A FRAMEWORK FOR ENHANCING THE DECISION MAKING PROCESSES TO DEVELOP OIL AND GAS FIELDS WITHIN SOME LIBYAN OPERATING OIL AND GAS COMPANIES

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Abstract: Decision Making Process (DMP) is considered to be as a set of connected steps, adapted to accomplish desired objectives within any organization. This paper aims to develop a framework for enhancing the DMP within some Libyan oil and gas operating companies. Required data were gathered through an intensive literature-review, personal interviews, and an intensive questionnaire. Based on data analysis, the main findings indicated that the procedures being used for making decisions related to developing oil and gas fields need to be seriously improved, well-documented, and should be designed for enhancing the quality of the DMP. One of the challenges that confronted DMP is found to be the required time for gathering and analyzing the data to make the proper decisions. For developing the framework, PDCA cycle was used, containing four phases; each curtained steps to achieve the desired goals. The framework seeks to enhance the decisions' quality in order to improve the performance throughout practicing the most effective tools and advanced techniques within this business area.

Keywords: Decision making Process, developing oil and gas fields, PDCA-cycle.

INTRODUCTION

DMP is a debatable issue for several oil and gas companies; it diverges from a company to another depending on the desired resolution and time needed to achieve targeted goals. Making a decision is a vital and difficult task for the management body; as the decision is a choice between alternatives in pursuit of objectives, where no alternatives exist no decision can be made.

In the area of making decisions specifically in the oil and gas industry, the DMP is not only a matter of having the right data or the right tool; it is an integrated approach that could be utilized.

This paper is carried out to develop a framework of DMP for developing oil and gas fields via adopting the most common tools and techniques that could be practiced to enhance decisions' quality.

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An Overview of DMP within Oil and Gas Industry

It was realized that the DMP is not an easy task; as it is permeated by some complexities in the absence of required information and tools that are used for data analysis. The procedures for making decisions within most participated Libyan operating oil and gas companies could be considered as the most crucial for improving the quality of the DMP, followed by the used tools and techniques. Whereas, communications as a factor influencing the processes of making decisions is found to be at the lowest level throughout the entire decision making processes (Hokoma & Aburas, 2018).

The steps for making a decision are not independent or separate from each other as they are linked and connected. In other words, what occurs at a certain stage directs procedures and defines what occurs in the succeeding stages. Each alternative of the suggested solutions has to be evaluated separately by comparing the potential outcomes and selecting what is the most beneficial against time, cost, value of information, potential applications, safety and security perspectives Frefer (2014).

Several oil companies spend up to eighteen months in decision cycle-gathering data, analyzing information and modeling risk and uncertainty before selecting the proper production system (Ellen et al, 2001). In respect of production plan, Hokoma (2016) stated that Just-In-Time (JIT) techniques should be considered as the proper production planning and quality enhancement techniques within the Libyan oil and gas industry. It was concluded that the management body within the said industry does not have a clear strategy towards most areas that are considered as being crucial in any successful implementation of JIT techniques. Additionally, some challenges were also being pointed-out for the decision-makers to be aware of, while implementing JIT systems within the industrial environment.

In respect of different types of decisions, decision making is located between three dimensions; certainty, risk, and uncertainty. The risk is the probability of an undesirable outcome and uncertainty is the inability to predict future events. Both risks and uncertainties inherent in oil and gas industry investment that are larger at the exploration stage, but they are reducing through appraisal and development stages. It is often forgotten that the goal is to make good decisions which will lead to better outcomes, not to reduce uncertainty (Bratvold, 2012).

Frefer (2014) referred that the scientific method for making decision involves six steps. However the process is varying from one to another, and to determine whether a decision is "good" or not, it should be focused on the process of making the decision rather than the outcomes of the decision.

Bickel & Bratvold (2008) focused on an upstream oil and gas industry, and stated that the decision making taxonomy involves four different elements: complexity, task constraint, ambiguity and the information structure of the environment. However, there is no such standard taxonomy or classification scheme for making decisions. Adding to that, due to the highly complex nature of the oil industry, a single person rarely has sufficient information to make a decision, hence a group decision is very essential to make an effective decision. Moreover, it was complained that several engineers do not believe, there is enough time to follow a decision analysis approach. Consequently, companies have a challenge finding time for value creating activities. One way to address this concern is to make sure that process adds value and working on the right things at the right time.

