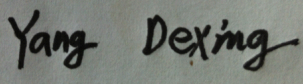




University of  
Stavanger

**Faculty of Science and Technology**

# **MASTER'S THESIS**

Study program / Specialization: Industrial Economics/ Project Management	Fall semester, 2013 Restricted access
Author: Yang, Dexing	 (Signature author)
Faculty supervisor: Professor: Tore Markeset	
Title of thesis: How to commission, maintain and manage a new rig	
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Key words: Condition based maintenance; commission ; COSL drilling 7S model; ABC management ;	Pages: 48 Beijing, May 2014

# **Abstract**

Corrective maintenance, time-based periodic maintenance and predictive maintenance are three maintenance measures which used in various industries, especially in maintain a drilling rig.

Compared with first-class drilling contractor companies which have sophisticated maintenance history, COSL (China Oilfield Services, Ltd) Drilling department still in the first stage which always use time-based periodic maintenance. This paper will distribute the situation of maintenance in COSL drilling department.

Moreover, the author was appointed to construct new rig and operate it. For a new rig, there was not only new equipment, but also new personnel, working abroad and cooperating with foreigners for the first time. These factors create challenge for the manager. How to make everything smoothly and successfully, how to keep all new equipment in good condition, and how to manage a new team was a big problem faced by the manager.

This study will use author's own experience to explain how to construct, maintain, and manage. Using author's experience, find the best way to construct, operate, maintain and manage a new jack-up rig.

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# Abbreviations

<b>BPP</b>	Bin-Packing Problem
<b>COSL</b>	China Oilfield Services Limited
<b>CAL</b>	Chinery Asset Limited
<b>AMOS</b>	Asset management operate system
<b>IMS</b>	integration management system

# Chapter 1 Introduction

## 1.1 Introduction and background

The author used to work as a rig manager, for a long time he was keep thinging about a question, “how to maintain, operate and manage a drilling rig” as long as possible under the term of usage. He was promoted to the rig manager from senior tool pusher, so he was familiar with drilling relatively more than the equipment maintenance. Fortunately, he has got a chance to learn industrial economy in university of Stavanger, especially the course of “Decision Engineering and Performance Management” and “Condition monitoring and management” has brought enormous influence and impact. Here he learned some equipment maintenance theories systemically on how to maintain a rig. Especially he was appointed to construct a new rig later, the equipment maintain theory guiding the construction well.

Last august, the author was appointed as the rig manager of COSLGIFT which was being constructed in shipyard of China Merchant Heavy Industry with the finish study in Norway. COSLGIFT was almost finished his main construct work and ready to start its commission job at that time.

These project team numbers come from 16 different rigs and they are entirely strangers before. How to make these people work as a whole and finish the construct and commission was the first problem for the author to face.

Respond to COSL headquarter all construct and commission work should be offered by the end of December. Then how to have the project finished on time was the second challenge.

After finish construct and commission work, COSLGIFT need to start dry tow to Myanmar directly and start drilling operation ASAP. So how to make sure all people being competent in operating and maintaining the new equipment and get enough spare parts was another problem faced by the author and his team.

## 1.2 Research questions

- 1) What are the problems of current maintenance sector COSL Drilling are facing
  - a) What aspects can be improved to reduce the occurrence of maintenance effectively;
  - b) Useful courses and theories needed to be used in the construction of a new rig;
  - c) What is the disadvantages in predictive maintenance

- 2) What measures need to be taken into in COSL's maintenance system ;
  - a) Pushed to obtain the support and investment from COSL ;
  - b) Find the best way to balance between different maintenance strategies ;
  - c) How to make the maintenance application keep going on.

### **1.3 Objective**

The main objective of this study is to find the best way to construct, maintain, and manage a new drilling rig in COSL Drilling.

### **1.4 Acknowledgement**

First of all I would like to express my appreciation to my academic supervisor, Professor Markeset Tore. Professor Markeset is a knowledgeable expert in the areas of maintenance management. He helped me to find this interesting topics that can reach scholarly Standard to achieve success my master degree in Offshore Technology at University of Stavanger. With his guidance, I learned more useful knowledge to my job.

I would also like to thank Professor J.P Liyanage and Professor O.T Gudmestad for their teaching of my study.

I would also like to express my appreciation to thank COSL for giving me the opportunity to study in University of Stavanger.

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I would also like to thank my wife's longtime silent support to my work ,my family, and of course for this thesis finish in time. And also my parents who are always be there as my everlasting back up.



# Chapter 2 the situation of maintenance in COSL Drilling division

## 2.1 General overview of maintenance

Maintenance plays a vital role in the industrial field, especially in petroleum field, like on a drilling rig. Maintenance is an integration of management and technology to keep all the equipment in good condition during all their life cycle. As that introduced in BS EN 13306, (2010), maintenance categorizes can be divided into preventive maintenance and corrective maintenance. Moreover, preventive maintenance is further subdivided into condition based maintenance and predetermined maintenance, corrective maintenance is further subdivided into deferred maintenance and immediate maintenance. Just as the figure 2.1 maintenance overview.

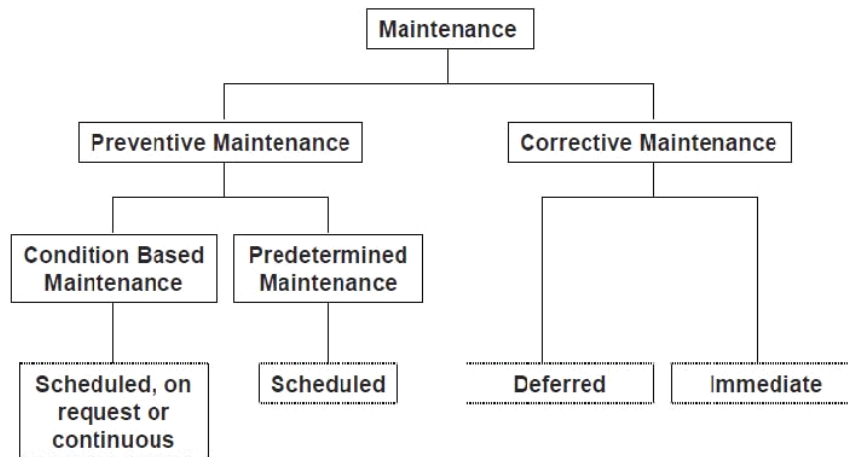


Figure 1 Maintenance Overview (EN 13306: 1)

All these maintenance categorizes were happened in COSL (China Oil Service Limited) Drilling.

## 2.2 Corrective maintenance in COSL Drilling

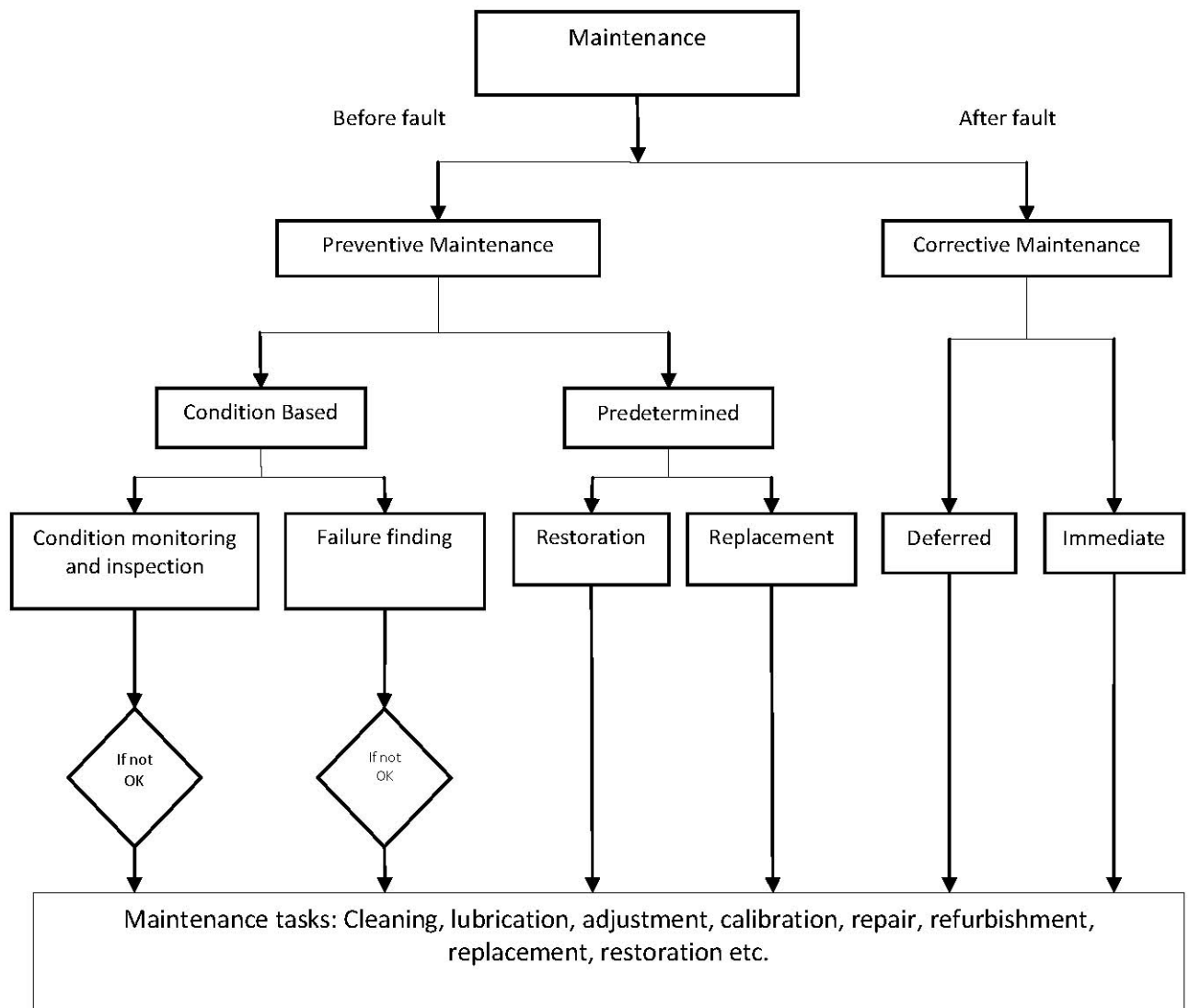


Figure 2 Maintenance types (IEC 60300-3- 11,2010)

As the figure 2, we can see it clearly that corrective maintenance always occurred after failures happened. When the machine loses its ability to do its required function or it breaks down, it's referred as a fault or functional failure, which is stated in (Rausand & Høyland, 2004). After the machine loses its normal ability, we need take some actions to repair it and make sure it can work as usual. That means there is no management on the equipment until the failures happen, which can be called “run to failure management”

However, we still stay in the first stage „failure at our goal of maintenance before the machines or systems failure, only a little maintenance has been done in advance. Once the failure happened, we need a lot to find the basic reason for the next step repair, including the subsequent extra money happened. More so, some failures may give rise to downtime for many days. Under this situation COSL drilling find it difficult to hold back the cost, then we have to taken measures to maintain our

equipment. Then simultaneously as an equipment management strategy, preventive maintenance execution only needs a short time for the operation so corrective maintenance is promptly replaced by the Preventive maintenance. But the corrective maintenance still deserves a seat at the daily operation, it constitutes but only happened on some non-critical equipment.

