



The Effect of Management on Reliability and Efficiency in Production Lines within Saudi Arabia's Industrial Sector in the City of Jeddah

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Abstract:

This study explored the impact of management practices on the reliability and efficiency of production lines within the industry in the Kingdom of Saudi Arabia. The Fourth Industrial Revolution lead to improve in this sector and increasing consumer demand for high quality and safe products. This study was conducted through the personal interviews with maintenance managers and specialists from industrial facilities in Jeddah and through research in previous studies. This study aimed to identify the management factors that affect performance in production lines, review current management practices and evaluate their behavior on production line results. The research also confirms the positive impact of the effective management strategies such as preventive and predictive maintenance and strategic leadership on the reliability and efficiency of the production lines. And the study focused on the important role for new technologies such as automation and training programs for improving operational performance. A strong relationship was also observed between the increase in reliability and efficiency as 90% of the participants confirmed that improving reliability directly leads to improving efficiency without affecting the stability of production lines. The results also confirm the importance of adopting artificial intelligence (AI), data analytics, the Internet of Things (IoT) and modern maintenance management systems to improve maintenance strategies. This research provided practical recommendations for Saudi industries to strengthen maintenance management practices and improve operational efficiency while maintaining a competitive advantage in the market, which helped achieve Saudi Vision 2030.

Keywords: Reliability, Efficiency, Production, Management, Maintenance, Strategies

Introduction

The modern world is experiencing a rapidly changes in the industry field. as a result of the Fourth industrial revolution that referred to as industry 4.0, it represents a massive transformation in manufacturing and production society driven by advanced and latest

technologies, this revolution is characterized by many innovations such as artificial intelligence (AI) , robotics and the Internet of Things (IoT). The production lines have being redefined and designed to achieve improvement in efficiency, reduce errors, and optimize product flow through functional design and effective planning. According to Alkhalfiaat, M. et al. (2024) “Innovation in digital environment is one of the key elements for the organizations that aim to be competitive in the market”. Also Automation is a key component to increasing productivity while minimizing the production waste. This integration of all these technologies in production lines is helping companies to improve their overall productivity and efficiency.

In recent years, The Kingdom of Saudi Arabia was not far from this revolution as one of modern world and modern societies. For several decades, the industry field has witnessed significant growth from new technology that has offered many advantages supported by increasing in the consumer demand and the economic diversification efforts. According to Dr. Al-Subayani, N. (2011) in his research in page number 3 “The significance of studying and enhancing productivity has become increasingly evident in both industrialized and developing countries, primarily due to its direct link to the effective utilization of economic resources”.

For example, the food and beverage industry in the Kingdom of Saudi Arabia has been more restricted and more important to Saudi Food and Drug Authority (SFDA), that makes all factories in food and beverage industry must improve their management strategy and fallowing the best manufacturing practices. According to Al-Bastawisi et al., 2017 in their research in page number 613 “Good manufacturing practices (GMP) is One of the most important tools used in the fields of pharmaceutical and food industries”. Therefore, this study aims to show the influence of management practices on the reliability and efficiency of production lines in this critical sector and focusing on local challenges and best practices. In light of the above-mentioned points, this study aims to examine the impact of management on reliability and efficiency in production lines within the Kingdom of Saudi Arabia industry. In light of the above-mentioned points, this study aims to examine the impact of management on reliability and efficiency in food and beverage production lines within the Kingdom of Saudi Arabia industry.

Defining the Study Problem

Because the demand for high quality and safe products was increased, managing production lines become critical and important to ensure efficiency and reliability. However, the lack of knowledge in effective management practices may result to impacting overall productivity, cost effectiveness and quality in the Saudi Arabian industry.

Study Questions

- How does management impact production line efficiency in food and beverage companies at the Kingdom of Saudi Arabia?
- What are the primary management challenges in achieving production reliability?
- How does management impact the efficiency of production line by reducing the maintenance budgets?
- How do management practices align with the industry standards in Saudi Arabia?

Table No. 1: Impact of the Management methodology

Management methodology		Impact on
Production Management		Efficiency of production lines
Maintenance Management		Downtime
Human Resources Management		Equipment reliability
Quality Management		Competencies of employees
Cost Management		Product quality
		Production costs

Objectives of the Study

The study aims to:

- Identify key management factors that influence production line efficiency and reliability.
- Examine current management practices within food and beverage companies at the Kingdom of Saudi Arabia.
- Assess the effect of these practices on production outcomes and identify potential areas for improvement.

Importance of the Study

1. Theoretical importance

This study appears to enrich the field of management science by enhancing the efficiency of production lines and expanding its direct impact on the manufacturing culture and attitudes of the management. Consequently, this research focuses on the relationship between management and performance efficiency in production. The researcher hopes that this study will inspire to creating more studies on similar topics in a scientific and comprehensive manner, in order to contributing to the accumulation of knowledge and research in this field.

