CHAPTER II

THEORIES & LITERATURE REVIEWS

Nowadays, production management has been challenged by global competitions, which lead to cost competition and extended quality demand by customers. Several modern management concepts have been developed for improving operation competitiveness; such as Life cycle cost management (NORSOK O-CR-002, 1996), or Asset management (Woodhouse, 2001). Those concepts provide similar view of *looking at whole picture,* by aligning activities in production process to business objectives strategically, and breaking barrier of old-fashion functional organization with modern management tools.

2.1 Operational Reliability Management

Operational Reliability Management System [ORMS] has widely implemented in major production-based industries; oil and gas, petrochemical, cement, and power generation. As mentioned previously, continuous process could obtain significant benefits for improving reliability. ORMS consists of 4 aspects; Process reliability, Human reliability, Equipment reliability, and Equipment maintainability, as shown in Figure 2.

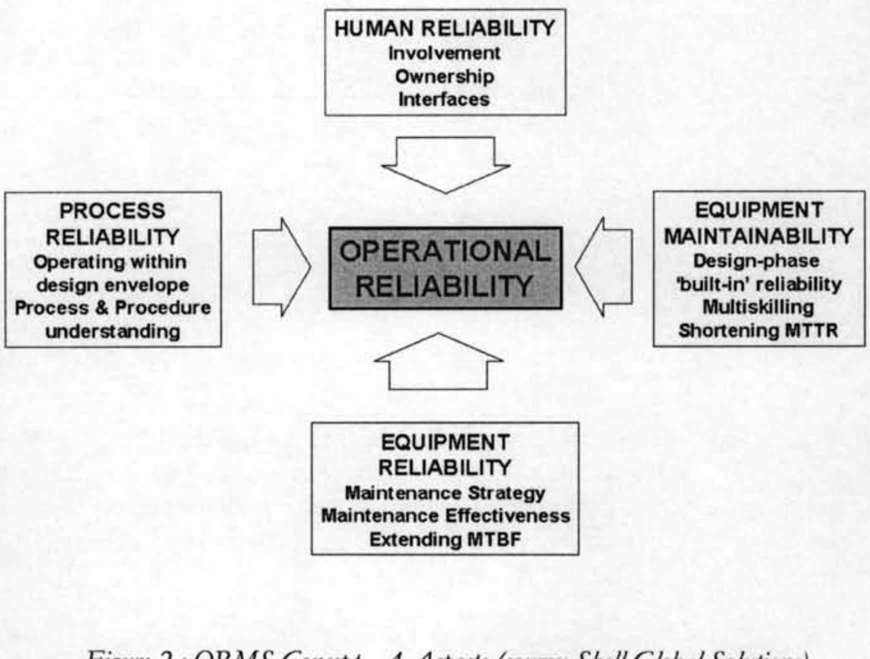

Figure 2 : ORMS Concept – 4 Aspects (source: Shell Global Solutions)

ORMS process involves with aligning business objective to operation level, changing culture of "Functional-based" to "Production-based" for improving communication and creating ownership, and using Risk-based management tools for making decision. The overall process of ORMS is shown in Figure 3.

There are 2 group of people involve in the process. First group called "Core team" which is group of Multi-disciplinary teams working together for taking care of their own production unit. The role of core team is very similar to Self-Directed Work Team [SDWT] or Multi-function Team in Lean Manufacturing as they take responsibility of reliability in their production. By using Risk and Reliability Management [RRM] tools like Reliability-Centred Maintenance [RCM], Risk Based Inspection [RBI], Safety Instrumented Functions [SIF], and Defect Elimination Method [DEM], Core team is expected to monitor the process, solve problems, and looking for initiatives for reliability improvement.

