DATA MANAGEMENT MATURITY MODEL (DM^3) FOR AN EXPLORATION AND PRODUCTION COMPANY

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DATA MANAGEMENT MATURITY MODEL (DM^3) FOR AN EXPLORATION
AND PRODUCTION COMPANY

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A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Software Engineering

Advanced Informatics School
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JANUARY 2012

I declare that this thesis entitled "*Data Management Maturity Model (DM³) For An Exploration And Production Company* " is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

The search for hydrocarbon deep in the subsurface depends greatly on the data and information about the subsurface structure. Exploration and Production companies around the globe are investing big to ensure they are at the heading the race to discover new hydrocarbon as the easy oil era has passed and more of unconventional resources emerge. One area of investment is about acquiring geological and geophysical data from the subsurface, managing oil and gas fields' development and production data. Over the years, exploration and productions companies are seeking ways to measure the progress and impact of the investment to the business, while developing and sustaining the capabilities to manage the complex data. A maturity model approach is proposed as a methodology to achieve these objectives of measuring the progress and impact of data management for the exploration and production companies. As such, this project was commissioned to explore the best practices of maturity model and adopt the best fit for purpose model which will help exploration and production companies to measure their progress and impact of data management. It gathered and analyzed available maturity models and recommended the adoption of maturity models which had met the requirement of the project. Then, the established maturity model, referred as Data Management Maturity Model (DM^3) was tested for an area of the business. The results of the assessment indicated the DM^3 had provided the means to measure the progress and impact of data management to an organization.

ABSTRAK

Pencarian hidrokarbon yang mendalam di bawah permukaan bumi banyak bergantung kepada data dan maklumat mengenai struktur sub-permukaan. Syarikat-syarikat berasaskan Eksplorasi dan Pengeluaran di seluruh dunia melabur dalam jumlah yang besar untuk memastikan mereka yang berada di hadapan dalam perlumbaan untuk menemui sumber hidrokarbon yang baru kerana era hidorkarbon yang mudah ditemui telah berlalu dan timbulnya sumber-sumber bukan konvensional sebagai sumber hidrokarbon yang baru. Salah satu pelaburan untuk pencarian hidrokarbon ialah pemerolehan data geologi dan geofizik, serta pengurusan data-data dalam Pembangunan and Pengeluaran di medan-medan minyak dan gas. Sejak kebelakangan ini syarikat-syarikat berasaskan Eksplorasi dan Pengeluaran mencari cara-cara untuk mengukur kemajuan dan hasil pelaburan mereka dalam pengurusan data di samping terus membangunkan dan mengekalkan keupayaan untuk menguruskan data yang kompleks. Kaedah yang dicadangkan untuk mencapai objektif untuk mengukur kemajuan dan kesan pengurusan data untuk syarikat-syarikat berasaskan Eksplorasi dan Pengeluaran ialah "Maturity Model". Oleh itu, projek ini telah ditugaskan untuk meninjau amalan terbaik dalam "Maturity Model" yang sedia ada dan menerima pakai penyuaian model yang terbaik untuk membantu syarikat berasaskan Eksplorasi dan Pengeluaran dalam mengukur kemajuan pengurusan data dan kesan pengurusan data kepada objektif busines mereka. Ia mengumpulkan dan menganalisis "Maturity Model" yang sedia ada dan mencadangkan penggunaan "Maturity Model" yang memenuhi keperluan projek. Kemudian, "Maturity Model" yang ditubuhkan, yang disebut sebagai "Data Management Maturity Model (DM^3)" telah diuji bagi satu bidang perniagaan. Keputusan penilaian menunjukkan DM^3 telah berjaya menyediakan cara-cara untuk mengukur kemajuan dan kesan pengurusan data kepada organisasi.

