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Contractor Work Preparation Process Improvement Using Lean Six Sigma

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CONTRACTOR WORK PREPARATION PROCESS IMPROVEMENT USING LEAN SIX SIGMA

A CASE STUDY OF A GLOBAL OIL AND GAS COMPANY IN INDONESIA

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Abstract

To ensure the health and safety of their workforce and protection of their assets and the environment, a global oil and gas company operating in Indonesia requires comprehensive identification and evaluation of job hazards that were included in work permitting process prior work execution in the field. Based on 20 data points obtained in August 2013, start-working time for contractors who worked for Capital Project Management (CPM) Team in Facility B was in average at 09.05 a.m. The aim of this paper is to present how the firm implemented Lean Six Sigma to reduce non-added value activities while fulfilling to its safety requirements and to share lessons learned from practical and theory testing perspective. The methodology used is Lean Six Sigma's DMAIC (Define, Measure, Analyze, Improve, Control) as mandated by the corporate policy of the firm. This research adopts a mix-methods approach, by using both qualitative and quantitative data. This study was a one year longitudinal study of the Lean Six Sigma implementation to improve contractors' work preparation process. The improvement resulted in reduction of non-value added activities and successfully increased the available working time per day by 59.3 minutes in average. The results of this case study reconfirm Lean Six Sigma as a good management theory since it shows a consistency between the theory and the real practice in a global oil and gas company in Indonesia.

Keywords: Lean Six Sigma, DMAIC, Work Preparation Process, Non-added Value Activities, Oil and Gas Company

Abstrak

Untuk memastikan kesehatan dan keselamatan pekerjanya dan perlindungan terhadap aset dan lingkungan, sebuah perusahaan minyak dan gas yang beroperasi di Indonesia membutuhkan proses identifikasi dan evaluasi bahaya dalam pekeraan yang komprehensif yang tercakup dalam proses perijinan kerja sebelum suatu pekerjaan dieksekusi di lapangan. Berdasarkan 20 data yang diperoleh pada bulan Agustus 2013, rata-rata jam mulai kerja kontraktor yang bekerja untuk tim Capital Project Management (CPM) pada fasilitas B adalah pada pukul 09:05 pagi. Objektif dari makalah ini adalah untuk mempresentasikan bagaimana suatu perusahaan mengimplementasi-

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kan Lean Six Sigma untuk mengurangi aktifitas yang tidak memberikan nilai tambah sedangkan di saat yang sama juga memenuhi persyaratan keselamatan kerja, dan membagi pelajaran dari segi praktikal dan teoritikal. Metodologi yang digunakan permasalahan ini adalah DMAIC (Define, Measure, Analyze, Improve, dan Control) milik Lean Six Sigma yang diwajibkan oleh perusahaan minyak dan gas tersebut. Penelitian pada makalah ini mengadopsi pendekatan gabungan dengan menggunakan data kuantitatif dan kualitatif. Kajian ini merupakan kajian longitudinal selama satu tahun terhadap implementasi Lean Six Sigma untuk memperbaiki proses persiapan kerja kontraktor. Hasil dari perbaikan ini adalah pengurangan aktifitas yang tidak memberikan nilai tambah (non-added value) dan berujung pada peningkatan jam kerja selama rata-rata 59,3 menit per hari. Hasil dari kajian kasus ini mengkonfirmasi bahwa Lean Six Sigma adalah teori manajemen yang bagus, karena menunjukkan konsistensi antara teori dan praktik sesungguhnya yang dalam hal ini praktik di perusahaan minyak dan gas di Indonesia.

Kata Kunci: Lean Six Sigma, DMAIC, Proses persiapan kerja, Non-added Value Activities, Perusahaan minyak dan gas

Like science (Babbie, 2010), applied disciplines, such as business and management, progress through theory and practice (Swanson & Chermack, 2013; van de Ven, 1989). Hence good theory is vital because it explains why and how a certain business issue or managerial problem occurs. Not only should good theory have coherent constructs, but it also has to withstand empirical testing (Vansteenkiste & Sheldon, 2006). Scholars and practitioners, therefore, play a major role in advancing both theory as well as practice in business and management field (Swanson & Chermack, 2013; Nakhai & Neves, 2009; van de Ven, 1989). The continuing cycle of good theory building in applied disciplines may go through five major phases, namely conceptualize, operationalize, confirm, apply, and refine (Swanson & Chermack, 2013).

Research in lean six sigma is abound. Research gaps on the conceptual or theoretical basis of lean six sigma has rarely been mentioned. Variations of lean six sigma implementation, however, offers opportunity in terms of confirming lean six sigma as a good theory. In particular, the applications of lean six sigma in the oil and gas industry has rarely been mentioned in the literature. This highlights a gap in the apply phase of that good theory building cycle. As such, this paper contributes on this application to expand the existing body of practices (Babbie, 2010) of lean six sigma in the oil and gas industry, particularly in the Indonesian context. Instead of theory building, the major contribution of this paper is on theory testing (Colquitt & Zapata-Phelan, 2007). By doing so, lean six sigma as a good theory, philosophy, or methodology can be reconfirmed or refined. As Jie, Kamaruddin and Azid (2014) argued, theoretical and practical aspects of lean six sigma is important.

This research is a case study of a global oil and gas company that is operating in Indonesia, IOG-Corp, which has adopted and implemented Lean Six Sigma. This firm was chosen since it has been implementing Lean Six Sigma for nine years in its global operation and for five years in its operation in Indonesia, and it is a firm where one of the researcher works.

IOG-Corp. runs both major and small capital projects. Its values place the highest priority on the health and safety of their workforce and protection of their assets and the environment. IOG-Corp. has an operational excellence that is defined as the systematic management of processes, involving safety, personal safety and health, environment, reliability and efficiency to achieve world-class performance. To manage this, the company develops Operational Excellence Management System (OEMS) to achieve competitive advantage and drive business results.

OEMS has certain vision, objectives, expectations, processes and standards. One of the operational excellence processes and standards that relates to the HES (Health, Environment, and Safety) area of focus is Managing Safe Work Process (FSWP). According to the company's FSWP guidebook (2010), Managing Safe Work (MSW) is an integrated process to identify, assess, mitigate, and control or eliminate the risks associated with the work. It guides the identification and evaluation of job task hazards, specification of control, management of those measures, control of the work, and behaviors to support safe work.

Managing safe work has several components, including: (1) Stop Work Authority (SWA). SWA gives an individual responsibility and an authority to stop any work when any unsafe acts are identified that may lead to unsafe condition or undesired event, (2) Hazard Analysis Procedure. This procedure starts from initial planning phase, to the work group pre-job onsite Job Safety Analysis (JSA) discussion in permitting phase, to individual's ongoing effort to Think Incident Free (TIF) in Implementing Phase", (3) SOP (Standard Operating Procedure) Qualification Procedure. This procedure intended to define how SOPs and their use by qualified personnel can be considered as equivalent to a hazard analysis used for planning a job, (4) Access Control Standard. Access Control Standard gives guidance on what should be included as minimum requirement for a facility or job sites to have, thus any individual or group entering the facilities whether as a routine or for the first time is aware of the safety requirement on that area, what hazard may exists and minimum PPE (Personal Protective Equipment) requirement to be worn, and what should be done during emergency situation, (5) Personal Protective Equipment (PPE) Standard. This component outlines requirements for minimum PPE and its association with international industrial standard, roles and responsibilities to all parties in complying with these requirements, (6) Material Safety Datasheet (MSDS) Standard. This procedure gives guidelines on treating hazardous material in the work and its categories, (7) Housekeeping Standard. This procedure outlines requirements for a minimum good housekeeping for all facilities and job sites, and (8) Permit to Work (PTW). PTW procedures give guidance on what circumstances requires PTW, who are responsible to submit, review and approve the permits, and procedure to process the permit requests. This has been a crucial process in any project and or work executed since no work is allowed to be executed before the permit is properly reviewed and approved by a representative or authorized person, and it's part of work preparation by each contractors. These requirements are compulsory for all IOG-Corp's contractors to start the work.

