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APPENDICES

APPENDIX A

NPC SDWT Experience

Introduction

NPC, had considered implementing SDWT in 1998. The concept had been proposed to Plant Management Team (PMT, consists of Production Vice President and Department Directors) by Maintenance manager. The proposal had been approved and managers in production area were assigned and formed Facilitators Team, FT, to set up objectives and scopes. Two production areas had been chosen for implementing SDWT as pilot project.

First SDWT was called "Hot-end" which meant production staffs the early section of Ethylene production. Team objective was to improve reliability in the production area. Team members were consisted of Operators who were in charge in the area, Process engineers, Maintenance engineers, technicians and inspectors.

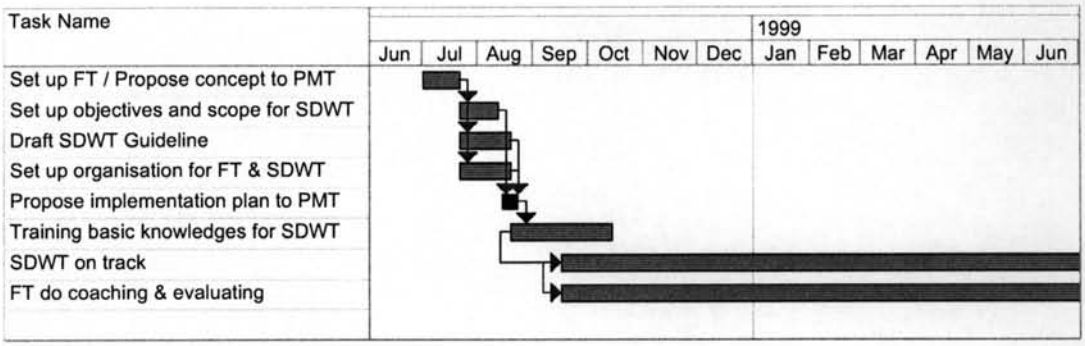
Second team was "Co-generation" team, which was in section of Utilities - Power generation. Production planning coordination was major concern for this area. Similar to Hot End Team, members were consisted of production staffs, Operators, Process engineers, Maintenance people, plus Production planner and Maintenance scheduler.

The reasons of choosing these two areas were;

- Hot-end production is required closer monitoring, since the process is in very severe conditions (some units are operated in very high temperature like 1,100 degree Celsius range, which breakdown could be easily occurred). SDWT was expected to perform and maintain reliable operation for this area.
- Hot-end production problems generally found as internal problems, and should be controllable by production staffs. Unlike Cold-end, later section of Ethylene production, which the process is much more complicated, Hot-end process is rather simple and minimum external factors would impact the area.
- Co-generation team had been already set up, unofficially. There was weekly coordinating meeting between production planner, operators, and maintenance people for scheduling equipment shutdown plan, however.
- These two teams had different objectives; therefore team development would be focused on different aspects, which led to broader range of pilot studying.

Implementation

The implementation plan had been proposed as follow;



At first stage of implementation, FT had been set up and discussed about justifying SDWT, and issued to Plant Management Team, PMT, for conceptual approval about alignment of business goal and teams concepts. Main concepts had been proposed as;

- To create teamwork environment in work place.
- To generate ownership feeling for frontline workers.
- To gather working knowledge and experiences.
- To enhance team members capabilities.
- To improve cost competitiveness.

The proposal was also subjected to ensure management support of the project.

Once SDWT concepts were approved, FT would build implementation plan; consisted of *Objectives & Scopes*, *SDWT Guidelines*, and *Organization*. The implementation areas would be chosen by following the approved concept. At this stage, detail steps and critical resources for implementation would be determined. SDWT members would be selected and assigned into the teams. Again, the plan would be approved by PMT as commitment for launching. However, neither organization change, nor working process modification was done.

