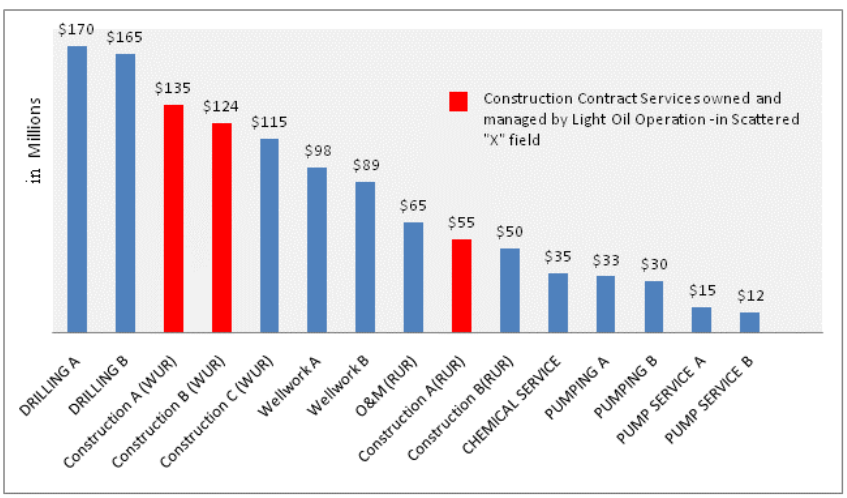


Fig. 1: PT. ABC – Top 15 Active Contract Values

Total Construction contractor population who working on Scattered "X" light oil operation is around 1,000 workers that are coming from 3 (three) construction contractors services.

Problem Formulation

One of the base business issues in this paper is how to improve the contractor workforce productivity performance through collaborative approaches on Integrated Performance Measurement System (IPMS) and Lean Sigma in the "Mature Oil Field"– Scattered "X" Light Oil Operation.

In this problem formulation, The Integrated Performance Measurement System (IPMS) aimed to describe the performance measurement system of contractor workforce productivity level and shall be formally formed as Key Performance Indicators (KPI). The scope of research only considers the construction contractor workforce in scattered "X" Light Oil Operation during 2011-2012 periods.

The existing Performance Measurement system used for contractors is done informally by using several indicators of measurement that are not really integrated. The Integrated Performance Measurement System developed by Wibisono (2006) can be considered as a refinement of the concept of BSC and Performance Prism, because it combines simplicity of design with attention BSC-Prism performance on the stakeholders, which is expected to be applied to companies in Indonesia.

Lean Sigma DMAIC Process Improvement tool will later be used to guide in achieving the defined metrics or KPI as results of IPMS study. This analysis study utilized both primary (in-depth interviewing for company officers as well as business partners and working time sampling process) as well as secondary resources (books, internets and newspaper). Some examples of actual cases in the field will be used as material to deepen the discussion perspective.

The root causes analysis (5 WHYs method & Fishbone diagram) was performed by involving all parties both from company officers and business partner supervisors in order to find the "exact" system level root causes that led to low of contractor workforce productivity performance in scattered "X" Light oil Operation during 2011-2012 periods.

Cause – Effect or Fishbone Diagram, has identified some of interconnection root causes that contributed to the low contractor productivity performance, as shown below;

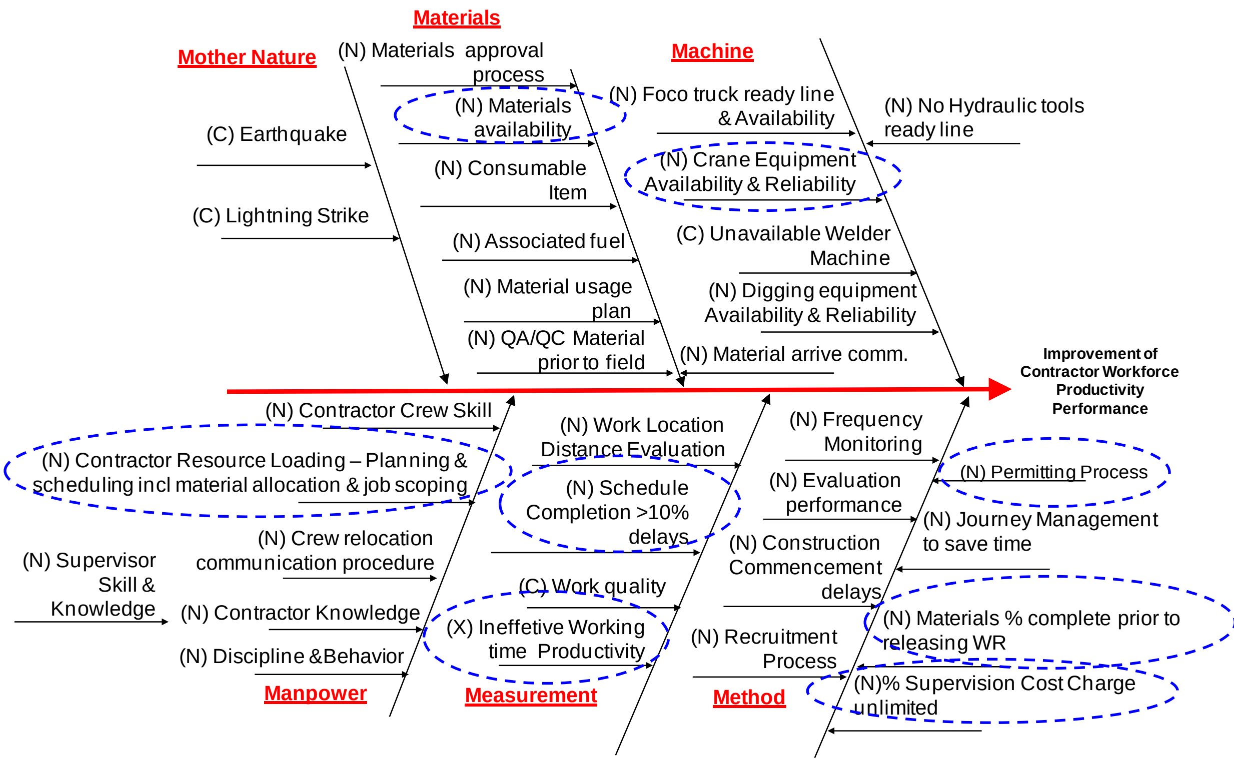


Fig. 2: Fishbone Diagram – Low Contractor Productivity Performance

Coefficient correlation will be used to analyze further the correlation between identified root causes with low contractor productivity performance. The correlation coefficient is a statistical measurement covariance or association between two variables. The magnitude of the correlation coefficient ranges from +1 s / d -1. Correlation coefficient indicates the strength and direction of a linear relationship of two random variables.

To ensure easier interpretation of the strength as well as the relationship between two variables, the author provides the following criteria;

- 0 : no correlation between two variables
- >0 – 0,25: weak correlation
- >0,25 – 0,5: fair correlation
- >0,5 – 0,75: strong correlation
- >0,75 – 0,99: very strong correlation
- 1: Perfect correlation

The identified root causes generated from fishbone and its correlation analysis will be mapped-out through the following table 1. Root Causes Table and Coefficient Correlation Analysis;

Refer to the table 1, there are top 3 (three) system level root causes identified based on the high percentage of directly influence to Cost Ineffectiveness and the high coefficient correlation analysis variables, such as;

1. Inefficient Contractors working time productivity Contractors
2. Some of Projects had over-run budget and its contributor is Supervision Cost.
3. Schedule completion of project > 10% delays.

