The Role of Lean Production Technology and Human Resource Flexibility in Reduce Costs: Applied Research in Petronas Oil Industries Company

Mohammed Alwan Rahima Al-Eqabi, Maytham Abbas Khudhair Al-Salmawi, Marwah Jumaah Tuama, and Makhlid Kazem Mutlaq

ABSTRACT

The research aims to study the impact of human resource flexibility and lean production and their foundations and ways to activate and follow up those tools and work to develop a vision for the economic unit in question in reducing costs as well as defining its importance in contemporary systems and identifying skills and behaviors that affect performance and productivity and ways to develop them and find a structure to enhance competition through coordination of the tools of the two variables together to achieve new methods in the concept of reducing costs and achieving impressive results, which included the pillars of lean production on total quality management, automation, comprehensive productivity maintenance and continuous improvement. The problem of the research was the lack of skilled workers in the economic unit in question and the extent of its application to the tools of lean production and the mechanism of eliminating waste in its operations. Through it to a set of conclusions, that there is an acceptance of these techniques and their methods by the workers in the economic unit in question for application because of their results that are reflected on them, on the activity in general, the existence of a correlation relationship between the independent variables, lean production and the flexibility of human resources and the effective role of them in reducing costs.

Keywords: Human resource flexibility, lean production, reducing costs, types of waste.

1. Introduction

The development in the surrounding environment in contemporary economic units, the technological expansion of these organizations, the difficulties associated with aspects of creative performance, and the need for continuity of economic growth necessary to achieve competitive strategies are pivotal in any organization, whether it is production or service. They stress the importance of having flexible human resources working to achieve innovation and development of the internal environment for work that the human element is the variable. Their importance crystallizes in the knowledge, capabilities and skills possessed by working individuals that help in finding new knowledge that is used and employed in the growth and progress of the organization, in addition to the application of the principles of lean production in the operations of the organization to be a tangible reality.

First, the research methodology was discussed, and then previous studies were discussed and what distinguishes them from the current study. The research was divided into several axes. The first axis dealt with the concepts of lean production technology. The second axis dealt with the concepts of human resources flexibility. The third axis dealt with the role of lean production technology and human resources flexibility in reducing costs. The practical aspect of the research was addressed, followed by conclusions and recommendations.

2. Research Methodology

2.1. The Research Problem

The problem of the research was the lack of multi-skilled workers in the economic unit in question and the weak cognitive level of the business environment in general. For
business management organizations, in particular, due to the importance of the flexibility of human resources in the administrative process and the organization of their performance in the economic unit, it is possible to find and develop human resources capable of correct thinking. It works to seize opportunities and invest them in a way that leads to strengthening and reducing costs, as well as the economic unit’s lack of awareness of the importance of the methods and principles of lean production and the poor awareness of managers in those units about the mechanisms of removing all forms of waste, which is negatively reflected on their excellence, and in light of the research problem, it can be put forward the following questions:

1. What is meant by the flexibility of human resources and the technology of lean production? How do they contribute to reducing costs?
2. What is the level of awareness of economic units of the importance of applying lean production systems and the flexibility of human resources?
3. Is it possible to rationalize costs and reduce them in economic units by applying the flexibility of human resources and the technique of lean production?
4. What is the extent of application of the foundations of lean production in the work environment in question? Is it monitored and levels determined?
5. What is the extent of the application of human resource flexibility in the work environment in question? Is it supported and activates its continuity?

2.2. The Importance of Research
1. Hard skills alone, despite their importance, have become deficient and unpopular with employers and those responsible for employment unless they are accompanied and supported by a set of flexible skills.
2. Awareness of business organizations’ administrations of the importance of lean production and the abundance of positive results obtained from its application.
3. Putting two variables in one perspective in order to achieve a new vision in implementing strategies that would open broader horizons to manage costs in the business environment.
4. It can constitute an incentive to encourage researchers, scholars and those interested in conducting more studies related to reducing costs through more than one variable at the same time.
5. Encouragement to raise the quality of products to match the quality of international products is an important factor in improving the reputation of organizations and the reputation of their products against competitors.

2.3. Research Objectives
The main objective of the research is to study the impact of human resource flexibility and lean production in reducing costs in economic units, as well as achieving the following:

1. Recognizing the most important flexible skills of employees in the work environment and methods of lean production and getting rid of the effects of modern waste and loss due to technological development.
2. Emphasizing the importance of the integrated work between the human resource and the machine despite the technological development.
3. Building a new structural model within organizations that uses diversification and merging of elements in the framework of reducing costs.