## **2.3 Preventive maintenance in COSL Drilling department**

By contrast, with corrective maintenance, preventive maintenance usually taken before equipment failure. So bring a lot of advantages, such as shorten the downtime, extend equipment life span, reduce equipment failure, increase equipment reliability, and save the cost. And as the figure, preventive can be subdivided into predetermined maintenance and condition based maintenance.

### **2.3.1 Predetermined maintenance in COSL drilling department**

Predetermined maintenance means all the maintain activities were planned before equipment failure happened. We make a Gantt chart of what kind of equipment and when they will be repaired or replaced. Also we can call it periodic maintenance which was executed on most COSL drilling rigs. Usually, every two half or three years, the rigs would be arranged into shipyard to maintain some critical equipment such as top drive, mud pump, and diesel engine. Every five years, the rigs would be scheduled into dock yard to maintain overhaul.

As a planned maintenance category, predetermined maintenance has many advantages mentioned above, and most rigs of COSL drilling department have a very good performance on equipment reliability. But some disadvantage should be aware, for example, we found it still maintains in serviceable condition when we arrange to replace the top drive, meanwhile the mud spudcan is in serious condition unexpectedly.

Moreover, periodical maintenance based on running hours of equipment, which could not reflect the real equipment condition to some degree. For example, two engines running the same hours with different workload will result in different abrasion.

Besides, some planned maintenance could not be executed due to drilling operation needs. For instance, if well kick happens, all the equipment should be ready for duty at any time. In such condition, we could not maintain any equipment as predetermined schedule.

COSL drilling department headquarter realized those shortcomings, and started to push COSL drilling departments' maintenance policy into condition based maintenance in late of 2008.

### **2.3.2 Condition based maintenance in COSL drilling department**

Preventive maintenance includes a combination of condition monitoring, inspection, testing and the ensuing maintenance actions (BS EN 13306, 2010). From the definition, we can know that condition based maintenance belongs to preventive maintenance, all the preventive maintenance is based on condition monitoring in some ways. If the condition monitoring measures was enough to indicate the real condition of the equipment, the condition based maintenance would be a perfect maintenance. But some time, condition measures were based on visual or audio inspection, which depend on inspector' subjective judgments, such as work experience, personal capability, sense of responsibility, etc. If the inspector is experienced, he might make a good conclusion promptly; if not, he could not make a right judgment fast enough. For example, a new inspector may lose the basic failure signal, such as abnormal noises, misalignment, smell, and so on.

Due to some disadvantages as mentioned above, COSL drilling department's maintenance was still not good at the first year after we started to implement condition based maintenance. Then the board council adopted some technical methods by introducing condition monitoring, such as tribology analysis, oil analysis, NDT test, and vibration monitoring.

In this paper, we only take oil analysis using as an example to illustrate what happened in COSL drilling department.

As we all know, there are physical and chemical interactions between different components when they contact, for instance, two or three rotary gears can produce force. The metal in special liquid, oil, or even in water can generate chemical actions. If we can analysis the debris in the oil, then we can know the situation of the equipment. With changing technique and taking maintenance work, the possible failure can be reduced, just as Markeset mentioned:

- The debris quantities indicates the degree of wear
- Morphology implies different wear process
- Debris size distribution demonstrates the changing of wear activities (Markeset, 2012)

This is the easy way to use on the drilling rigs to reduce the failure of equipment. COSL drilling department use a rig as the pilot rig. Compared the one with other rigs, we find its' maintenance cost reduced, and its' maintenance rationality increased. Then all COSL rigs took oil analysis as technical method to monitor the condition of the equipment. As the same process, vibration monitoring, NDT test, and so on were took on COSL drilling rigs. Although there are still many technical methods need to be improved and many new technical methods need to take in COSL drilling department, COSL drilling departments' maintenance improved very quickly. As the picture below (COSL 2013 annual report), we can know it very well.

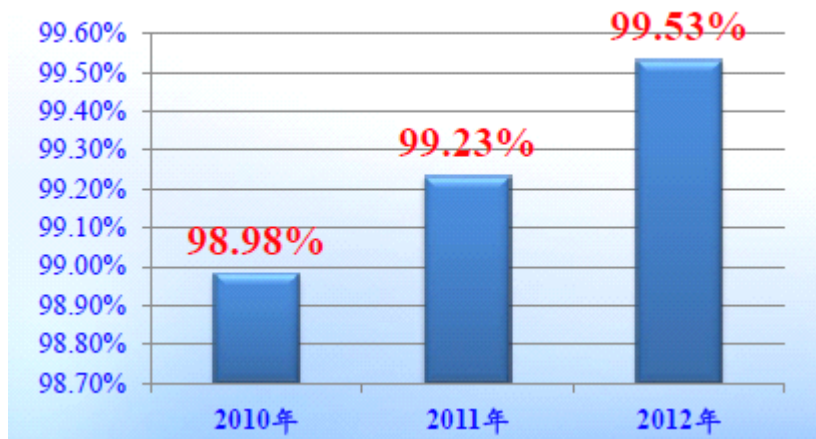


Figure 3 Equipment performance (COSL 2013 annual report)

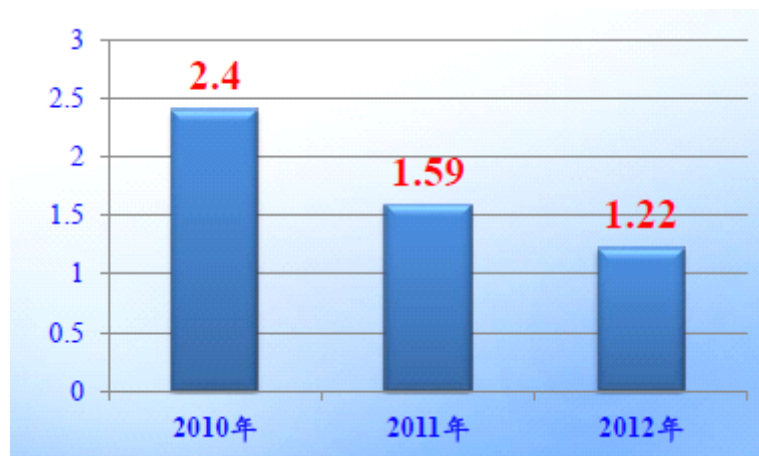


Figure 4 Downtime statistics (COSL 2013 annual report)

## 2.4 The trends in predictive maintenance management and condition monitoring

Maintenance has been developed and changed a lot following the needs of industry and business and the technology's unceasing progress. The first stage of maintenance is no maintenance until the machines or systems failure, and this maintenance strategy is called "run to failure management". For few maintenance has been done before failure, the corrective measures might need a lot of work to find the reason of the failure, repair the failure machine, and spend extra cost on returning to normal. The second stage of maintenance is preventive maintenance management. This maintenance strategy is designed on the statistical data of the machine or the design requirements, for example, the MTTF, the bathtub curve, the specification's requirements. Thought it is better than the first strategy, it is still not reliability, for some times the maintenance follow the schedule may be a waste or the failure may come early before the schedule. So a reliability and availability maintenance strategy is needed to reduce the maintenance cost, increase the profit, and keep human and

environment safety.

The predictive maintenance (PDM) has been used to satisfy such needs by directly monitoring the machine condition periodically or real-time. The maintenance manager could implement the maintenance as needed on the actual indicating condition. There are most common ways also five non-destructive ways: vibration monitoring, process parameter monitoring, thermography, tribology, and visual inspection. Usually the predictive maintenance utilizes these methods or combinations in different conditions.

However, the high environmental risk, huge investment and high reliability have become a global concerned problem for the economy world. The application of new generation maintenance technology should tend to focus on such aspects—greater accuracy in failure prediction, holistic view of equipment condition, reducing the cost of condition monitoring, improving the reliability of system, and optimization of equipment performance. In order to fulfill the requests above, we should expect to see from hardware and software (technical solution and management solution) to develop new generation maintenance and condition monitoring for now and the future.

- Improving and integrating the existing measures of information detecting and collecting, which would provide us integrated and accurate information about the system performance to predict the system or components failure. As the application of new technology, new methods and tools would be created to be applied in condition monitoring area.
- Application of multidisciplinary analysis and interdisciplinary.
- Developing smart sensor and some other low-cost real time monitoring systems that will permit the cost-effective continuous monitoring of key equipment items.
- Focusing on the business implications and applications of new technologies, leading to the utilization of condition monitoring technologies to improve equipment or system reliability and performance, rather than to predict components failure only.
- Increasing integration, and acceptance of common standards for interfacing condition monitoring software with CMMS and process control software.
- Developing sophisticated condition monitoring software, with rapidly developing "expert" diagnosis capabilities.
- Creating smart industrial devices with embedded intelligence. Just like humans, they need online services (i.e., for condition monitoring, remote diagnostics, maintenance, etc.) It is the goal of e-maintenance to answer this need.
- More and more efficient and effective application and integration of the management technologies and strategies. The experts have set up new ways and models to analyze the data, for example, FTA, ETA, FMECA. Such analysis has offered a lot of helpful information to modify design, to establish the new maintenance procedure and schedule, to prognose the failure models and consequences.

Some applications will be used in the future in COSL drilling department

- Intelligent Predictive Decision Support System (IPDSS) for condition-based maintenance. The IPDSS for condition-based maintenance integrates the concepts of:
  - Equipment condition monitoring.
  - Intelligent condition-based fault diagnosis.
  - Prediction of the trend of equipment deterioration.
  - Through integrating these three elements, the quality of maintenance decisions could be improved.

Application of information and communication technologies. The ICT increase the maintainability, reliability and reduce the cost, time, labor and risk. It is possible to collect and store infinitely many data from the maintenance industry, then analysis them efficiently. Without ICT, people cannot gain something in their life from the data. The new technology also makes the e-maintenance or remotely maintenance become possible. An expert in European office could get the real running information of a drilling system in the central Atlantic Ocean. An expert can monitor the whole oilfield oil gas production on the screen. The research and development ( r& d) personnel have also developed some software, to quickly locate the failure component or give the maintenance advice, what you need to do is run the program. The applications of the automation technology save much labor and avoid the disadvantage of human factors. A lot of new sensors, with different principles, performance, characterize, function and range of use have enabled the industry to predict its future.