Therefore, this research will prioritize to develop the integrated Key Performance Indicators (KPI) that will overcome the root cause and later can improve the current productivity level of construction contractor workforce in scattered “X” fields

No	Problems	Possible Causes	Root Causes	Correlation Analysis	Influence to Cost Ineffectiveness
1	Misleading Contractor Resource Loading on job planning & scheduling – that affected to work order backlog and project schedule completion delays. (lack of actual manpower onsite)	Users are less aware regarding the resource loading planning and scheduling confirmation prior to releasing the work order to contractor through the system.	No governance of resource loading vs work orders	0.7	6%
		Contractor project control was not good in allocating crew planning and scheduling.	No both ways communication protocol with PT. ABC Project control and users	0.6	5%
		There is no governance of both ways communication between PT. ABC's project control and contractors' project control as well as users to update contractor resource loading and its readiness to receive work order	No governance of resource loading vs work orders	0.7	6%
		Rapid operational changes of job site condition	Mother Nature	0.25	0%
2	Schedule completion of project > 10% delays from its agreed end date.	Lack of Contractor man powers, material or heavy equipment to perform the project as per agreed job scoping	No Governance to allow work order released after %min material achieved	0.8	9%
		Rapid operational changes of job site condition	Mother Nature	0.25	0%
		Contractor project control was not good in allocating crew planning and scheduling.	No both ways communication protocol with PT. ABC Project control and users	0.6	5%
3	Inefficient Contractors working time productivity both WUR and RUR Contractors	Improper Journey management of Contractor crew to go to the job site that caused late to perform the work.	No program update for Journey effective JMP	0.9	12%
		Long Process of Permit To Work (PTW)	Lack of Knowledge & Communication	0.5	2%
		No material available on job site	No Governance to allow work order released after %min material achieved	0.7	4%
		No Straight governance for contractor to work on time at job site, by considering the travel time.	No Governance updates between Users and Contractors to start the	0.75	8%

			job onsite.		
		Weather condition on job site that's not allowing to safely work.	Mother Nature	0.25	0%
4	In-effective process of Permitting To Work (PTW)	Less knowledge of contractor regarding the PTW timeframe and procedure	Lack of Knowledge & Communication	0.5	2%
		In-effective PTW process for the job site is quite far from gathering stations. (Back-forward travelling)	Lack of Knowledge & Communication	0.5	2%
		Documents required for PTW approval is less than adequate.	Lack of Knowledge & Communication	0.5	2%
5	Lack of material on job site. No governance regarding the minimum % material complete prior to releasing Work Order to Contractors.	No Governance in place regarding the minimum material completeness prior Users releasing the work order to contractors.	No Governance to allow work order released after %min material achieved	0.7	5%
		Users are less aware regarding the resource loading planning and scheduling confirmation from PT. ABC project control prior to releasing the work order to contractor through the system.	No governance of resource loading vs work orders	0.7	6%
6	Some of Projects had over-run budget and its contributor is Supervision Cost.	Lack of awareness of PT. ABC project owners to control the monthly budget spending.	No SOP to perform monthly monitoring of project expense for supervision cost	0.8	12%
		Lack of control from PT. ABC project control to remind the project owners and Contractor Supervisor regarding the over-run charges.	No SOP to perform monthly monitoring of project expense for supervision cost	0.8	6%
7	Lack of In-Line heavy equipments has caused project completion delays	Not good Planning and Scheduling with other crew to utilize the spares of heavy equipments	No both ways communication protocol with PT. ABC Project control and users	0.6	6%
		Aging heavy equipment units tend to low reliability and availability.	Aging units	0.5	2%

2. Conceptual Framework

Theoretical Framework

Refer to Artley W, performance measurements provide quantitative information regarding something important in associated with products, services and also processes that produced a product. There are 3 (three) Performance Measurement System methods that will be assessed and then selected the suitable one with PT. ABC's Performance Management of Contractor program. These three methods are; Balanced Score Card (Kaplan & Norton, 1996), Performance Prism (Neely, 1999) and Integrated Performance Management System (Wibisono, 2006). The following table will summarize the strength and delta of Performance Measurement System Framework of each method;

Aspect	BSC (1992)	Prism (2002)	IPMS (2006)
Design & Procedure	Stated clearly	General overview	Stated clearly
Performance Variables	4 major perspectives; Financial, Customer, Internal Process, Learning & Growth	More than 200 individual performance variable	3 major perspectives that correlated each other; Organization output, internal process and resource capability
Formulation of performance variables	General overview supported with detailed formula implementation to specific company	Detail formulation on each variable	Detail formulation on each variable and be related
Final Output	Financial Aspect	Stakeholders satisfaction aspect	Integrated financial and non-financial aspects that represent stakeholders' satisfaction

Table 2: Framework Comparison between BSC, Prism and IPMS

The selection method of contractor performance measurement through IPMS concept approach is being aligned with the problem scope discussed in this paper. Based on the problem formulation, there are some factors that can influence the Performance Management of Contractor in scattered "X" Light Oil operation. Those factors are Performance Measurement System, Customer, contractors, internal resources and contract process. Its correlation can be illustrated on this following figure.

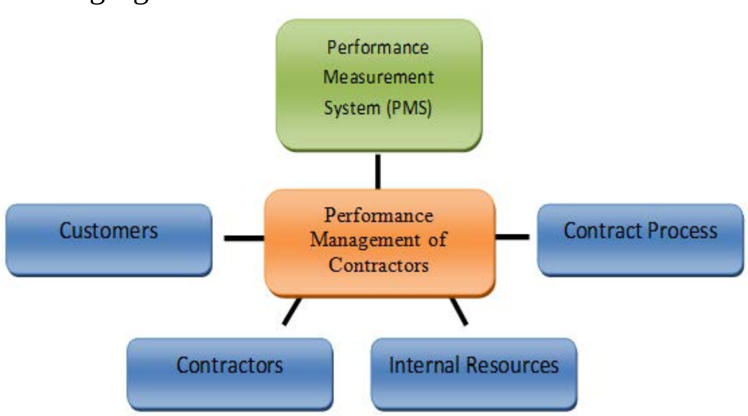


Fig. 3: Conceptual Framework

The following diagram below shows the all parties connection and business relations in scattered "X" Light Oil Operation;