2.4. Research Hypotheses
H1: The Iraqi industrial economic units in question do not use the information provided by the technology of lean production and the flexibility of human resources because of the importance of these variables and their role in reducing costs.
H2: The use of lean production technology and the flexibility of human resources provide the necessary information for the purpose of applying it in the economic unit under study and its effective role in reducing costs.

3. Research Methods
In an attempt to achieve the objectives of the research and prove the validity of its hypotheses, two approaches were adopted:

1. The inductive approach: to review the literature that dealt with the topics and paragraphs of the research for the purpose of arriving at analyses and theoretical conclusions that support the idea of the research.
2. The descriptive (analytical) approach: to study the reality of the work system in economic units and the extent of the application of research variables, flexible human resources and lean production in them, and analyze it in the light of the requirements reducing costs and reaching the desired results of the research.

3.1. The Temporal and Spatial Limits of the Research
1. Spatial boundaries: A practical case study in Petronas Oil Industries Company within the boundaries of Al-Rifai city in Dhi Qar Governorate.
2. Temporal limits: The research was conducted in 2021, relying on analysis and testing the answers of the workers on the axes of the questionnaire questions that were distributed to them.

3.2. Sources of Data Collection
In presenting the theoretical framework of the research, the researcher relied on the contributions of writers and researchers collected from sources represented by books, magazines, studies, letters, scientific thesis and related research available from them inside or outside the country and what was published on the information network (Internet). Relying on the study and analysis of the reality of the work system of the economic unit in question and measuring the appropriateness of the results, information and research variables it provides for the purpose of supporting their wider application, as well as strengthening this by analyzing and testing the answers and opinions of
employees in this company on a special questionnaire form for this purpose prepared by the researcher.

4. Literature Review

Al-sayed (2023) aimed to show the role played by lean manufacturing, which considered one of the most important industrial systems that are concerned with reducing losses of all kinds, which leads to a reduction in production costs. The study concluded that there was a statistically significant relationship among all three variables of the study.

Al-Quseir (2016) conducted a research study to explore whether there are tools other than value stream and continuous improvement that can be used in companies or in a sample to eliminate waste, reduce costs, gain customer satisfaction, increase production and production quality, and increase sales to achieve a competitive advantage. He recommended companies allocate a portion of funds to research and development programs in technical methods to manufacture the final product in a larger quantity.

Sabuhari and Irawanto (2020) aimed to understand the role of human resources that triggers corporate performance improvement in the context of the dynamics of human resource flexibility. Their study introduced a conceptual framework to enhance the understanding of the versatility of human resources. They suggested that the performance of workers can be affected by exogenous factors such as the versatility of employee abilities, flexibility of employee actions, and flexibility of human resource practice.

Muhammad (2018) conducted an analytical study of the opinions of a sample of heads of scientific departments at Al-Qadisiyah University. His research demonstrated that the faculties investigated stressed the necessity of developing training programs that enhance the ability of department heads. These colleges could perform the tasks required of them with high efficiency and effectiveness. One of the most important recommendations was that the examined colleges must develop training programs for heads of scientific departments in order to possess the appropriate talents and expertise to support their outstanding performance.

To the researcher’s knowledge, there were no previous research and studies linking the two variables: Lean production and the flexibility of human resources and their role in reducing costs. Therefore, the current studies aims to explore the relationship between lean production and human resources flexibility and their role in cost reduction.

5. The First Axis: Lean Production Technology

5.1. The Theoretical Side

Increasing global and local competition, increasing production costs and currently scarce resources have forced companies to think about new directions in production. In order to remain competitive, it is important to have efficient, accurate and simplified production processes, so many companies choose to introduce Lean manufacturing systems to improve competitiveness by creating value for customers while eliminating any waste in the company (Al-Dandis, 2018, p. 2).

Achieving excellence in providing products and enjoying high flexibility enables it to adapt to these changes, so the normal performance to meet these challenges is no longer sufficient, and it is clear that any institution, regardless of its capabilities or capabilities, cannot maintain its competitive position by returning to the same level of performance and reliability. To the same traditional methods, this imposes the presence of flexibility for human resources to enhance competition strategies.