Based on initial data collection and qualitative data gathered by interviews, contractors that work for IOG-Corp's small capital project started their work around 10 a.m. in the morning, while the normal working hour in IOG-Corp was 7 a.m. to 4 p.m. This is caused by ineffective use of time due to work preparation, which includes work permit preparation, toolbox meeting, and others that led to reduced available working hour per day to only 5 to 6 hours, or one or two hours less than the normal available working hour. This waste of time reduced the productive hours of construction activities. In the past, some efforts had been done to reduce the problem, it was when IOG-Corp faces claim from contractor in a certain amount due to a complaint in regards of long permitting process, which has caused time loss. It was suspected that IOG-Corp's safety requirement and safe work practices by IOG-Corp employee caused the delay. The major research questions of this case study research are: How did IOG-Corp implement lean six sigma in the Facility B? To what extent, do the results of this case study confirm or disconfirm lean six sigma as a good management theory? This research aims to address and share how the company dealt with this business issue by finding the root causes of contractor late start working time and finding a solution on how the process can be improved without sacrificing the safety of both contractors and IOG-Corp personnel. Lessons learned from this study are important for practical perspective.

LITERATURE REVIEW

Literature review on lean six sigma can be organized into three major perspectives, namely conceptual or theoretical, methodological, and empirical. First, from the conceptual or theoretical point of view, research in lean six sigma has converged to a common agreement that it is a philosophy (Naslund, 2013; Hilton & Sohal, 2012; Dahlgaard & Dahlgaard-Park, 2006), paradigm (Gitlow & Gitlow, 2013), and methodology (Assarlind et al, 2012; Laureani & Antony, 2012, 2010; Atmaca & Girenes, 2011; Nave, 2002) that integrates both lean and six sigma with an underlying belief that each alone cannot produce the maximum expected results; only the combination will do it. Both similarities and differences of each is well recognized and cross fertilization of both is possible (Assarlind et al, 2012).

Lean six sigma has been discussed whether it was a management fashion or fad or not (Antony, 2007; Naslund, 2008). This debate can be viewed from two different, but related points of view, namely the concept and the user. Through its long historical discourse, discussion, and development, the concept of lean six sigma is already mature as there has been more agreement than disagreement. As a management theory, lean six sigma has major constructs, for example, rationale, objective, methodology, tools and critical success factors. A collection of these properties does not constitute a theory (Sutton & Staw, 1995); however, lean six sigma can be categorized as a process-centered theory (Jaccard & Jacoby, 2010) as this is obvious in its famous DMAIC (Define, Measure, Analyze, Improve, Control) methodology. Moreover, the prescriptive methodology of DMAIC has also been widely accepted. Therefore, lean six sigma is no longer a management fashion, nor a fad (Gibsons & Tesone, 2001; Naslund, 2008; Towill, 2006). Snee (2010) stated that lean six sigma is not a fad. From their literature review on lean six sigma, Zhang et al (2012) found that 53% published papers were case study and 47% were theory-based. This reinforces that lean six sigma is a management theory. From the users' perspective, however, lean six sigma can be a fad if it is used without a critical reason for its adoption (Miller & Hartwick, 2002), or the user used it because it had been widely used by others (Antony, 2007).

Another critique is also worth to be mentioned, that lean six sigma can also be fallen into a management fashion or fad, if it is believed to be a panacea for all business issues or any kind of managerial problems (Antony, 20007). In this sense, the deployment of lean six sigma entails some pitfalls (Snee, 2010), critical failure factors (Albliwi et al, 2014), or obstacles (Arthur, 2014; Laureani et al, 2010). Not all lean six sigma initiatives implemented were significant to achieve the expected performance (Gowen et al, 2012). There may be some unique distinguishing characteristics or critical success factors or attributes for lean six sigma successful implementation in any company (Lameijer et al, 2016; Jayaraman & et al, 2012; Psychogios et al, 2012; Timans et al, 2012; Pepper & Spedding, 2010; Pranckevicius et al, 2008; Byrne et al, 2007; Cupryk et al, 2007).

Lean six sigma has been numerously mentioned as a mix or combination of lean management and six sigma (Antony, 2014, Sarkar et al, 2013; 2010; Siddh et al, 2013; Kumar & Bauer, 2010; Thomas et al, 2009; Arnheiter & Maleyeff, 2005; Sheridan, 2000; Snee, 2005) as part of process improvement methods (Dahlgaard & Dahlgaard-Park, 2006; Naslund, 2008; Bendell, 2006; Nave, 2002). In this regard, Pepper & Spedding (2010) summed up major properties of lean, including establishment for improvement methodology, focus on customer value stream, project-based implementation approach, understanding existing condition, collecting product and production data, layout and flow process charting, time study, process capacity measurement, and cycle time reduction. They also characterized six sigma into policy deployment methodology, measurement of customer requirements, cross-functional management, project management skills, data collection and analysis tools, process mapping and flowcharting, and data collection tools and techniques such as SPC.

Lean Six Sigma is also associated with quality improvement or management (Andersson et al., 2006; Snee, 2010). According to Assarlind & Gremyr (2012), lean six sigma contain seven major parts, namely major steps of DMAIC (define, measure, analyze, improve, control), toolbox, organization, variation reduction, customer focus, fact-based decisions, and bottom-line focus. A good review on the evolution of Lean Six Sigma can be found in Maleyeff et al. (2012) and Pepper & Spedding (2010). A few critical success factors (CSFs) for lean and sigma include management support, organizational culture, strategic alignment, project management, and training (Naslund, 2013). In sum, research gaps related to conceptual or theoretical aspect of Lean Six Sigma have rarely been mentioned in the literature, although Maleyeff et al (2012) argued that Lean Six Sigma body of knowledge might have to be adapted to the new realities. A note mentioning of possible future replacement of Lean Six Sigma with another future management theory will emerge when Lean Six Sigma is no longer effective to achieve its promised benefits (Snee and Hoerl, 2010). This may represent the maturity of Lean Six Sigma as a management theory.

Second, from the methodological point of view, there is a converging conclusion regarding major steps or stages in implementing Lean Six Sigma, involving the DMAIC (define, measure, analyze, improve, control). As mentioned in Andersson et al. (2006), according to Pyzdek (2003), the define step involves identifying product and process that requires improvement, establishing a team for the improvement project, defining the customers of the process as well as their needs and requirements, and determining the process that should be improved. In the measure step, key factors are identified especially those that have the most influential impact on the process of requiring improvement, and then deciding on how to measure these key factors. The substance of the analyze step is to discover root causes or factors that need improvements. The improve step deals with the design and implementation of the chosen improvement option that is the most effective solution. Ideally, a cost-benefit analysis should be used in this step to single out this best solution. And, the control step is designated to make sure that improvements have been achieved and that they can be sustained in the future. Research gaps on the methodological aspect has also been rarely highlighted, only pinpointing on possibilities for employing any other tools to complement those already established tools aforementioned (Naslund, 2008). Mixing or combining other approaches (Mingers & Brocklesby, 1997) with lean six sigma are possible (Huang & Klassen, 2016; Habidin & Yusuf, 2012).

