

# Lean Philosophy towards the Enhancement of Maintenance Programs Efficiency with Particular Attention to Libyan Oil and Gas Scenario

Sulayman Adrees Mohammed, Ahmed Faraj Abd Alsameea

**Abstract**—The ongoing hindrance for Libyan oil and gas companies is the persistent challenge of eradicating maintenance program failures that result in exorbitant costs and production setbacks. Accordingly, this research is prompted to introduce the concept of lean philosophy in maintenance, which aims to eliminate waste and enhance productivity in maintenance procedures through the identification and differentiation of value-adding (VA) and non-value-adding (NVA) activities. The purpose of this paper was to explore and describe the benefits that can be gained by adopting the Lean philosophy towards the enhancement of maintenance programs' efficiency from theoretical perspectives. The oil industry maintenance community in Libya now has an introduced tool by which they can effectively evaluate their maintenance program functionality and reduce the areas of NVA activities within maintenance, thereby enhancing the availability of the equipment and the capacity of the oil and gas facilities.

**Keywords**—Efficiency, lean philosophy, Libyan Oil & Gas Scenario, maintenance programs.

## I. INTRODUCTION

**M**AINTENANCE programs in oil and gas industry are defined as the arrangement of all technical and administrative measures, that can mitigate the impact of system failures and extend the lifecycle of operating system, which ensures continuous operation, and growth of industrial processes [1]. In addition, maintaining a system is usually related to maintenance actions such as repairing, replacing, overhauling, inspecting, servicing, adjusting, testing, measuring and detecting faults in order to prevent any potential failures that may result in disruptions to production operations. [2]. Along the same vein, [3] believes that, the maintenance program is a recurring comprehensive program that plays a substantial role in ensuring the long-term stability and uninterrupted operational capacity of oil and gas plants. Consequently, maintenance programs are renowned for their intricate nature due to the substantial involvement of extensive manpower and resources in the planning and execution phases. For this reason, [4] reported that a major maintenance programs could potentially cause an annual loss of production availability of 2-3%.

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## A. Maintenance Routine: Scenario of Libyan Gas and Oil Sector

Currently, routine maintenance, inspections, replacement, cleaning, painting, and defect correction are among the various maintenance activities carried out by Libyan oil and gas companies. However, these actions are commonly referred to as maintenance activities and are considered fundamental to financial management.

Even though, the continuous objective of Libyan oil and gas production companies has been to enhance the efficiency and effectiveness of their maintenance processes. Yet, the persistent challenge faced by these companies remains the prevention of failures that result in significant costs and reductions in production. Not only the selection of suitable maintenance strategy, but also the use of appropriate techniques and tools to support the decision-making process in this area. Overall, Table I illustrates the most appearing drawback in Libyan oil and gas maintenance programs.

TABLE I  
DRAWBACK IN LIBYAN OIL AND GAS MAINTENANCE PROGRAMS

No	Drawback in Libyan oil and gas maintenance programs	Category
1	Lack of strategy knowledge and experience related to maintenance implementation.	Managerial Support
2	Lack of qualified expertise of maintenance technical requirements.	Process Management
3	Lack of financial resources, cost control and venture capital.	Process Management
4	Lack of providing quality education and professional maintenance training programs.	Technology Infrastructure
5	Lack of providing and managing high-qualified human resources.	Managerial Support
6	Factors related to employee perceptions and behavior of maintenance.	Individual Behavior

Jasiulewicz-Kaczmarek et al. [5] clarified that, improperly defined maintenance activities result in a range of issues, with the primary concern being the association between inadequate maintenance practices and costs, downtime, breakdowns, defects, additional inventory, and other factors that impact product quality and the company's overall performance [6]. Remarkable investigators like those [7]-[8] have revealed repeatedly that lean maintenance is essential for the accomplishment of an oil industry, where lean delivers a comprehensive philosophy towards the functionality of maintenance process.

### B. Statement of the Problem

Understanding lean philosophy in maintenance by Libyan oil and gas society has the potential to bring considerable enhancement to vital characteristics of maintenance programs productivity. However, the overall expenses and duration can be significantly decreased, thereby ensuring a reduction in maintenance requirements and maximizing the life of the equipment in long run. Exclusively, all the above-mentioned assumptions lead this investigation to present lean philosophy in maintenance where VA and NVA a popular activity to reduce waste and expand productivity to maintenance programs procedures. That being said, owing to the nature of maintenance, its significance to the Libyan oil and gas society and the current economic resources available by the National Oil Corporation (NOC), more focus must be given to lean maintenance philosophy.