5.2. The Concept and Origin of Lean Production Technology

This concept appeared starting in Japan, specifically in the Toyota Motor Company in the forties of the last century, as Japanese industrial companies, especially after World War II, faced a shortage of resources, which prompted them to search for production systems through which they could face this deficit. Japan’s adoption of a national goal of full workforce employment through industrialization has contributed to lean production since World War II (Al-Dabbagh & Hassan, 2010, p. 102).

Lean Production or Lean Manufacturing is a systematic way of creating and eliminating all types of waste (MIDAS) through lean principles and tools to improve the industry’s efficiency and effectiveness. The term “Agile” refers to the system that exploits the inputs to generate the same outputs that are configured in the traditional large-scale production system. It uses few human resources in equipment, factory time, little manufacturing capacity, less investment in a shorter period to develop the new product, and less time for production, in addition to the list of required materials. Less than large-scale production and indicates that lean production depends on five principles, which are (Al-Jarjari, 2014, p. 454):

1. Knowing the added value of the products according to the customer's point of view,
2. Removing all operations that do not add value to the products,
3. Make the products flow continuously according to the planned schedule,
4. Production depends on the withdrawal system by the customer,
5. Improvement to reach the best by eliminating all forms of waste.

5.3. Definitions of Lean Production Technology

Several definitions of Lean Production System have been provided, including the following:

1. Lean Manufacturing, or Lean Production, is a production method derived from the work of Toyota in the 1930s and consists of five main principles: Determining the exact value of a specific product, determining the value flow for each product, making the value flow uninterrupted, and allowing the customer to withdraw value From the producer, and the pursuit of perfection (Singh & Singh, 2016, p. 80).
5.4. The Types of Waste
The types of waste consist of seven types, which are as follows (Al-Jarjari, 2014, p. 455):

1. Overproduction: The losses of overproduction result from making more material a faster time, or both, compared to what the beneficiary needs or demands.
2. Transportation and material handling: The transportation of materials is an expensive and time-consuming process. The cellular arrangement method eliminates or reduces wastage in transportation time within the manufacturing process to ensure continuous production flow.
3. Storage: Storage may be the source of waste because it does not add value to the final product.
4. Movement: Unnecessary movements of workers lead to increased stress and loss of time, which entails additional costs, as well as waste resulting from not entirely using the capabilities of individuals (ideas, creativity, experiences, skills).
5. Waiting times: Some materials may be damaged due to waiting in front of workstations for a relatively long period, in addition to the fact that waiting leads to the accumulation of produced units and the occurrence of the so-called (productive imbalance phenomenon).
6. Over-processing: It means that there are steps in the process that do not add value from the beneficiary's point of view.
7. Defects: These defects often appear due to poor quality, resulting from design error, insufficient training, and lack of standard working methods and guidelines. Fig. 1 shows these seven defects.

5.5. Principles of Lean Production Technology
Lean production principles focus on the study of processes and identify unnecessary costs and ineffective procedures, contribute to reducing waste (waste is anything that adds cost but does not add value to the product), and helps to keep materials flowing through the production system on time (JIT). Lean production depends on five principles that can be identified as follows (Al-Rubaie, 2019, pp. 16–18):

1. Value: The starting point is to determine the value from the customer's point of view, and in light of it, the marketing ideas are determined.
2. Value Stream: The value stream refers to the sequence of operations from raw materials to the end customer. The value stream defines all the processing steps and tasks performed to complete a product or provide a service from start to finish.
3. Flow: Flow is one of the essential factors in eliminating waste. If the value chain stops for any reason, waste will occur.
4. Withdrawal: The fourth principle of agile production is withdrawal, which means the production of what is withdrawn by the customer only, which is a short-term response to the rate of demand from customers and not production, and the principle of withdrawal refers to not doing anything until the customer’s orders are issued. Achieving this requires great flexibility and concise cycle times from designing, producing, and delivering goods and services.
5. Perfection: Pursuing perfection requires continuous improvement of all processes and drastic redesign when necessary. When continuous improvement is undertaken, more value is created for the organization in its pursuit of customer perfection.

5.6. The Pillars of Lean Production
The most important of these tools pillars are as follows, arranged according to the percentage of recurrence and the highest importance (Al-Azaiza, 2019):

5.6.1. Continuous Improvement (Kaizen)
It is a philosophy used by many economic units to fulfill their responsibilities and evaluate performance, and it means continuous re-evaluation and improvement of the efficiency of the activities of economic units. Continuous improvement is the search to (Lanen et al., 2010):

1. Improving the activities in which the economic unit participates by relying on documentation and understanding.
2. Exclude activities that do not add value.
3. Improving the efficiency of value-adding activities.