Third, from the empirical point of view, Atmaca & Girenes (2011) provided a list of lean six sigma application in various sectors, including aircraft sub-industry, service, white goods industry, general, IT, public, pharmaceutical, call center, casting, insurance, and marketing. The objects of the improvement initiatives may involve error reduction, cost reduction, defects reduction, production line design, financial process, and service quality. The application of Lean Six Sigma in oil and gas industry has rarely been mentioned and this has caused a research gap. Therefore, any application on this sector will expand the body of practice of Lean Six Sigma. In addition, this application can also be used to reconfirm Lean Six Sigma as a management theory.

RESEARCH METHOD

Lean Six Sigma framework was chosen as an approach for this study because IOG-Corp. has adopted Lean Six Sigma as a tool for the improvement process for all of its worldwide operations since 2007. Lean will identify things which do not have additional value (waste) to start the work, and six sigma will help producing consistent input within tolerable limits or requirements. Lean Six Sigma methodology uses five steps namely Define, Measure, Analyze, Improve, and Control. By approaching the problem using this framework, it is expected that the improvement activities can be managed in a structured manner, data driven, and involve all line of workers.

This research adopts a mixed-method approach because it combines both qualitative and quantitative data (Creswell, 2002; Neuman, 2006). According to Creswell (2002), the qualitative method is suitable for any research problem seeking to understand a phenomenon, exploring a concept or identifying the variables to examine. In this regard, the identification of the business issue came from numerous informal observations in the field by the managements and the project owners. The random observation showed that almost in every visit on the field, the contractors started their work around 10 a.m., while the normal working hour started at 7 a.m. The formal report of these observations and the gaps are available in forms of emails and minutes of meeting, as well as interviews. This informal observation was then used as a "voice of customer" and a basis to conduct further formal observation based on quantitative method for a month. This top-bottom approach came natural as IOG Corp. has a functional Lean Sigma Advisory Team from managements that regularly reviews the improvement opportunities and cascaded them down for further actions.

The quantitative method in the early measurement phase was conducted in three steps. First, doing the gemba (seeing where the preparation of works were made in the field) and mapping the processes of work preparation. Second, from this rough mapping, log sheets were made to reflect the existing processes and how and when it is done step by step. Three, these log sheets were then shared and socialized to supervisor of Project X for them to fill the actual time when one process was started and finished. This was done for about two weeks to validate the qualitative data and brought up the case for framing a Lean Six Sigma Project formally. The objective of these three steps were to understand the current condition and to brought up the case for improvement. Please note that during the formal "measure" phase of the project, this log sheet will be distributed to a broader scope as per agreed in formal "Define" phase.

This research will give insight on how IOG Corp. implements DMAIC, how do the project team framing the scope of the project, how do they measure and provide valid justification of the current performance, what are root causes of the problem and how to identify them, what are the solutions, how are they implemented, what are the result and how Lean tools bring benefits to the successful of the project.

The step by step phase from define to early control phase are implemented within four months, and the control phase itself lasted for 12 months. During the define phase, qualitative data gained before the project initiated was used, and in addition to that, additional interview was conducted from the selected project members (10 members) during project kick-off meeting. The results are treated as "customer voice". These qualitative data were then validated during measurement phase using the same quantitative method used before the project started with a bigger scope to cover several projects in various area. This will be detailed in the result part of this paper.

During the analyze phase, value stream mapping and brainstorming primarily used to understand in depth the root cause of the problem and what are potential solutions to solve or prevent the contractor from late to start the work. In the improve phase, the potential solution were implemented across organizations from the bottom to the top, adopting the lean philosophy in employee involvement and engagement at all levels. The results of the improvement in control phase were monitored using the same methods that were used in measure phase to ensure consistency. The improvement result also tested using f-test and t-test.

RESULTS AND DISCUSSION

The results of DMAIC implementation will be detailed phase by phase starting from Define phase to Control phase.

Define Phase

Identify the opportunity for improvements

The first step of Lean Six Sigma is Define that started with identifying the opportunity for improvement. The purpose of the define phase is to identify opportunity for improvement, which was cascaded down from the business issue. The opportunity was the contractor's late start working time, which consequently results in reduced effective working hours per day and prolonged project duration and affected the schedule predictability.

Understand the customer requirements

The next step is understanding the Voice of Customer (VoC), which was defined as an expression of willingness of the customers, where customers are receiving products that made by the company. In this case, the customers (both internal and external customers) are Facility Operation Team, in which the small capital projects took place, the Capital Project Management team that acted both as an owner of the umbrella contract and user of those contract, and the contractors.

To collect the Voice of Customer, interviews with the Champion and a dialog with the contractor were conducted in August 2013. The list of questions for interview available in the appendix A. These voices were then translated into Critical Customer Requirement (CCR) as shown in table 1. CCR is a translation data from the VoC into quantitative data and has several advantages such as specific and measurable, dealing directly with the product attributes, complete and unambiguous, and describing what the customer wants and how to achieve it.

From the Customer Critical Requirement, we can conclude that it was desired for both IOG-Corp and contractors to work as early as possible so that available working time per day

Table 1. Translation of Voice of Customer into Critical Requirements

No	Voice of Customer	Customer	Clarification	Customer Critical Requirement
1	Contractor is always late coming to work	IOG-Corp's Management and contractors	Based on several management visits conducted in the past, they often saw the crew sitting idly outside the facilities even after 9 a.m. in the morning	Contractor to start working at 8 a.m. or earlier
2	Each facility had different policies on the permission processes	Contractors	One facility might request the contractor to add complimentary document on their permit, and the other facility did not do it for the same case	Consistent safe work practices across Sumatera operations
3	The project material often came late	Contractors	Some contractors sat idly while waiting for the project material to come	no contractor should stand-by to wait the project material to come
4	Available working hour per day was very low	IOG-Corp Capital Project Team and management	Since contractors often started working late, the available working hour per day was reduced	Available working hour per day was increased as the contractor started working earlier
5	It took too long to get permit from the facility owner	IOG-Corp Capital Project Team and management	It was said from the interviews that it might take one to two hours for contractor to get the permit approved	Duration for the contractor and facility owner to get the permit approved was reduced

source: IOG Corp

increased and was consistent with the implementation of Safe Work Practices, a governing procedure that includes the permitting process.

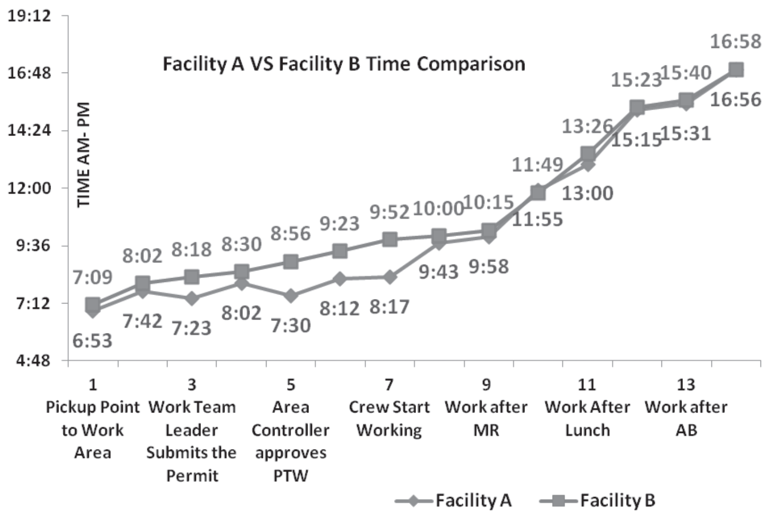
Define the process

The process that needs to be improved is contractor work preparation process that covered the process since the contractor crews were picked-up in the pickup point until they started the work in IOG-Corp facilities. It also included how the contractors prepared the work permit for the day and prepared the work. The preparation process was chosen since it's done in the first place before the contractors could start the work, which involved series of activities and took about 2.5 hours to complete. Although the scope is limited until the contractor starts the work, the data collection covers the time study until contractor finish the work. This is to calculate the overall time loss within a day.