## II. RESEARCH METHODOLOGY AND LIMITATIONS

A comprehensive analysis of the research methodology is

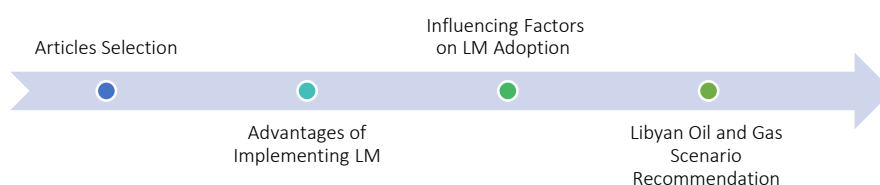


Fig. 1 The conducted systematic literature review process

## III. RELATED WORK: LEAN PHILOSOPHY

The concept of lean philosophy has been incorporated into the domain of maintenance management in order to establish a strategic framework commonly known as lean maintenance. Accordingly, the concept was developed based on the Total Productive Maintenance (TPM), which aims to eliminate production loss and optimize the reliability and effectiveness of manufacturing equipment. Table II represents list of related definitions of lean maintenance throughout the academic literature.

Author	Provided Definition	Description
[11]	Lean maintenance	Lean maintenance is an approach that redirects the focus of maintenance improvement from technical aspects to the managerial aspect, with an emphasis on eradicating underlying issues through collaborative decision-making and implementation.
[12]	Lean maintenance	Lean maintenance is regarded as a comprehensive framework encompassing a wide collection of maintenance schemes and models in order to achieve the necessary enhancements in plant reliability, availability, and process repeatability.

### A. Factors Influencing the Implementation of Lean Technique in Maintenance Programs

One of the specific objectives in this article is attempting to highlight the factors which influencing the implementation of lean technique in maintenance programs. However, for several

illustrated in Fig. 1. However, four phases of systematic literature review were modified in order to address the research objectives formulated in the study. More specifically, initially articles selection was carried out through a systematic review method, which precisely specified the supportive articles employed for this study. The second phase consisted of exploring and interpreting the advantages of implementing lean maintenance, wherein VA and NVA proved to be a popular activity for minimizing waste and enhancing productivity in maintenance program. The third phase entailed clarifying the factors that are believed to influence the adoption of lean maintenance by Libyan oil and gas companies. Overall, the undertaken systematic literature review (SLR) proposed valuable recommendations regarding LM implementation towards assisting Libyan oil and gas maintenance scenario [9], [10]. This research was carried to introduced LM as new form of strategy to assist public companies owned by Libyan National Oil Corporation (LNOC). Hence, the outcome of this study cannot be used to form a general conclusion for other foreign subcontracting companies hired by LNOC.

years researchers have tried to identify the common factors, which stand behind the implementation of lean technique in maintenance programs and finding, revealed that, organizational consideration factors, which include leadership, vision, direction, statement of objectives, commitment, supervision, maintenance analysis and planning, are well demonstrated in the literature by which directly influencing the implementation of lean technique.

In [13], the correlation between employees' perception of organizational consideration and the support they receive from their supervisors and colleagues in lean maintenance was examined. However, the findings revealed that when workers experience high levels of support from both the organization and their supervisors, which demonstrates a genuine concern for their well-being, they are more likely to effectively implement lean maintenance programs.

Responsibility for accomplishing lean maintenance activities must be effectively delegated to individuals at lower levels of authority. However, such argument is further supported by [14] where they argue that, delegating effectively entails bestowing sufficient authority and allocating unambiguous accountability for executing particular tasks, alongside an ample provision of resources, including suitable timeframes, financial means, and the collaborative commitment of all parties involved.

Expanding this further, [15] assumed that outstanding lean maintenance program results can be achieved when goals are clearly established. In addition to the above findings, [15]

argued that lean culture goals should give a clear picture, direction, and focus for performing day-today maintenance activities in order to achieve desired results.

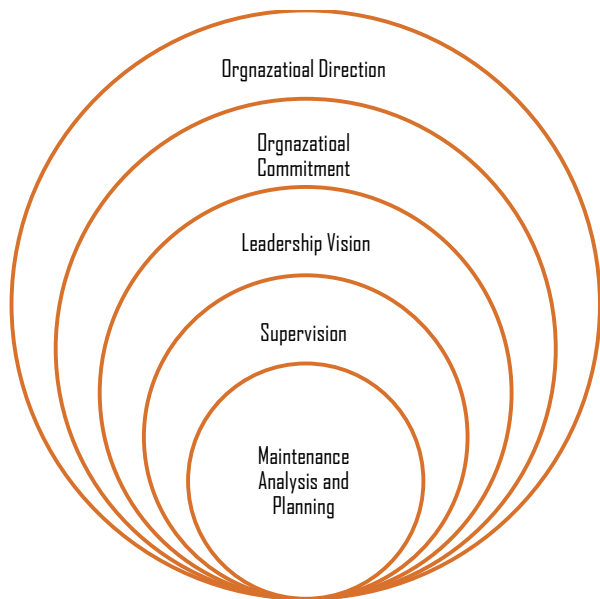


Fig. 2 Organizational factors influencing the implementation Lean Technique

According to [16], it has been stated that the effectiveness of communication in the workplace can facilitate the formation of highly efficient teams among the workforce and managers. Consequently, the presence of effective communication between the workforce and managers would enhance lean productivity, reduce errors, and improve the smooth functioning of maintenance programs. In order to gauge the extent to which lean programs accomplish their goals and objectives, it is essential to periodically evaluate them. This implies that organizations can assess the effectiveness of their efforts and ensure continuous improvement and long-term success of maintenance programs by establishing evaluation procedures and a process for enhancing lean programs.