Global competition is forcing companies to continuously improve their operations. Continuous improvement is the constant effort to eliminate waste, reduce response time, simplify the design of both products and processes, and improve quality and customer service. One compelling reason for the need for continuous improvement is the price down/cost down concept. This refers to the tendency of prices to fall over the life cycle of a newly introduced product. Think, for example, about the prices of laptop computers, personal listening devices, and high-definition
television. When each of these products was first introduced, prices were quite high. However, as manufacturers gained experience in producing them, prices fell and the products became accessible to a much wider customer pool. However, if prices are to fall over time, manufacturers must continually reduce costs as well. One widely used approach to cost reduction is kaizen costing, which is the process of cost reduction during the manufacturing phase of an existing product” (Hilton, 2011).

5.6.2. Total Productive Maintenance (TPM)

It is a systematic approach to better management and maintenance of equipment, and to achieve the goal of comprehensive production maintenance, four basic techniques must be followed (Al-Dandis, 2018, p. 26–30):

1. Preventive maintenance: Preventing breakdowns.
2. Corrective maintenance: modifying and improving equipment to prevent it from malfunctions and to make it easier to maintain.
3. Maintenance prevention: Equipment is designed so that it needs little or no maintenance maintenance.
4. Maintenance of faults: maintenance of faults after they occur.

5.6.3. Automation

Automation is the application of machines to tasks accomplished by a human once or more than once, in addition to tasks that seem impossible. In manufacturing processes and systems, human effort and intelligence can be replaced by mechanical, electrical or computer work (Groover, 2016).

5.6.4. Total Quality Management

Total Quality Management is a new management philosophy based on the importance of investing all the energies and human resources of the organization to achieve its goals on the one hand and satisfy the needs of customers on the other hand. It is a philosophy with new parameters that crystallize and become apparent in the following (Jeblak, 2021, pp. 8–10):

a) Having effective leadership,
b) Preoccupation of workers and teamwork,
c) Accepting change and dealing with it,
d) Doing the right job in the right way,
e) Competitive advantage,
f) Profit through continuous improvement,
g) Strengthening the concept of psychological ownership of the organization,
h) Focusing on the idea that nothing is wrong does not mean that everything is right,
i) Effective training,
j) Focusing on the principle of cost reduction,
k) Avoid unapproved decisions,
l) Creating a positive organizational culture.

While growing up (TQM) In the manufacturing sector, its principles can be applied to various industries. Focusing on long-term change over short-term goals, it is designed to provide a coherent vision of systemic change. With this in mind, it is used (TQM) In many industries, including, but not limited to, manufacturing, banking and finance, and medicine (Barone, 2023). Fig. 2 shows the lean house of Toyota’s production system, TPS.

6. THE SECOND AXIS: THE FLEXIBILITY OF HUMAN RESOURCES

6.1. The Concept of Human Resource Flexibility

The concept of flexibility generally refers to the extent to which the organization’s control system can monitor changes that occur in the remote work environment and adapt to its variables. Moreover, its sources, by linking the factors of its administrative environment with the factors of its external environment, reflect the organization’s ability to take the appropriate reaction to rapid changes in the competitive environment and depends on the administrative capabilities and the degree of control over them promptly to interact with risks and opportunities (Al-Sabti, 2017).

Human resource resilience often refers to the ability of workers to anticipate and adapt to any incremental change that may appear in the performance of the organization, as well as to anticipate, prepare for, respond to, and adapt to sudden disruptions—survive and thrive (Alaideim & Abu-Helaleh, 2022).

The concept of human resource flexibility refers to “the capacity of HRM to facilitate the organization’s ability to adopt effectively and in a timely manner to changing or diverse demands from either its environment or from within the firm itself” (Zolin et al., 2011, p. 1098).

From the preceding, it can be said that human resource resilience practices “are an integrated system of skills, knowledge, behaviors and procedures that the organization uses in order to overcome the environmental conditions it faces” (Muhammed, 2018, p. 163). Table 1 shows the difference between the flexibility human resources and the traditional human resources.