# Chapter 3 How to construct and commission a new rig

At the end of last August, the author handed over the project of construct and commission COSLGIFT. This is a mature and advanced jack-up drilling rig, which has strong drilling operational capability and survival capability. The main refer parameters as below:

- Rig Type: Jack Up/Self-elevation
- Unit/Design/Shape: Gusto MSC B.V. CJ46-X100-D
- Unit Flag: SINGAPORE
- Unit Classification: ABS &CDS
- Which Code Version: Code 2009 IMO MODU Code consolidated edition
- Construction Yard: China Merchants Heavy Industry Ltd.

COSLGIFT was constructed by LONGZHU Company, and sold to COSL on 2013 July 31st. At the delivery time, there were still some equipment needs to be installed, such as top drive, drawwork, and BOP.

The author collect some data about the new rigs of COSL which were built in nearly ten years, and list them in the below table.

The statics of COSL new rigs						
rig name	HYSY941	HYSY942	HYSY936	HYSY937	COSLHUNTER	HYSY981
item						
rig type	jack-up	jack-up	jack-up	jack-up	jack-up	sub-semi
construct time(month)	31	29	28	26	24	34
commission time(month)	7	6	7	6	5	9

Figure 5 construct and commission time statics of COSL new rigs

As the figure above, we can know that a rig needs 5months for commission at least. But as the requirement of COSL' headquarter, the towing of COSLGIFT to Myanmar to work for Chinnery Assets Limited should be started before the end of December, which means we only had 4 months to finish the construction and commissioning. It was a arduous assignment for author and his team to have complete the work in such a short time. So the author and his team took some positive activities.



### 3.1 Focus on COSL drilling 7S model

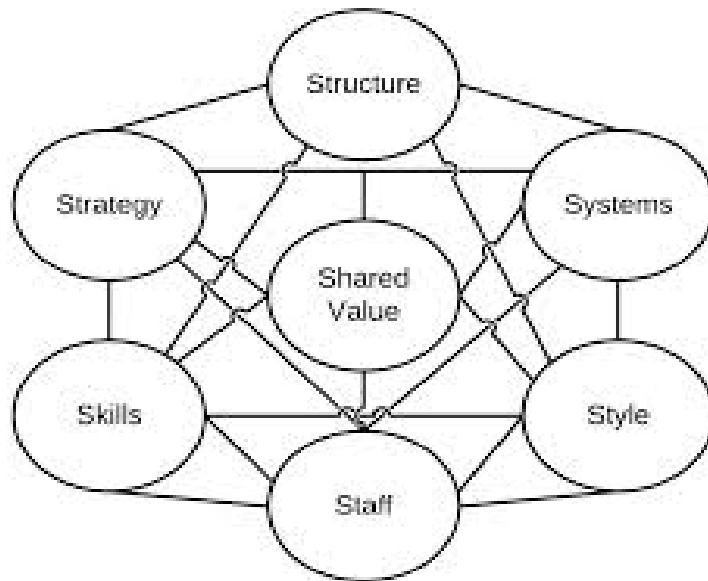


Figure 6 Mckinsey 7S Model (Mckinsey)

As the figure 3.2 Mckinsey 7S Model, if a company or organization want to accomplish his final targe, he needs to take some methods on structure, strategy, systems, skills, staff, style, shared value, which we call them 7S.

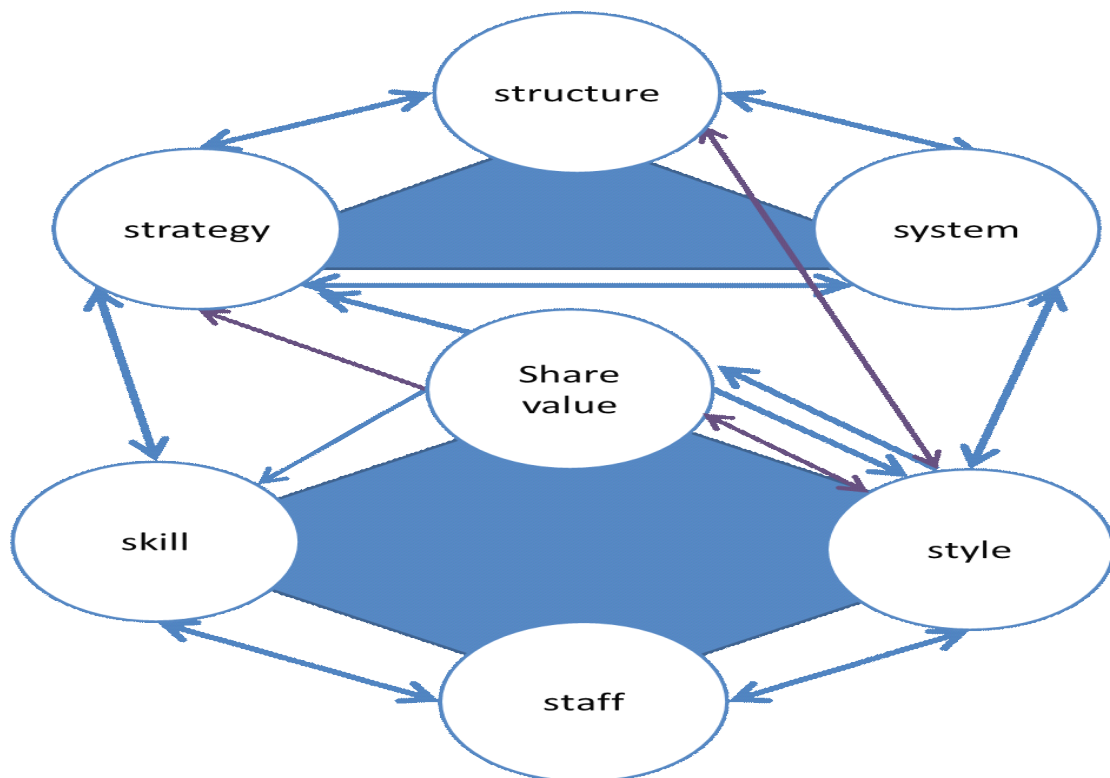


Figure 7 COSL drilling 7S model

We revise Mckinsey 7S model to COSL drilling 7S model, as the figure 3.3 shows.

For the first three S—structure、strategy、 system, we call them iron triangle in COSL drilling, all of them have been already designed and executed in COSL Drilling daily operations.. So the author only focus on the last ones—shared value、 skills、 style and staff.

All the staff of COSLGIFT came from 16 different rigs, they are entirely strangers before, and they all have their own way of life and customs. In order to make people become familiar with each other , strengthen the cooperation spirit and inspire our work enthusiasm, the author has decided to organized his team had an extended activities. It is the spirit of cooperation training our group members through this activity.

Especially for the last training project, just as what the below picture shows, the coach asked us challenged the “victory wall”, and we complied with the requirement. Eventually we finished satisfactorily much more than the expectation. The projects does perhaps help we know each other, and finished all the items in time.



Figure 8 outside training

The wall is 4.2 meters, our team, 44 people, attended the game, all of us got on the top of the wall only used 10.44 seconds, without any tools. We broke the record of the training school. The coach gave us high praise; he said “I never saw a team like you”. After that valuable experience, we know that our team can trust each other and cooperate without any hesitation.

### 3.2 Focus on the training

COSLGIFT is one of the most advanced jack-up rigs in the world. Some equipments and systems are seldom used on other COSL rigs , say the drilling control system is Amphion control system, which was used start from 2005. Especially for COSLGIFT, the Amphion version being used was the newly update version. All our people were not familiar with it. Then we applied the National Oil Varco (NOV) training for our engineers, including drillers, toolpushers, electric engineers, and so on.

National Oilwell Varco		Proposal Number:	176397	
		Revision:	0	
		Proposal Type:	FDD	
		Date:	12-Feb-2013	
P# / Id# / Item	Description	Qty	Unit Price	Total Price
<b>Summary (continued)</b>				
11	Initial Preparation Fee	1	8,000.00	8,000.00
12	TDS-8SA TOP DRIVE ELECTRICAL SYSTEMS - RIG SPECIFIC	1	24,000.00	24,000.00
13	Initial Preparation Fee	1	8,000.00	8,000.00
14	SHAFFER EQUIPMENT MECHANICAL COURSE (SURFACE) - RIG SPECIFIC	1	24,000.00	24,000.00
15	Initial Preparation Fee	1	8,000.00	8,000.00
16	BX-4-75 ELEVATOR, PS 30, D-495 ROTARY SUPPORT TABLE & HC-26EV HYDRAULIC CAT	1	24,000.00	24,000.00
17	Initial Preparation Fee	1	8,000.00	8,000.00
18	TRN-210-003 AMPHION MAINTENANCE COURSE FOR RIG ELECTRICIAN & E.T.	1	20,100.00	20,100.00
19	TRN-210-002 AMPHION CONTROLS OPERATORS COURSE	1	20,100.00	20,100.00
20	CPK1000 / RigSense / DAQ Total System 4	1	11,400.00	11,400.00
21	KRS 1030 / Drilling Equipment, Hyd/ Mech Course	1	16,000.00	16,000.00
22	Initial Preparation Fee	1	8,000.00	8,000.00
23	KRS 1210 / Pipe Handling Crane, Knuckle Boom, Operator Course	1	24,000.00	24,000.00
24	Initial Preparation Fee	1	8,000.00	8,000.00
25	KRS 1220 / Pipe Handling Crane, Knuckle Boom, Electro Technical Course	1	32,000.00	32,000.00
26	Initial Preparation Fee	1	8,000.00	8,000.00
27	KRS 1230 / Pipe Handling Crane, Knuckle Boom, Hyd/ Mech Course	1	24,000.00	24,000.00
28	Initial Preparation Fee	1	8,000.00	8,000.00
<b>2) Id#447025, Rev.0 Other Miscellaneous</b>				<b>171,000.00</b>
1	Rig Consultant	60	2,850.00	171,000.00
2	Instructor Travel Cost	1	(TBD)	(TBD)
3	Shipping Costs	1	(TBD)	(TBD)
4	Translation	1	(TBD)	(TBD)

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 NATIONAL OILWELL VARCO

Summary

4 of 44

Figure 9 part of NOV training items (NOV Proposal Prepared for: TS Drilling PTE LTD)

After NOV training, our people know Amphion very well, they can not only operate them very well, but also found out the problem and then suggest some solutions during the construction and commissioning.