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LIST OF ACRONYMS

AM	-	Academic Mentor
CMMI	-	Capability Maturity Model Integration
DM^3	-	Data Management Maturity Model
E&P	-	Exploration and Production
ERP	-	Enterprise Resource Planning
GQM	-	Goal, Question, Metric
IA	-	Industrial Attachment
IEC	-	International Electrotechnical Commission
IEEE	-	Institute of Electrical and Electronic Engineers
IM	-	Industry Mentor
ISO	-	International Organization for Standardization
IT	-	Information Technology
MDM	-	Meta Data Management
PMBOK	-	Project Management Body of Knowledge
PMI	-	Project Management Institute
PSC	-	Production Sharing Contract
SEI	-	Software Engineering Institute
SG	-	Specific Goal
SP	-	Specific Practice
SWEBOK	-	Software Engineering Body of Knowledge
VPN	-	Virtual Private Network
WBS	-	Work Breakdown Structure

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CHAPTER 1

PROJECT OVERVIEW

1.1   Introduction

In the fight towards discovering new source of hydrocarbon, exploration and production companies are depending greatly on their ability to effectively manage their information resources. This is mainly due to the nature of hydrocarbon reserve which is usually found deep in the subsurface of the earth, especially those which are located in the offshore. The search for hydrocarbon reserve relies heavily on the availability of accurate data from the target area of prospect trap. If there is no relevant data available about the area then exploration and production companies may opt to acquire the data either via data acquisition project or they may purchase the data from another company. This data acquisition usually results in heavy financial commitment, and therefore it is important to measure the impact of the data management to the business. A data management maturity model is proposed as a measurement to gauge the impact of data management strategy to the business and guide the improvement of the companies towards achieving high maturity in managing its data.

1.2 Company Background

This Exploration & Production Company (herein after referred as "E&P Company") was incorporated in 1978 as a wholly owned subsidiary of a national oil company. The E&P Company was incorporated to increase the country's participation in the exploration and production industry. The E&P Company started with very limited knowledge about the industry but with a strong aspiration. The E&P Company quickly built and acquired its capabilities in this industry and establishing its reputation among the major players in the similar industry. The company was also gaining trust and confidence in the international arena and as a result, the company had expanded its operation into the global arena.

The E&P Company is involved as the main supplier of the hydrocarbon products which are crude oil and gas to the downstream industry like oil refinery, gas processing and liquefaction. These products can be further processed to produce petroleum products, liquid natural gas, petrochemical, fertilizer and cooking gas, to name a few. The E&P Company is the initiator of a value chain for the national oil and gas company as indicated in Figure 1.1 on the next page.
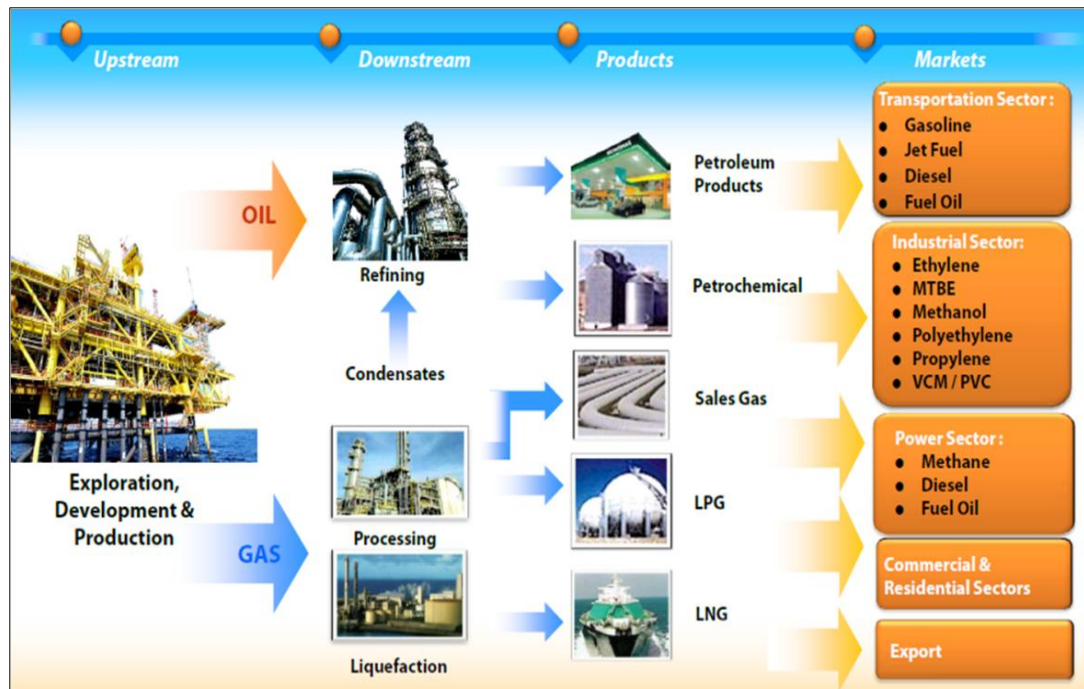
Figure 1.1 : Value Chain of the National Oil and Gas Company