In respect of technology and decision analysis in reservoir management, using technology & techniques to support making decisions usually costs. Thakur (1995) stated that any development of new reservoir management technology and its applications must be subjected to a thorough economic screening. However, using and supporting such a technology is justified based upon business needs.

In a strategic reservoir planning which is necessary for developing and managing oil producing asset. Gerbacia & Al-Shammari (2001) have debated that making decisions involve uncertainty parameters, such as economic factors and production potentials lead to uncertainties in predicting results as often uncertainties in the planning parameters are not recognized. Therefore, multi criteria decision making is required to identify the most influenced parameters that influence making decisions. Several attempts have been adopted to determine the proper procedures of making decisions, and how to follow-up the process. For enhancing the decisions' quality, the processes should be developed and improved continuously using the most advanced techniques and tools, sharing new ideas and learning from fault decisions which could be considered as an essential success factor for any organization (Hokoma & Aburas, 2018).

Aburas (2018) stated that several factors usually influence the quality of DMP within many companies, a many of them are procedures that has big impact, followed by with less contribution communications and tools/techniques. This relatively true to the real world as the decision is made regardless involving the whole team and using simple tools.

Parakash (2012) stated that, there is a strong correlation between process, people and technology for processing making good decisions. Therefore building and integrating approaches towards DMP should be considered as an important aspect for creating a strong decision support system. Goren and Taylor (1978) described the correct process for making decisions on large projects in the North Sea were subject to an undetected scale effect which resulted in their getting off-schedule and over-budget. An effective organizational set-up and suggest that a management scheme should include a "feedback" function which will form the basis for top level decision making and will enable the project managers to exercise control over their project.

METHODOLOGY AND DATA COLLECTION

The data were being gathered through literature reviews, direct observations, a survey questionnaire and some personal interviews; all used for gathering the required data to investigate the conducted DMP within the targeted companies.

The population size was acquired from expertise in each participated company. Sampling is chosen to shorten the time, effort and to determine the lower limit of the population sample. The sample size for this survey was calculated. 237 hard copies were distributed and a total of 216 were returned, giving a response rate of 91%.

DATA ANALYSES AND DISCUSSION

As a first stage for analyzing the gathered data, a reliability test (Cronbach's Alpha) was applied to examine the internal consistency of the entire questionnaire, and was equal to 0.839, giving a strong evidence that the questionnaire is stable and reliable enough to be analyzed.

The analysis was performed using the Statistical Package for the Social Sciences (SPSS), and it was found that who dominate the seniority managerial levels and involved in the DMP are mostly men (85%). Approximately above 90 % of the participants are well-highly qualified with BSc & MSc. degrees (Aburas, 2018). This leads to the availability of qualified people in the participated companies within almost all the related departments. The diversity in managerial levels that were participating in this study are shown in Table (1).

Table 1. The participated managerial levels.

Managerial levels	Frequency	%
Manager	32	14.8
Superintendent	29	13.4
Coordinator	42	19.4
Supervisor	14	6.5
Team Leader	4	1.9
Specialist	23	10.6
Senior	63	29.2
Other	9	4.2
Total	216	100.0

The researchers investigated the issue of how many steps of DMP are carried out in the participated companies. Table (2) shows most participants (70.8%) don't know how many steps are used for conducting the DMP in their companies. This might refer to absence of having clearly documented DMP. About 15% of participants stated that the steps of making a decision are less than four. Observingly, it was found out that some participants had just provided a rough number which might be inaccurate, meaning that the procedures of making decisions are not well-defined in their workplace.

The availability of using any specific processes in making decision for developing oil and gas fields was also investigated. Table (3) shows most participants (45.8%) don't know if there is any specific process of DMP and 19.4% of participants stated that there is no such specific process. Despite the fact that only 16.7% of participants said "Yes", but the process was unclearly provided in this study. Few participants (18 %) preferred not to provide any answer.

Proceeding to the previous discussion, some participants stated that Brain Storming technique and Decision Tree Analysis are considered as techniques and tools of DMP. Others stated the time, quality, accuracy and cost should be taken into considerations when making decisions. Besides the process of decision making is subject to the specialist to provide the conceptual basic details such developing oil and gas fields with including risk analysis. Another way of processing the decision making starts with gathering data, analyzing, screening, delivering draft report and then a final report is accepted. All in all, it was observed that past experience and key learning are being widely used in the DMP for developing oil and gas fields.