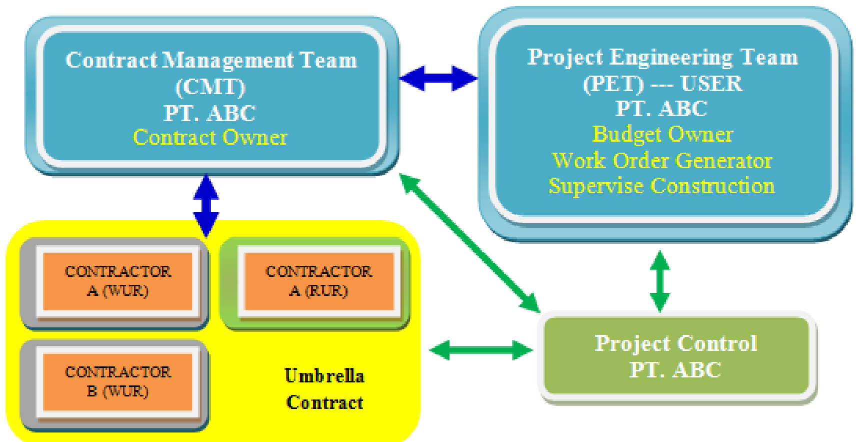


Fig. 4: Organization Position between Company Officers and Contractors in Scattered "X" Light Oil Operations

Based on reviewing and analyzing the information from conceptual framework factors, there are some performance variables generated as per Integrated Performance Measurement System (IPMS) perspectives, and later on the top 3 will be select as the main key performance indicators (KPI) to address to improve the contractor productivity performance;

Perspectives	Aspect	Variable	Definition	Formula
Organization Output	Financial	Working Time Productivity Ratio	The compliance of contractor to deliver amount of product/service within the assigned working time (wrench time) without sacrificing product quality and safety performance	$=\frac{\sum Actual\ Working\ Time/day}{Wrench\ TIme}$
		Supervision Cost <=10%	The supervisory cost from seconded contractor for active job performed by	$Over-run\ Supervision\ Cost$ $=\frac{(Actual\ \%-10\%)}{10\%}x100\%$

			the construction contractor	
	Non-Financial	HES Performance	The compliance of the contractor to follow regulations in associated with Safety, Health and Environment while performing the work	$Safety\ Rate = \frac{\sum Incident}{\sum Working\ Hours}$ $Safety\ Compliance = \frac{\#violation}{\sum Contract} x100\%$ $Enviro\ Compliance = \frac{\#\ Violation}{\sum Contract} x100\%$
Internal Process	Operation Process	Project Schedule Completion	Measuring the actual workdays completion by contractor vs assigned project timeframe (not > 10% days Delays)	$= \frac{(Actual\ days\ over\ from\ End\ date)}{Project\ timeframe\ days} x100\%$
		Contractor Resource Loading Availability	Measuring the available crew to execute upcoming work order from users	$= \frac{\sum Assigned\ Crew}{\sum Based\ Crew} > 0$
Resource capability	Project Engineer	Contractor monitoring capability	Work Progress Surveillance performed by contractor	$\sum_{1}^{n} (Score\ x\ weight)$

Table 3: IPMS Performance Variables

As the results, 3 (three) Key Performance Indicators (KPI) were determined and endorsed by stakeholders in accordance to properly measure the construction contractor productivity level. These Key Performance Indicators (KPI) are being formalized to track and monitor; *Working Time Productivity Ratio increased by 7%*, *Supervision Cost reduced by 5%*, and *Schedule Compliance <10%*. These KPI's are being applied for both Work-Unit Base and Resource-Hour Base Contractors.

Design of Problem Solving

Lean Sigma Define-Measure-Analyze-Improve-Control roadmap will be used to facilitate business process improvement in order to provide statistical approach of data baseline, analytical system level of root causes, generate and implement the improved scenario to achieve metrics as defined and then sustain its improved process within the next 12 months of control phase.

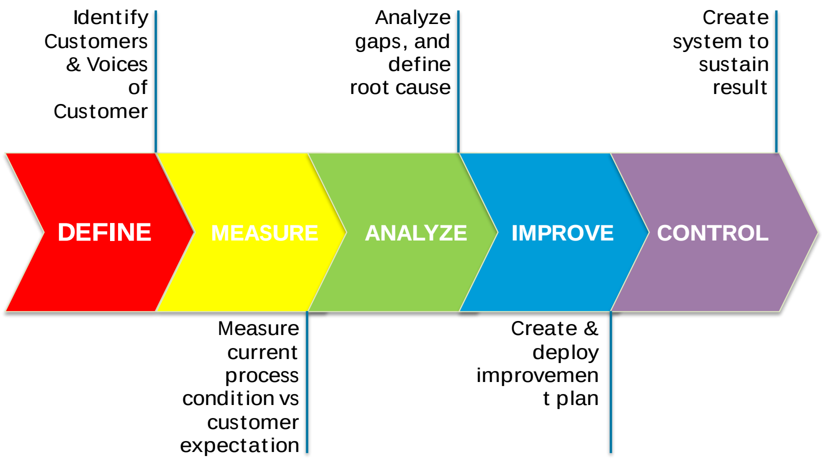


Fig. 5: Lean Sigma – DMAIC Roadmap

Define Phase: Identify the business drivers and defined metrics to be improved that formally refer to Customer voices or stakeholders expectations.

- **Business Driver:**
  - Improve Contractor Workforce productivity performance
  - Cost Effectiveness
  - Reduce waiting or idle time

- **IPO Diagram**

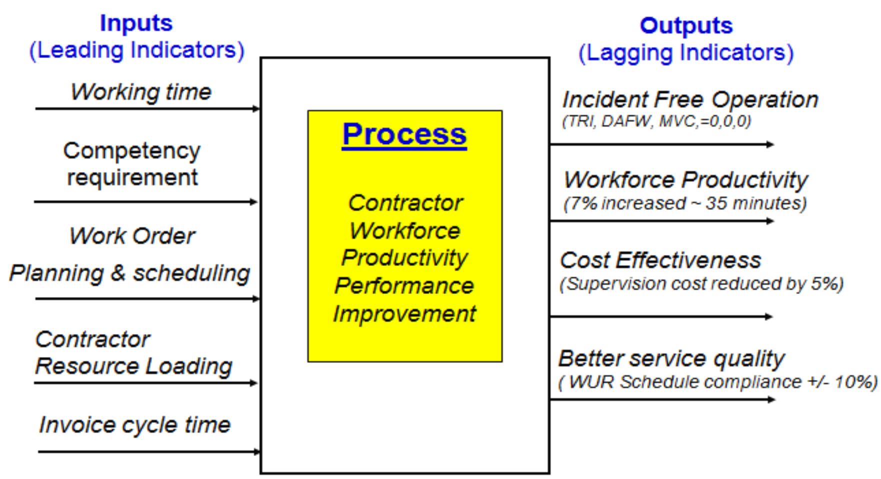


Fig. 6: Input Process Output Diagram

- **In- Scope:**
  - ✓ The construction contractor workforce activities in scattered "X" Light Oil Operation

- **Out Scope:**
  - ✓ The other operation area beyond scattered "X" Light Oil Operation

- **Vision of Success:**

  Contractor workforce productive increase with acceptable productivity level, proper resource loading plan, schedule completion with proper spending per unit work and achieve supervision cost effectiveness as regulated in the project management system.

Measure Phase:

1. Measure the baseline contractor productivity performance and compare to work productivity standard as managed in the contract terms.
   - Detail baseline data is presented in the "**Data Processing**" section
2. Calculate Cost of Poor Quality (COPQ) based on baseline performance.