2. Practical importance:

This study is essential for understanding the impact of management on production reliability and efficiency, which directly influences operational costs, Equipment maintenance, and regulatory compliance. Improved management practices could have far reaching effects on the competitiveness of the Saudi Arabian food and beverage industry in regional and global markets.

Study Concepts

Key concepts in this study include:

- **Production lines:**

It is refers to a series of sequential processes or stations where raw materials are convert into finished products. Each station (machine) is responsible for a specific task, such as assembly, or packaging, allowing for the efficient flow of materials and labor. According to V. Narayan (2012) in his book in page number 18 “It is the process of converting raw materials into useful products”. Production lines are designed to maximize productivity and minimize waste. It is often using new techniques or technology such as automation. It became an important in many industries such as automotive, electronics and consumer goods. In order to provide high production with consistent quality.

- **Management:**

It is the process for coordinating and organizing multiple resources such as human, financial, and all materials to achieve specific goals efficiently. And it also includes some activities, planning, organizing, leading, directing, and monitoring performance. The primary goals from the management is to increase the productivity, encouraging the innovation and contributing to more success of the organizations. Zaki, D et al., (2020) in their research in page number 2 “management is managing the organizations or factories with conscious decisions to reduce waste and solve problems permanently and continuously”. In addition, the management plays important role for decisions making and adapting to the changing in market environment.

- **Strategy:**

It is refers to the methods that would be used to achieve certain goals also refers to management behaviors for planning. According to Dr. Tabidi, M (2010) in his research in page number 20 " Strategy it's a vision for the organization of what the organization wants to be in the future". In addition it is refers to important decision for achieving the maximum benefits such as increase in revenue or reducing production waste.

- **Management Practices:**

It is refer to the methods and strategies used by leaders and managers to coordinate and guide an organization's resources and activities. These practices including a range of functions, planning, organizing, leading, and controlling, for achieving organizational goals. Effective management practices involve setting clear objectives, fostering communication, motivating employees, and implementing performance measurement systems. According to Zaki, D et al., (2020) in their research in page number 2 “It is the behavior to allow the institution or factory to be managed by conscious management. Which makes its decisions on real information through statistical or numerical data from the work environment, and analyzes this data to reaches a solution that contributes to solving problems and reducing defects permanently and continuously”. They also include adopting best practices in decision-making, problem solving, and conflict resolution. In other words, it is an action taken by company leadership to oversee and improve production operations.

- **Reliability:**

It is refers to the ability of a system, component, process to perform over a period of time. and it is a important measurement which often used to evaluate, statistical analysis and testing. According to V. Narayan (2012) in his book in page number 15 “it is failure

histograms data and probability curves to identify maintenance strategies”. In contexts of engineering and manufacturing reliability is also refers to how the product or the service can be expected to perform without failure. High reliability reduces the costs that related to failures and contributes to increase overall operational efficiency. Ensuring reliability often includes the quality control, the regular maintenance and the continuous improvement practices.

- **Efficiency:**

It is refers to the ability to achieve the maximum output with the minimum input witch often measured in terms of resource utilization. It is also reflects how well the resources are used to produce desired outcomes or results such as time, money and materials. In different contexts, the efficiency can be related to processes, systems or organizations that highlighting the importance of Simplifying operations to minimize the waste and maximize the productivity. High efficiency is related with improved the performance, cost savings and the ability to achieve the goals effectively According to V. Narayan (2012) in his book in page number 15, “In any process, we can obtain the end result in one or more ways. When one method needs less energy or raw materials than another, we say it is more efficient”. Efficiency goals often include optimizing workflows, implementing the best practices and using technology to improve overall performance.

- **Maintenance:**

It is refers to repairing the damaged resulting from the usage or preventing and avoiding the damaged, also maintaining the ability to do the work properly. And in the manufacturing context the maintenance refers to maintaining machines, equipment and instruments for using certain level and performance in order to achieve production goals. According to Baabdullah, A (2024) in their research in page number 25 "maintenance is searching for the best preparation to avoid shortages in operations or production". So maintenance it is one of the most important factors to keep the equipment efficient and reliable.

Research Limitations:

- **Scope of Research:** The research is limited to specific geographical area which is Jeddah city and this may affect the results.
- **Methodology:** the qualitative methodology on the research may limit the possibility of getting comprehensive quantitative data and may affect the comprehensiveness of the results.
- **Time and Resources:** The time and resource are limited which may affect the interviews participants numbers and the duration of the study the time for this research will be from February to May 2025.