Besides, we trained each other mutually. As I mentioned earlier our people came from different rigs. They had different experience and features with drilling operations and equipment. So we asked them training each other to make sure that all our people know how to operate and maintain the equipment they had used before in other rigs. If the equipment was totally new, and all the people had not use them before, we assigned some engineers to read the instructions carefully, made training PPT to teach all other people and auured all our works know how to maintain and operate them. Teaching benefits teachers as well as students through this invaluable process.

### **3.3 Focus on time schedule**

As COSL's headquarters' requirement, we should finish the project before the end of December. With this time as deadline, we made several time schedules for the main construct job and commission items. The below table is one of them.

date \ equipment	2013. 11. 22 FRI	2013. 11. 23 SAT	2013. 11. 24 SUN	2013. 11. 25 MON
POWER STATION	just finished black out recovery. 100% complete	just finished black out recovery. 100% complete	just finished black out recovery. 100% complete	just finished black out recovery. 100% complete
DWS	100% complete	100% complete	100% complete	100% complete
TDS	80%complete,hydrualic elevator didn't installed	80%complete,hydrualic elevator didn't installed	80%complete,hydrualic elevator didn't installed	85%complete, alarm functions completed, IBOP functions completed
ROUGH NECK	90% complete	90% complete	90% complete	90% complete
DIVERTER	finished valve control funtion	finished valve control funtion	finished valve control funtion	finished valve control funtion
BOP SYSTEM	finished valve control funtions and back up pressure functions	finished valve control funtions and back up pressure functions	finished valve control funtions and back up pressure functions	finished valve control funtions and back up pressure functions
amphion system	100% complete	100% complete	100% complete	100% complete
RIGSENSE	100% complete	100% complete	100% complete	100% complete
mud pumps	100% complete	100% complete	100% complete	100% complete
RT	90% complete, can't reach the 15rpm as designed	90% complete, can't reach the 15rpm as designed	90% complete, can't reach the 15rpm as designed	90% complete, can't reach the 15rpm as designed
mud treatment	100% compelte, didn't commission by liquid.	100% compelte, didn't commission by liquid.	100% compelte, didn't commission by liquid.	100% compelte, didn't commission by liquid.
CHOKE& KILL	didn't commission	didn't commission	didn't commission	didn't commission
alarm system	2 H2S detectors broken, transferring from vendor	2 H2S detectors broken, transferring from vendor	2 H2S detectors broken, transferring from vendor	2 H2S detectors broken, transferring from vendor
PA/GA system	60% complete	60% complete	60% complete	60% complete
CATWALK	100% complete	100% complete	100% complete	100% complete
hpu	100% complete	100% complete	100% complete	100% complete
PRS-8I& fingerboard	software problems with coordinate, NOV engineer doing fix job	software problems with coordinate, NOV engineer doing fix job	software problems with coordinate, NOV engineer doing fix job	software problems with coordinate, NOV engineer doing fix job

Figure 10 Time schedule of part equipment

With the time schedule, we hold meetings with ship yard every day to discuss what caused the deviation from time schedule. If the actual process was ahead of plan process, then we keep continuing. If the actual process was behind of scheduled process, then we analyzed what happened , how to solve in order to finish them on time. No matter how tiny the deviation is, we keep giving enough attention. Start from the above thinking we can always find what caused the deviation and the solution.

Finally, we finished the construction and commission in shorter time than other rigs, just as the figure shows.

The statics of COSL new rigs							
rig name	HYSY941	HYSY942	HYSY936	HYSY937	COSLHUNTER	HYSY981	COSLGIFT
item							
rig type	jack-up	jack-up	jack-up	jack-up	jack-up	sub-semi	jack-up
construct time(month)	31	29	28	26	24	34	22
commission time(month)	7	6	7	6	5	9	3

Figure 11 time statics of COSL new rigs(include COSLGIFT)

## **Chapter 4 How to maintain a new rig**

For a new rig, the top management should be effective and strict. The safety management seems to be given the priority for all. Safety education, safety monitor, and safety tips should be highlighted to all staff of equipment department in daily work, in order to guarantee the compulsory safety.

Equipment, the hardware of enterprise, is the source of an enterprise to survive and develop.

For the survival and development of an enterprise, equipment is also critical as second to the decisive factor of people. "If we want to reduce accidents, we need to focusing more on maintenance ", the saying fully shows the equipment plays the key role in normal production operations. Equipment needs maintenance, repair, and intensive care. Therefore, the equipment maintenance is a priority of our work. From daily inspection to routine maintenance, we should be able to achieve our goals of resolving various problems of equipment the first time, and protect the equipment in normal running. In some large or special operations who asked the department to increase the inspection efforts to avoid safety risks. As a new rig, staffs on COSLGIFT were not familiar with the equipment either. In our daily work, we must strive to understand the equipment -related knowledge, learn from each other and help each other. With the problems encountered on the job, we need to think more, communicate more, inspect more, and perform maintenance according AMOS Maintenance system, the goal is to keep equipment always in good condition, and to avoid production downtime caused by equipment failure.

### **4.1 Use human control loop**

Human control loop is a machine or process that is designed to fulfill a function and humans are required to monitor its performance and make adjustments or intervene in the event or malfunction. (Redmill,F., Rajan,J.,1997). The process of human control is illustrated in the figure 4.1

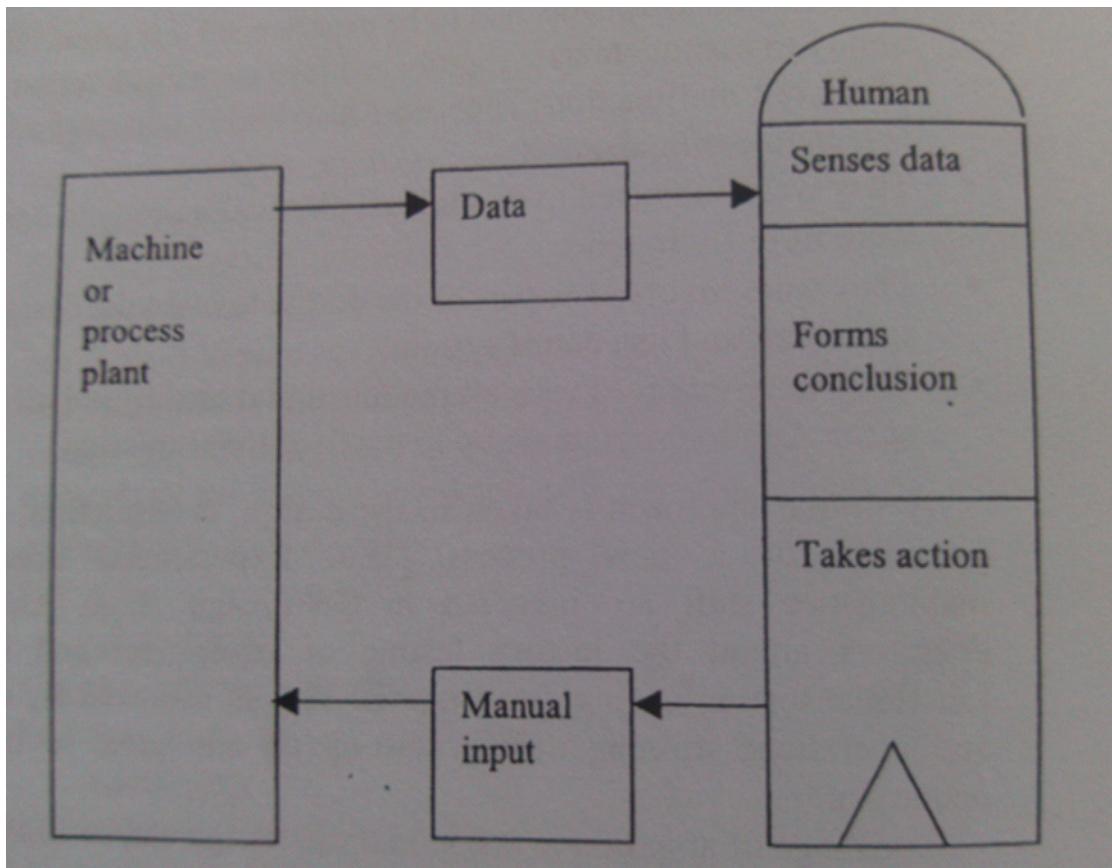


Figure 12 human control loop( Redmill,F., Rajan,J.,1997)

As the figure, we can know that the human control loop is consists of four major steps, which forms a circle process.

The first step is machine or process plant. This is the basis of the control loop. People operate a machine or process plant gaining information or data.

The next step is data or information collection. The data should be clear and sufficient for people to make a right decision.

The third step is data analysis. In this phase, proper and effective information is selected for people. Then people can analysis these data, make a conclusion, and take actions.

The last step is manual input phase. What we have done in the earlier phase will input to the first step.

Through these four steps, a loop is finished, and a new loop can repeat like this. We use human control loop as our new rig's tool. Collect relevant information into the control loop, and re-start the loop again and again. So our equipment staffs know the equipment very well and always made right decision.



## **4.2 Use AMOS system instead PMS system**

Compared with PMS system (preventive maintenance system), we thought AMOS system (Asset management operate system) has many advantages, so we took it as our rigs' maintain system.

- AMOS basic function is same as PMS, it arrange the maintenance job in schedule. We can trace the maintenance history in system, maintenance records were kept in system history as real name ID. So no one can be irresponsible. (PMS only position ID).
- AMOS data base is coded, each equipment has its own code named SFI code. As the same token, the parts of the equipment followed equipment SFI code, just make more digital place. The DW's SFI is 312.312.01, its parts must be 312.312.01.xx. So if we got some parts we didn't know, its SFI code is 312.312.01.xx, it must belong to the DW.
- Material management. AMOS's important function, it's similar as COSL's ERP. At first, we can check the stock and details such as P/N, prize. Once we purchased the parts in system, we can also chasing them by the purchase form number, and the office in shore can key any information of the purchasing on AMOS office terminal. It's simple and effective, Matco and engineer does not need to send email back and forth.
- Stock out in detail. When we use the parts to repair or replace. We can use the requisition Work function. Any problems of the equipment and any method to fix it also record in the Requisition Work history. As engineer finished Requisition work, just need to give Matco this work order number, Matco can do records on stock out. This can not only record the repair history but also reflects the stock consuming.
- Others. AMOS also have the function to insert accessory such as photos, lists, and pdf pages.
- High level for supervisor. If the supervisor found some maintenance work orders haven't done properly or in poor condition. Supervisor can reject the work order and make a report to in shore office. So less cheat on the maintenance jobs happens.