Scope the project

To scope the project, IOG-Corp narrowed down the opportunity to which facility had the latest start working time and the result can be seen in Figure 1. The upper line belongs to Facility B, and the bottom line belongs to Facility A.

To collect data, motion and time study was conducted in August 2013. Motion and time study helped employees understand the nature and true cost of work, and assisted management in reducing unnecessary costs and balancing works to make work flows smoother (Meyers, 1999). This motion and time study was conducted as part of "Going to Gemba" activities, where facilitator and several project teams went to the facilities, observed, and took note each of activities' duration and/or starting time. The activities were also part of the measurement activities.



Source: IOG Corp.

Figure 1. Activities time study comparison between Facility A and Facility B

The selection to narrow down the scope was also discussed with the management level, including Champion and Sponsor of this project. Based on the data, it was clear those contractors that worked for the facility B started the work later than those who worked in the facility A. Therefore the project was narrowed down to improve the work preparation process in the Facility B.

Form the team

IOG-Corp developed standard for all the Lean Six Sigma project team as follows:

Project Sponsor

The sponsor for this Lean Six Sigma project was CPM Manager, since he managed all small capital projects in the field.

Project Champion

The champion selected for this project was Team Manager of Construction Management Team (CMT) under CPM team, which also a Subject Matter Expert when it came to safe work practices process Project Team Member.

To ensure a comphrehensive analysis and big impact, the project team member comprises representative from the contractor, Facility Owner Operation Representative, project engineer from capital project team, construction management team, third party supervision, and contracting team.

Make a project contract

IOG-Corp also included project contract as a compulsory requirement for a Lean Six Sigma project to start and it was used to formalize a project. Project team also developed an Input-Process-Output (IPO) Diagram to examine what process to be improved, variables that affected the results, and what output metric was measured as an outcome of this project. This IPO diagram is shown in Figure 2.

Measure Phase

IOG-Corp's Lean Six Sigma Measure Phase could be divided into several phases below:

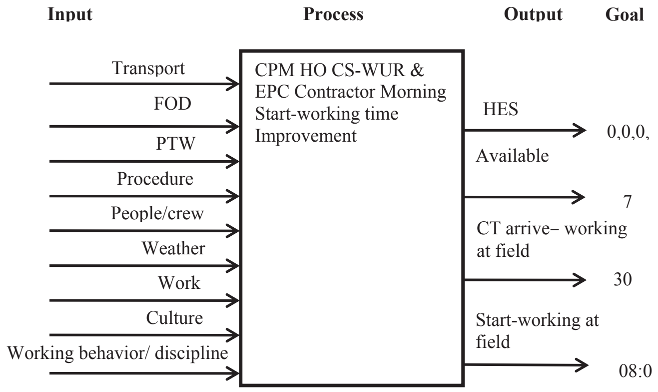


Figure 2. IPO Diagram

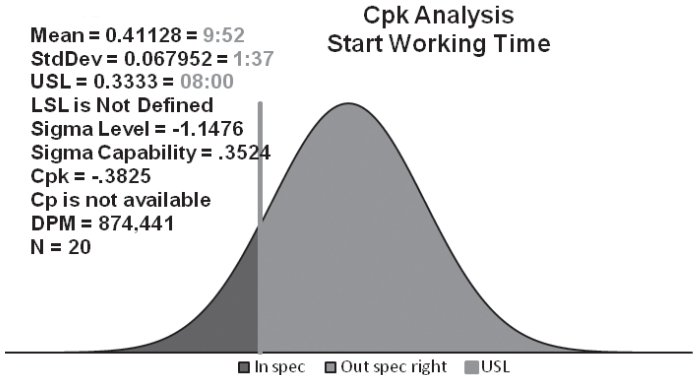
1. Determine what to measure

In the first step of the Measure phase, we determined what to measure. As indicated in the Figure 2 of the IPO Diagram, expected output metrics to be measured from this project consisted of:

a. Start Working Time
   As mentioned in the Define phase of this project, the main concern from all parties was how late contractor start their work, which will impact the second metric.
b. Available working time per day
   The available working time per day is calculated as follow:
   [A] Available working time per day = Working duration per day [B] - Break Time [C]
   [B] Working Duration per day = Time contractor finish the work [D] – Time contractor start the work [E].
   [E] is the main metric to be improved. And therefore, available working time per day was affected by how early contractors started their work. Any available working hour that was reduced due to haze, heavy rain, natural disaster, project material unavailability, and other abnormal condition would be excluded.
c. Cycle time since contractor arrived at the facilities until contractor started the work.
   This cycle time would affect how early contractor could start the work. The lower the cycle time, the earlier contractor could start the work.
d. HES Metric
   To avoid sub-optimization that resulting from improving permitting work, low quality HES review and HES Metric were also included to ensure all the works executed safely, while improving the efficient process of work permitting review. The target is Zero (0) Incident, Zero (0) Days away from Work (DAFW), Zero (0) Fatality, Zero (0) Motor Vehicle Crash (MVC), and Zero (0) Oil Spill.

2. Determine the measurement system

To measure those metrics, manual data gathering was chosen. This was done by making a log sheet and distributed it to all contractors. The log sheet is available in Appendix B. Contractor's Work Team Leader (WTL) was required to fill in the log sheet, and this was socialized and shared during the project kick-off meeting with all the contractors.



Source: IOG Corp.

Figure 3. Measurement of contractor start working time

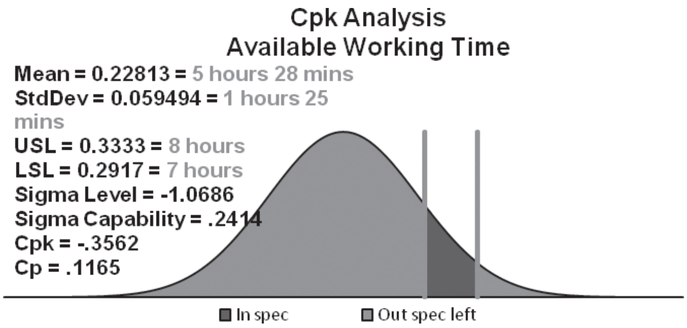
The log sheet contained step by step of each activity of the contractor since they were picked up until they started the work in on-plot facility. To determine what activities to be logged, an early observation is made (Going to Gemba) as discussed earlier in the Define phase of the project. Observation in Lean Six Sigma involves an investigator who is viewing a process or activities of people and/or equipment and registering, by some means (either noting down or registering in mind), in order to reach the subsequent critical analysis to come to a meaningful and logical conclusion on some clues, which are the potential causes of variation in the process outcome (Arumugam, V, et.al., 2011)

The project team simply observed what the actual activities performed in the field, its sequence and took notes of its time. This method was chosen since there was no mistake-proving method or automatic record that tracks each of those activities. After the period that had been agreed on, contractors submitted their log sheet to the project team. This observation is very critical to witness the process as it is, in order to identify the origin of the problem, to get thorough point of view from both company and contractor's side.

3. Collect the data and baseline process capability

The collected data was then manually entered to the excel spreadsheet and further analyze using SPC-XL program by SigmaZone.

a. Start working at the field
   Time unit of measurement was used to measure the average of crew start working at the field. As shown in the Figure 3., Cpk analysis was generated from the SPC-XL to show the process capability, with one-sided requirement was set (start work maximum at 8:00 a.m). The red color part of the graph represents those outside the requirements of start working at 8:00 a.m. and blue represents those within specification.
   The average start working in on-plot facilities was 9:52 a.m., with standard deviation about one and a half hours (1.5 hours). All the information was gathered from 20 samples with DPM (Defect per million) equals to 874,441. The negative Cpk (-0.3825) means that the process mean was outside the specification limits and the process mean in here was 09:52 a.m., which was outside the control requirement at 08:00 a.m. Cp value



Source: IOG Corp.