Theoretical Framework

The Role of Management in Production Line Efficiency

The management role in production line for efficiency is critical and important because it directly influences the overall productivity, quality, and effectiveness in cost for manufacturing operations. And the effective management involves overseeing the improvement and optimization of workflows, ensuring that resources materials are utilize to their maximum potential such as labor and equipment. the managing includes scheduling and planning to minimize the downtime, implementing lean practices to reduce waste in production and building continuous improvement culture. The managers also need to monitor the performance for identify bottlenecks and making decisions depend in data driven to adjust the processes when necessary. Strong leadership with clear communication and effective training are essential for motivating employees also ensuring the safety standards are applied and maintaining high morale. According to Zaki, D & others (2020) in their research in page number 6, “The labors problems are due to lack of training programs to raise the level of performance and skills”. in addition the role of management is also to balance efficiency with quality and keeping production process simple as possible while meeting customer demands and keeping costs and prices under control.

Factors Influencing Reliability in Food and Beverage Production

Reliability in food and beverage production is affected by a several factors that Including both operational practices and external conditions. The key elements include commitment to high quality control measures, which ensure that products meet standards. The sourcing of raw materials with high quality is also plays a crucial role because it directly impacts the final product's taste and safety. Additionally, the training and employee efficiency are vital for example, the skilled employees are more likely to following the protocols and troubleshooting for issues more effectively. According to Al-Bastawisi, A & others (2017) in his research in page number 621, “It is important to conduct training programs for all employees to enhance their cultural awareness and quality standards, and some of these courses are general for all levels”. And the maintenance equipment’s and technologies get more benefit from improved reliability by minimizing the breakdowns and ensuring the efficient production processes. Finally, regulatory compliance and industry standards must always building consumer trust and brand reputation in order to reinforcing the overall reliability of food and beverage products.

The Impact of Management on Production Line Efficiency through Reduced Maintenance Budgets

The management approach in production line efficiency can be affected by reduced maintenance budgets often lead to balancing between cost savings and operational reliability. While spending in the maintenance is reducing may appear to saving in short-term budget and financial but it may result in decreased efficiency in the long term. Without proper maintenance the equipment may having more breakdowns leading to increase the downtime, lower production rates and

potential quality issues. Machines with poor maintenance may lead to higher repair costs over time, offsetting any initial savings. According to V. Narayan (2012) in his book in page number 349, “Reducing in maintenance cost will result to increase the risks to the organization”. Effective management must carefully allocate resources to ensure that maintenance is prioritized in critical areas, balancing cost reductions with the need for consistent and reliable production. A proactive approach investing in (PM) preventive maintenance, training staff, and implementing predictive technologies may help mitigate the risks of underfunding while still keeping maintaining operational efficiency. Additionally, management’s ability to navigate this complex balancing directly affects both the smooth running of production lines and the long-term profitability of the organization.

The Management Strategy to Maintaining Production Lines

Maintaining production lines is one of the main important element for successful management in manufacturing. According to Zack (2020) “Machines with inappropriate maintenance could be unrepairable and must be replaced”. And there are some essential components in the management strategy:

- **Maintenance strategy:**

Applying maintenance strategy will lead to keep the machines, equipment and instruments in good condition and serving the production demand. In addition, good designed maintenance program often using combines these strategies:

- 1- **Preventive Maintenance (PM):** it is regular and scheduled maintenance tasks such as lubrication, inspection and replacement parts in order to prevent failures.
- 2- **Predictive Maintenance (PdM):** it is advance maintenance technique by using data analytics, machine learning and IoT (Internet of Things) before breakdowns happen.
- 3- **Corrective maintenance (CM):** it is unplanned maintenance usually happened if there is luck of maintaining and leading to downtime in production and come with high cost, and also called as run to failure (RTF) strategy.

- **Reliability Strategy:**

Reliability strategy will ensure the productivity of the process and preventing failures, reducing operational costs, improving safety and performance. By applying risk management method, understanding of equipment lifecycle, analyzing failure (Ex. Root Cause Analysis), spare parts management and training programs for equipment operators.

- **Efficiency Strategy:**

It is the management plan to optimize resources and maximize production with minimize the waste. The efficiency can be monitor by overall equipment effectiveness technique (OEE). The organizations should set a goal or targets for improvement in efficiency.

$$OEE = Availability \times Performance \times Quality$$

$$Availability = \frac{\text{Run time}}{\text{Planned Time}} \quad Performance = \frac{\text{Actual speed}}{\text{Designed speed}} \quad Quality = \frac{\text{Good products}}{\text{Total products}}$$

Management Strategies in Saudi Arabia's Food and Beverage industry

This section will focus on the cultural, economic, and regulatory factors that shape the management practices in the local food and beverage industry at the Saudi Arabia. Also will focus on adapting to the changes in consumer preferences, advanced technology and the Required regulations. Using some new technique and new strategies such as PMP and Six sigma. According to Zaki, D et al., (2020) in their research in page number 2 “ Six Sigma is utilizing rigorous data collection, statistical analysis and research to identify defects and find ways to eliminate them”. One of the key strategy is to focus on the quality control and food safety standards to comply both local regulations and international certifications. Because growing on the demand for health-conscious products and sustainable products the companies are diversifying their offers, organic, low-calorie, and the ingredients from local source into their menus.