## **4.3 Put the corporate" safety first" into daily equipment management**

During work, we asked our staff make a good pre-tour meeting, layout tasks and give a detailed safety risk tip. As our rigs' policy, all staff had to analyze risks that may exist and take appropriate precautions to ensure work safety before they start their work. No matter what kinds of jobs will execute, they had to take job analysis and get work permit. For daily work, the chief must supervise the job and conduct safety operations in order to avoid unsafety behavior occurs. For important and special task,

the chief must organize detail safety analysis and introduce the procedures and precautions to staff, invite HSE supervisor to analyze the risk with other department members, check the operations on-site, monitor all the steps.

We made sure everyone being involved in the rig safety management procedures and sharing safety pressure to improve safety awareness. We required our staff to collect the problems that had happened on other rigs before for the same equipment, discuss the reason and get the final method to avoid them yesterday once more on our rig. We also required out team remind each other during the daily job. We held weekly meeting to discuss the good or bad situation that happened in the last week, then adopt the good points and avoid disadvantages happened again in the future. We also organized our staff to learn accident case, analysis and review the potential hazards and dangerous situations appeared, awake everyone in time. Besides, we organized department members to conduct in-depth analysis and discussion, associating with rig actual conditions and give top priority to check their own work in addition to the safety risks, to make the appropriate preventive measures to avoid the accident in the team. We also take great importance to train staff's safety awareness, and educate people from accidents, and thus achieve the purpose of preventing a number of accidents.

We took these measures to avoid the regular work mistakes, the event of danger and events which was mostly low-level incidents.

#### **4.4 Strict do the AMOS and daily inspection**

The equipment need periodic inspection and maintenance, to keep their normal running. For a drilling rig, equipment inspection and maintenance benefit us on one side to ensure the drilling and completion of production tasks smoothly, on another side to decrease equipment maintenance cycle and reduce equipment repair times. In order to ensure the effective perform the AMOS, first requires strict daily inspection, and sign in the daily AMOS sheet, to ensure the reliability, timeliness. Equipment management person should seriously treat the issues raised by drilling department. They should be able to solve small troubles immediately. If the issue need more time to treat, clear explain is required. In case of the problem cannot be eradicated in a short period, temporary methods should be taken to control the situation.

As GIFT rig being new, possibly part of the equipment is not included in the AMOS system , so we need full use of the production gap time to maintenance, timely settle the abnormal operation, eliminating equipment failure risks. Strengthen inspection of key equipment, such as drawworks, mud pumps, and cranes. Establish a special checklist, measure and record the related data, in order to grasp its function. For the repaired equipment, we need priority inspect and record operating parameters, to immediately solve the exception problem. Establish safety equipment inspection system for lifting, safety and emergency equipment, record the maintenance item that

not involved in AMOS system, add this item to checklist, and in the further inspection cycle, so that all the equipment are being monitored. Carry out "low old bad manner" activities, to eliminate the phenomenon of low old bad manner happens in the new rig from beginning, forming a health working atmosphere rig, improve work standards, effective performance all the rig safety management. For the equipment cannot be replaced by another one, we need to tighten the inspection in daily management, such as: keep daily inspection and full care, correctly use the drilling time gap, solve the abnormal factors, and eliminate equipment failure risks. We should make great efforts to continue improving our work standards and overall equipment management standards, according to the actual situation to adjust and refine the equipment and facilities integrity checking system, to keep the rig in safety performance.

#### **4.5 Deepen and refine the budget management**

Change passive management to active management, in order to achieve a real sense of orderly management of the equipment. Holding central place in management philosophy to handle the inputs and outputs, costs and profits, such basic elements of budget. Strengthen cost-saving awareness, strengthen store management, strengthen communication between equipment staff and material man, carry the regular check of the spare parts to ensure that equipment repair, spare parts order, periodic inspection and other work can be done basically reasonable and orderly. According to the rig equipment repair plan, renovation plans, consumption and inventory, we organize relevant staff to carry out a full assessment of the development of material procurement plans, so that the necessary spare parts are in store , consumption parts is not excessive. We make various spare reserves reasonably, accord to the equipment functions, status, life cycles, which are important to determine the quantity of parts in store. Also, we adjust quantity according to actual situation, in order to achieve scientific inventory management, dynamic management. We make plan according to the rig equipment repair, renovation plans, and the actual use of consumption parts and inventory. We organize relevant staff to carry out a full assessment of material procurement plan, summary and analysis, to overcome the low awareness of cost-saving, to ensure that the rig store in reasonable level. For overhaul materials, high value spare parts and long cycle repair equipment spare parts order, we need chief, material man and supervisor' suggestions or decisions, to avoid "a final say" situation. Truly understand the equipment, refine the budget, and improve the effectiveness, reasonable and orderly costs.

In making equipment repair projects, our principle is that equipment staff should be added self-repair on first, third party repair takes second place. We will not bother others about the repair work ,providing we can fix it ourselves, if it is necessary for third party to repara equipment, we remains analysing and tring our best to take self-repair in advance. For safety reason, we concerns pripority of repairing old ones, revalue resource, promote technological innovation, to solve the problem by ourselves, saving the cost, improve the abilities of staff. For overhaul project, we should refer

the equipment maintenance manuals and the actual operation, effectively make the equipment overhaul cycle and budget, to ensure equipment effectively use. In the development of maintenance program, to fulfill all repairs needs to keep or restore performance, any necessary modification must be done to enhance the capacity and improve the environment. We must strengthen assessment of the overall project and analysis, every repair project must be revised and improved several times, descriptions and all materials to be constantly verified and refined, some project needs continue to improving.

## **4.6 Perfect equipment document management**

Document management is an important part of the equipment management, if we have a complete set of equipment original data, running records, maintenance records etc., we can save a lot of time to repair, and to understand the details in a short time. A perfect document management system can help us to order the spare parts, make plan of equipment repair, and make a purchase of various spare materials more reasonably, by referring to the original record of spare parts usage. So that, we can decrease store, reduce material cost target, reducing the cost of production rigs. Management of equipment document is an important work for equipment staff. Each equipment, each inspection and maintenance, accessories updates, problem situations, and running time should be logged in file. We saved them for future inquiries and made the equipment staff know the importance of the equipment history and maintenance plan. So that reasonable purchase of maintenance materials was came true.

# Chapter 5 How to manage a new rig safety

## 5.1 Introduction

Safety is the life and soul for all the companies. Especially petroleum industry. offshore drilling industry is recognized as a high-risk and frequent-disaster industry in the eyes of many. Once an accident happened in the offshore drilling operation, it does not only bring the property loss, but also bring the injuries even fatality to the employees; what's more, the accident also bring a heavy strike to the family and negative impact to the company image , even affect the harmony society construction and economic development.

The safety management on the drilling worksite is conducted for the safety production. The emphasis of the worksite safety management is to control the human unsafe behavior and object unsafe condition, implement the safety management decision and target. The aim of the safety management is to eliminate all the accident and incident, avoid the human injuries, and reduce the accident loss.

## 5.2 Features of offshore drilling operation

Due to the environment and properties of offshore drilling operation, this is a high-risk, accident happening, and easy-injury industry. The below is the typical features of offshore drilling industry.

- Working outdoors on the sea with high temperature or other extreme weather such as strong wind, float ice on the sea.
- The occupational disease existing during many special type work, such as pneumoconiosis, noise deafness.
- Heavy work especially high intensive physical work make the employees feel tired and distract, so that the accident and incident occurs.
- Cross-operation need more employee to sincerely cooperate with each other. Such as casing running, BOP nipple up and down. The poor cooperation, bad commendation is the main factor that causing the accident and incident.
- Work at high is frequent, such as working at monkey board during tripping operation.
- The young employee gets more and more due to the COSL rapid development. They are lack of experiences, rush to prove themselves, which are all the unsafe factor during the operation.
- Work environment is enclosed, which make people feel anxious during the long term working on the rig without family around.

- A lot of contractors on the rig for the irregular operation. They are lack of sense of responsibility, poor safety awareness.

### **5.3 Main hazardous factors on the rig**

Base on the Enterprise Worker Casualty Classification ( GB6441--1986 ) , there are these hazardous factors as below described:

- Object hit or strike
- Equipment injuries
- Lifting operation
- Electric shock
- Falling objects from high
- Fire injuries or accident
- Vehicle injuries or accident
- Burning injuries
- Explosive accident or incident
- Other injuries or accident

Due to many hazardous factors described above existing throughout the drilling operation, if the accident or incident happened, it will make series of worse consequence. The employees with poor safety awareness, low culture level and insufficient safety knowledge cannot learn the professional knowledge to improve, broaden and practice their safety skill actively. On another side, the safety training and education is simple but not practical. In general although the head of the company conduct the safety training and education for the employees working offshore as a foundational job, take the “3-grade” training for the new employees, develop the training for the safety officers and team leaders regularly, the effect is still not so good to improve the employee safety awareness, strengthen safety management employee responsibility, deepen the team safety culture construction.

Safety management also needs to be coached on the worksite

### **5.4 Current situation of offshore drilling operation**

The accident and incident including extremely serious accident happened now and again on the offshore worksite. The safety situation is still very severe. Take the drilling worksite as the emphasize, control the accident and incident happen as the target, take the active and effective measures to improve the employees’ safety awareness, strengthen the safety control and supervision on the worksite according to the offshore drilling features, there is the measures as below:

#### **5.4.1 Safety responsibility system**

Implement the safety responsibility system, we should build the defined rules and regulations for all the people including the leaderships and the normal worker, they

need to know what their responsibilities are and what they should do for the safety clearly. All the people on the rig should sign the safety production duty pledge level by level, the safety production target, targeted measures and specific rewards and punishment rules.

The Rig Manager should be the first responsible people for the whole rig, take the overall responsibilities. He must set a good example about the safety management for all the employees on the rig. If the employees see that their boss focus on the safety, they will be affected to care about the safety. If not, we can imagine the consequence.

#### **5.4.2 Strengthen safety training and education, Implement the safety inspection**

According to the accident statistics, there are two main factors to cause the accident: one is human unsafe behavior, another is external reason. Based on the investigation, the accidents caused by human take up more than 85%, it shows: operations against the regulation, faulty operation, lack of experience and so on. So we must strength the safety training and education to the employees to improve their safety awareness, broaden their safety knowledge, in order to eliminate the human unsafe behavior, reduce the human faulty. The safety training and education is the effective way to control human behavior.