Figure 4. Measurement of available working time per day

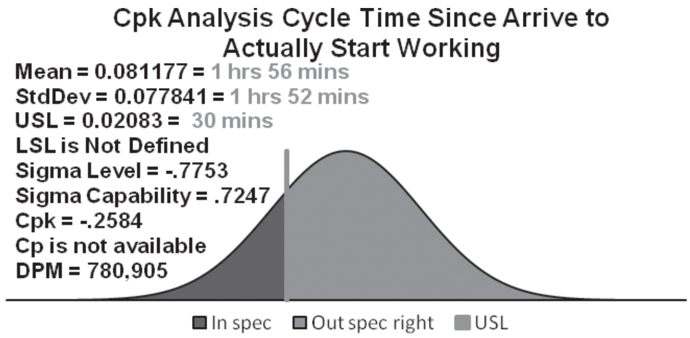
Table 2. The five quality conditions

Quality Condition	C_1 Values
Inadequate	$C_1 < 1.00$
Capable	$1.00 \leq C_1 < 1.33$
Satisfactory	$1.33 \leq C_1 < 1.50$
Excellent	$1.50 \leq C_1 < 2.00$
Super	$2.00 \leq C_1$

Source: Pearn & Chen (2002)

quality for one sided equation can be seen in Table 2., whereas C1 be either CPU or CPL (Capability indices designed particularly for processes with one-sided specifications, which required only the upper or the lower specification limit). Negative C1 means that the process was incapable.

b. Available working time per day
   Unit of Measurement used in this metric was hours. VoC is used to determine the specification. Considering the normal working hour started at 7:00 a.m. and ended at 16:00 p.m., the expected working hour per day was between seven to eight hours. The current available working hour per day was in average of 5.5 hours, or 1.5 hours below its minimum requirement.
   As can be seen in Figure 4,The standard deviation was around 1.5 hours which means that the available working hour might vary between 4 hours to 7 hours. Cp is lower than 1 (0.1), and Cpk is negative, which indicates that the average is beyond the specification. This generates sigma level of -1.06 and the sigma capability is 0.2414.
c. Cycle time since arriving to start working
   As mentioned earlier, the crew started working time was affected by how early the crew could finish all the preparation. In other words, the faster the cycle time contractor was able to finish preparing their work (including permit, etc.), the earlier they could start the work. As indicated in Figure 5, the average cycle time since contractor arrived until they started the work was around 2 hours, while the requirement was 30 minutes; it also generated negative Cpk and Sigma level. It means that the process was incapable of generating the result as required and the mean was beyond an allowable limit.



Source: IOG Corp.

Figure 5. Measurement of cycle time since arriving to start working

d. HES Metric

The measurement of HES metric will not be discussed in detail, since the metric and measurement system was already established, owned and controlled by each team together with HES team. This project will refer to it and use it as countermeasure to the above three metrics.

4. Calculating the COPQ

COPQ is Cost of Poor Quality, impact on cost or financial caused by the problem if nothing is done to correct it. In this particular case, COPQ is calculated as $1 or deemed to have “soft saving”, instead of direct impact or “hard saving” towards financial measures. The inefficient use of working hour leads to schedule delay and may impact cash flows and net present value of a project. However, the calculation to identify the portion of single impact from late working time among other causes such material unavailability, contractor unavailability, and many more require further effort on a higher level. Therefore, the champion decided that the project will solely focus on the soft saving (available working time per day) and the capital impact (hard saving) from late project execution will not be calculated.

Analyze Phase

The objective of the Analyze phase is to identify the root causes of the problem and prioritize them. Analyze phase in IOG Corp. was divided into three steps. They are determine the source of defect/process variance, identify potential root cause, analyze data and verify root causes, and determine critical success factor.

1. Determine the source of defect or process variance

In determining the root causes, the project team conducted the following: Going to Gemba and time and motion study, interview with the contractor crew, Value Stream Mapping, and brainstorming. The Going to Gemba, interview, and motion and time study were conducted all together. The purpose of going to Gemba was to validate the result during measurement phase by looking the actual event in the field. Value Stream Mapping and brainstorming were conducted together with project team on a two-day workshop in September 2013 after the aforementioned activities had been conducted. In this workshop they were encouraged to map all the detailed activities since they were picked up in the pickup point until they finished the work. Post-it was used to map all the detail processes. The purpose of conducting value stream mapping together were: to make every parties involved understood the process visibly, to have more detailed activities that might have not been captured during initial identification and measure phase, to engage everyone on the issues faced day by day, and to have an eye-opening impact to the supervisors and managers about the actual problems.

The result of the mapping can be seen in Figure 6. It reflects the current process that is mapped together with contractors, facility owner and project team. It was also validated by the actual observation made prior to the meeting. The red color represents the duration of non-value added activites, and the black color represents the duration value added activites.

2. Identify potential root cause, analyze data and verify root causes

Project Team identified potential root causes by conducting the Five Whys.

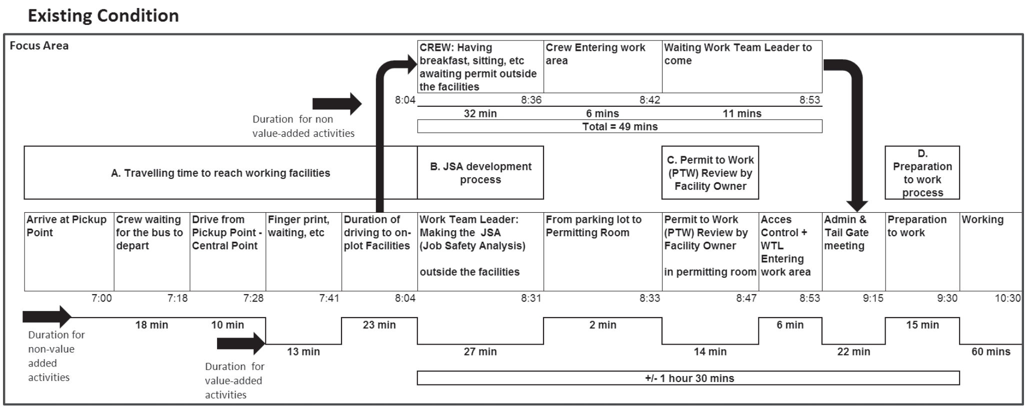
"*The Five Whys have been used as a root cause tool for many years. The approach uses a systematic questionnaire technique to search for root causes of a problem*. The *tool Five Whys is used by asking "why?" at least five times as you work through various levels of detail. Once it becomes difficult to respond to "why?" the probable cause of the problem may have been identified*" (Pojasek, 2000).

In order to perform the five whys, the work preparation process that has been mapped in Figure 6 was divided into four big processes. And each question was developed to find the root causes of each process as can be seen in Table 3. The result of the five whys can be seen in Table 4. Contractor was able to depart earlier, but with the limitation hours (might not start until after 7:45 a.m.) by facility operation as bottlenecking, there will always be "waiting" on contractor side. This would rotate back the root cause to point where the permitting hour was set to start 7:45 a.m., instead of earlier.

The contractor also were not allowed to go inside the facilities before the permit was approved since it was feared that any accident would occur if the JSA (Job Safety Analysis) and any others had not been properly and thoroughly reviewed and approved in the permission process, since the workers might not be well prepared and be aware of the surrounding hazard.