Financial Parameters	Contractor (RUR)	Contractor (WUR)
• Working Time Productivity Ratio increased by 7%	$ 2,120,000	$ 1,740,000
• Supervision Cost reduced by 5%	$ 210,000	
Cost Of Poor Quality :	**$ 2, 330,000** (Benefits to PT. ABC)	**$ 1,740,000** (Benefits to Contractor)

Table 4: COPQ of Contractor RUR and WUR

Analyze Phase:

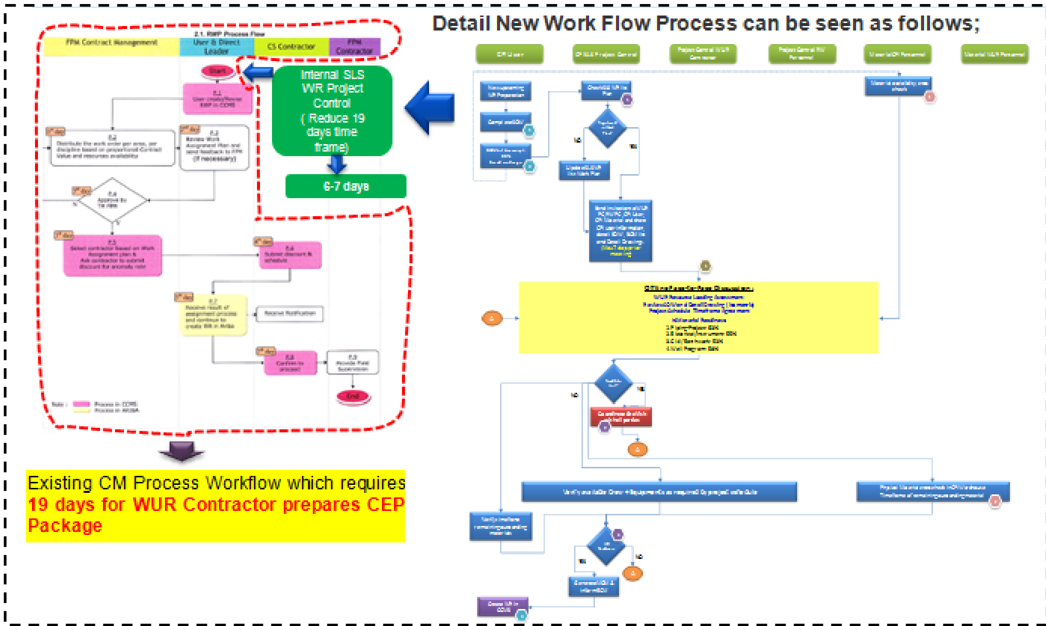
1. Analyze gaps and define root cause.
   Detail Fishbone report can be seen on the "**Problem Formulation**" section.
2. In the Analyze Phase, the project team performs analytical approach to deepen data clarification and investigation in associated with the "exact" contributors that led to low productivity level of contractor performance. In the section of "**Data Analysis**" has shown the breakdown the potential contributors that need to be eliminated by providing the possible solutions which will be applied during Improve Phase.

Improve Phase:

1. Socialize and deploy the improved scenario as results of analysis phase and then monitor its implementation.
2. Formalize the improved scenario in the form of SOP or governance model.
3. Develop mitigation plan to go back to analysis phase in case the scenario doesn't work as expected

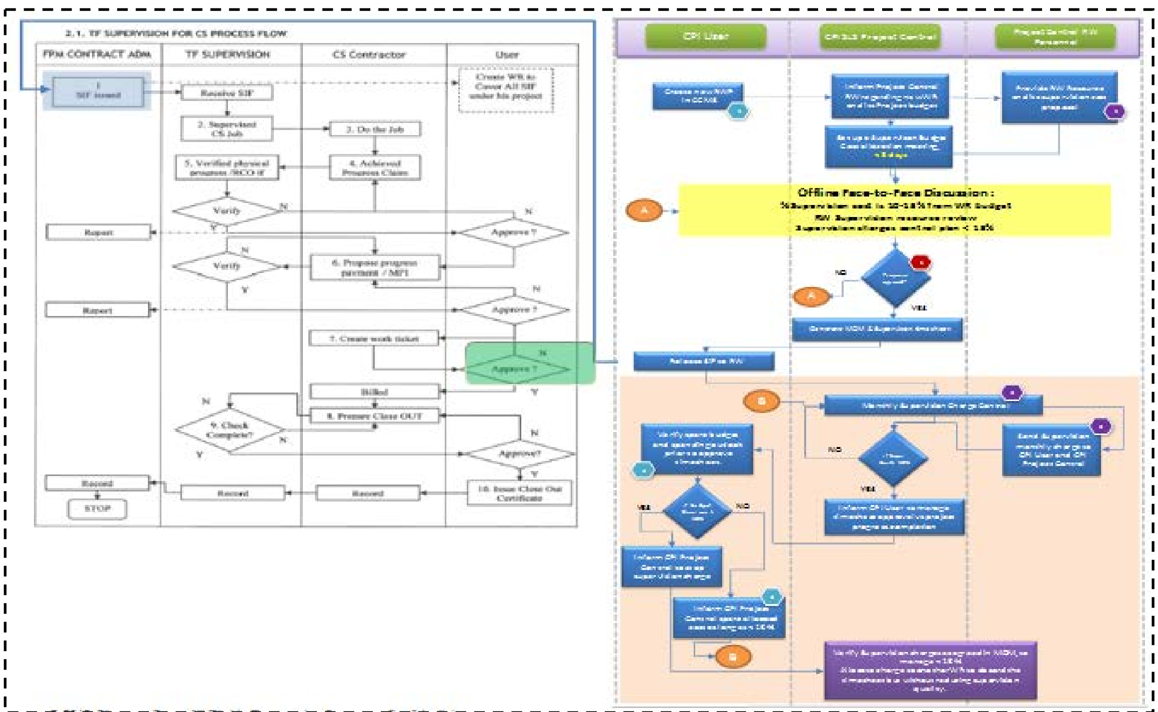
These are the improved scenarios that have been deployed to improve construction contractor workforce productivity performance in Scattered "X" Light Oil Operation;

I. New Governance Model for Work Order Procedure to Contractors;



II. Strengthen the commitment regarding the working time started on job site, by applying New Journey Management plan for deliver the crews that applicable for each work location at Scattered "X" Light Oil operation.