6.2. The Importance of Human Resource Flexibility Practices

The importance of human resource practices from the point of view lies in the following (Bal & De Lange, 2015):

1. Organizations help to enhance the participation of new employees in making decisions as well, and they use it for senior employees to improve the performance of their jobs.
2. Helping organizations to provide flexibility to their employees while performing their work.
3. It helps individuals in the organization to achieve a balance between work demands and personal life.

7. THE THIRD AXIS: ROLE OF LEAN PRODUCTION TECHNOLOGY AND THE FLEXIBILITY OF HUMAN RESOURCES IN REDUCING COSTS

Companies actively seek to remain in the market and continue in their field of work, but this is not achieved easily and smoothly. Instead, they are exposed to intense and strong competition. To avoid this and achieve their desired goals, it is necessary to enhance their competitive...
Advantage by reducing costs so that they and through them can be unique. Other competitors are working hard to maintain this distinction, so it is important to know the rules of competition in the market and how to gain this advantage and outperform competitors. Competitive strategies, including low cost, are a standard for companies that want to survive and grow. Successive innovations accelerating knowledge and low cost make competitive strategies temporary unless they constantly enhance them.

Hence, the need for methods and strategies that can enhance the organization’s reduced costs and achieve its goals in leadership among competitors. Lean production and its distinctive tools through (total quality management, maintenance, automation and continuity of improvement) and its connection with the flexibility and dimensions of human resources (flexibility skill, behavior and flexibility of practice). The distinguished role in reaching the strengthening of reduce costs. This correlation relationship has a future of valuable results for the organization and an anticipation of a future that puts it among the ranks of competitors in the market and creates continuous creativity that enhances its competitive strategies.

Therefore, the development of human resource flexibility is based on achieving flexibility in the practices and applications of its management, which helps to exploit the inherent flexibility represented in the flexibility of skills and competencies, as well as flexibility in behavior, as the exploitation of quantitative flexibility, which must be used in integration with the first types of flexibility until positively affect the organizational performance of the institution that individuals are the ones who make excellence and influence and are affected by the lean production system and the extent of continuity in enhancing this distinction and maintaining its efficiency. The Japanese institution is the best proof of that as it is the first sponsor of automation and lean production, and it is the one who achieved strength in the market through the quality of its individual and collective human resources.

Lean production technology has an important role in reducing costs through the application of a set of tools, including comprehensive quality management, continuous improvement, automation, comprehensive production maintenance, and on-time production. The application of lean production technology in organizations will lead to reducing costs in the production system, as lean production technology and its tools are very effective in eliminating activities that do not add value and, hence, costs that do not add value. Examples of activities that do not add value include transporting materials and spare parts from one place to another, numbers to monitor the machine, and storing materials, parts, and finished goods. Manufacture, inspection, remanufacture, and purchase. Although these activities consume resources, they
do not add value to the product. Therefore, lean production technology and its tools are very useful in this case because they reduce activities that do not add value. The application of lean production technology and its tools affects reducing the cost of products through the following:

1. Getting rid of inventory which is one of the most important goals of the costing system, and focusing on studying the cost of each product individually and at the level of production cells.
2. Decrease in the cost of direct labor, as it now represents a small percentage of the total manufacturing costs, thus reducing the ratio of direct costs to total costs.
3. Due to the reliance on automation in the production process, the cost of automated equipment increased, which led to an increase in the ratio of the fixed cost to the total production cost, which facilitates the estimation process and makes its analysis easier.
4. Adopting the method of directly charging the cost elements supported for production activities. This procedure has helped in addressing the problem of cost allocation, as well as reducing accounting procedures.
5. The goal of projects changed from simply controlling each independent cost element to trying to reduce the total cost.
6. Increased interest in raising quality levels and the need to measure and control their costs while adopting the philosophy of zero defect production, and not looking at quality costs as an additional cost to production and the resulting acceptance of a percentage of defective units as natural spoilage and treating it as part of the costs.
7. Excluding activities that do not add value to the products and the resulting exclusion of their cost pools.

Also, the flexibility of human resources has an important role in reducing the cost of products through the use of multi-skilled workers, represented by the flexibility of skill, behavior, and flexibility of practice, which has an impact on reducing costs associated with the cost of work and reflects this on achieving a competitive advantage that enables economic units to compete with similar economic units in the same sector. The following figure shows the correlation between the research variables and their interactions.