Additionally, many businesses are benefiting from advanced technologies such as automation, artificial intelligence, and data analytics to optimize the processes in production, improve in supply chain efficiency and reduce production waste. in line with Vision 2030, which encouraging the economic diversification, the food and beverage industry sector is also beside increasing in the using of digital platforms for E commerce and delivery services, Meeting the needs of increasingly smart technology and the convenience oriented consumer base. According to Alkhalfiaat, M. et al. (2024) “Innovation in digital environment is one of the key elements for the organizations that aim to be competitive in the market”.

Furthermore, the strategic partnerships with international and local suppliers are helping the companies for their market position, improve cost management and ensure the continuous supply of high quality ingredients. According to Dr. Al-Subayani, N. (2011) in his research in page number 546, “As a result of the development and progress that has happened in the production of industrial projects in machinery, equipment and production lines, the management strategy is an important element in the development of the industry”. Through all these strategies the Saudi food and beverage companies are positioning themselves for sustained growth and competitive advantage in the market that rapidly improving.

Previous Studies

The previous studies have addressed that management responsible for productivity. Most of the studies have focused on the impact on reliability and efficiency. Some studies have also focused on the management strategies. However, there was also a difference in the manufacturers in which previous studies were applied.

Alkhalfiaat, M. et al in 2024 for their research aims to identify the dimensions of management practices and the levels of the innovative performance in Jordanian food industries. The study tools included questionnaires and descriptive analytical methodology in 9 companies with 151 survey. The study came to these results high relative importance of operations management practices And importance of innovative performance in food industry companies.

Baabdullah`s study in 2024 for his master degree aims to analyze the maintenance methodologies and how these strategies could affect the performance. The study tools included by interviews methodology with 30 managers and experts in maintenance from different companies. The study came to these results the maintenance methodologies lead to reduce

breakdown and improve equipment efficiency. And the study confirms that there is strong relationship between management strategies and performance.

Zaki, D and others in 2020 for their master degree their study was aim to the impact of using Lean Six Sigma to obtain a high-quality product in the operating stages of production lines, and the possibility of achieving six sigma to reduce production defects in factories. The study tools included a descriptive and experimental methodology. The study came to these results applying the Six Sigma methodology has led to an increase in the quality level from 3 sigma to 4 sigma with 4.6% difference, which has led to an improvement in performance and a decrease in the percentage of rejected products. And Six Sigma level not reach due to several of obstacles such as maintenance, employees training, and the difficulty of purchasing some high-end machines due to their high price.

Al-Bastawisi, A. and others study for their PhD in 2017 was conducted through 112 surveys on 83 labors, 20 supervisors, 6 administration Managers and 1 general manager. This study aims to improve and develop the quality of production sector by applying total quality management using the manufacturing principles program to reduce rejected production rates. The study tools is consists of an analysis, and descriptive methodology. The study came to these results from the surveys are first is increase the rate of rejected units than the average (6% from the overall production compere to the planed which is 2% that led to increase the production cost). Second, the rate of using row materials in the production has increased by 5.34%. In addition, there is a strong relationship between production quality and the use of Good Manufacturing Practices (GMP). It is necessary to have training programs for all employees to raise their level of quality culture.

Dr. Al-Subayani`s study in 2011 aims to identify and developing a scale to study the factors affecting production lines in factories in Jeddah City. The study was conducted on a sample of 10 factories in Jeddah, Saudi Arabia, selected based on they employ experts with at least 10 years of experience. The study tools included a questionnaire, data collection, and sample description. The study came to these results that the first group that have lower score in the scale that was created is less than 82.75 and the second group that have higher score in the scale that was created is greater than 110.

Amar, Z` study in 2011 for his master degree aims to prove the relationship between risk management the maintenance strategy and one of the ways to avoid risks. The study tools included an interviews and thematic analysis methodology. The study came to these results contracting with the professionals in maintenance field such as OEM (original equipment manufacturer) will lead to reducing costs and increasing productivity and the modern maintenance management culture requires responsiveness to changes and applying maintenance based on reliability.

The study that conducted by Dr. Tabidi, M in 2010 for his PhD in Business Administration aims to identify the application and practice of strategic management and to trace its impact on the efficient and effective functioning. The study tools is the descriptive analytical, comparison and statistical analysis methodology. The study came to these results the 90 % of the participants

convinced of the important to applying strategic management in it. The study proved that top and middle management have the knowledge of strategic concepts and management practices.