Job Description for FT and SDWT had been assigned as follow;

Facilitator Team Job Descriptions

- To set up objectives, guideline, and plan to PMT.
- To provide guideline and support SDWT for setting up each SDWT's objectives, goals, and steps of work.
- To sponsor SDWTs in training required skills and knowledge; both Technical and Teamwork skills.
- To track progresses and difficulties of SDWT implementation.
- To provide guideline and support SDWT for solving team problems.
- To encourage SDWT to use their knowledge and abilities for improving their works.

- To encourage teamwork environment in SDWT; especially setting up common goal, trust, and synergy.
- To evaluate and report SDWT progress, comparing to expected objectives, with problems and difficulties, to PMT.

Self-Directed Work Team Job Descriptions

- To study objectives with FT.
- To set up target and plan to achieve assigned objectives.
- To set up teams directions, scope of works and team norms for internally use.
- To analyze production capabilities, efficiency and reliability of area under control, and also include breakdown cost, maintenance cost, operation history, etc.
- To set up performance indicators for targeted area; in term of Capability, Efficiency, Reliability, and Cost.
- To prioritize production problems for focusing on important issues.
- To set up and improve equipment monitoring procedures.
- To follow up and control equipment conditions.
- To evaluate Capability, Efficiency, Reliability, and Cost, comparing to targets, and set up improving plan. Then report to FT.
- To share knowledge and coach each other in team.
- To seek technical information as required.
- To set up regular meeting to follow up issues of 1-10, routine works, and production problems.

And three phases of team mission and development was planned as following;

Phase 1: Maintain existing plant and equipments efficiency.

SDWT would set up the way to work together. Knowledge sharing and team aligning would be major activities. Interdepartmental conflict would be expected and planned for neutralizing.

Phase 2: Improve work processes and equipments efficiency and reliability. Also, reduce losses.

SDWT would begin to understand potential of team-based organization. Conflict would be minimized so teams could focus on the goal.

Phase 3: Generate innovation.

Teams would have capabilities for running by their own. Members would have quality awareness and ownership of their product. Several solutions would be proposed for improving customer satisfaction.

Then SDWT members would get training of basic skills, which consisted of; Team Effectiveness, Problem Solving & Decision Making, TQM, and Reliability concepts. The first two courses had been done by Kepnor Tregoe representative's instructors. The last two courses had been held by NPC's in-house instructors.

The teams would start by set up team norms, meeting process, and define their own goal which compiled with the assigned missions. Since conflict was expected, team alignment period (3 to 6 months) would be reserved in the plan. Team leader would be elected and the main duty was coordinating with FT and facilitating the meeting. FT would guide SDWTs along the process, provide resources for supporting teams, and allow SDWT leaders to join FT's monthly meeting for transferring management objectives. SDWT would be evaluated every 3 months for tracking progress.

Problems & Results

Two SDWTs had been deployed in third quarter of 1998 and implementation progress had been observed as following;

Hot-end team:

Since there is no reference of team-based works before, Hot-end SDWT had to start from scratch. After the team had been assigned, it took about 6 to 12 months to align members to begin to realize and understand the same goal. In early stage, several problems had been observed as;

- Members still stuck in functional roles. Organizational boundaries could not be eliminated.
- Needs for change was not clear. The team had not been encouraged for teamwork, and only looked for individual benefits.
- FT did not provide clear messages to SDWT, since FT had tried to avoid dominating of SDWT concepts and ideas, but it led to misunderstand that FT just dump their responsibilities on SDWT.
- SDWT members consisted of frontline workers and engineers which had strong technical skills and experiences, but lack of communication skills and leadership capabilities. This made team set up much harder.

Most of Hot-end team members had suggested that FT should provide more supports; like coaching or guidance, since team had stuck in decisional issues frequently. Without competent facilitator, most meetings had tended to be frustrated and made members feel boring and wasting of time. SDWT contribution had been prioritized below routine works and meeting absence had been frequently found. SDWT leader had difficulties on keeping meeting consistently and transferring messages between FT and SDWT. Moreover, the team had feeling of "on your own" from the managements.