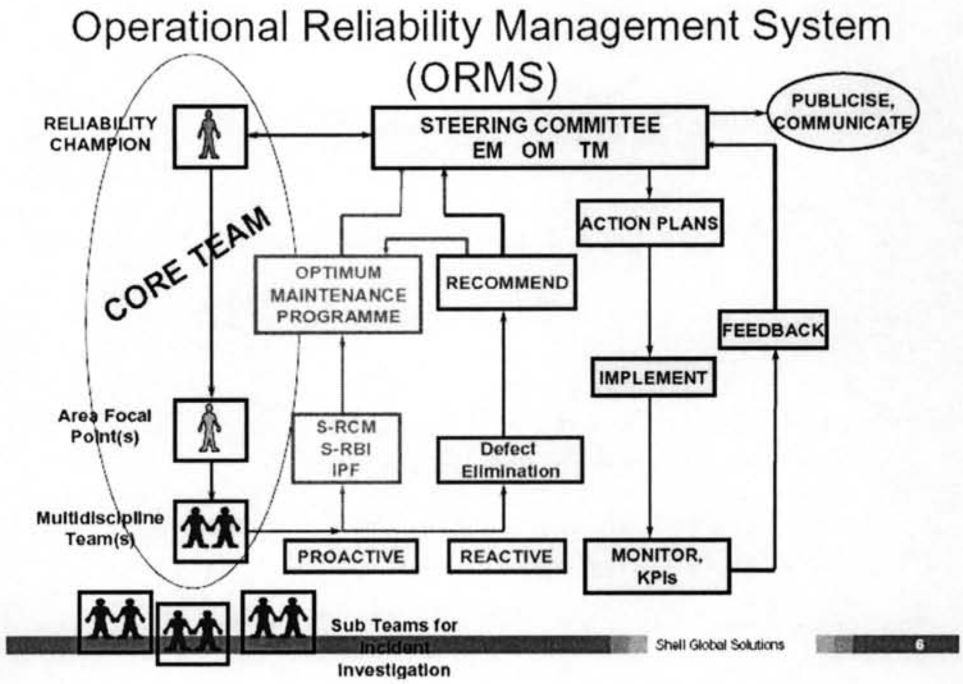

Figure 3: ORMS Process (source: Shell Global Solutions)

Another group is "Steering Committee" consists of management staffs that take responsibility of production management; typically included Operation manager, Technical Manager, Engineering and maintenance manager. Steering committee translates business requirement to operation targets, then manage and control core team through Key Performance Indicators [KPI].

Since ORMS concept is about long–term continuous improvement, in addition to monitored and controlled by Steering Team, it is quite similar to other quality management tools like TQM, TPM; used in the process. Hence, Total Quality Management [TQM] has been suggested for Steering Committee to use for deploying objectives and strategies to operation level.

Core Team implementation is solely based on Self-Directed Work Team [SDWT] and Multi-Function Team in Lean Manufacturing, which would be discussed further in the study about how it works and things to consider in the implementation. Core team is also responsible for developing action plans to maintain production reliability. There are several risk and reliability management tools used as Proactive approach in the process; consists of Reliability-centered maintenance [RCM], Risk-based inspection [RBI], and Safety Integrity Function [SIF]. Problem solving and decision making tools; consists of Root Cause Analysis [RCA], and Defect Elimination Method [DEM], are also used as Reactive approach and provide recommendations for improving the maintenance program.

2.1.1. Reliability-Centered Maintenance [RCM]

Refer to SAE-JA1012 (2002), Reliability-Centered Maintenance [RCM] is defined as "a specific process used to identify the policies which must be implemented to manage the *failure modes* which could cause the *functional failure* of any physical asset in a given operating context.". RCM is used as a systematic decision making tool for determining proper maintenance activities, justified by comparing total risks of running the equipment with and without maintenance. Though, there are several RCM methodologies in the market which are different in details of analysis and assumptions, but the most well-known RCM is RCM2 (so called *Classical RCM*), developed by Moubray (1997), and considered as base-line for industrial use.

2.1.2. Risk-Based Inspection [RBI]

Refer to API RP 581 (2002), Risk-Based Inspection (RBI) is defined as "a method for using risk as a basis for prioritizing and managing the efforts of an inspection program.". The RBI method gives recommendations for the development and implementation of a risk-based inspection program in the process industry in general - and refineries, gas and petrochemical facilities specifically - and should be applied to determine inspection plans for the pressure containing parts of all static pressurized equipment, including vessels and piping. While mainly applied in the process industry, the methodology is also applicable to other industries.

2.1.3. Safety Integrity Function [SIF]

Refer to IEC 61511 (2003), this international standard is primarily about safety instrumented systems for the process industry sector. It also requires a process hazard and risk assessment to be carried out, to set requirements for the risk reduction to be achieved by the safety instrumented systems. The risk reduction to be achieved is expressed as a Safety Integrity Level (SIL) assigned to the instrumented safety function.

2.1.4. Defect Elimination Method [DEM]

Defect Elimination Method [DEM] is a structural Problem Solving and Solution Development process, used for making decision on solving plant problems to prevent the problem reoccurring again. DEM is adapted from Kepner & Tregoe (1981) methodology to fit in the industry application. The process consists of 4 main phases, as summarized in Table 1, and focuses on not only problem root causes but also sound solutions.

Table 1 : Defect Elimination Method process

PHASE	STEP	END PRODUCT
Incident Capture	Incident Reporting Incident Ranking	Record of incident Criticality of incident
Problem Analysis	Problem Identification Problem Description	Problem Statement Is / Is Not Model
Root Cause Analysis	Possible Cause Analysis Data Validation Cause Verification	Possible Causes Probable Causes Root Causes
Solution Development	Decision Statement Criteria Selection Alternative Solutions Decision Analysis	Decision Statement Solution Criteria Possible Solutions Best Balanced Choice

2.2 Self-Directed Working Team [SDWT]

2.2.1. Introduction

Self-Directed Work Teams, SDWT, has been introduced for over 30 years, about same time as Japanese Quality Circles. Though, Mary Parker Follett (1918) introduced concept of self-motivated groups far back in 1920s. F. Herzberg's (1966) motivator-hygiene model discussed about Motivation and Job Enrichment that strike at the heart of the success of self-direction concepts. Deming's (1986) principles also support the idea of Pride of Workmanship which is the single most important motivator in the workplace.