It is clear from Fig. 3 that lean production technology and the flexibility of human resources have an important role in reducing costs through the interaction of their respective tools to influence and correlate variables and achieve the required cost reduction and then the ability of economic units to achieve competitive advantage. This may be a theoretical assumption whose results are difficult to predict. Without conducting a practical study, this will form the focus of discussion in the third section.

<table>
<thead>
<tr>
<th>TABLE II: DESCRIPTIVE STATISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable type</td>
</tr>
<tr>
<td>The independent variable is the first variable</td>
</tr>
<tr>
<td>X1</td>
</tr>
<tr>
<td>X2</td>
</tr>
<tr>
<td>X3</td>
</tr>
<tr>
<td>X4</td>
</tr>
<tr>
<td>X5</td>
</tr>
<tr>
<td>X6</td>
</tr>
<tr>
<td>X7</td>
</tr>
<tr>
<td>The independent variable is the second variable</td>
</tr>
<tr>
<td>X8</td>
</tr>
<tr>
<td>X9</td>
</tr>
<tr>
<td>X10</td>
</tr>
<tr>
<td>X11</td>
</tr>
<tr>
<td>X12</td>
</tr>
<tr>
<td>X13</td>
</tr>
<tr>
<td>X14</td>
</tr>
<tr>
<td>Dependent variable</td>
</tr>
<tr>
<td>Y2</td>
</tr>
<tr>
<td>Y3</td>
</tr>
<tr>
<td>Y4</td>
</tr>
<tr>
<td>Y5</td>
</tr>
<tr>
<td>Y6</td>
</tr>
<tr>
<td>Y7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE III: SIMPLE LINEAR CORRELATION MATRIX BETWEEN THE VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
</tr>
<tr>
<td>X1</td>
</tr>
<tr>
<td>X2</td>
</tr>
<tr>
<td>Y</td>
</tr>
</tbody>
</table>

Note: **p < 0.05.
The Role of Lean Production Technology and Human Resource Flexibility in Reduce Costs

Al-Eqabi et al.

The method of the questionnaire was adopted as a tool for research, achieving objectives, testing hypotheses and obtaining data. A closed-type questionnaire was designed that included a paragraph regarding general information of the questionnaire members. Then, three axes were developed, the first of which was devoted to questions about the variable Lean production and the effect of its use in the economic unit under study. As for the other axis, questions about the variable role of human resource flexibility and its impact on the economic unit in question, and the third axis questions of the dependent variable included cost reduction through the use of the aforementioned independent variables and the Likert scale relied on the five-point (Likert scale) whose answer points are determined between very effective (5) to not influential at all (1) and the number (Likert scale) whose answer points are determined between very effective (5) to not influential at all (1) and the number (3) represents the neutrality of the scale.

The questionnaire was represented by taking the opinions of a group of workers in Petronas Oil Industries Company in Dhi Qar, Iraq, and within the various work departments and different specializations, as it represents a reflection of the reality of economic work and the challenges accompanying the developed environment within this field and competition within similar work frameworks, the number of forms that were collected \((N = 35)\). A valid questionnaire for analysis after excluding the invalid ones.

### 8. Method

The method of the questionnaire was adopted as a tool for research, achieving objectives, testing hypotheses and obtaining data. A closed-type questionnaire was designed that included a paragraph regarding general information of the questionnaire members. Then, three axes were developed, the first of which was devoted to questions about the variable Lean production and the effect of its use in the economic unit under study. As for the other axis, questions about the variable role of human resource flexibility and its impact on the economic unit in question, and the third axis questions of the dependent variable included cost reduction through the use of the aforementioned independent variables and the Likert scale relied on the five-point (Likert scale) whose answer points are determined between very effective (5) to not influential at all (1) and the number (3) represents the neutrality of the scale.

The questionnaire was represented by taking the opinions of a group of workers in Petronas Oil Industries Company in Dhi Qar, Iraq, and within the various work departments and different specializations, as it represents a reflection of the reality of economic work and the challenges accompanying the developed environment within this field and competition within similar work frameworks, the number of forms that were collected \((N = 35)\). A valid questionnaire for analysis after excluding the invalid ones.