III. New Governance Model for releasing Supervision Work Request to Seconded Contractor

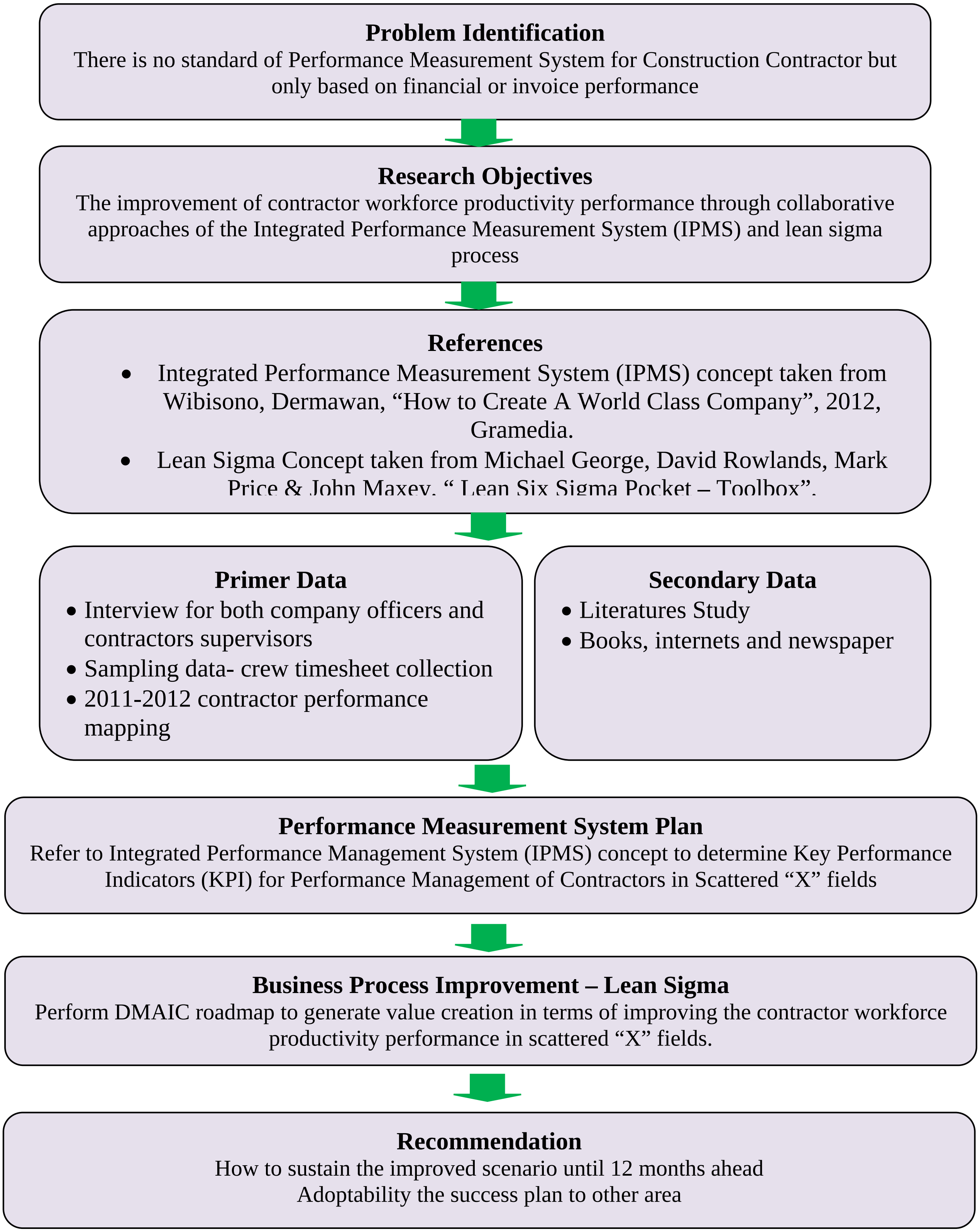


Control Phase:

1. Create system to sustain the improvement result and adoption plan to other area.
2. The control chart usually used to monitor the improvement over time.

3. Methodology

a. Flowchart



b. Data Sampling

The contractor population sampling was performed to gather the contractor crew timesheet collection. Total contractor personnel in scattered "X" fields is ~ 1,000 people.

$$n = N / (1 + Ne^2)$$

Note: N : Population, n: Sample Size and e: Margin error (Confidence Level)

➔ **Confidence Level: 95%** (Margin Error:0.05).

Sample Size to Estimate the Mean of a Normal Distribution	
User defined parameters	
Estimated Standard Dev	0.43
Half Interval Width	0.05
Confidence Level	95.00%
Results	
Estimated Sample Size (n)	285

Fig. 5: SPC-XL Sample Size Table Calculation

The sample size is 285 people and data sampling will be taken from:

- Contractor A (RUR) : 104 personnel
- Contractor A (WUR) : 100 personnel
- Contractor B (WUR) : 81 personnel

c. Data Processing

The feasibility test statistics performed to check whether the sample size represented the statistically population sampling.

Baseline for sampling data collection of contractor crew timesheet had been performed within 3 months. The SPC-XL was used to generate statistically data analysis. So that, the baseline data that represented the current performance of construction contractor workforce productivity performance in scattered "X" light oil operation, can be illustrated as follows;