We can conduct the training from the bellows:

- COSL Drilling IMS (Integrated management system) training. As we all know, IMS is the guiding principle on the worksite, which is the rules and regulations that we must follow and implement. So we should put the IMS training as emphasize for the training work. There are two ways we can conduct to develop the training, the employee self-study, and the team collective learning. We can use the both two ways as described above to develop the IMS training, making everyone know the IMS's importance. Also the leadership can test the IMS learning's effect regularly to urge the employees to study the IMS actively. If everyone on the rig knows, is familiar and master of the IMS, I believe their safety awareness and knowledge will improve unknowingly. So the safety management will get easier and easier for the leaderships on the rig.
- Professional skill training: more and more young people graduated from the college come to work on the offshore rig these years. Some of them have taken up the key position. They are lack of the work experience and professional skills, so they are always in danger when they are working. Realizing this we must utilize all the potential chance to train these young people. Take an example, when the mud pump is off of service, we can organize the young people together to learn how to fix the pump. If the time available, we can ask them to fix the pump step by step by themselves. So that they will improve their professional skill rapidly. If the professional skill improved, the safety awareness and knowledge will also improve together.

Also the safety inspection is the important and effective way to find the human unsafe behavior and object unsafe condition. It can eliminate the hidden danger; urge the corrective measures to be implemented. The safety inspection includes: safety management inspection, rules and regulations inspection, worksite inspection, hidden danger inspection and accident handling inspection. According to COSL Drilling IMS, we have regular inspection, season inspection, special inspection and holiday inspection. We should utilize all these four inspection properly. Four these four inspections, I think we should focus on the regular inspection. According to my experience, we can divide the whole rig into some specific areas, and then we make an inspection plan for the whole year by week and week. We inspect the specific area every week to achieve the inspection of the whole rig repeatedly week by week. For the problems found during the inspections, we must pay high attention to them. Based on the principle of “who is in charge, who is responsible”, we will pick up the designated people to correct the problems in a specified duration. After the duration, the Senior Toolpusher should double-check whether the corrective measure is taken and useful.

## **5.5 Strength operation control, focus on the safety**

### **management on the worksite**

All the people should involve in the safety management. Every people from leadership to normal workers must take part in the safety management; conduct the production according to the relevant rules and regulations. The leadership takes a leading role, focus on the safety investment, ensure the hidden danger be corrected. The normal worker do every job in accordance with COSL Drilling IMS, be honored to be a part of the safety management.

Implement the rules and regulations strictly, strength the process control. As we all known, drilling operation is a labor intensive industry, which needs lots of people to do the job. We should make the different safety rules and standards for every position; develop the work instruction to guide the people to do the job correctly.

According to the work instruction and IMS, we can standardize all the jobs, so that every people can do the job correctly with the guideline to avoid the potential hazard as much as he can. If someone does the job without following the IMS or the work instruction, he will be punished and be sent to learn the IMS and work instruction again. So the behavior of bad habit, low standard will get less and less.



## **5.6 Improve safety supervisor qualification, set up the authorities**

Safety supervisor is responsible for the COSL Drilling on the rig. According to the COSL Drilling IMS, he supervises all the operation on the rig to follow the national laws, local government regulation, COSL Drilling IMS and so on; inspect and review the worksite HSE performance, give the advice to the rig about the environment protection, safety management, employee health and so on; supervise and urge the inconformity and problem to be corrected in time; supervise and control the large-scale to be performed in accordance with the relevant rules and regulations.

The safety supervisor must have high sense of responsibility on the rig. He should care about all the operations causing potential hazard. For the problems or the unconformities he found, he will track all the way until the problems or the unconformities are corrected.

The leadership on the rig should set up the safety supervisor's authority. They are pleasant to accept the safety supervisor's comment or suggestions. Once the authority is set up, it will be helpful for the safety supervisor to carry out his job.

Also the safety supervisor should improve his knowledge and ability. Only his knowledge and ability can be recognized by the employees, he will be convinced. The communication skill is also important for his job. A good communication will make his job be easy to develop. The safety supervisor should regard him as a part of the rig, not a representative from the COSL Drilling. If the safety supervisor can do all above well, he would be a helpful role for the safety management on the rig.

Drilling operation is a very important link of the petroleum exploration, the safety of the drilling operation has a close relationship with the speed and quality. Make a good performance of the safety management on the worksite will have the great significance, regardless of the economic benefit or the enterprise development. All the above I talked about is just my opinion or the experience, some may be shallow, some may be empty, but I think we can learn something if we can read and think about it carefully.

“Safety First” is not only a slogan, but also it is a real concept for all of us to understand and take more effort to achieve it.

# Chapter 6 How to control cost and save money on new rig

For a company, whether it is private enterprise or state-owned enterprise, achieving the most benefits through cost control become the inevitable option for all industries. For most drilling rigs, they control cost through managing inventory. The platform is mainly through the inventory to control cost, which inventory is stored in a state of temporarily idle for future supplies to achieve enterprise resource reserves. Generalized inventory also includes manufacturing and processing status in the state of supplies and transport. The rig needs to store enough spare for equipment to make sure the equipment have enough spare parts for maintenance when some failures happen. If the rig stores more spare parts, the cost will increase obviously, but if the spare parts are not enough, some failures may cause downtime, which will result more lost. So the rig need to balance the quantities and categories, make sure the inventory is optimum, which has many advantages shows up as:

- avoiding the risk caused by price increases
- shorten the procurement cycle and improve the user's response
- maintain equipment in good condition in lowest cost
- reducing additional costs arising out of occurrence .

## 6.1 Use inventory classification on rig

Inventory, by intelligent methods, can be divided into:

- in-transit inventory, means inventory in transit expressed in the location and mode of transport related, for example, oil pipeline
- Cycle Inventory , consumption for cyclical stocks arising ;
- safety stock ,due to demand and supply uncertainty arising from inventory ;
- expectation or certainty stock, in response to the needs of future deterministic set of inventory .

Inventory, by periodic classification, is divided into:

- single-cycle inventory , disposable cease order to replenish stocks
- multi-cycle inventory, a period of time under constant use during the inventory reduction in the number of repeated orders to replenish stocks iterative process .

Through the classification as above, we can know the material very well and control their quantities accurate, in order to fine the cost.

Inventory and cost management in the enterprise are mutually contradictory, because the establishment of inventory increased business costs, so companies seeking inventory management aiming at reducing the side effects of inventory and improve

inventory positive effect, with a minimum investment in inventory to ensure the production and operation costs normal operation, this is our long-standing pursuit of inventory analysis and control goals.

## 6.2 Make sure the quantities of spare parts is reasonable

Inventory and cost management in the enterprise are mutually contradictory, because the establishment of inventory increased business costs. so companies seeking inventory management to reduce the side effects of inventory and improve inventory positive effect, with a minimum investment in inventory to ensure the rig operate normally is our long-standing pursuit.

Ordering supplies ordered when inventory reaches a point refers to the number of values you need to be continued under a single order to replenish stocks. The formula:

$$EOQ = \sqrt{\frac{CO \cdot D}{C_i \cdot U}}$$

EOQ ordering supplies means supplies per order exists when a number of points, you can make purchases and transportation costs to achieve an optimal reasonable value, which is calculated as:

$$T = \sqrt{\frac{2CO}{DC_i U}}$$

EOQ ----- Economic ordering quantities  
 CO ----- cost per order  
 D ----- annual demand  
 C<sub>i</sub> ----- cost of maintaining inventory  
 U ----- unit cost

## 6.3 Control inventory maintenance cost

Inventory maintenance costs include: inventory capital costs, inventory service costs, warehouse space costs, and inventory risk costs.

1、 The inventory cost of capital is occupied inventory funding sources may be caused either from internal or external, this part of the capital stock can be used in other areas of corporate investments have a certain rate of return. The cost of capital should be the opportunity cost of funds used inventory calculation. The formula is:

The cost of capital = inventory finance related yield \*

As the formula above, we can know that the cost of capital in inventory holding costs account for a large proportion.

2、 The inventory service cost is the storage of purchasing goods after taxes and inventory in order to protect accidental loss (fire, theft, etc.) and investment insurance. Under normal circumstances, tax is different with different inventory levels. Inventory levels have little effect on insurance premiums.

3、 Storage space costs unlike warehousing costs, including those with only the number of changes in the cost of inventory. Warehouse space and four common facility costs are typically related to: factories, warehouses, public warehouses, leasing warehouses, company-owned or private warehouse. Four kinds of storage conditions, storage space costs are different. Public warehouse handling fee is usually out of storage costs and save storage costs to be calculated.

4、 inventory risk costs

- refers to the renewal of equipment discarded costs arising from technological backwardness or low-cost supplies scrap disposal costs incurred .
- the cost of the warehouse operation damage occurred during the product damaged , expired , etc., that part of the loss of value in use and costs.
- loss cost more because of theft and loss caused by the product missing that part of the product cost .
- the cost shift library refers to the location of inventory shipped from a warehouse to another warehouse location handling costs incurred .

## **6.4 Use ABC management**

The most classic inventory control is one called the ABC Management. ABC Management is an Italian economist Barrett in the 19th century through changes in wage costs out widely used inventory, production, cost management as a management method, also known as ABC classification management method.

ABC classification management method is in accordance with certain criteria into the stock A, B, C categories, the implementation of key management by species, by category generally controlled by the total flexibility of inventory management, control methods.

The objective of ABC classification management is to manage the process of prioritizing, priorities, seize the key, focus on solving major problems and improve the overall effectiveness of financial management inventory.

ABC classification has two criteria, one is the amount of the standard, the other is the number of varieties standard (the standard for reference only).

Class A : Amount huge number of varieties less - about 10% , which take about 70% of the amount of storage

Class B : Amount accounted for about 20%, about 20% of the number of species

Class C : Amount accounted for about 10%, about 70% in the number of species

In order to enable better inventory control, inventory and consumption should be limited , inventory and consumption norms have come into being fixed mode, inventory and consumption quota is fixed for the annual inventory and consumption based on historical consumption data values for a certain budget , thus controlling costs limited.

Reserve quota:

Regular order is based on the consumption of goods ordered once for each period of time, and each batch of goods ordered is variable supplies control methods. This approach is conducive regularly cover material reserve quota.

Quantitative ordering method: refers to when inventory drops to a certain amount of inventory (reorder point), the start order, and each quantity ordered is the same material control methods.  $\lambda$  This is a kind of order point and order quantities based inventory control methods.

Inventory (stock) turnover rate is the enterprise a certain period of materiel costs incurred and the ratio of the average stock inventory balances.

Inventory turnover reflects inventory turnover rate. The mobility of inventories and inventories are reasonable amount of funds used to promote enterprise production and management, to ensure continuity while improving capital efficiency and enhance the ability of short-term debt. Inventory turnover rate is higher, indicating that business inventories, the stronger the realization of assets, inventories and occupied the capital turnover in inventory faster.