Global studies

Zhou, L and others in 2021 for their PhD research their study aims to discuss the value creation mechanisms, resource configuration, production planning and scheduling. The study tools included a descriptive and thematic analysis methodology. The study came to these results intelligent manufacturing systems brought new opportunities and challenges in production and operations management. And from the perspective of industrial sectors 86.6 % most papers on production and operations management do not indicate a specific industry.

The study that conducted by Smith, J & Jones, A in 2020 to evaluate the effect of maintenance management strategies on operational performance. It aims to understand how different methods that applied on maintenance strategies can led to improve equipment effectiveness and productivity. The study tools included questionnaires and experimental methodology by collected data from 150 companies in the manufacturing sector. The study came to these results applying maintenance strategies such as preventive and predictive lead to reduce breakdown by 30 % and increase the productivity by 20. So companies that invested in maintenance strategies or training programs more likely to achieve more improvements in performance.

V. Narayan` book (2012) aims to improve technical and production efficiency, which helps reduce safety, health, and environmental issues, while also increasing quality, production levels, and reducing costs and industrial risks. The study tools included a descriptive, data collection, and experimental methodology. The book came to these results the professionals in maintenance must understand the importance of data in the continuous improvement process and improvements in maintenance performance. So to stay in business, managers need to adapt to changing situations. Some changes are within their control, but market forces can also affect the operating context with the passage of time, managers must make decisions with limited information.

Melhem, R and others in 2004 for their research, their study aims to investigate the effects of energy management on reliability. The study tools included a descriptive and experimental methodology and comparison of previous studies. The study came to these results energy management could dramatically reduce the system reliability and If the energy management ignored the fault rate it may lead to unsatisfied system reliability.

The previous studies are providing many theories about the management effect on reliability and efficiency. After analyzing these studies the finding the importance of management strategy to increase productivity.

The results of previous studies:

- Management Strategies have direct impact on reliability and efficiency in production.
- Management strategies will cause increase or decrease in the cost, quality and productivity.

- Training programs will improve the culture of management and employees.
- Applying preventive and predictive maintenance methodologies can lead to improvements performance.
- Low maintenance budget will lead to increase the cost of the maintenance because the lack of preventive and predictive plans.
- New technologies such as AI and automation helps companies to achieve management goals.
- Now having the ability to identify gaps in previous researches, preparing the case study, and building the research problem.
- Identifying the research methodology and choosing the best methods and tools for analyzing the data.
- Showing the importance of the research topic from theoretical and practical perspectives.
- Determine the appropriate samples number for this research.

This study will be different from previous studies because:

This study focuses specifically on the city of Jeddah in the Kingdom of Saudi Arabia. Which gives the study great value related to the local challenges and opportunities specific to this region. Also because 2030 Vision the results and recommendations will be more important for improvement and development in industrial sector.

The Hypothesis:

The first main hypothesis: The management methods effect on the reliability of production lines.

Sub-Hypothesis Related Questions:

1- The application of TQM methods increase the reliability of production lines?

- 1.1 Does your company use TQM methods in your production lines?
- 1.2 Does your company measure the reliability of production lines?
- 1.3 Hard to apply TQM methods to increase the reliability in your production lines?

2- Leadership efficiency is important for increasing the reliability of production lines?

- 2.1 Are the supervisors trained to manage production lines?
- 2.2 Does your company have training programs for the engineer and technical team?
- 2.3 Are the supervisors and technical team handling problems and challenges in production lines proper?

The second main hypothesis: The management strategy effect on the efficiency of production lines.

Sub-Hypothesis Related Questions:

1- Applying the management methods will increase the efficiency of production lines?

- 1.1 Does your company or management measure the efficiency of production lines?
- 1.2 Does your management use overall equipment effectiveness (OEE) for efficiency measurement?
- 1.3 Does your company need to improve the efficiency of production lines?
- 1.4 Kaizen system applied in your company for improvement?

2- The automation level and new technology affects the efficiency of production lines?

- 2.1 Does the technology updated in your production lines?
- 2.2 Are programs used for analyze data and improve the efficiency?
- 2.3 Data analysis done automatically from production lines?
- 2.4 Hard to measure efficiency in your production lines?

3- Training and Development Programs affect the workers efficiency on production lines?

- 3.1 Training programs provided for operators and workers in production lines?
- 3.2 Training have an impact on employee productivity?

The third main hypothesis: the relationship between the reliability and the efficiency in production lines

Sub-Hypothesis Related Questions:**1- Increased reliability will increase the efficiency in production lines.**

- 1.1 Have you noticed a relationship between the reliability of production lines and their efficiency?
- 1.2 Failures and stoppages affect the production efficiency?
- 1.3 Scheduled and preventive maintenance reduce sudden failures?

2- Improving the efficiency affects the reliability of production lines.