❖ **Histogram: Inefficient working time productivity**

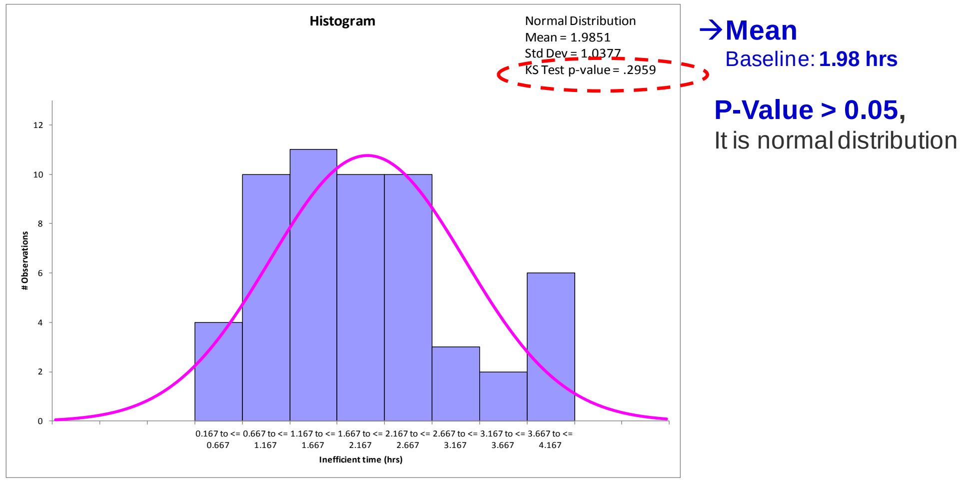


Fig. 6: Histogram – Contractor A (RUR) Inefficient Working Time

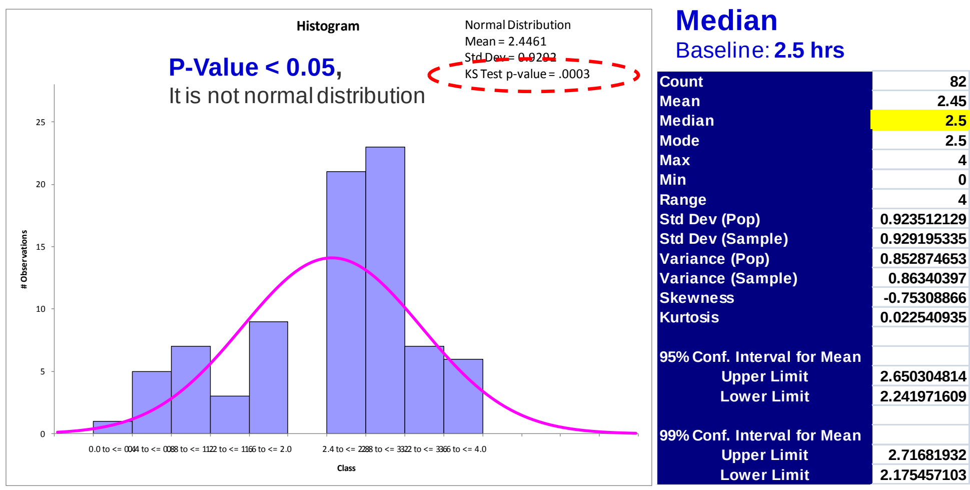


Fig. 7: Histogram – Contractor A (WUR) Inefficient Working Time

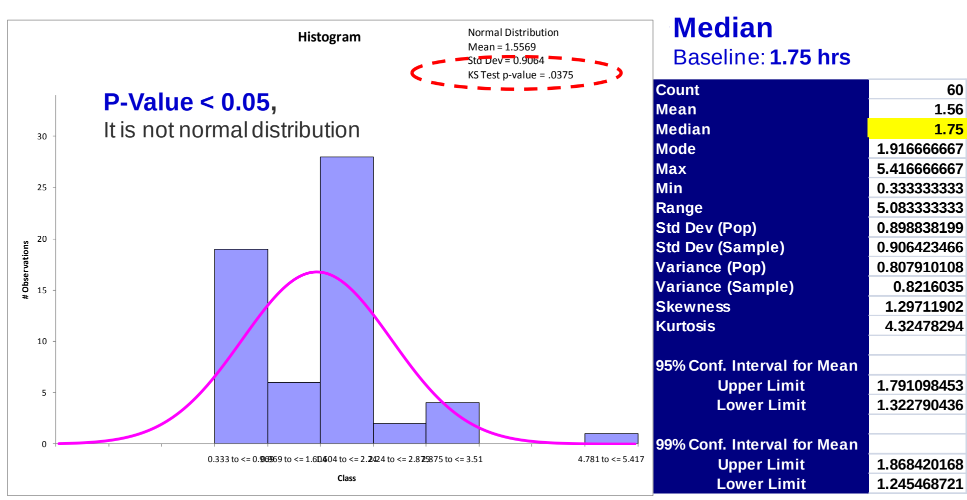


Fig. 8: Histogram – Contractor B (WUR) Inefficient Working Time

❖ Average Supervision Cost

The current Average Supervision Cost is averagely 20% from total Work Order Budget. The Supervision cost allocation is regulated by project management team is not higher than

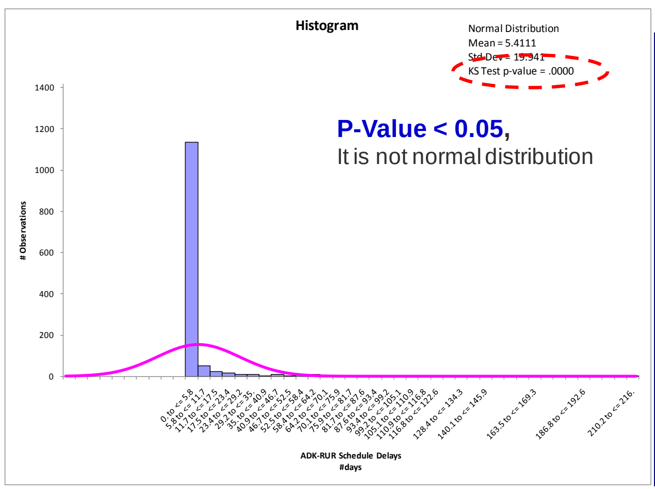
10% for each Work Order budget released in the Contract Management (CM) system. The table below is the example of monthly tracking in terms of supervision cost monitoring.

SUPERVISION ALLOCATION CHARGE

	Data		
WR	Sum of WR AMOUNT	Sum of NOS AMOUNT	Average of NOS%
WRXXXX	$ 706,100	$ 127,098	18%
WRXXXX	$ 231,454	$ 37,033	16%
WRXXXX	$ 654,213	$ 150,469	23%
WRXXXX	$ 367,567	$ 77,189	21%
WRXXXX	$ 376,086	$ 82,739	22%
WRXXXX	$ 38,800	$ 7,760	20%
WRXXXX	$ 170,450	$ 35,795	21%
WRXXXX	$ 450,000	$ 103,500	23%
WRXXXX	$ 600,688	$ 126,144	21%
WRXXXX	$ 400,000	$ 76,000	19%
WRXXXX	$ 131,554	$ 23,680	18%
WRXXXX	$ 621,863	$ 111,935	18%
WRXXXX	$ 20,000	$ 4,000	20%
WRXXXX	$ 49,057	$ 10,302	21%
WRXXXX	$ 111,457	$ 23,406	21%
Grand Total	$ 29,599,985,045	$ 4,298,517,739	20%

Fig. 9: % Supervision Cost For Work Order in Month "YY" - 2012

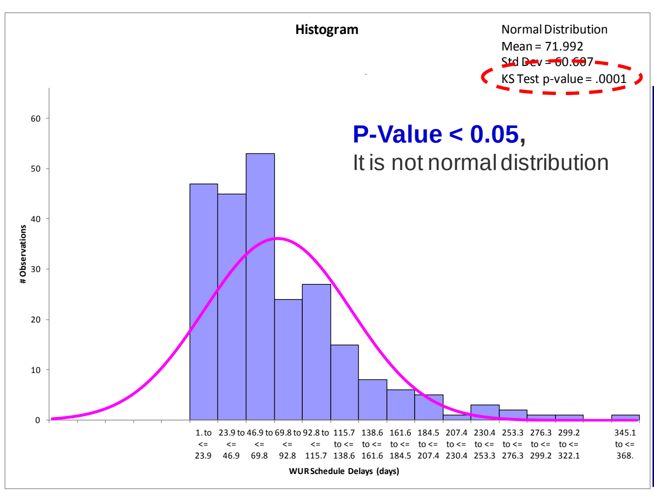
❖ Histogram: Project Schedule Completion Delays



Median
Baseline: **0 day**

Count	1311
Mean	5.4
Median	0
Mode	0
Max	216
Min	0
Range	216
Std Dev (Pop)	19.93340165
Std Dev (Sample)	19.94100837
Variance (Pop)	397.3405015
Variance (Sample)	397.6438148
Skewness	5.80954681
Kurtosis	41.59053928
95% Conf. Interval for Mean	
Upper Limit	6.491563199
Lower Limit	4.330709875
99% Conf. Interval for Mean	
Upper Limit	6.831815782
Lower Limit	3.990457292

Fig.10: Histogram – Contractor A (RUR) Schedule Completion Delays



Median
Baseline: **58 days**

Count	239
Mean	71.9916318
Median	58
Mode	24
Max	368
Min	1
Range	367
Std Dev (Pop)	60.47960282
Std Dev (Sample)	60.60652762
Variance (Pop)	3657.782357
Variance (Sample)	3673.15119
95% Conf. Interval for Mean	
Upper Limit	79.71457062
Lower Limit	64.26869298
99% Conf. Interval for Mean	
Upper Limit	82.1712819
Lower Limit	61.8119817

Fig. 11: Histogram – Contractor A & B (WUR) Schedule Completion Delays

d. Data Analysis

The SPC-XL will be used to support data analysis within Analyze and Improve phase in which the result of data analysis will be compared with the baseline data in order to prove the existence of process improvement after the improved scenario deployed.

