Review and Definition

Dr. Helmy Sayyouh
Petroleum Engineering
Cairo University
Introduction

Various panel, forum, seminar, and technical sessions have provided the framework for information sharing and exchange of ideas concerning many practical sound reservoir management.
The need to enhance recovery from the vast amount of remaining oil and gas-in-place requires better reservoir management practices.
Historically some form of reservoir management has been practiced when a new field development or water flood installation is planned.

The reservoir management studies in these instances were not integrated (i.e., different disciplines did their own work separately).
During the past 20 years

greater emphasis has been placed on synergism between engineering and geosciences

Progress on integration has been slow.
A reservoir's life begins with exploration that leads to discovery, which is followed by delineation of the reservoir, development of the field, production by primary, secondary, and tertiary means, and finally to abandonment.

Integrated, sound reservoir management is the key to a successful operation throughout a reservoir's life.
The good news is that many technological advances have now been made in geophysics, geology, petro-physics, production, and reservoir engineering.

Mainframe super computers, more powerful personal computers, and workstations are providing ever increasing computing power.
DEFINITION OF RESERVOIR MANAGEMENT

There are many reservoir engineers, geologists, and geophysicists follow the principles of reservoir management for maximizing economic recovery of oil and gas.

This is essential to the future success of the petroleum industry.
The *Webster Dictionary* defines management as the "judicious use of means to accomplish an end."

OR

The judicious use of various means available to a business man in order to maximize his benefits (profits) from a reservoir.
Sound reservoir management practice relies on the utilization of available resources (i.e., human, technological and financial) to maximize profits from a reservoir by optimizing recovery while minimizing capital investments and operating expenses.
Reservoir management involves making certain choices:

Either let it happen, or make it happen.

OR in other words

Leave it to chance to generate some profit from a reservoir operation without ongoing deliberate planning, or we can enhance recovery and maximize profit from the same reservoir through sound management practice.
Early 1970s, reservoir engineering was considered the most important technical item in the management of reservoirs.

After understanding the value of geology, synergism between geology and reservoir engineering became very popular and proved to be quite beneficial.
Reservoir management has advanced through various stages in the past 30 years.

The techniques are better, the background knowledge of reservoir conditions has improved, and the automation using mainframe computers and personal computers has helped data processing and management.
The developmental stages of reservoir management

**Stage 1** - Before 1970, reservoir engineering was considered the most important technical item in the management of reservoirs.

**In 1962, there are two key items:**

(1) clear thinking utilizing fundamental reservoir mechanics concepts and

(2) automation using basic computers.

**In 1965, "reservoir engineering" was described.**
Stage 2- This covers the time period of the 1970s - 1990s.

The value of **synergism** between engineering and geology was explained.

The value of **detailed reservoir description**, utilizing geological, geophysical, and reservoir simulation concepts was emphasized.
Accurate reservoir description to be used in engineering calculations was provided.

The reservoir heterogeneity due to complex variations of reservoir continuity, thickness patterns, and pore space properties (e.g., porosity, permeability, and capillary pressure) was presented.
The **synergism** is provided between geology, reservoir engineering and other disciplines (e.g., geophysics, production operations, drilling, and different engineering functions) and has been quite successful.
The **prime objective** of reservoir management is the economic optimization of oil and gas recovery, **which can be obtained by the following steps:**
a. Identify and define all individual reservoirs in a particular field and their physical properties.

b. Deduce past and predict future reservoir performance.

c. Minimize drilling of unnecessary wells.
d. Define and modify (if necessary) well bore and surface systems.

e. Initiate operating controls at the proper time.

f. Consider all pertinent economic and legal factors.
The basic purpose of reservoir management is to control operations to obtain the maximum possible economic recovery from a reservoir based on facts, information, and knowledge.
The Petroleum engineering system was described of three subsystems:

a. Creation and operation of wells.
b. Surface processing of the fluids.
c. Fluids and their behavior within the reservoir.
The first two subsystems depend on the third because the type of fluids (i.e., oil, gas, and water) and their behavior in the reservoir will dictate how many wells to drill and where and how they should be produced and processed to maximize profits.
The previous items could jeopardize our objective.

For example, we could do well in studying the fluids and their interaction with rock but if the proper well and/or surface system design is not considered, then recovery of oil and/or gas will not be optimized.
The suggested reservoir management approach emphasizes interaction between various functions and their interaction with management, economics, and legal groups.

*Reservoir management model* that involves interdisciplinary functions has provided useful results for many projects.
When should reservoir management start?

The ideal time to start managing a reservoir is at its discovery.

It is never too early to start this program because: provides a better maintaining and evaluation tool cost less in the long run.
Analogy between reservoir and health management can be drawn.

It is not sufficient for the reservoir management team to determine the state of a reservoir's health and then attempt to improve it.

The team must maintain the reservoir's and its sister subsystems' health from the start.
Most often reservoir management is not started early enough. Many times we consider reservoir management at the time of a tertiary recovery operation.

It is critical and a prerequisite for an economically successful tertiary recovery operation to have a good reservoir management program already in place.
In the Permian Basin, carbon dioxide (CO2) flooding project:

An efficient reservoir management program for CO2 flooding (with a $2 per barrel injecting cost) is even more critical compared to water flooding (with a 5-10 cent per barrel cost for water).

Thus, it is very important that all injected CO2 be properly utilized in displacing oil to the production wells.
What, how, and when to collect data?

To answer this question, we must follow an integrated approach of data collection involving all functions from the beginning.

Before collecting any data, we should ask the following questions:
a. Are the data necessary, and what are we going to do with these data? What decisions will be made based on the results of the data collection?

b. What are the benefits of these data, and how do we devise a plan to obtain the necessary data at the minimum costs?
The reservoir management team must show the need for the data requirement, along with their costs and benefits.

Early definition and evaluation of the reservoir system is a prerequisite to good reservoir management.
The team members must convince the management to obtain necessary data to evaluate the reservoir system.

The team should participate in making operating decisions.
What kind of questions should be asked if we want to ensure the right answer in the process of reservoir management?

What does the answer mean?

Does the answer fit all the facts; why or why not?

Are there other possible interpretations of the data?

Were the assumptions reasonable?
Are the data reliable?

Are additional data necessary?

Has there been an adequate geological study?

Has the reservoir been adequately defined?
The modern reservoir management process involves good setting, planning, implementing, monitoring, evaluating, and revising plans.

Setting a reservoir management strategy requires knowledge of the reservoir, availability of technology, and knowledge of the business, political, and environmental climate.
Formulating a comprehensive management plan involves:

depletion and development strategies.
data acquisition and analyses.
geological and numerical model studies.
production and reserves forecasts.
facilities requirements.
economic optimization and management approval.
Success of the project depends upon careful monitoring and thorough, ongoing evaluation of its performance.

If the actual behavior of the project does not agree with the expected performance, the original plan needs to be revised.