According to the statistical results and throughout reviewing the literature of DMP principles along with some used tools/techniques it can be seen that, each department has its own way to make an effective decision, and there is no specific process to make a particular decision; as some of the procedures have been inherited from previous experienced ones. One more thing, from close observations with the participants, using simple tools/techniques with less cost and more reliably are preferred to be used in the DMP.

Table 2. Number of steps conducting in the participated companies.

DMP steps	<= 4	5	6	7	8	9	10	11	>14	Don't know
As seen by participants, %	15.3	6.9	2.3	1.4	0.5	0.5	0.5	0.5	1.4	70.8

As a result, improving the quality of making decisions for developing Oil and Gas fields, requires to use different simple, understandable techniques and tools such as Brain Storming technique, (Plan, Do, Check and Action) PDCA cycle (comprehensible and simple cycling), Decision Making Matrix and feedback process. Adding to that; taking into account other factors that may influence making decision such as culture and policy of the company.

SUGGESTED FRAMEWORK FOR DEVELOPING OIL AND GAS FIELDS

Several processes of making decisions are being used in oil and gas industry have been adopted to meet corporate goals. The PDCA Cycle is broadly used to enhance the DMP quality more efficiently as it consists of four phases (Plan, Do, Check and Action); it is a circle with no end, and it should be repeated again and again for seeking continuous improvement, and each phase has certain steps, and between each phase there is a Decision Gate (DG) to go through to confirm and agree the outcomes of phase to move into the next phase, and so on. The suggested framework is illustrated in Fig. 1.

To be in mind, it is believed that the culture intervention (human factor) as well as government policy and country regulations should be taken into considerations when making decisions. The framework of DMP is illustrated and started with the following:

Phase I (Plan)

Establishing the main strategic and desired objectives of any organization should be achieved first throughout conducting several meetings among related departments; involves professional members who are being selected from reservoir engineers, operating engineers, drilling engineers, project engineers, economist, environmental, and anyone related to the project of developing oil and gas fields. The Decision Making matrix should be utilized to identify criteria of making decisions, which can be considered as an essential part in achieving the overall aspect, such as (economic, environment, political, and technological factors). The suggested DMP should employ the Brain Storming qualitative technique, throughout the DMP.

Table 3. Used process in making decisions.

Availability of specific process of DMP	Yes	No	Don't know	Prefer not to say
As seen by participants, %	16.7	19.4	45.8	18.1

Phase II (DO)

This section identifies 3 steps of the DMP to investigate and predict the reservoir performance for developing oil and gas fields.

1. Data Collection: It includes gathering the related data as; Rock and fluid data, special core analysis, well logs, the production history of the field, the entire reservoir description and a reliable existed 3D dynamic reservoir simulation model.

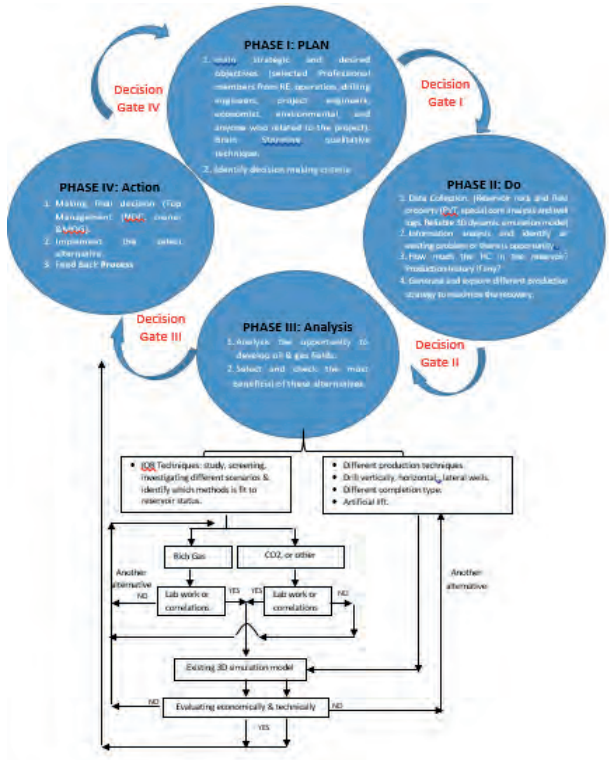


Fig. 1. Framework DMP for oil and gas fields.