### 9. Results

The following statistical tests were conducted to test our hypotheses:

1. Arithmetic Mean: A measure of central tendency by which a single value can represent a set of data.
2. Weighted Mean: One measure of the central tendency to give the most important answers and give more weight when calculating the arithmetic mean.
3. Standard Deviation: It represents the positive square root of the average sum of squares of deviations of the values of the random variable from its arithmetic mean, as this scale is used to find out the extent to which the values of the random variable are dispersed from its arithmetic mean.
4. Correlation Simple Coefficient: To determine the degree and type of the relationship between two independent variables.
5. Multiple Regression Equation: One of them is dependent \((Y)\) to measure the relationship between several variables. The other is independent variables \((X_1, X_2, X_3, \ldots, X_n)\).
6. The Coefficient of Determination \((r)\): The percentage of what the independent variable explains from the change in the dependent variable as a result of the change in the independent variable.
7. Test stats \((F)\): The F-test tests the significance of the estimated regression parameters.
8. Test stats \((T)\): The t-test tests each hypothesis separately.

#### 9.1. Descriptive Statistics

Table II shows the mean and standard deviation values of each variable to give an idea of the data used in the statistical analysis process.

The results of the simple linear test appeared among the independent variables \((X_1, X_2)\) and the dependent variable \((Y)\) in Table III. Positive indicators helped to continue the process of statistical analysis of the empty data from the questionnaire without resorting to methods of addressing the problem of multicollinearity, as the measure adopted for the positive case of the simple linear correlation relationship between the independent variables \((X_1, X_2)\) and the dependent variable \((Y)\). This means a positive direct correlation exists between the independent variables, lean production and the flexibility of human resources \((X_1, X_2)\) and its effect on Reducing costs \((Y)\). It is noted from Table III that the simple linear correlation between the independent and dependent variables was all positive. The lowest value for the correlation between the mentioned variables is 0.453.

It is clear from Table IV that the relationship between the independent variables represented in lean production and its foundations and the flexibility of human resources and their dimensions with the dependent variable \((Y)\) were significant \((p < 0.001)\), representing the By reducing costs, and this is what the research aims to achieve.

#### 9.2. Hypothesis Test Results

The first hypothesis: The Iraqi industrial economic units in question do not use the information provided by the lean production technique and the flexibility of human resources because of the importance and role of these variables in reducing costs.

In Tables V–VII, the frequency distributions and the questions posed in the questionnaire show that there is a response and desire by the workers and management to apply the principles of lean production through the response measures presented, which it agrees to some extent on the desire to apply the foundations of lean production in the economic unit of the research sample. Required to carry out business according to multiple skills, Which has a basic role in achieving productive efficiency and eliminating waste of all kinds, which is reflected in Rationalizing and reducing costs of all kinds, and this means rejecting the first basic hypothesis and accepting the second hypothesis which states (the use of lean production technology and the flexibility of human resources provides information necessary for applying it in the economic unit under study and its effective role in reducing costs).
The Role of Lean Production Technology and Human Resource Flexibility in Reduce Costs  

Al-Eqabi et al.

TABLE V: Frequency Distributions and Percentages of Agile Production

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>I do not totally agree</th>
<th>I do not agree</th>
<th>Somewhat agree</th>
<th>I agree</th>
<th>Totally agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>2</td>
<td>5.7</td>
<td>9</td>
<td>25.7</td>
<td>10</td>
</tr>
<tr>
<td>X2</td>
<td>1</td>
<td>2.9</td>
<td>3</td>
<td>8.6</td>
<td>7</td>
</tr>
<tr>
<td>X3</td>
<td>2</td>
<td>5.7</td>
<td>4</td>
<td>11.4</td>
<td>6</td>
</tr>
<tr>
<td>X4</td>
<td>1</td>
<td>2.9</td>
<td>5</td>
<td>14.3</td>
<td>11</td>
</tr>
<tr>
<td>X5</td>
<td>4</td>
<td>11.4</td>
<td>8</td>
<td>22.9</td>
<td>8</td>
</tr>
<tr>
<td>X6</td>
<td>2</td>
<td>5.7</td>
<td>7</td>
<td>20.0</td>
<td>5</td>
</tr>
<tr>
<td>X7</td>
<td>2</td>
<td>5.7</td>
<td>3</td>
<td>8.6</td>
<td>7</td>
</tr>
</tbody>
</table>