During Analyze phase, the project team had conducted Site Data Gathering (GEMBA or Walkthrough) in order to confirm the suspected system level root causes as well as to verify the data accuracy that was used as the baseline in Measure Phase. The data collection after the improved scenario deployed can be seen as follows;

❖ **Histogram: Inefficient working time productivity of Contractor A (RUR)**

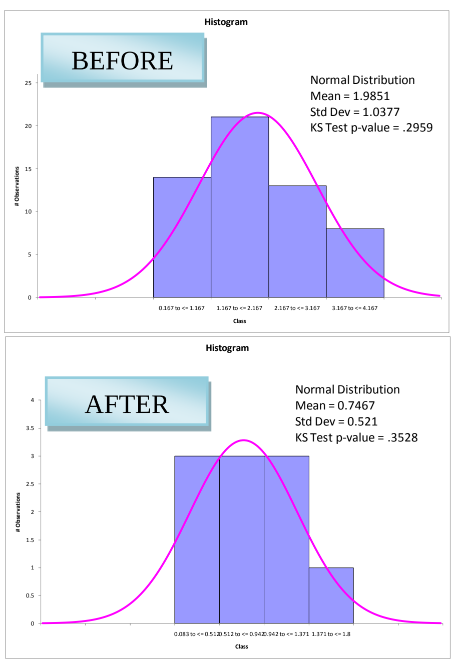


Fig. 12: Histogram – Inefficient working time of Contractor A (RUR)

During 2 months trial and monitoring, the data has shown that the inefficient working time productivity of Contractor A (RUR) has decreased from 1.98 hours to 0.75 hours or the improvement claimed is 62%.

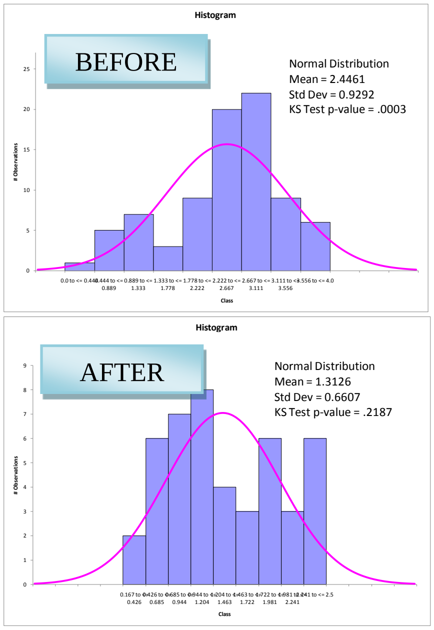
The improvement of working time doesn't sacrifice the quality of product and the contractor safety performance.

The scenario will be continuously applied and monitored until the next 12 months to ensure its sustainability of result.

❖ **Histogram: Inefficient working time productivity of Contractor A (WUR)**

During 2 months trial and monitoring, the data has shown that the inefficient working time productivity of Contractor A (WUR) has decreased from 2.5 hours to 1.31 hours or the improvement claimed is 48%.

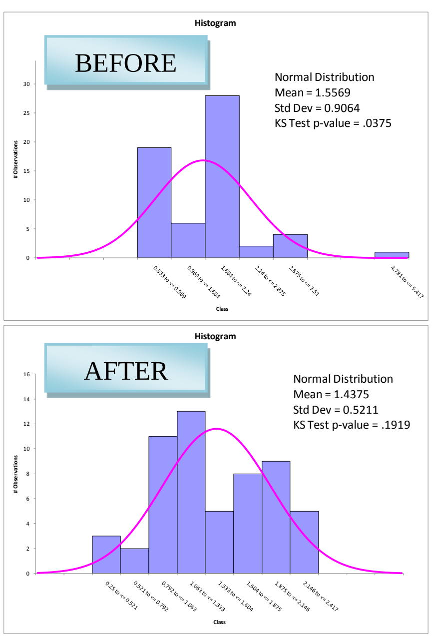
The improvement of working time doesn't sacrifice the quality of product and the contractor safety performance



Count	82
Mean	2.45
Median	2.5
Mode	2.5
Max	4
Min	0
Range	4
Std Dev (Pop)	0.923512129
Std Dev (Sample)	0.929195335
Variance (Pop)	0.852874653
Variance (Sample)	0.86340397
Skewness	-0.75308866
Kurtosis	0.022540935
95% Conf. Interval for Mean	
Upper Limit	2.650304814
Lower Limit	2.241971609
99% Conf. Interval for Mean	
Upper Limit	2.71681932
Lower Limit	2.175457103

Fig. 13: Histogram – Inefficient working time of Contractor A (WUR)

❖ Histogram: Inefficient working time productivity of Contractor B (WUR)



Count	60
Mean	1.56
Median	1.75
Mode	1.916666667
Max	5.416666667
Min	0.333333333
Range	5.083333333
Std Dev (Pop)	0.898838199
Std Dev (Sample)	0.906423466
Variance (Pop)	0.807910108
Variance (Sample)	0.8216035
Skewness	1.29711902
Kurtosis	4.32478294
95% Conf. Interval for Mean	
Upper Limit	1.791098453
Lower Limit	1.322790436
99% Conf. Interval for Mean	
Upper Limit	1.868420168
Lower Limit	1.245468721

Fig. 14: Histogram – Inefficient working time of Contractor B (WUR)

During 2 months trial and monitoring, the data has shown that the inefficient working time productivity of Contractor A (WUR) has decreased from 1.75 hours to 1.43 hours or the improvement claimed is 18%.

The improvement of working time doesn't sacrifice the quality of product and the contractor safety performance.

The scenario will be continuously applied and monitored until the next 12 months to ensure its sustainability of result.

❖ Average Supervision Cost

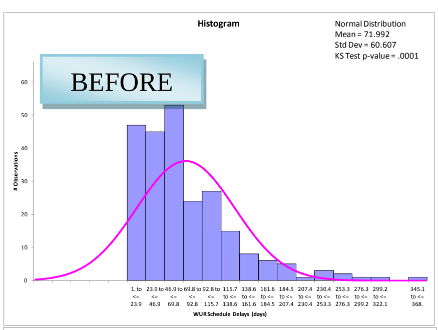
By deploying the new governance model, the supervision cost can be managed in range of 10%. The following table has shown the supervision cost decreased in average from 20% down to 10% for all active work orders.