2. Identify an existing problem and analysis the information: Making a decision is called a problem solving process that eliminates barriers to company goal attainment. The first step in this elimination process is identifying precisely what the problems or opportunities are that assist developing such fields. The gathered information should be analyzed in qualitative and quantitative perspective and representing in a meaningful way so that the relationships between varieties of data/ information can be detected.
3. Generate and explore alternatives: Key staff should list various possible solutions/alternatives. Then developing an action plan in order to address any obstacles/barrier that may prevent achieving the required goals. There are different production technologies to prolong the field life. For instance, in the late stage of developing oil and gas field, planning of Enhance Oil Recovery (EOR) projects may require in which involving a multiple hurdle decision making task; procedures to be undertaken in planning EOR projects is a conducted preliminary screening process and selecting the appropriate EOR techniques. Reservoir description involves reviewing comprehensively by a team of geologist, geophysicist, petrophysicist, drilling and completion engineer and reservoir engineer and to reach a total understanding of the reservoir and its performance. Then gather needed laboratory and field data and followed by field pilot testing to examine the performance of choosing a technique, which all need to be modeled and duplicated mathematically by numerical reservoir simulation, followed by performing technical/economic feasibility report.

Phase III (Check and Analysis)

This section identifies one step of the DMP. After fully understanding the entire reservoir status and the related issue, examining the possible optimum production strategy should be investigated.

4. Check and Select the most beneficial of these alternatives: Each alternative has to be evaluated separately comparing against potential outcomes, constraints, assess the risks associated with the optimum solution. Decide carefully which alternative will be implemented according to proposed decision making criteria.

A different strategic plan should be defined and different production forecasting scenarios for subjecting reservoir should be created by using existing 3D dynamic reservoir simulation tool. After acquiring the results, the risk and economic analysis should be performed accordingly. The SWOT analysis tool is valuable in this stage to investigate the strength, Weakness, Opportunity and threats of the chosen solution. Financial decision is quantitative analysis tool, deciding, whether to pass forward or stop at this stage or re-evaluate and addressing a new possible option.

Break-even analysis is used, to determine when an option becomes profitable, whereas, the Net Present Value (NPV) is an indication of how much the project will earn in comparison to putting the money in a bank that offers an interest rate equals the discount rate. Besides, Cash flow forecasting, to forecast the impact of a financial decision. The evaluation stage is significant; it is considered as it is a beginning of gaining experience/ learning to enhance the performance of making decisions in hereafter. The main decision criteria are, operational profit, project reliability, working environment, personnel safety, risk to the environment and total project cost (Thakur, 1995).

The decision making cannot be completed unless measure and assess the entire results, and which is always determined by an interactive technical and economic feasibility criterion.

Phase IV (Action)

In this phase, including two steps; implementing the selected alternative and feedback process as follows:

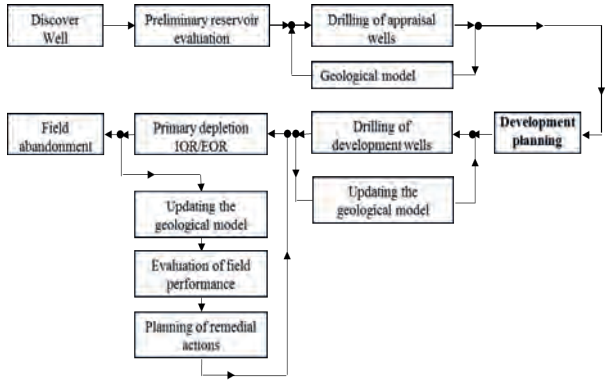


Fig. 2. Reservoir management feedback system.