However, after first 6 months the team had aligned better and began to realize the works improvement. Workers in the area had better communication and functional barriers had been reduced. The team could make decision on their routine works without waiting for coordinating or authorizing, which led to speed up works and reduce errors from miscommunication.

By nature of the production area, Hot-end process consisted of series of units and many types of equipment to concern. The team had set up *deliverables* for each production unit in series in Hot-end area and used them for focusing problems that could effect *specifications* and *capacity* of the unit's deliverable. The team had tried to control each unit to keep its expected production, to maintain the production of overall area. Potential

problems had been analyzed and listed for set up monitoring and prevention plan. The first draft of Hot-end potential problems, including prevention plan, had been issued at end of 1999, about 18 months from start SDWT.

Regular bi-weekly meeting had been used for controlling the potential problems and following up the implementation plan. Reports had been delivered to FT every 6 months about SDWT progress and suggestions. And the aligned team could spend more time focusing on production issues.

Team norms had been developed. Knowledge had been exchange inside team. Each member had learnt others' professions and could perform their roles in certain degree. The attitude of "My turn has done, you next" had transparently changed to "What may I help to get the job done faster/better?"

After 2 years on track, Hot-end SDWT had been settled and able to roll out its roles, with original organization structure. Unfortunately, there was major organization change in year 2000 and the team had been abandoned due to lack of sponsorship from key disciplines and no tangible benefit was clearly proven.

Co-generation team:

As Co-generation team members had been experienced in coordinating meeting before setting up SDWT, therefore team building took much less time than Hot-end team. The team had started in similar manners to another team, by setting up their target for each production unit. Since the process of Co-generation area was much less complicated than Hot-end's and the goal had focused on production planning, the performance indicators were easier to measure and understand.

Another notable factor was; Co-gen team leader, who worked as a production planner, was very competent in team skills. The meeting had been facilitated effectively and members were able to focus on the objectives, without much confusion on conflict solving.

Co-gen team had performed well in assigned tasks, and adopted team roles into regular works. In 2000, about the same time that Hot-end team was disbanded, Co-gen team had no longer been recognized as SDWT as well, but the team decided to continues to work by their own same as before, as part of regular works, though less recognition from managements was realized.

APPENDIX B

NPC DEM Guideline

The defect elimination process that NPC adopt from SGSI is used to identify root cause of incidents, and to develop solutions. The developed solutions are then used to solve the problems and to prevent the similar incident for reoccurring in the future.

The process can be divided into 4 main steps as followed.

1. Incident Capture

Incident capture is the first step of defect elimination process.

1.1. Incident Reporting

In this step persons involved in the incident or responsible for this step must report only the facts that related the incident, and the following items must be written in the reports.

What incident did happen?
When did the incident happen?
Where did the incident happen?
How much did the effect or loss of the incident?

Avoid putting the opinion and the causes of incident into the incident report. Let the process runs step by step.

1.2. Incident Ranking

In this step person responsible for this step must rank the criticality of the incident based on probability that incident is happening and its consequence using DEM Risk Matrix. The criticality level of incident is then used to identify the persons who will then involve in the later steps of defect elimination process.

2. Problem Analysis

Problem analysis is the step that used to identify the problem based on the fact in incident report. After the problem is identified, the last part of problem analysis is to gather all the fact the related to the incident.

2.1. Problem statement

In this step set up a team must do brainstorming to identify the problem. Sometime there is more than one problem. After problems are identified team must write down the problem statement, which consists of:

Object - the specific process, equipment or activity that does not perform as expected
Actual vs. Expect - the difference between the expected performance and the actual performance /output.
Impact - the measurable extent of impact when process or equipment have problem.

2.2. Fact finder (Is/Is not)

In this step set up a team must acquire all the fact that related to the incident in four aspects as followed. This is to find the distinct issue, and to help the team to identify possible root cause:

(Is)

What - What item specifically has trouble? What is wrong with it?
When - When did it happen - time, before /after, point in cycle?
Where - Where on item did it happen? Where was item located?
How much - When it happens how much is affected? Any pattern?