SDWT became more popular in 1990s and have been widely recognized by industries. Procter & Gamble was one of the pioneer companies in using Self-Directed Work Teams in the early 1960s. Later, other large and small companies began using them, including Xerox, Northern Telecom, General Motors, Ford, Johnson & Johnson, Tektronix, Digital Equipment, General Mills, Aetna Life and Casualty, Federal Express, General Electric, Milliken, Saturn, Caterpillar and Boeing. Organizations have reported varied but almost always positive results from the implementation of team-based operations.

By demand of Total Quality Management and Lean Manufacturing, SDWT has been used as management tool for improving production performance since most of quality problems are from human factors issues, and SDWT effectively help frontline workers do the job by themselves to promote productivity and quality awareness like QCC. Moreover, SDWT also create "Ownership" norm and motivate people to improve their works, and teams as well. Networking between SDWT is commonly observed in company with team-worked environment.

2.2.2. Definition

This concept goes by many different names: Self-Directed Work Teams, Self-Managing Teams, High-Involvement Workforce, etc. In the workplace, these labels are generally shortened to "teams."

According to Northern Telecom, an SDWT is:

"A group of co-workers in the same areas sharing common goals and objectives. They are accountable for planning and managing the work in their area by pooling their skills, talents and knowledge to achieve quality results."

AT&T Power Systems defines SDWT as:

"A group of people performing as valued team members who share common interests and goals; skilled through experience and ongoing training, and empowered with authorization, resources, information and accountability. Members of teams typically handle job assignments, plan and schedule work, make production-related decisions and take action on problems. Employees on teams participate in an atmosphere based on mutual trust and respect with a minimum of direct supervision."

The concept of SDWT is related to Deming's principles, as the teams tend to motivated themselves to improve their own works. This is similar to Japanese Quality Circle concept, but SDWT focus more on Output so Teams can direct themselves to their own goal, while QCC utilize members' skills and knowledge for improving Process to accomplish assigned tasks.

Not just for blue-collar environments, SDWT can make positive impacts on white-collar and service environments.

2.2.3. Characteristics

SDWT vary depending on what makes sense for the type of work being performed, but, generally, they share the common characteristics as follow:

Multi skills

SDWT members work together and share their skills and knowledge. Therefore, member can represent each other's roles, with certain limitation. However, from past experience, there are some difficulties if some key members were missing since they could not be substitutable.

Accountability

Teams can handle job by their own, including area of production, quality, cost, and schedule. Required authorization is released from supervisors to support the work. These would be noticeable changes from traditional organization.

Day-to-day works

Teams do tasks related to their routine works. Occasionally, teams may be pulled away to solve some specific problems, but main job still be: keep their own area in place.

Unlimited time service

SDWT have no service period. Teams are kept running by motivation of ownership, not an assigned duty.

Social skills required.

To make team works, communication ability need to be developed as there are a lot of information using inside team transfer between members. Listening is as important as presentation skill. Also, since teams do many discussions and disagreement cannot be avoided, conflict management is critical for team survival.

Set own objectives, inline with management goal.

Each team has their own objectives which related to business goal. The targets are set, monitored, and controlled by team. There is no direct assignment from upper level to distract the team from their way.

However, SDWT are not left to survive alone by themselves nor have limitless authority in the organization. In some cases, Facilitator Teams [FT], are assigned for supporting, coaching, and providing business direction for SDWT. FT also provide evidence for sponsorship from upper-management to recognize the teams.

2.2.4. Benefits

Settling SDWT is not an easy task, and it takes long time, like two to five years, to sustain the change and affect the organizational life. However, returns are much more beneficial as distinctive capabilities for company. Several competitive aspects are expected to be achieved.

Increased productivity, quality and customer service

Since SDWT work closer to customer, they can understand and response customer requirements much more effective than traditional organization. Ownership and flexibility conveyed by team environment can promote customer focus and customer satisfaction.

Enhanced communications.

Not only information required for accomplish work, but also context, purpose, and knowledge can be more clearly understood. Comparing to traditional organization which information only flow in line of command, teams will reduce hops of communication in organization and lead to effectively communicate.

Reduced operating costs

Teams take control of their work, simplify its process, customize its operating practices and remove hierarchical inefficiencies. These improvements can reduce cost of operation significantly.