- 2.1 Does improving the efficiency increase pressure on production lines?
- 2.2 Do you think that focusing on increasing the efficiency only will reduced the reliability?

Concluding Questions:

- 1. What are the main challenges in production line management?
- 2. What is the recommendations or improvements do you see for maintenance management at your facility ?

Methodological procedures for the study

Industrial facilities are looking for better efficiency operation, lower costs and higher product quality. The effective maintenance management is important to achieving these goals by minimizing the breakdowns and maximizing the productivity

This research will investigate how maintenance management impacts to operational performance of production lines in Jeddah. It will examine the traditional and the modern maintenance

approaches using qualitative research methods to understand how to improve the efficiency and reduce the costs through strong maintenance strategies.

The study requires a careful analysis from the perspectives of maintenance experts. This will provide valuable insights into current practices and challenges. By qualitative analysis will reveal patterns and trends that quantitative studies might miss and offering deeper understanding of success and the failure factors in maintenance management.

Furthermore, this research will confirm the importance of the training and development for maintenance employees and explore how the modern technology can improve the operations. And the findings are expected to provide practical recommendations for Saudi industries to improve their maintenance management strategies and improve the overall performance.

By this methodology, this study will deliver valuable insights for improving maintenance management and operational performance in Saudi industry, also it will help them to achieve their strategic objectives and increase the market competitiveness.

Research Methods:

This study used the qualitative research methodology and personal interviews as the primary data collection. The interviews will be done with the maintenance managers and specialists to explore their perspectives and from their experiences regarding the impact of maintenance management on production lines and the operational performance.

The research steps include the following:

- **Writing the Interview Questions:** open-ended questions were developed to cover many aspects of the maintenance management and its impact on performance and allowing the participants to express their opinions and experiences.
- **Data Collection:** The interviews were used with participants from industrial companies and the answers were carefully recorded for analysis process.
- **Data Analysis:** the thematic analysis techniques will be used for analyze the data from the interviews that will help us to identify the patterns and trends in the participants opinions.
- **Statistical processing and tools used:** The Statistical Package for the Social Sciences (SPSS IBM 30 v) program was used and other statistical tests were used to verify the study objectives and answer the researcher's questions. Which includes:
 - Using frequencies and percentages to describe the study sample: (Educational level - Number of years of experience - Company size - Position).
 - Arithmetic means and standard deviations, the result, the relative weight, the level and the rank to answer the research questions.
 - ANOVA test of research hypotheses.

- **Correction Criterion:** Likert scale for five-point was used to evaluate answers to the questions. To determine the correct cell length, the difference between the limits ($5 - 1 = 4$) was divided by the number of cells on the scale ($4 \div 5 = 0.8$).

This value added to the lowest value on the scale to determine the upper limit for that cell as shown in the following table:

Table No. 2: Answer weights according to the five-point scale

Arithmetic Mean Value	Result (General Trend)	Relative weight %
From 1 to less than 1.80	Strongly Disagree	From 20% to less than 36%
From 1.80 to less than 2.60	Disagree	From 36% to less than 52%
From 2.60 to less than 3.40	Not Sure	From 52% to less than 68%
From 3.40 to less than 4:20	Agree	From 68% to less than 84%
From 4:20 to 5	Strongly Agree	From 84% to 100%

Research community:

Industrial establishments located in the Jeddah region, where these establishments represent a variety of industrial sectors, represent the research community. In addition, the samples will be selected to include large, medium and small companies to ensure a comprehensive representation of different perspectives and experiences in maintenance management. The community consist of 15 companies and 35 participants. This diversity will help to ensure that the results can be generalized in the industrial context.

Data Analysis:

This research will help to explore the impact of different maintenance management methodologies which including the preventive, predictive and reactive maintenance on the operational performance of the industrial systems in Jeddah city.

To achieve this, the interview questions designed to collect qualitative data reflecting the maintenance managers and specialists experiences and opinions. These questions will showing how each methodology effects on the equipment effectiveness, downtime and working conditions. By analyzing the participant responses and feedback, we gain valuable Ideas for improving the maintenance strategies and overall industrial performance.

After interviewing with 35 participants (maintenance managers and specialists) from in industrial companies in Jeddah. The data is analyzed according to the questions that presented. and the participants were categorized based on the type of the company (large, medium and small) to provide a comprehensive view, and the participants was as follows:

Table No. 3: Type of participants by company size:

Company Size	No. Companies	Percentage
Large	4	27%
Medium	6	40%
Small	5	33%

The interview was done with 15 companies in Jeddah 4 of them consider as a large company which represents 27% of the participant companies, 6 medium companies represents 40% , and 5 small companies which represents 33%.

Table No. 4: Type of participants by their experience:

NO. Years	No. Participants	Percentage
More than 15 years	10	29%
15 to 10 years	10	29%
Less than 10 years	15	42%

This table shows the years of experience for the 35 participants, 42% have less than 10 years of the experience, 29% of them have more than 15 years of the experience, and 10 participants with 15 to 10 years of experience.