#### B. Classification of VA and NVA in Maintenance Programs

Lean maintenance is grounded in the core principles of lean philosophy, which focuses on minimizing various forms of waste. It prioritizes the identification and removal of waste to clarify and enhance value. Thus, the activities directed in maintenance programs have to be identified and organized in order to attach the value and waste attributes accurately. However, this argument is further supported by [17] where scientists claim that any operation in the maintenance process that referred as any action or process is defined as value adding. In the academic literature, for instance, researchers [18], [19] in too many occasions have established that in maintenance process, waste typically consists of outdated measures, overstocked, underused inventory of equipment, material, parts, as well as wasted labor, time, and transportation. Waste in maintenance programs presented in Table III.

TABLE III

TYPES OF WASTE IN MAINTENANCE PROGRAMS		
No	Waste in maintenance	Description
1	Unproductive work	Work that does not require any effort or action.
2	motion Delays	Periods of waiting, including delays caused by waiting for necessary tools, equipment, or individuals.
3	Unnecessary motion	Unnecessary movement of items or workstations in search of tools or materials without valid reasons.
4	Poor management of inventory	Inability to provide the correct parts at the appropriate time.
5	Rework	Repeating tasks or introducing additional tasks due to poor planning.
6	Ineffective data management	Gathering data that holds no value or neglecting to collect essential data.
7	Underutilization of people	Failure to utilize individuals to their full potential.

#### IV. DISCUSSION: MEASURING THE IMPACT OF LM PROGRAMS ON LIBYAN OIL AND GAS COMPANIES

Libyan Oil and Gas Companies' representatives' and parties whoever involved in maintenance programs should acknowledge that lean philosophy is their new coming systematic approach that aims to enhance maintenance programs by reducing waste, increasing efficiency, and improving overall productivity. The competent authorities involved in oil and gas industry are also recommended strictly to adopt lean principles that can streamline their maintenance processes, optimize resource allocation, and ultimately deliver higher quality results while minimizing costs. By applying lean principles in maintenance programs, Libyan oil and gas organizations can eliminate non-value-added activities, reduce lead times, minimize inventory levels, and improve the flow of work, ultimately resulting in improved maintenance outcomes. Hence, implementing lean principles in maintenance programs requires careful planning and a comprehensive understanding of the existing lean tools of maintenance. However, the most common lean tools developed for maintenance activities within an organization include VSM, 5S, overall equipment effectiveness (OEE), Kaizen, work standardization TPM, SMED, computer maintenance managed system (CMMS).



Fig. 3 Most common lean tools for maintenance activities

#### A. Value Stream Mapping

Value stream mapping is a commonly employed technique in Lean environments for the purpose of examining and developing flows at the system level, encompassing multiple

processes [20]. Through the practice of value stream mapping, both material and information flow are subjected to analysis. By means of drawing the VSM, practitioners have the capacity to visually perceive and comprehensively comprehend the entire flow, as well as discern the waste present in the value stream. Moreover, they are able to establish a connection between the information flow and the material flow [20].

### B. 5S Practices

The implementation of 5S practices within lean maintenance facilitates the establishment of a standardized work environment. This approach emphasizes the eradication of waste and encompasses five distinct steps. The successful adoption of 5S can yield a multitude of benefits in the realm of maintenance [21]. These advantages include heightened efficiency, enhanced organization, cleanliness, productivity, and safety within the workplace. Furthermore, the utilization of 5S leads to an improvement in overall working conditions, as well as a clearer understanding of underlying issues. Additionally, this methodology promotes a reduction in costs, unproductive time.

### C. Total Productive Maintenance

The initiative known as TPM aims to enhance the dependability and efficiency of manufacturing equipment [19]. TPM is a proactive and team-based approach to maintenance that encompasses all levels and functions within the organization, spanning from top-level executives to the shop floor [21]. It focuses on the entire life cycle of the production system and establishes a robust system based on the shop floor to mitigate all forms of losses.

## V. CONCLUSION

The literature review on maintenance reveals that lean philosophy is being adapted to maintenance in order to eliminate NVA activities. Similarly, the Libyan oil and gas maintenance community now has an introduced tool by which they can effectively evaluate the maintenance function and reducing the areas of NVA activities within and thereby enhancing the availability of the equipment and the capacity of the operation facility.

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