5. Implement the selected alternative: This step is to put the selected alternative into the implementation stage. The implementation plan is required and containing important issues; for instance required actions to achieve the goal, create a time scale (Schedule), ways to reduce the risks to a minimum, and a remedial action should be involved in case of non-functioning of any stage as a contingency plan.
6. Feed Back Process: it is very important step; as after selecting the implemented alternative, decision makers must gather feedback to determine the consequences negatively/ positively of the implemented alternative. If the identified problem is not being solved, managers need to seek out and implement some other alternatives instead. The learning feedback system is shown in Fig. 2, as adopted by Chierici (1990).

To acquire reliable reservoir information, it should be taken into account periodically run numerical reservoir simulation model. Each step should be validated by the dynamic simulation model against actual reservoir behavior. Therefore, the feedback system should be developed with reservoir management requirements.

For each previous phase, a decision has to be taken to proceed the following phase. Eventually, after recommending the proper production strategy for developing a certain oil and gas fields, the National Oil Corporation (NOC); the company which controls and handles the oil and gas industry (upstream and downstream) exclusively make a decision at the end.

In respect of reservoir management, to be more successful managed, there was a study (Chierici, 1990) identified elements of successful reservoir management teams, the main ones as follows:

1. Cross-functional team, and empowerment and reduced routine supervision.
2. Minimum individual technical reviews by functional heads in favor of joint reviews.
3. Informal communication and clarification of priorities and periodic project reviews.
4. Quick approval process making a decision by all team members, technology transfer between various teams, and well-trained and highly motivated individuals.
5. Frequent office staff visits to the subject area and creation of interests regarding the reservoir performance among the field operators and supervisors.
6. Comprehensive and cost-effective surveillance and management program, well planned data collection and management program, and
7. Innovation and risk taking by integrating a new technology into the reservoir management program to maximize profitability and economic recovery.

CONCLUSIONS

The paper makes a contribution by developing a framework of decision making processes for developing oil and gas fields within some Libyan operating oil and gas companies which their operations' management systems are limited and governed by two parts, the owner and NOC.

After intensively investigating the conducted DMP within the surveyed companies, some concluding remarks are illustrating as following:

- There is an integrated work between relevant departments (Geology/Geoscience, petroleum, reservoir, production, and process operation specialists) to be employed intensively in the DMP for developing oil and gas fields.
- The reservoir dynamic simulation tool is considered crucial to assist decision makers in developing oil and gas fields and used mainly in the reservoir department. Hence the simulation tool is recommended to generate different scenarios of production strategies of such fields.
- Experience and practices in making decisions in similar situations help managers to make occasional decisions without going through an (a-to-z) of the DMP, as most of made decisions are regularly intuitive decisions; in other words, it is based on experience in such similar situations.
- It was realized that the decision environment within the business area is controlled by the top management body within the related companies.
- Clear procedures for making decisions within the related companies should be adopted more effectively.
- NOC is always seeking to improve the quality of making decisions to obtain valuable resolutions, and paying serious attentions for improving the whole situations.

To sum up, it is recommended to adapt the developed DMP framework for developing oil and gas fields to enhance the quality of making decision and to meet the management requirements. Furthermore, a working team approach and

integrated advanced technology should be used to seek for leading a successful reservoir management.