Daily Job Safety Analysis was repeatedly written everyday because the different understanding and different interpretation when it came to the implementation. This was shown during the workshop, where one person had a different idea with the other about how the JSA shall be performed.

According to IOG-Corp's Permit to Work Standard (2011) a Job Safety Analysis shall be performed onsite prior to the initiation of work and daily thereafter until permit had expired or work had been completed. The hazard analysis was used for planning the work, a qualified standard operating procedure (SOP) or an existing JSA might be used as a starting point for the JSA. However, it must be edited to reflect current conditions. This statement from the IOG-Corp's Permit to Work standard states clearly that JSA had to be validated every day (until the



Source: IOG Corp.

Figure 6. Value Stream Mapping of contractor work preparation process (before improvement)

Table 3. Investigative question of 5 Whys for each work preparation process

NO	Process	Question for 5 Whys
1	Transportation process (since the contractor picked-up in the pick-up point until they are arrive in the working facilities)	Why does it take 1 hour for the contractor to arrive at the facilities?
2	Job Safety Analysis (JSA) Development Process	Why it takes so long to develop JSA?
3	Permit to Work (PTW) review by facility owner of IOG-Corp	Why PTW process contributes to the delayed of start working hour?
4	Preparation to work	Why does it take so long to prepare the tools?

Source: IOG Corp.

permit expire) to reflect the most current condition. However, it was also meant that if nothing was changed in the work locations, the JSA remained the same as previous day and needed not be re-written all over again.

During the interview, the contractor stated that sometimes, the tools were worn out which caused them stop working momentarily , or waiting for the new tools to be delivered from their workshop. The replacement might be slower, but this was a rare case.

3. Determine critical success factor

In determining the critical success factors, a facilitator conducted interview and discussion with the champion. The critical success factors were factors that determining the successful implementation of the action items, they were:

- Leadership Behavior. As would any Lean Six Sigma project would need, leadership from Facility Operation, contractor management and Capital Project Team were more needed. The specific support needed from the Facility Manager was to emphasize the importance of efficient permitting process to enable effective project activities and overall organizational capability.
- Consistency and continuous coaching. When the change of behavior was needed, constant and consistent reminder shall be in place.
- An integrated action plan to implement the action item all together

Improve Phase

Based on the root causes identified using five whys, action items were developed as can be seen in Table 5.

Table 4. Five Whys on the contractor work preparation

1. Why does it take 1 hour for the contractor to arrive at the facilities					
No.	Why 1	Why 2	Why 3	Why 4	Why 5
1	Because the crew has to go to the centre point first	Because they have to do the finger printing	To ensure each worker is accounted for and doesn't play truant	Past experience recorded some of foul play by the contractor crew	No system in place to prevent such thing from happening
2		Because they will be re-arranged based on their work location	IOG-Corp, Inc has a vast work location	Facility design and location is fixed	
3	Because the distance of work area is far	The original design of the facilities is fixed and based on best practices			
2. Why it takes so long to develop JSA?					
No.	Why 1	Why 2	Why 3	Why 4	Why 5
1	Because they do it manually, written by hand	because it shall based on hazard identification on the field observation,			
2	JSA is repeatedly written every day while it is not required by the procedure	No similar understanding in the procedure	Each person has a different interpretation and practices	The practical implementation has never been gauged	Tend to just assume or follow the rigid requirement while it may not be required
3. Why PTW process contributes to start working late?					
No.	Why 1	Why 2	Why 3	Why 4	Why 5
1	Current time for PTW request are set up late: 07:45 - 08:45	Waits for the night shift transitioned to morning shift.	They put the handover process before the permitting process	Because the impact of such arrangement had not been known	Because it was never brought to light and no leadership commitment
2	While waiting for permits approval, crew having breakfast, smoking, sits, etc. This prolong talk, discussion and other non-value added activities	Crew are not allowed to enter the facilities before permit is approved	It is feared that contractor start working without proper permit and hazard review		
3	During facility operation weekly meeting, permit approval may be slower than usual	No assigned permit approver while meeting is taken place	No awareness to expedite the permitting process	Because the impact of such arrangement had not been known	Because it was never brought to light and no leadership commitment
4. Why does it take so long to prepare the tools					
1	Why 1	Why 2	Why 3	Why 4	Why 5
	In some cases, contractors are waiting for the material availability	The work order to contractor is placed in advance before the material is available	To secure contractor resources	No proper and centralized contract & resources management	

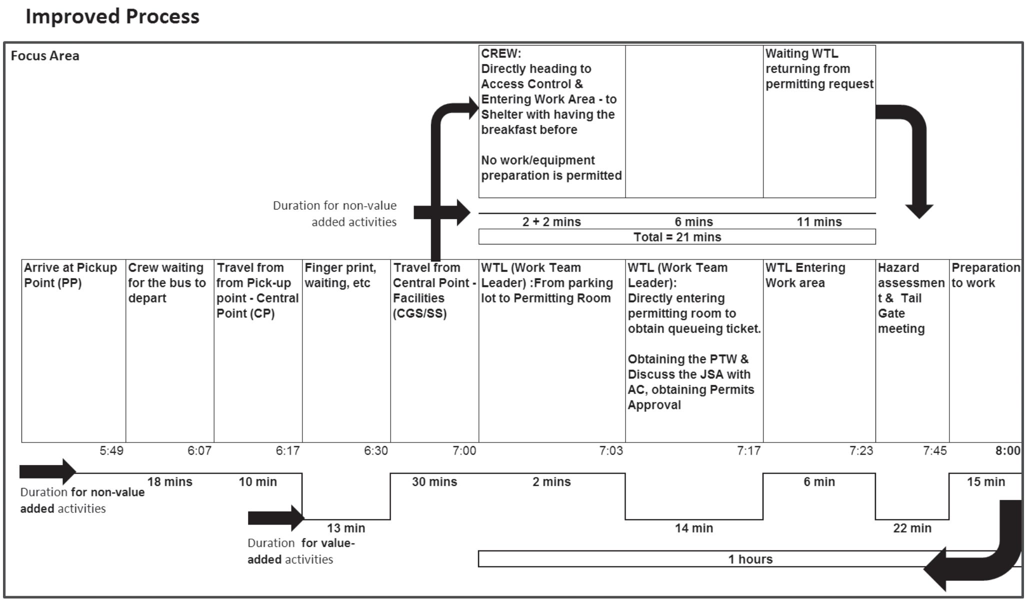
Source: IOG Corp.

After the action item was developed, the project team communicated and sought for approval with the Facility Operation manager. The proposal was approved for the permit review to start from 7:20 a.m. to 7:50 a.m. The project team then developed a step-by-step procedure about how is the work

Table 5. Improvement recommendation

No.	Process	Question for 5 Whys	Root Causes	Recommendation
1	A.Transportation process	Why does it take 1 hour for the contractor to arrive at the facilities	The distance is a constant parameter. They can go earlier, but with the permitting time is still started at 7:45, it will not expedite the process	The contractor need to depart earlier, and the permitting time will be set to start at 7:20
2	B.Job Safety Analysis (JSA) Development Process	Why it take so long to develop JSA?	Because the contractor and facility owner understanding towards permitting procedure varied. JSA does not need to be re-written every day. It only needs to be validated and added if any new hazard is introduced	Socialize the requirement of Job Analysis Process
3	C. The Permit to Work (PTW) review by the facility owner of IOG-Corp	Why PTW process contributes to start working late?	The facility owner puts the handover process over permitting review, and set the permitting review to start at 7:45 am. And contractor is not allowed to enter the facilities	1. To have a parallel process, and allow the permit review process to start at 7:20 am 2. Allowing contractors to enter the facilities before the permit is approved, but only for toolbox meeting purpose.
4	D.Preparation to work	Why does it take so long to prepare the tools and material	Some tools are worn out, and contractors are sometime have to wait for material	Why does it take so long to prepare the tools

Source: IOG Corp.