Table No. 5: Type of participants by their position:

Position title	No. Participants	Percentage	Received Feedback	Percentage
Mangers	15	43 %	15	100 %
Section Head	10	28.5 %	10	100 %
Engineers	10	28.5 %	10	100 %

All participants volunteered to participate in this study and they answered all the given questions, 43% of them mangers, 28.5% as section head and 10 engineers represents 28.5% of the participants.

Data Analysis Results The Impact in Production Line Management

Questionnaire Results:

The first main hypothesis: The management methods effect on the reliability of production lines:

Table No. 6:

Q	Statements	Arithmetic Mean	Standard deviation	Result	Relative weight %
1	The management methods effect on the reliability of production lines.	4.7	0.458	Strongly Agree	94

2	The application of TQM methods increase the reliability of production lines	4.8	0.355	Strongly Agree	96
3	Does your company use TQM methods in your production lines	3.9	0.781	Agree	78
4	Does your company measure the reliability of production lines	3.7	0.987	Agree	74
5	Hard to apply TQM methods to increase the reliability in your production lines	1.4	0.654	Strongly Disagree	28
6	Leadership efficiency is important for increasing the reliability of production lines	5	0.000	Strongly Agree	100
7	Are the supervisors trained to manage production lines	4.6	0.481	Strongly Agree	92
8	Does your company have training programs for the engineer and technical team	4.7	0.458	Strongly Agree	94
9	Are the supervisors and technical team handling problems and challenges in production lines proper	3.7	0.957	Agree	74
Total		4.0	0.570	Agree	81.1

According to the above table No. 6 the management methods will effect on the reliability of production lines and it come with this result “Agree” which show there is similarity in points of view with the participants, Arithmetic Mean is 4.0, Standard deviation 0.570 and the overall percentage is 81.1 %. The participants agree on “Leadership efficiency is important for increasing the reliability of production lines” and they are strongly disagree with this statement “Hard to apply TQM methods to increase the reliability in your production lines” with Mean 1.4, Std. deviation 0.654 and 28 %.

The second main hypothesis: The management strategy effect on the efficiency of production lines.

Table No. 7:

Q	Statements	Arithmetic Mean	Standard deviation	Result	Relative weight %
1	The management strategy effect on the efficiency of production lines.	4.8	0.322	Strongly Agree	96
2	Applying the management methods will increases the efficiency of production lines	4.9	0.235	Strongly Agree	98
3	Does your company or management measure the efficiency of production lines	4.6	0.639	Strongly Agree	92
4	Does your management use overall equipment effectiveness (OEE) for efficiency measurement	4	0.874	Agree	80
5	Does your company need to improve the efficiency of production lines	4.5	0.657	Strongly Agree	90
6	Kaizen system applied in your company for improvement	3.6	0.807	Agree	72
7	The automation level and new technology affects the efficiency of production lines	5	0.000	Strongly Agree	100

8	Dose the technology updated in your production lines	3.8	0.857	Agree	76
9	Are programs used for analyze data and improve the efficiency	4.4	0.658	Strongly Agree	88
10	Data analysis done automatically from production lines	3.1	1.309	Not Sure	62
11	Hard to measure efficiency in your production lines	3.6	0.683	Agree	72
12	Training and Development Programs affect the workers efficiency on production lines	5	0.000	Strongly Agree	100
13	Training programs provided for operators and workers in production lines	4.9	0.284	Strongly Agree	98
14	Training have an impact on employee productivity	4.4	0.739	Strongly Agree	88
Total		4.3	0.576	Strongly Agree	86.57

According to the above table No.7 the management strategy effect on the efficiency of production lines and it come with this result “Strongly Agree” which show there is Strongly similarity in points of view with the participants, Mean is 4.3, Standard deviation 0.576 and the overall percentage is 86.57 %. The participants agree on these “The automation level and new technology affects the efficiency of production lines” and “Training and Development Programs affect the workers efficiency on production lines”. And the last statement is “Data analysis done automatically from production lines” it show not sure result with Mean 3.1, Std. deviation 0.1.309 and 62 %.