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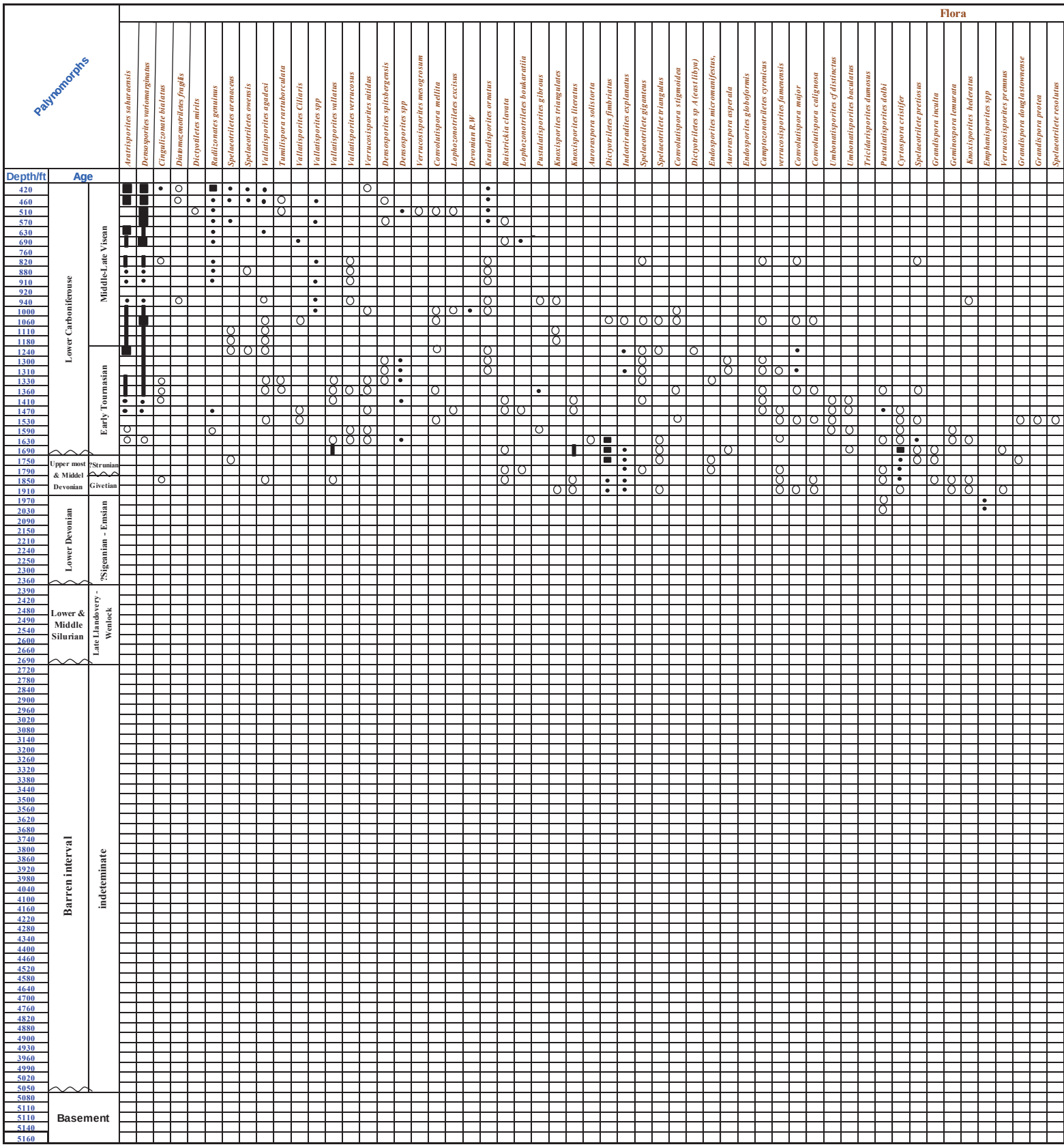
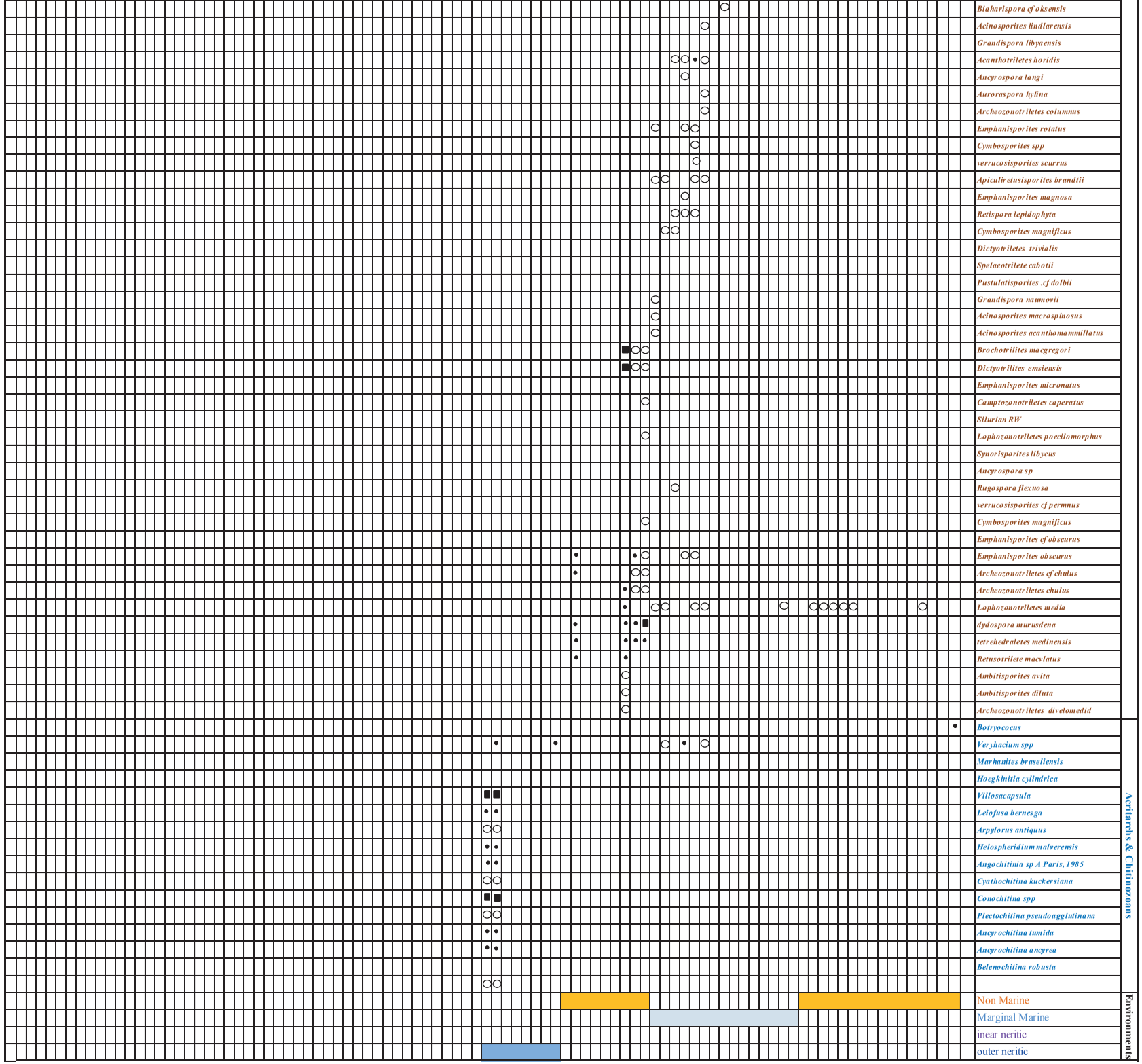