TABLE VI: Frequency Distributions and Percentages of Human Resource Flexibility

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>I do not totally agree</th>
<th>I do not agree</th>
<th>Somewhat agree</th>
<th>I agree</th>
<th>Totally agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>X2</td>
<td>3</td>
<td>8.6</td>
<td>5</td>
<td>14.3</td>
<td>6</td>
</tr>
<tr>
<td>X3</td>
<td>2</td>
<td>5.7</td>
<td>6</td>
<td>17.1</td>
<td>10</td>
</tr>
<tr>
<td>X4</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>2.9</td>
<td>8</td>
</tr>
<tr>
<td>X5</td>
<td>1</td>
<td>2.9</td>
<td>3</td>
<td>8.6</td>
<td>6</td>
</tr>
<tr>
<td>X6</td>
<td>4</td>
<td>11.4</td>
<td>7</td>
<td>20.0</td>
<td>5</td>
</tr>
<tr>
<td>X7</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>8.6</td>
<td>7</td>
</tr>
</tbody>
</table>

TABLE VII: Frequency Distributions and Percentages of to Reduce Costs

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>I do not totally agree</th>
<th>I do not agree</th>
<th>Somewhat agree</th>
<th>I agree</th>
<th>Totally agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>2</td>
<td>5.7</td>
<td>1</td>
<td>2.9</td>
<td>1</td>
</tr>
<tr>
<td>X2</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>8.6</td>
<td>3</td>
</tr>
<tr>
<td>X3</td>
<td>2</td>
<td>5.7</td>
<td>1</td>
<td>2.9</td>
<td>5</td>
</tr>
<tr>
<td>X4</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td>5.7</td>
<td>3</td>
</tr>
<tr>
<td>X5</td>
<td>1</td>
<td>2.9</td>
<td>2</td>
<td>5.7</td>
<td>5</td>
</tr>
<tr>
<td>X6</td>
<td>1</td>
<td>2.9</td>
<td>6</td>
<td>17.1</td>
<td>9</td>
</tr>
<tr>
<td>X7</td>
<td>3</td>
<td>8.6</td>
<td>4</td>
<td>11.4</td>
<td>10</td>
</tr>
</tbody>
</table>

10. Conclusions and Recommendations

10.1. Conclusions

1. We concluded that lean production, by applying its tools in all the structure of the economic unit, has an important role in eliminating and excluding waste and contributes to focusing on preventing errors, adding and improving value and achieving productive efficiency. The principles of lean production emphasize improvement at the system level and raise the quality level in units through economic and reducing costs and achieving competitive advantage.

2. The theory also concluded that the flexibility of human resources through multiple skills, flexible behaviors, experiences, and the ability to adapt and change with different circumstances has an effective role in achieving and implementing the pillars of lean production in order to enhance productive efficiency, reducing costs, produce products that meet customer demands, and Continuing to create value for the economic unit enhances its competitive advantage.

3. It was found through the results of the questionnaire for the research sample that there is an acceptance of these techniques and their methods by the workers in the economic unit in question for application because of the results that are reflected on the workers and the activity of the economic unit in general.

4. It was concluded through the practical application and the results of the questionnaire analysis that there is a correlation between the independent variables (lean production and the flexibility of human resources) and their effective role in reducing costs.

5. The analysis of the results of the practical study showed that lean production and the flexibility of human resources contribute to reducing costs, and The cost reduction variable is significantly affected
by lean production and the flexibility of human resources.

10.2. Recommendations
In light of the conclusions that have been reached, the researchers put the following recommendations:

1. Develop employees’ skills, intensify training courses, and set programs to maintain those skills to achieve results. Through which it is irrationalizing and reducing costs and enhancing competitive advantage.

2. Follow up the behavior of the employees, the level of production, and the individual performance in the workplace environment because of its significant impact on the quality of work.

3. The researcher recommends encouraging, improving and motivating ideas and studying the proposals submitted by the employees, especially those that improve the production process.

4. Awareness of senior management and employees of the importance of applying lean production technology and its foundations to achieve distinguished and efficient productivity, whether through information or attracting effective expertise in this field, would help improve the performance of the economic unit in question, which leads to cost reduction and it adds an enhancement to the competitive advantage.

5. The researchers also recommend the Iraqi economic units use the technology of lean production and the flexibility of human resources because of its importance in improving their performance, reducing waste and getting rid of negatives at work, as well as recommending the expansion of studies and research to use this technology to achieve practical results in reducing cost and enhance competitive advantage.

Conflict of Interest
The authors declare that they do not have any conflict of interest.

References