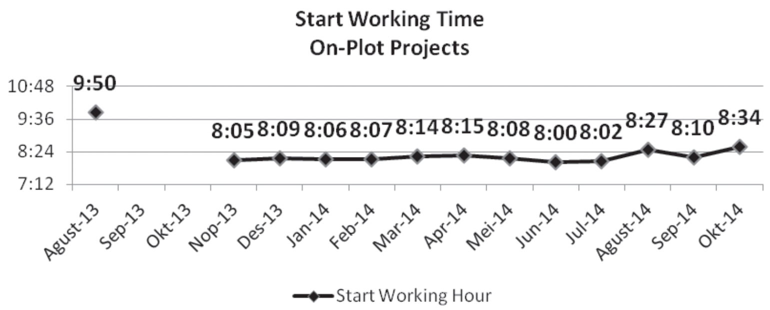


Source: IOG Corp.

Figure 7. Value Stream Mapping of Contractor Work Preparation Process (Improved)

preparation conducted, especially related to managing safe work shall be performed. The process flow after the improvement can be seen in Figure 7. This procedure was then socialized to all contractors that work for the facility B. All of these were executed in October 2013.

The socialization of this procedure was divided into two sessions, one for the contractor, and one for the operator



Source: IOG Corp.

Figure 8. Start working hour improvement result

Table 6. T-Test and F-Test for contractor start-working time

t-Test Result	
Hypothesis Tested:	H0: Column B Mean = Column C Mean H1: Column B Mean not equal to Column C Mean
p-value (probability of Type I Error)	0.000
Confidence that Column B Mean not equal to Column C Mean	100.0%

F-Test Result	
Hypothesis Tested:	H0: Column B Variance = Column C Variance H1: Column B Variance not equal to Column C Variance
p-value (probability of Type I Error)	0.000
Confidence that Column B Variance not equal to Column C Variance	100.0%

Summary Statistics	Column B	Column C
Mean	0.41128	0.34011
StDev	0.067952	0.020835
Count	20	273

Summary Statistics	Column B	Column C
Mean	0.41128	0.34011
StDev	0.067952	0.020835
Count	20	273

The results above represent the p-values from a two sample, 2-tailed t-test. This means that the probability of falsely concluding the alternative hypothesis is the value shown (where the alternate hypothesis is that the means are not equal). Another way of interpreting this result is that you can have (1-pvalue)*100% confidence that the means are not equal.

The results above represent the p-values from a two sample, 2-tailed F-test. This means that the probability of falsely concluding the alternative hypothesis is the value shown (where the alternate hypothesis is that the variances are not equal). Another way of interpreting this result is that you can have (1-pvalue)*100% confidence that the variances are not equal.

		True State of Nature	
		H0	H1
Conclusion	H0	Correct	Type II Error
Drawn	H1	Type I Error	Correct

		True State of Nature	
		H0	H1
Conclusion	H0	Correct	Type II Error
Drawn	H1	Type I Error	Correct

Source: IOG Corp.

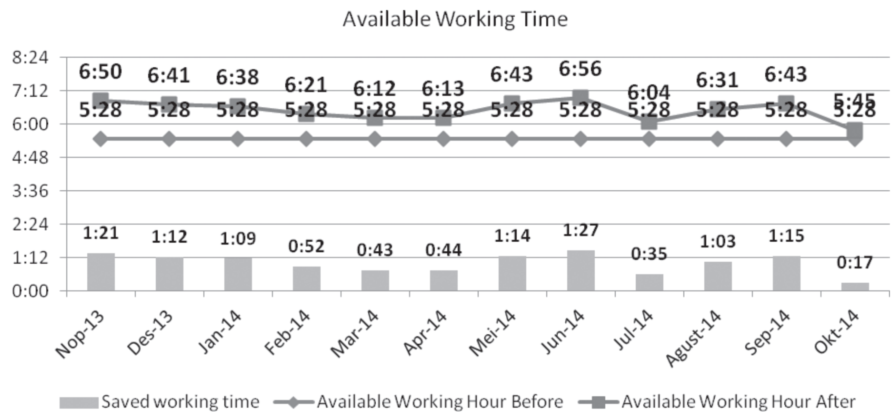
as a permit approver and area controller. Manager from Facility Operation and contractor were also requested to open the training, to show their commitment towards this process change.

Control Phase

After the improvement actions were completed, the project team monitored the results to ensure it was sustainable for the next 12 months. The following result was shown during the 12 months of control period since November 2013 – October 2014.

1. Start working at the field

As shown in figure 8, the mean was drastically reduced from 9:50 a.m. to around 8:11 a.m. (an average in 12 months observation). However, the



Source: IOG Corp.

Figure 9. Available working time per day improvement result

Table 7. t-Test and F-Test for contractor available working hour per day

t-Test Result			F-Test Result		
Hypothesis Tested:	H0: Column H Mean = Column I Mean H1: Column H Mean not equal to Column I Mean		Hypothesis Tested:	H0: Column H Variance = Column I Variance H1: Column H Variance not equal to Column I Variance	
	p-value (probability of Type I Error)	0.000		p-value (probability of Type I Error)	0.000
	Confidence that Column H Mean not equal to Column I Mean	100.0%		Confidence that Column H Variance not equal to Column I Variance	100.0%

Summary Statistics	Column H	Column I	Summary Statistics	Column H	Column I
Mean	0.22014	0.2735	Mean	0.22014	0.2735
StDev	0.067489	0.025762	StDev	0.067489	0.025762
Count	19	240	Count	19	240

The results above represent the p-values from a two sample, 2-tailed t-test. This means that the probability of falsely concluding the alternative hypothesis is the value shown (where the alternate hypothesis is that the means are not equal). Another way of interpreting this result is that you can have (1-pvalue)*100% confidence that the means are not equal.

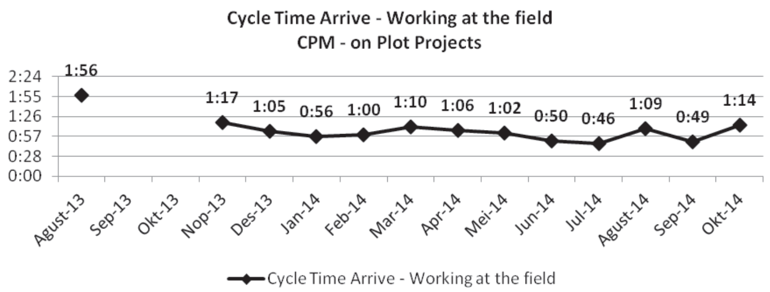
The results above represent the p-values from a two sample, 2-tailed F-test. This means that the probability of falsely concluding the alternative hypothesis is the value shown (where the alternate hypothesis is that the variances are not equal). Another way of interpreting this result is that you can have (1-pvalue)*100% confidence that the variances are not equal.

		True State of Nature H0	H1			*True State of Nature* H0	H1
Conclusion	H0	Correct	Type II Error	***Conclusion***	H0	Correct	Type II Error
Drawn	H1	Type I Error	Correct	***Drawn***	H1	Type I Error	Correct

Source: IOG Corp.

tendency to increase started on August . And in October 2014, it reached 08:34 a.m. The reason behind this fall back was due to procedure change that resulting from a recent near-miss, where contractor work under high H2S (Hydrogen Sulfide) condition.

The data were also inputted in SPC-XL software to perform t-Test and F-Test. As shown in Table 6 below, the t-Test results in 100% confident that column B (data were taken before the improvement) were not the same with data in column C (data was taken dur-



Source: IOG Corp.