(Is not)

What - Are there similar items? How are they affected?
When - What are other likely times? Is it happening then too?
Where - What parts are unaffected? Are others having trouble?
How much - Is some portion consistently not involved? Is this usual?

3. Root Cause Analysis

Root Cause Analysis will focuses on determining the causes of the problem as identified in the Problem Statement. The actual root cause must have facts support. Be aware that during root cause analysis do not to fall into the traditional pattern of jumping into conclusion without considering the acquired fact.

3.1. Possible Cause Analysis

In this step set up a team must do brainstorming to identify the cause of the problem stated in problem statement.

3.2. Data validation

In this step set up a team must use fact that acquired in 2.2 to eliminate the poor logic and unverifiable cause and leave only possible cause for verification in the next step.

3.3. Cause Verification

The final step of root cause analysis is to verify and identify which of the remaining possible causes is the root cause. This is done by verify it with the fact in four aspects. The root cause must have support fact, and must not conflict the fact acquired in 2.2

4. Solution Development

The final phase of 'Defect Eliminaton' is solution development. In this phase a team must develop solutions, which is based on the root cause of the incident.

4.1. Decision Statement

Prior to develop the solutions, a team must set an objective, or decision statement based on the root cause acquired in root cause analysis step. The decision statement must include:

a. What is the **object / subject**?
b. What is the **desired action**?
c. What is the **intended outcome of the action**?

For example:
a. Debris in Instrument air
b. Eliminate or prevent
c. False trip and unit shutdown

Statement: Prevent debris in Instrument Air System from causing false trips ,which result in unit shutdown

4.2. Criteria Selection

In this step, a team must set up the criteria for solution selection. The criteria is divided in to two group, **'MUST'** and **'WANT'**. Once solutions are developed, all the MUST criteria must be achieved, whereas all the WANT criteria may not be achieved. These depend on the need of the particular WANT criteria. It is possible to set up more than one criterion.

4.3. Solution Selection

In this final step, a team must do brainstorming to develop solutions. Once solutions are developed, a team must put all the developed solutions and set up criteria into selection grid as shown in the next page.

		ALT 1	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6
(Must)		No	No	Yes	Yes	No	Yes
Criteria 1		x	x	-	X	x	-
Criteria 2		-	-	-	-	-	X
Criteria 3		X	X	x	X	X	x
		X = High effect x= Slight effect					
(want)	**Weight**						
Criteria 4	5	5	10	0	0	10	0
Criteria 5	9	0	0	10	0	0	10
Total Score for Wants		25	50	90	0	50	90
		= Sum (ScoreXWeight)					

As shown in table above, all the MUST criteria must be responded, and some solution may not be selected. This is because some solutions respond to the same criteria. Therefore they may not be selected.

In WANT criteria we multiply the weight with score for each solution and sum the result. The solution which is not responded to the MUST criteria, but the sum number in WANT criteria is high may be selected.

Tips for success

- Defect Elimination must be conduct as soon as possible. This is to prevent data loss after the period of time, and team member may forget the detail of the event
- Do not jump into conclusion. Usually people who have experience ignore the detail of the fact. They are jump to conclusion without concern whether the root cause is conflict with the fact or not.
- Be careful when define the problem. More often that people have so many data in hand, and do not know what the real problem is. This causes mislead in the defect elimination process, and wrong solutions are develop
- Do not develop solution, if the root cause has not specified. Sometime people do not know that root cause, and develop many solutions. This is because they hope that some solutions may be the right.

BIOGRAPHY

Mr. Pratee Chittrakoon was born on April 14, 1971. He got Bachelor Degree of Mechanical Engineering from Chulalongkorn University, in 1991. He had started his career as project engineer in power plant construction site for 2 years. After that, he has joined a petrochemical company as maintenance engineer and worked there ever since. His professionals and interests are mechanical maintenance practice (especially machinery), maintenance management, asset management and reliability management.

His current position is manager of olefins maintenance division in olefins production department. He has been studying for Master Degree in Engineering Management at Chulalongkorn University since 2005.