Fig. 2 Distribution of common and stratigraphically significant palynomorphs in the investigated intervals of well A1-177/01.


Biaharispora cf oksensis
Acinosporites lindlarensis
Grandispora libyaensis
Acanthotriletes horidis
Ancyrospora langi
Aurorospora hylina
Archeozonotriletes columnus
Emphanisporites rotatus
Cymbosporites spp
verrucosisporites scurrus
Apiculiretusisporites brandtii
Emphanisporites magnosa
Retispora lepidophyta
Cymbosporites magnificus
Dictyotriletes trivialis
Spelaeotrilete cabotii
Pustulatisporites .cf dolbii
Grandispora naumovii
Acinosporites macrospinosus
Acinosporites acanthomammillatus
Brochotrilites macgregori
Dictyotrilites emsiensis
Emphanisporites micronatus
Camptozonotriletes caperatus
Silurian RW
Lophozonotriletes poecilomorphus
Synorisporites libycus
Ancyrospora sp
Rugospora flexuosa
verrucosisporites cf permnus
Cymbosporites magnificus
Emphanisporites cf obscurus
Emphanisporites obscurus
Archeozonotriletes cf chulus
Archeozonotriletes chulus
Lophozonotriletes media
dydospora murusdena
tetrehedraletes medinensis
Retusotrilete macvlatus
Ambitisporites avita
Ambitisporites diluta
Archeozonotriletes divelomedid
Botryococus
Veryhacium spp
Marhanites braseliensis
Hoegklnitia cylindrica
Villosacapsula
Leiofusa bernesga
Arpylorus antiquus
Helospheridium malverensis
Angochitinia sp A Paris, 1985
Cyathochitina kuckersiana
Conochitina spp
Plectochitina pseudoagglutinana
Ancyrochitina tumida
Ancyrochitina ancyrea
Belenochitina robusta
Acritarchs & Chitinozoans
Non Marine
Marginal Marine
inear neritic
outer neritic
Environments