Inventory turnover rate is calculated :

Inventory turnover ( times ) = inventory costs incurred  $\div$  average inventory

Average inventory = ( beginning inventory + ending inventory )  $\div$  2

Inventory turnover ( days ) = 360  $\div$  Inventory turnover ( times )

Inventory Turnover ( Month ) = 12  $\div$  Inventory turnover ( times )

## **6.5 Make sure the rig have reasonable spare parts and reduce downtime**

As the figure below we can know that downtime of a system can be divided into active maintenance time, logistics delay time, and administrative delay time.

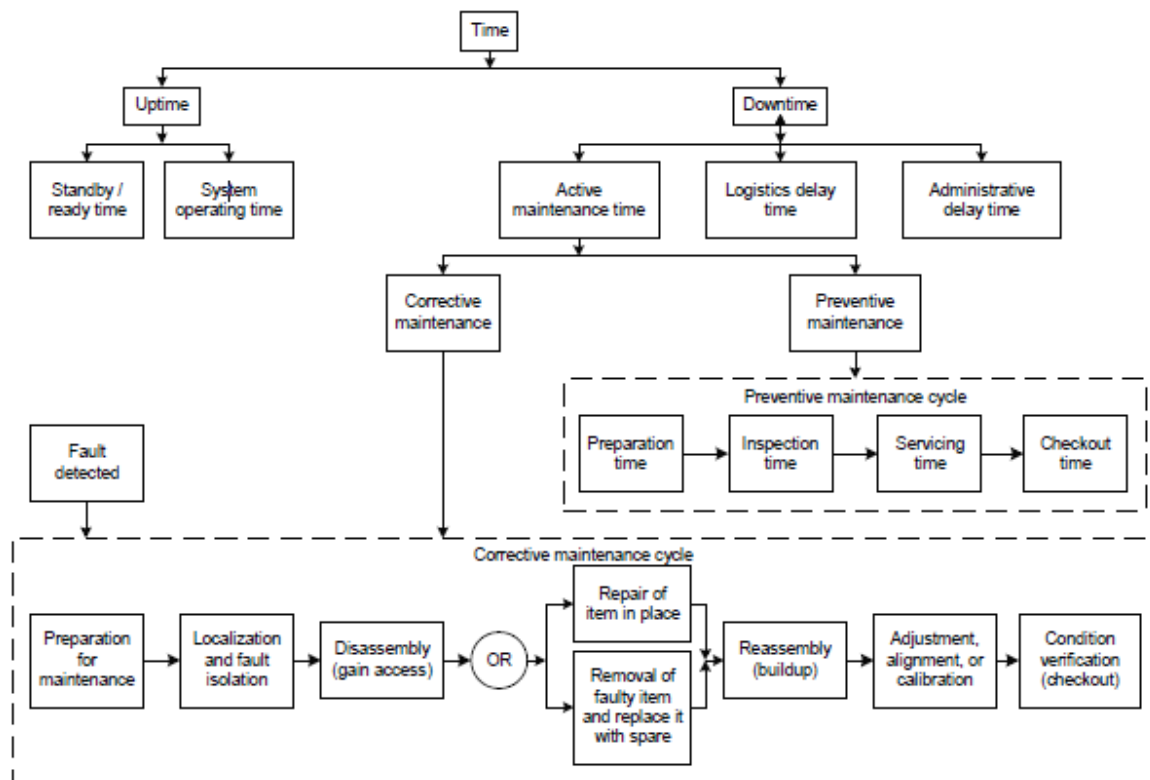


Figure 13 System uptime and downtime (Blanchard & Fabrycky, 1998).

### 6.5.1 For active maintenance time

Driessen et al. (2010) point out that “active maintenance downtime of a system is usually divided into: diagnosis and maintenance time and maintenance delay caused by unavailability of the required resources for diagnosis and maintenance”. We think that diagnosis and maintenance of our equipment can be planned in advance to ensure it happens in non-operational time. During diagnosing if we find that some parts need to be changed in the machine, but they are not in the inventory, then we have to repair or to buy them. But for some parts will take us longer time than non-operational to solve them, then downtime happens. So we can say that the inventory of a spare part has a significant influence in the downtime of system directly or indirectly. We following illustrate them:

- The inventory of spare parts affects the downtime of the system directly in corrective maintenance, because the corrective maintenance is conducted after a failure has occurred. When a failure happens, we need to maintenance it immediately. But if the parts we need to replace are not in the inventory of spare parts, downtime is unavoidable and it decrease operational availability of the asset.
- It influences the downtime of system indirectly in preventive maintenance, because the purpose of preventive maintenance is to prevent failure. This preventive maintenance is always planned in advance and the asset is in non-operating condition at that time. We can check the asset carefully and change some failure parts. If the part we need to change is not in the inventory of spare

parts, we can repair or buy and change it. In this condition, rescheduling of maintenance tasks is often possible, but if the time of repair failure part or buy new part is longer than non-operating condition, it also decreases the operational availability of the asset.

- It influences the downtime of system indirectly in modificative maintenance, because the purpose of modificative maintenance is to improve the performance of the equipment. Although we can delay this maintenance until all the spare parts are available, it decreases the performance of the capital asset.

### **6.5.2 For logistics delay time**

If a company could not manage its' inventory properly, downtime or logistics delay time might happen:

- The location of spare parts may cause the downtime of system. For example, some drill rigs locate some parts on land base where the part can be transferred easily to rig by helicopter or supply tug when the rig needs them. But sometimes the part could not transfer to the rig in time due to bad weather or towing of the rig. Moreover, the size of some parts might cause the downtime. As the same example, the parts could not be transferred from land base to rig quickly if the parts are too large to land by copter, which could cause maintenance delay. So our rig prepared all the critical big spare parts on the rig before it depart ship yard.
- Adverse storage environment may cause downtime. Spare parts should be stored in a suitable condition, because adverse storage conditions can shorten the expected life. For example, rubber products should be stored in a dry cool place and should be protected from light, heat, moisture, oxygen, and so on. If rubber products exposed strong light and high temperature, they may fail in a short time. Downtime may happen due to the failure of product, which caused by adverse storage condition. So our rig keeps different spare parts in different store rooms with right environment.

## 6.6 Using repairable spare parts

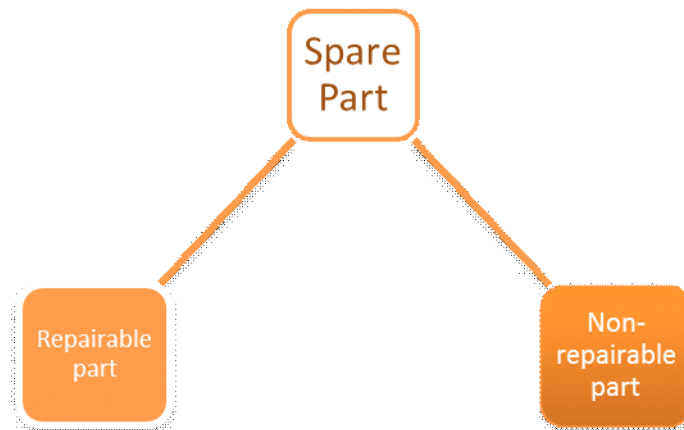


Figure 14 Spare part composition ( COSL classification for spare parts)

Using repairable parts can decrease downtime and reduce the cost. From the figure above, we can know that the spare part can be divided into repairable parts (parts which are ready-for-use again after repair) and non-repairable parts (parts which are discharged after replacement). Hence the spare parts in inventory include not only new parts but also repairable parts. If we keep some repairable in our inventory, then we can use them to maintenance our equipment. For example, as COSL drilling department's requirement, all the rigs have to store 6 mud pump pistons, but we usually keep four new pistons and two repaired pistons in our inventory. Comparing with six new pistons, we can save two pistons money. So we can say that keeping repairable parts in inventory can decrease downtime of system and reduce the cost.

## 6.7 How to save and earn money on new rig

### 6.7.1 Look for the contract before construction finish

After the author was appointed to the rig manager of COSLGIFT in last August, he and COSL drilling market department started look for contract for his rig. They made an introduction PPT for his rig, which include the equipment introduction and staff introduction. And then introduce to some potential customer, such as Chevron, PTTEP, and CNPC. CNPC had interest in COSLGIFT drilling rig, we had discussed with each other and sign LOI ASAP. Then they negotiated with each other carefully, and eventually signed the contract before November. For COSLGIFT they were lucky, get a high day rate, 1,788,000US\$. They saved the time for looking for contractor after finish all the construction and commissioning. Save time means earn more money.

### 6.7.2 Invite company and third party inspect the rig before the rig start moving

During the joint commissioning, the author invited headquarters leadership and third party to the rig for inspection. They find many questions about the rig, as the below



figure.


No.	CORRECTIVE ACTION	Ref. Standard	Criticality	Completed	Verified
1.3.2	block. Install the maintenance chain hoist on the crown block lifting beam.		Minor	Closed	
1.3.3	Provide crown block documentation for review.		Minor	Closed	
1.4	<b>Travelling Block and Hook</b>				
1.4.1	Re-torque of the bolts and install the locking wire.	API RP 64, Equipment Maintenance	Major	2013.12.20 completed	

Figure 15 RSI inspection

Some of them already been mentioned by the rig, but some of them was not found before. So the rig discussed with the shipyard and solved all the problems before the rig departing the dock. Under normal circumstance for inspecting team to take 10-15days to check accept the rig especially for new rig. But this time we only spend 7days on COSLGIFT, in other words this means COSLGIFT saved or earned at least 10 days day rate:

$$178,800\text{US\$}/\text{day} * 10\text{days} = 1,788,000\text{US\$}$$

# **Chapter 7 Suggestion on optimize construct, maintenance and manage a new rig**

## **7.1 Full preparation**

COSLGIFT was a new rig just finished construction in December 2013. After we took over the rig on July 2013, the leadership of the rig headed by Rig Manager devoted themselves to prepare everything ready for the future operation. Considering most of the staffs on the rig were from other different rigs with little working experience about the new equipment and system, for example Amphion system, DCS system and other advanced equipment, the leadership tried their best to make the opportunity to learn the Amphion system from NOV in Singapore including the tool pushers and drillers, which enhance the staff's experience about the Amphion System. We also send the staffs to HYSY 941 to learn how to operate the advanced equipment such as hydro raker, iron roughneck and so on catching the opportunity of HYSY941 in the shipyard. Prior to conducting the actual operation, we valued all the opportunities to let our staffs to touch the real situation either operating the equipment or learning the relevant knowledge and so on.