SUPERVISION ALLOCATION CHARGE

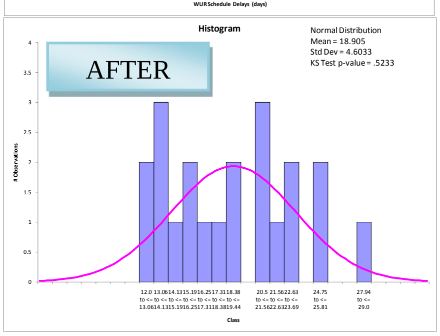
	Data		
WR	Sum of WR AMOUNT	Sum of NOS AMOUNT	Average of NOS%
WRXXXX	$ 600,688	$ 60,069	10%
WRXXXX	$ 400,000	$ 40,000	10%
WRXXXX	$ 131,554	$ 15,786	12%
WRXXXX	$ 621,863	$ 68,405	11%
WRXXXX	$ 120,000	$ 13,200	11%
WRXXXX	$ 490,557	$ 44,150	9%
WRXXXX	$ 111,500	$ 10,035	9%
WRXXXX	$ 746,599	$ 82,126	11%
WRXXXX	$ 223,146	$ 26,778	12%
WRXXXX	$ 211,134	$ 21,113	10%
WRXXXX	$ 123,535	$ 12,354	10%
WRXXXX	$ 187,942	$ 18,794	11%
WRXXXX	$ 299,401	$ 29,940	9%
WRXXXX	$ 433,099	$ 43,310	12%
WRXXXX	$ 527,085	$ 52,708	8%
Grand Total	**$ 35,967,985,045**	**$ 3,716,691,788**	**10%**

Fig. 15: % Supervision Cost For Work Order in Month “ZZ” - 2012

❖ Histogram: Project Schedule Completion Delays Contractor A & B (WUR)



Count	239
Mean	71.9916318
Median	58
Mode	24
Max	368
Min	1
Range	367
Std Dev (Pop)	60.47960282
Std Dev (Sample)	60.60652762
Variance (Pop)	3657.782357
Variance (Sample)	3673.15119
95% Conf. Interval for Mean	
Upper Limit	79.71457062
Lower Limit	64.26869298
99% Conf. Interval for Mean	
Upper Limit	82.1712819
Lower Limit	61.8119817



During 2 months trial and monitoring, the data has shown that the schedule completion delays reduced from 58 days down to 19 days.

The improvement claimed is 67%

The acceleration of project schedule completion doesn’t sacrifice the quality of product and the contractor safety performance.

Fig. 16: Histogram – Project Schedule Completion Delays of Contractor A & B (WUR)

4. Research Finding

During 2 months deployment of new contractor performance measurement system and new governance model to manage work order and contractor resource loading has generated positive results on 3 (three) Key Performance indicators. The continuous monitoring example of working time productivity is showing as follows;

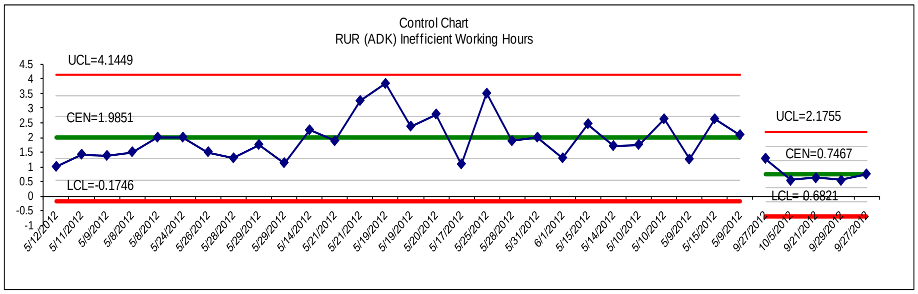


Fig. 17: Control Chart – Inefficient working time of Contractor A (RUR)

The contractor A (RUR) Inefficient working hour's trend continued to decline from 1.98 hrs down to 0.75 hrs.

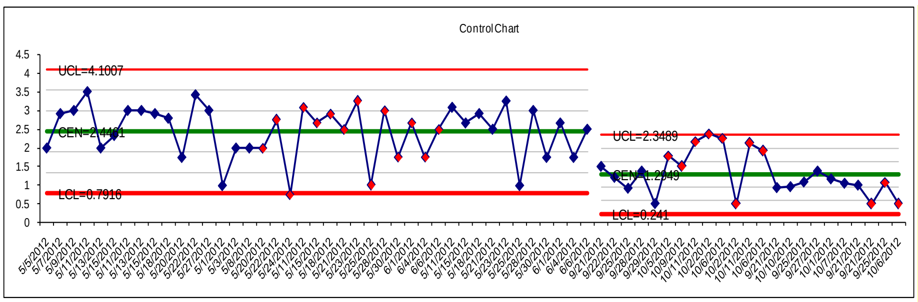


Fig. 18: Control Chart – Inefficient working time of Contractor A (WUR)

The contractor A (WUR) Inefficient working hour's trend continued to decline from 2.5 hrs down to 1.31 hrs. However, there are challenges to sustain the results.

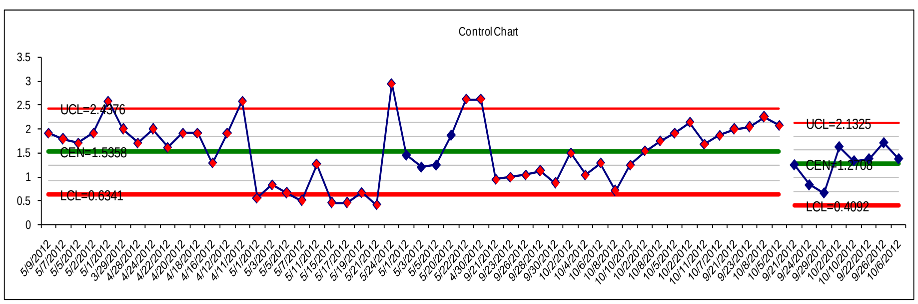


Fig. 19: Control Chart – Inefficient working time of Contractor B (WUR)

The contractor B (WUR) Inefficient working hour's trend continued to decline from 1.75 hrs down to 1.43 hrs.

It showed that the new governance model of performance management contractor work properly and the new contractor performance measurement system are well understood by all parties. However, the efforts to sustain the results by monthly are really challenging and it requires great cooperation from all parties to commit and consistent applying the new performance management of contractor governance model. The new performance measurement system generated from IPMS concept is easily understood and followed to determine the contribution of each employee, so that the increased performance of each party can be done independently. Learning from monitoring process (control chart) of Contractor A (WUR), in which internal organization issues could crate barrier and inconsistency to the improvement results.

5. Discussion and Recommendation

PT. ABC business process improvement tool of Lean Sigma DMAIC roadmap has been successfully applied to provide statistical data baseline, analytical root cause, generate the improved scenario to achieve metrics as defined and sustain its improved process within the next 12 months of control phase. The total financial benefits claimed is US$ 2.4 MM by improving ~ 43% working time productivity ratio, supervision cost saving by 10% and sustain effective 8 (eight) hours working of resource-hour base contractor.

The Integrated Process Measurement System (IPMS) and Lean Sigma collaborative approaches have given a platform of common understanding among the parties and measurement of progress towards readiness for the process improvement deployment as well as to ensure its sustainability. Prior to adapt this process improvement to other PT. ABC operation area, the author would like to recommend monitoring the result until next 12 months in order to ensure sustainability results. The adoption of business process improvement success story will always generate value creation as the company competitive advantage.

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