As the initiator of the value chain for the national oil company, it is crucial for the E&P Company to continuously replenish its reserves of hydrocarbon (oil and gas) as the hydrocarbon is continuously being produced and supplied to the downstream industry. This is achieved by ensuring acquisition, exploration, development and production activities of the oil and/or gas fields are continuously running. If there is a discontinuation of activities in a particular oil and/or gas field, the E&P Company will then execute Abandonment activity to clean up the site. Brief descriptions of those activities are as below:

    a.   Acquisition – Acquire new block of potential hydrocarbon reserve or data for the block with potential hydrocarbon reserve.

    b.   Exploration – The search for oil and gas fields using geophysical and geological techniques such as outcrop studies, gravity, magnetic and seismic surveys.

c. Development – Once an exploration activity encounters hydrocarbon, more appraisals are conducted to assess the potential of the find to complete a feasibility study. A Field Development Plan will be drawn up to chart the works required to put the field on production economically. Then, the whole construction of production facility is developed to produce the hydrocarbon.

d. Production – Production activity commences with the "first oil or gas" flowing through the wellhead to the surface, gathering, treating, processing and storage facilities. Production will be ceased when reserve is exhausted or contractual agreement period expires.

e. Abandonment – Abandonment activity will kick in when the time at which income from production no longer exceeds the cost of production. There is a requirement by regulatory body to clean up the production site.

These activities construct the "Life of Field" concept in the exploration and production industry as it reflects the starting and ending of the oil and/or gas field.

In current status of the company, it is building its robust business strategy to further generate value in pursue of growth in the industry and building its competitive advantage. The company is operating in more than 20 countries with expected manpower of more than 8,000 employees globally.

1.3   Background of the Problem

The E&P company in general is relying heavily on the available data about a potential hydrocarbon reserve before they can make a decision either to continue with their investment or not. The E&P Company may respond quicker to a business decision because of the availability of accurate and reliable data which can remove or reduce the uncertainty about the understanding of subsurface. This is mainly due to the fact that human eyes will not be able to see deep into the subsurface and its structure as illustrated in Figure 1.2.
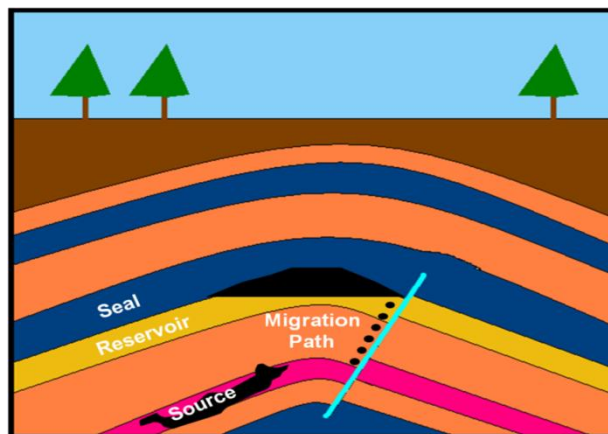
Figure 1.2 : Illustration of subsurface structure