Improved organizational ability to change

SDWT can response to changes faster by nature of team which have greater skills, broader perspective, more information, better communication, and close to process and customer. Also, the need for change will be easier to be understood since teams have already aligned their goal to business context.

Quicker adaptation to new technologies

Again, teams have ability to adapt new technology to improve their works. Multi-skilled members and knowledge sharing environment can minimize resistances to change.

Enhanced behavioral change

The social structure of SDWT enhances behavioral change. Members get training of leadership and conflict resolution, set up their goal together with disciplines of professional, and teams facilitate job-sharing and cross-training as learning organization. These promote improved performance and pride to work.

Fewer, broader job classifications

Functional organization creates gaps in work processes as there are boundaries between disciplines. Working as team can eliminate those gaps and get work done more effective with less people.

Increased employee satisfaction

Refer to Deming's "Pride of workmanship" and Herzberg's "Job enrichment" principle; SDWT motivate people to do good jobs and pride with the accomplishment, which lead to "Virtuous circle" of teamwork and quality improvement.

Since SDWT is like other organizational management tools, which can not be simply measured or justified the results. However, improvements on above issues can be easily recognized once teams on the run.

2.3 Performance Management

There are numerous aspects that performance measurement expected to deliver. The measures need to be aligned with business objectives; Balance Scorecard [BSC] (Kaplan, 1992) and Strategy Maps (Kaplan, 2004), are quite popular and widely used by executives for strategically controlling performance of business activities. BSC and Strategy Maps are not only used at corporate level, but also be effectively used at operation level as well. Beck's article (2002) provided some examples of using Strategy Maps for deploy business objectives to operation control measurements.

Table 2: The 10 Tests (source: Neely et al, 2002)

The Truth Test	Are we really measure what we set out to measure?
The Focus Test	Are we only measure what we set out to measure?
The Relevance Test	Are we measure the right thing?
The Consistency Test	Will the measurement be same whoever make the measurement and whenever it done?
The Access Test	Can the data be easily accessed and understood?
The Charity Test	Is there any possible ambiguity in the interpretation of the results?
The So-What Test	Can and will the measure be acted upon?
The Timeliness Test	Can the data be accessed and analysed rapidly enough to allow action to be taken or trend to become apparent?
The Cost Test	Is the measure worth the cost of measurement?
The Gaming Test	What behaviours will the measure actually encourage?

However, with complexity of operation-leveled processes, Performance Prism (Neely et al, 1992) offers alternative vision of performance metric development by not only top-down strategy deployment, but also considering stakeholder view. Also, The 10 Tests is considered to use for assessing effectiveness of the KPI (as details in Table 2).

Key Performance Indicators [KPI] means to track short-term progress to objectives (Narayan, 2004) and consists of several metrics to yield objective performance facts, which classified as either *Lagging* or *Leading* indicators (Smith, 2004). Lagging indicator shows result efficiency and usually response slower than Leading indicator which measure process effectiveness. Several articles discuss that a metric could be either Lagging or Leading indicator when combine with other KPI, depend on its "customer" process.

Other than text books, author has been study through articles discussed about issues of implementing performance measurement process. Several articles are discussed about guideline for setting up the process, things to concern, and case studies (Neely, 1995-2000). Also, there are discussions about how to using performance measurement for supporting other management process (Sinclair, 1995). This information is very useful for initiating new performance measurement system.

The standard ISO/DIS 14224 (2004, Annex E), suggests process to develop Key Performance Indicators [KPI] for using in reliability management. ISO/DIS 14224 is also one of "deploy-strategy" method, like Kaplan's BSC, but also suggests using Benchmarking and Taxonomy on KPI development step. Though the standard is currently under draft stage, it provides examples of taxonomy and KPI used in petroleum and petrochemical which is very useful for further development. Table 3 compares aspects between KPI and Benchmark.

Table 3: KPI vs Benchmark (source: ISO/DIS 14224, 2004)

	KPI	Benchmark (BM)
Purpose	Track progress and effectiveness of management	Identify gaps in present performance level
Frequency	Reasonable expectation of change occurring	Once-off / in-frequent
Source of data	Internal systems	External sources
Level of control	Immediate to short-term	Longer term
Number of influencing parameters	One or few	Many
Accuracy	Interested in trend	Interested in absolute value
Targets	Set, based on objectives	No target

2.4 Information Management

As majority of company in the industry (including company under study) are using SAP as Enterprise Resource Planning [ERP] system, the data structure is expected to be complied with *SAP* while still maintain KPI objectives. Since various analysis methodologies are used to estimate the risk of hazards to people and environment, or to analyze plant or system performance. For such analyses to be effective and decisive, equipment reliability and maintenance [RM] data are vital. In order to KPI development, reliability and maintenance data need to be carefully collected and standardized. ISO/DIS 14224 (2004) does provide recommendation of RM data collections for specific oil and gas industry, which enormously help in setting up KPI monitoring system.