Figure 10. Cycle time since arriving to start working improvement result

Table 8. t-Test and F-Test for Cycle time since arriving to start working

t-Test Result			F-Test Result		
Hypothesis Tested:	**H0: Column E Mean = Column F Mean H1: Column E Mean not equal to Column F Mean**		**Hypothesis Tested:**	**H0: Column E Variance = Column F Variance H1: Column E Variance not equal to Column F Variance**	
	p-value (probability of Type I Error)	**0.000**		p-value (probability of Type I Error)	**0.000**
	Confidence that Column E Mean not equal to Column F Mean	**100.0%**		Confidence that Column E Variance not equal to Column F Variance	**100.0%**

Summary Statistics	Column E	Column F
Mean	0.081177	0.04346
StDev	0.077841	0.019121
Count	19	273

Summary Statistics	Column E	Column F
Mean	0.081177	0.04346
StDev	0.077841	0.019121
Count	19	273

The results above represent the p-values from a two sample, 2-tailed t-test. This means that the probability of falsely concluding the alternative hypothesis is the value shown (where the alternate hypothesis is that the means are not equal). Another way of interpreting this result is that you can have (1-pvalue)*100% confidence that the means are not equal.

The results above represent the p-values from a two sample, 2-tailed F-test. This means that the probability of falsely concluding the alternative hypothesis is the value shown (where the alternate hypothesis is that the variances are not equal). Another way of interpreting this result is that you can have (1-pvalue)*100% confidence that the variances are not equal.

		True State of Nature	
		H0	**H1**
Conclusion	**H0**	Correct	Type II Error
Drawn	**H1**	Type I Error	Correct

		True State of Nature	
		H0	**H1**
Conclusion	**H0**	Correct	Type II Error
Drawn	**H1**	Type I Error	Correct

Source: IOG Corp.

ing 12 months of control period). The F-Test result also shows a 100% confident that there's a shift in standard deviation of start working time between before and after improvement.

2. Available working time per day

The data shown in Figure 9 was also inputted in SPC-XL software to perform t-Test and F-Test. As seen in Table 7, the t-Test results in 100% confident that Column B (data were taken before the improvement) were not the same with data in column C (data were taken during 12 months of control period). The F-Test result also shows a 100% confident that there's a shift in standard deviation of available working time/day between before and after improvement. As the start working time improved, the saved working time per day is also improved, that was how much inefficient time was saved per day.

3. Cycle time since arriving to start working

The data shown in figure 10 were also inputted in SPC-XL software to perform t-Test and F-Test. As seen in Table 8 below, the t-Test results in 100% confidence that column B (data were taken before the improvement) were not the same with data in column C (data were taken during 12 months of control period). The F-Test result also shows a 100% confidence that there's a shift in standard deviation of Cycle time since arriving to start working between before and after improvement.

CONCLUSION

This case study outlines and discusses how a corporate philosophy and methodology of lean six sigma adopted by a parent, global oil and gas company, were implemented in its branch in Indonesia to tackle a managerial problem of contractors' work preparation time. Before the lean six sigma project, the average of the contractors' start working time was at 09.50 am. The robust DMAIC methodology was consistently applied in this study and after 12 months of monitoring, this resulted in reduction of the contractors' work preparation process, leading to an increased in the effective working hours by an average of 59.3 minutes with standard deviation of 21.1 minutes. A critical part of this successful improvement project was due to the early engagement of the project's champion and sponsor. In addition, process mapping was also critical for identifying the detailed process involving multiple activities that might be arranged in series or parallel. We can also conclude that it was important to have all the project members involved by using kaizen, and make every process visible.

The implementation of this Lean Six Sigma Project was specifically adressed a problem that related to work culture in IOG-Corp. The scope was made very specific in a managable portion to improve the possibility of success with focus of arranging work sequences. A few major conclusions can be drawn. First, the project was cascaded down from both business issue and daily observation where contractor start working very late which reduces the effective working time per day. It is very important to have a Lean Six Sigma project that has a very strong correlation with business issues and business unit's objective. The successful implementation of this project is partly because of the strong business case related to it. Second, the Define phase is the most crucial step in doing a Lean Six Sigma project, since this will put a strong base for the project team to move forward. Early engagement to Champion and sponsor is imperative to make a successfull project. Champion and Sponsor's leadership behavior is a must for a successful Lean Six Sigma project. Third, in Measure phase, the use of manual data gathering approach challenges but can be mitigated by good communication and leadership. It is also very important to validate the data to ensure there's no gap between the numbers and the actual implementation in the field. Observation in the field is the key to understand the real problem, further investigate and balance the collected data. Process Mapping is very useful for identifying the detail process that has multiple activities, be it in series or parallel. Fourth, the Analyze phase of a Lean Six Sigma project is the core where the project team investigate the problem using the data and observation gained from the improve phase. It is important to have all the project members involved by using kaizen, and make every process visible. Fifth, all root causes and ideas during analyze phase may and may not directly related to the problem. It is advised that the project team shall focused on several items that are impactful. Sixth, the benefit in terms of monthly average saved working time resulted from the Improve phase was 59.3 minutes with standard deviation of 21.1 minutes. The saved working time means additional effective working hours available for contractors. Seventh, it is imperative to involve management in the implementation of the plan to empower the change. Eighth, the managerial implication for IOG-Corp is to apply the same initiative to other areas, to ensure the legacy of improvement is cascaded down to the management despite of rotation, or in the other words to have a change management in place, and to apply reward and punishment towards contractor that exceeds the requirement of start working time. Ninth, generalization or the external validity from one case study across different sectors demands cautions (Manville et al, 2012; Yin, 2009). The highest level of generalization of this case can occur at similar business issue, that is reduction of contractor work preparation time in any other units in IOG, Corp. and other oil and gas firms. A moderate level of generalization ability from the results of this study lies in non-added value process time reduction initiatives that may occur in any other companies. Last, this study reconfirms lean six sigma as a good management theory since it shows a consistency between the theory and the real practice in a global oil and gas company in Indonesia.

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Appendix

A. INTERVIEW QUESTIONS

Prior the define phase, interviews were made from management to project owners and executors in the fields and used as a "voice of customer". The questions are as follow, the first type was questioned to company's side and the second type were asked to the contractors who work for the company.

First type of questions:
1. The identity of the employee (name, what team they work for)
2. When the specific observation was made regarding situation on the project before the contractor start the work
3. What time did the observation take place
4. The name of the project they visit and what are the scope of work they are going to perform on that day
5. What time did the contractor start the work
6. If they start early (8 am was considered early), what do they do to be able to start early
7. If they were late, what caused them starting late

Second type of questions:
1. The identity of the employee (name, what team they work for)
2. What job they are going to perform on that day
3. What time does the permit usually get signed
4. What time do they start the work
5. What common problem do they see often happen when they prepare the work (this include safety administration preparation)

B. CONTRACTOR WORKING ACTIVITIES TIME TRACKING LOG SHEET

Contractor working time log sheet
Project Name:____________________
Contractor Name: ____________________
Job Number: ____________________

		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
NO	Date						
	Day						
	Job Type						
	Facility Name						
	Activities						
1	Time crew depart from the pick-up point						
2	Time crew arrive at the facilities						
3	Time crew arrive at the working area						
4	Time crew start the Tail Gate Meeting						
5	Time Work Team Leader of the crew arrive in permitting Room						
6	Time daily work permit is signed						
7	Time crew start working						
8	Time crew have morning break						
9	Time crew start working after morning break						
10	Time crew have lunch break						
11	Time crew start working after lunch break						
12	Time crew have afternoon break						
13	Time crew start working after afternoon break						
14	Time crew finish working						