For example, the E&P Company may explore this area as based on the company's study on available data, it has a potential hydrocarbon reserve. The company may proceed with additional data acquisition if required. The company may have generated an extensive amount of data at this earlier stage of acquisition and exploration as illustrated in Figure 1.3, on the next page, where the final outcome may be the decision to drill at a particular target location. At this stage, the company will be able to get the results of discovery of new oil or gas, or whether it is a dry well i.e. no oil/gas.
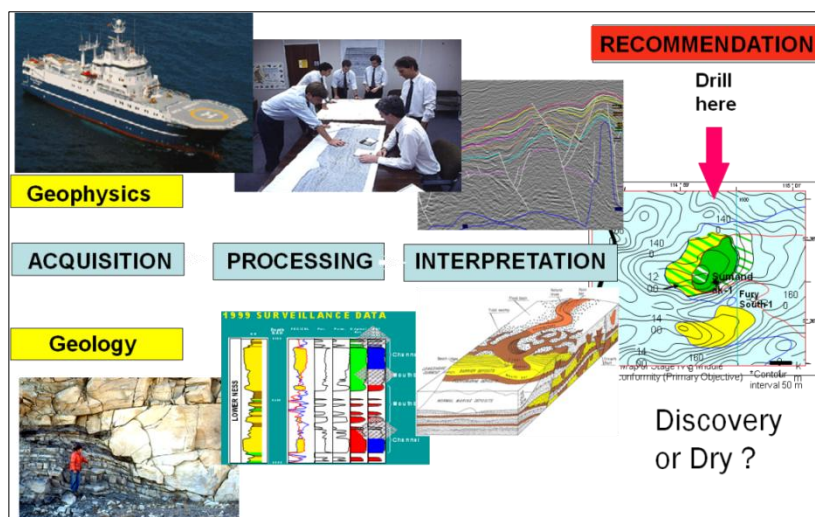
Figure 1.3 : Illustration of processes that generates data

Taking this into a bigger perspective of all the activities in the "Life of Field", it is considerably a huge task to manage its data, which exists in many forms, both physically or electronically. In addition, the company may re-visit some historical data in future where development of a field may become more economic, for example, when the price of oil is higher than normal. There is a need for the company to maintain the accessibility of the data effectively and efficiently for the users to enjoy minimal effort in retrieving the data, as illustrated in Figure 1.4.
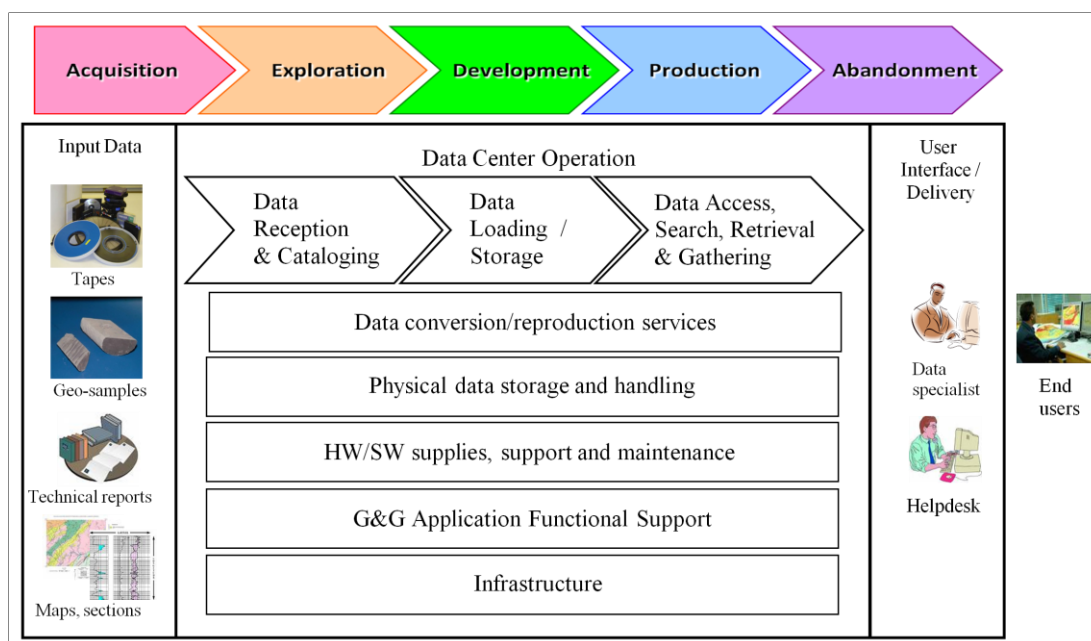
Figure 1.4 : Illustration of data accessibility throughout the "Life of Field"[1]

With this rapid expansion of both geographical presence and skilled workforce, one of the main challenges for the company is about managing its voluminous data, both for domestic and international operations. In the exploration and production industry, data is being generated throughout the lifecycle of an asset, from the day the asset was being acquired, explored, developed, produced and until the day it is abandoned. The data submission to the host country is mandatory by law. An exploration and production company, who is deemed as contractor, is obliged to submit the data in accordance to the host country rules and regulation. For example, in Malaysia, a data submission is managed under a Production Sharing Contract (PSC). Failure to submit will results in a non-compliance which may results into penalty or other consequences. Sample of data which needs to be submitted, in order of main category, is as below:

- Exploration data - geophysical and geological data, e.g. seismic and well data.