On 20th Jan 2013, we sent a tool pusher and a safety supervisor to Myanmar for the further preparation. They worked with our agent in Myanmar to hire the local employees, invested the logistic condition for the food and materials, communicated with the client. Before the rig was towered to Myanmar on 6th Jan 2013, everything had been got prepared well, which saved lots of time and efforts.

## **7.2 Good communication**

A good communication was the key when dealing with the client. A good communication can eliminate the misunderstanding, get quite abundant and valid information from the client, shorten the distance with the client, and build a good relationship with the client.

After get the intention of the first contract especially the client visited the rig in shipyard, we started to make the reformation based on the client's suggestion and requirement. All the relevant positions keep a good communication with the client through the email and telephone. As long as the client submitted any question or doubt, we will reply them as soon as possible.

After arriving in Myanmar, the tool pusher and safety supervisor contacted with the client directly. Every day they attended the client's coordination meeting, answering the questions proposed by the client about the rig, solving the relevant problems, contacting the rig leadership in shipyard about any question or doubt from the client, which enhanced the relationship with the client a lot, get the confirmed by the client.

During the period of the normal operation after being towered in Myanmar, the Senior Tool Pusher and other staffs on the rig made a good cooperation and communication with the client. Any problems occurred which would affect the operation, could be told to the client at the first time, prior to taking the further operation we could get the recommended suggestion and their permission. They are our distinguished client so we cherish their feedback so much. Any problem or request we beyond our ability, we would let the client know and tell them the reasons and temporary methods. So they recognized that we have their interests at heart, cared about what they want and what they think, which was better for us to get the understanding from the client and we make the win-win.

On the shore office in Yangon, the rig leadership attended the coordination meeting organized by the client every day even Saturday and Sunday. They acted just like an information bridge between the client and the rig at that time, answered any questions from the client, and delivered the feedback of the client to the rig in time.

### **7.3 Strong Team**

On the first meeting of COSLGIFT (a new rig and new team), the author said "all the people dispatched for COSLGIFT are very capable and talented. I trust them, and they are the real iron army". It was true that the staffs on COSLGIFT were very capable. But here we have to admit that they are young without much working experience, which was easy to make them lost themselves on the complicated condition. However they were very willing and thirsty to learn what they did not know on the rig, such as the advantaged equipment, the strange operation system, and different rig structure. When the rig being built at the shipyard in Shen Zhen, all the staff tried their best to learn the new rig related to their position as much as possible. They grabbed any opportunity to ask the shipyard engineer, NOV engineer or anyone who can answer their questions without any shame or doubt. The rig was getting better and better day by day. Our team also was improving step by step. The confidence instead of doubt or non-confidence was being shown on everyone's face.

As a saying says, one tree does not make a forest. We all know that one man no matter how powerful he is cannot make a good performance without the team's

support. So the teamwork on the rig is very important. When we were in the shipyard, we conducted an outdoor team training to train the staff working with the spirit of the team. Here I want to say, COSLGIFT like a big family, all the people treat each other as their own brother, care about each other, so there is no wonder that a good team work and cooperation generated on COSLGIFT. When working in Myanmar, the major hydraulic pipeline burst one day, which could cause the rig shut down potentially. Senior Tool Pusher, Tool Pusher, Equipment Supervisor, Safety Supervisor all came on the worksite. Even some of them cannot help anything, but they brought the support which is the core of the team work.

## **7.4 Dedicated Leadership**

The leadership's example effect is a silence force, which affect the staffs on the rig little by little. If the leadership devotes them to the job, there is no doubt that the staff will focus on the job. We rejoice that we have such a leadership on COSLGIFT, no matter working onshore or offshore.

As head of the leadership, the author set a good example on the rig as a rig manager. The rig COSLGIFT worked in Myanmar in total 110 days. The rig manager worked on the rig more than 60 days. Everyone on the rig can feel his dedication and diligence on the job, and was affected by him.

Not only the Rig Manager, but also the Equipment Superintendent, Material Superintendent, and Senior Tool Pusher, set the example for the staff and showed their dedication to the job. All leadership members performed their responsibilities with all their might. They gave up the vocation to go home to visit their home even in Chinese New Year.

Just because of the existence of the leadership, we could conduct the operation offshore fluently. Whenever we were lack of any material or equipment, they would provide in time. Any problem we could not solve, they would give the idea timely. We trusted them and admired them dedication to the job.

## **7.5 Learn lessons from the first well**

A saying says that success always comes from failure. If we don't pay attention to the fault that we made before, learn the lessons from what we did before, we won't get the progress, we will make the same fault when doing the same thing. Only can we make the summary in time, analyze the reason and take the correction measure, so that we can make sure the same fault not happen again.

COSLGIFT drilled two wells in total in Myanmar, AD6-1, AD6-3 respectively. AD6-1 was the first well, designing time is 45 days, but we took nearly 60 days to finish drilling the first well. There were many factors which caused the designing time extend. COSLGIFT is a new rig with new equipment. Although all the equipment had been commissioned in the shipyard by the professional engineer, there were still some problems happened when conducting the real operation due to the long time and high load running. On another hand, some people on the rig were not very familiar with the procedure such as setting the CTU deck, nipple up and down the BOP stacks as the equipment were different from the rig where they worked on before.

We realized this problem at the beginning of drilling the first well. We asked all the operation responsible to make a good record and summary in time after finishing the job especially the problems existed, different procedures from the old rigs for the next well AD6-3. So when drilling the well AD6-3, we would hold a meeting, develop a detailed discussion about the job, make a full and detailed operation plan including every step especially the measures for the problem we made last time before conducting the operation that we did not make a good performance in AD6-1. So that we avoided the same problem happening again, saved the time, improved the efficiency, which also satisfied the client.

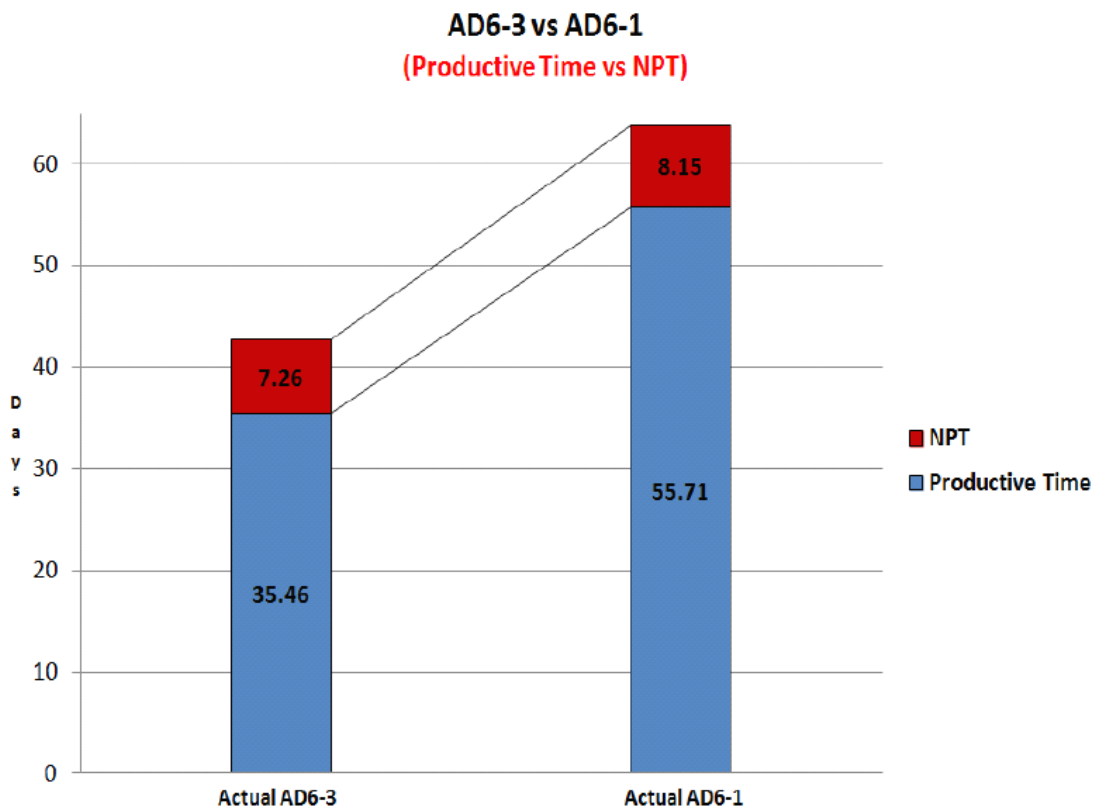


Figure 16 AD6-1 well VS AD6-3 well (CAL report)

We must shift our perspective from “getting more performance into the learning process” to “getting more learning into the performance process”, so we got the great

improvement, just as figure 16 shows.

## **7.6 Put Safety First at the Primary Place**

Safety is the life and soul of all the companies. Petroleum industry especially offshore drilling is recognized by all the people as a high-risk and frequent-disaster industry. Once an accident happened in the offshore drilling operation, it does not only bring the property loss, but also bring the injuries even fatality to the employees; what's more, the accident also bring a heavy strike to the family and negative impact to the company and the society.

All the people on COSLGIFT are from other different rigs with different safety awareness. The first contract for COSLGIFT is from CAL (Chinery Asset Limited) working in Myanmar. The safety concept of the client always conflicts with COSLGIFT's including safety culture, safety standard and so on. Also people on COSLGIFT over 120 are from more than 10 countries with different culture background, which bring a big challenge to the safety management on COSLGIFT.

All the staffs on COSLGIFT devote themselves to build a cultural rig as a long-term target. As an important part of the cultural rig, safety is always been put the primary place on the rig. All the people know that all the hard work we have done will be blank without safety.

“Safety First” is not only a slogan, it also need us to take the action to achieve. On COSLGIFT we developed the training including IMS (integration management system), skill, technology, professional knowledge for all the staff via video, PPT, practical exercise and so on ; organized the staffs learn the relevant accident and incident related to the operation; implemented the IMS strictly; learned the advanced safety concept from the foreign company working on COSLGIF. No matter any operation conflicted with the safety, it must let the safety go first.

## **Chapter 8 the conclusion of construction, maintenance and management a new rig**

- 1、 Focus on the team building. Make sure the team can familiar with each other and work together.
- 2、 Make a same goal for the whole team. Make sure all the people work for the same target.
- 3、 Take training. Make sure all the people know the standard of construction and commission ASAP.
- 4、 Invite the company and third part inspection into the commissioning of the rig.
- 5、 Use lesson learns. We must shift our perspective from “getting more performance into the learning process” to “getting more learning into the performance process”.
- 6、 Put the corporate “safety first” into daily work.

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