- Development data - petroleum engineering, e.g. reservoir, log; facilities engineering, e.g. engineering drawings.

- Production data - production operation, e.g. production volume, pressure, temperature; reliability and integrity data; maintenance data.

Traditionally, these physical data are catalogued and stored in manual ways, for example the exploration physical data is filed into a record management center. As the company grows, the size of the data becomes voluminous and more difficult to be managed. It leads to a relatively longer cycle time to search and retrieve known data for analysis and decision making process. In addition to the physical data, exploration and production companies are also being challenged to manage their massive digital data, as a result of data generation from processes which are utilizing software technology. The data which is stored in multiple databases in various technology platforms made it difficult for the users to access and ascertain the quality and integrity of the data.

1.4   Project Objectives

The objectives of the project are as below:

a. To conduct a study on available maturity models relevant to the data management, especially in the exploration and production industry.

b. To analyze and to specify the adoption of available maturity models to meet the business requirement of the E&P Company.

c. To specify detail elements of the DM^3 including maturity levels, process areas, descriptors of goals and practices.

d. To implement the DM^3 by conducting baseline assessment of a selected area in the business using the Data Management Maturity Model.

1.5   Project Scope

The list below describes the scope of work for this project to achieve the objectives of the project:

a. Establish a project plan to define the activities or tasks which are required to achieve the DM^3.

b. Conduct literature survey to study the available maturity models which are suitable to be adopted as a DM^3.

c. Capture the requirement on the DM^3 to meet the business needs.

d. Analyze and specify the adoption of the available maturity model to align with the requirement of the DM^3.

e. Design and specify the details elements of the DM^3 to tailor the adopted maturity models to the requirement of DM^3. The elements will include maturity levels, process areas, description of goals and practices. This shall be considered as the development phase of the project.

f. Conduct baseline assessment to determine the current level of maturity as part of a testing phase of the maturity model.

1.6 Importance of the Project

This project is important to the E&P Company to ensure data management in the company becomes more efficient, effective and has a measurable impact to the business. Availability of Information Technology introduces some challenges in managing the data, especially from the context of technology implementation and different level of readiness of the organization, including the competency of the people in managing the data. In some situations, the availability of competent personnel to manage the data or low level of prioritization to managing the data has led to a scenario where the data is not being managed at all. As the operation of the company progresses over the years, the data is being neglected and there is a risk of data loss.

In order to get the data management back on track, there is a need to implement a structured approach towards measuring the progress of data management. As a result, Data Management Maturity Model, hereinafter referred as DM^3, is proposed to be implemented to measure the progress of the data management and appropriate actions to be taken to address each data management gaps. This DM^3 will focus on the data related

to Exploration and Production organization, and serves as a guide for data management process improvement, data management projects prioritization, standardization of practices and relevant investment appraisal, to indicate measureable impact to the organization.

1.7   Chapter Summary

This chapter has described some background information about the E&P Company and the importance of managing its data as it has a great impact to the E&P Company in its quest to find more hydrocarbon in the subsurface. The company requires a mean to gauge the impact of its investment on data and what can be done to continuously improve the way the company is managing its data. As a result, the DM^3 project has been established to pursue these objectives.

In this chapter, the project overview information has been captured as described by the following list:

- Introduction to the project,
- Company background,
- Background of the problem,
- Project objectives,
- Project scopes, and
- Importance of the project

This report will continue to cover key areas of the project as described in the following list:

- Chapter 2 – captures the literature review which was conducted for this project.

- Chapter 3 – describes the methodologies which have been adopted for this project. The methodologies will include the project execution and problem solving methodologies.

- Chapter 4 – records the pertinent discussions about the project in the context of its deliverables, outcomes, constraints and recommendations for future related projects.

- Chapter 5 – captures the conclusion of the project and it will include the lessons learned and comments from the project. It will highlight the lessons learned from the Software Engineering perspectives.

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