The third main hypothesis: the relationship between the reliability and the efficiency in production lines

Table No. 8:

Q	Statements	Arithmetic Mean	Standard deviation	Result	Relative weight %
1	the relationship between the reliability and the efficiency in production lines	4.5	0.742	Strongly Agree	90
2	Increased reliability will increase the efficiency in production lines	4.9	0.284	Strongly Agree	98
3	Have you noticed a relationship between the reliability of production lines and their efficiency	4.7	0.518	Strongly Agree	94
4	Failures and stoppages affect the production efficiency	3.7	0.689	Agree	74
5	Scheduled and preventive maintenance reduce sudden failures	4.7	0.426	Strongly Agree	94
6	Improving the efficiency affects the reliability of production lines	4.3	0.832	Strongly Agree	86
7	Does improving the efficiency increase pressure on production lines	1.4	0.610	Strongly Disagree	28

8	Do you think that focusing on increasing the efficiency only will reduced the reliability	4	1.150	Agree	80
Total		4.0	0.656	Agree	80.5

According to the above table No.8 the relationship between the reliability and the efficiency in production lines and it come with this result “Agree” which show there is similarity in points of view with the participants, Mean is 4.0, Standard deviation .0656 and the overall percentage is 80.5 %. The number 1 statement that agreed on “Increased reliability will increase the efficiency in production lines” it show Strongly Agree result with Mean 4.9, Std. deviation 0.284 and 98 %. And the last statement is “Does improving the efficiency increase pressure on production lines” with Strongly Disagree, Mean 1.4, Std. deviation 0.061 and 28 %.

Hypotheses Results:

The study results showed consistency with the research hypotheses and confirming the validity as follows:

The first main hypothesis: The management methods effect on the reliability of production lines:

H0: There is no effect on the reliability from the management methods of production lines.

H1: There is an effect on the reliability from the management methods of production lines.

Table No. 9:

Descriptives

The management methods effect on the reliability of production lines.

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
						Lower Bound	Upper Bound			
Mangers		15	4.8000	,41404	,10690	4.5707	5.0293	4.00	5.00	
Section Head		10	4.7000	,48305	,15275	4.3544	5.0456	4.00	5.00	
Engineers		10	4.6000	,51640	,16330	4.2306	4.9694	4.00	5.00	
Total		35	4.7143	,45835	,07748	4.5568	4.8717	4.00	5.00	
Model	Fixed Effects			,46435	,07849	4.5544	4.8742			
	Random Effects				,07849 ^a	4.3766 ^a	5.0520 ^a			-.00824

a. Warning: Between-component variance is negative. It was replaced by 0.0 in computing this random effects measure.

Table No. 10:

ANOVA

The management methods effect on the reliability of production lines.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,243	2	,121	,563	,575
Within Groups	6.900	32	,216		
Total	7.143	34			

From the above table NO.10 we found ($0.00 < 0.5$) that lead us to accept the alternative hypothesis and reject the H0 which mean there is effect on the reliability from the management methods of production line.

The second main hypothesis: The management strategy effect on the efficiency of production lines.

H0: There is no effect on the efficiency of production lines from management strategy.

H1: There is an effect on the efficiency of production lines from management strategy.

Table No. 11: Descriptives

The management strategy effect on the efficiency of production lines.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
					Lower Bound	Upper Bound			
Mangers	15	4.8667	.35187	.09085	4.6718	5.0615	4.00	5.00	
Section Head	10	5.0000	.00000	.00000	5.0000	5.0000	5.00	5.00	
Engineers	10	4.8000	.42164	.13333	4.4984	5.1016	4.00	5.00	
Total	35	4.8857	.32280	.05456	4.7748	4.9966	4.00	5.00	
Model	Fixed Effects		.32275	.05455	4.7746	4.9968			
	Random Effects			.05472	4.6503	5.1212			.00005

Table No. 12: ANOVA

The management strategy effect on the efficiency of production lines.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.210	2	.105	1.006	.377
Within Groups	3.333	32	.104		
Total	3.543	34			

From the above table NO.12 we found ($0.00 > 0.5$) that lead us to reject accept the alternative hypothesis and accept the H0 which mean there is no effect on the efficiency of production lines from management strategy.

The third main hypothesis: the relationship between the reliability and the efficiency in production lines.

H0: There is no relationship between the reliability and the efficiency in production lines.

H1: There is a relationship between the reliability and the efficiency in production lines.

Table No. 13: Descriptives

There is a relationship between the reliability and the efficiency in production lines

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
					Lower Bound	Upper Bound			
Mangers	15	4.4667	.74322	.19190	4.0551	4.8783	3.00	5.00	
Section Head	10	4.6000	.69921	.22111	4.0998	5.1002	3.00	5.00	
Engineers	10	4.5000	.84984	.26874	3.8921	5.1079	3.00	5.00	
Total	35	4.5143	.74247	.12550	4.2592	4.7693	3.00	5.00	
Model	Fixed Effects		.76308	.12898	4.2516	4.7770			
	Random Effects			.12898 ^a	3.9593 ^a	5.0693 ^a			-.04616

a. Warning: Between-component variance is negative. It was replaced by 0.0 in computing this random effects measure.

Table No. 14: ANOVA

There is a relationship between the reliability and the efficiency in production lines

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.110	2	.055	.094	.910
Within Groups	18.633	32	.582		
Total	18.743	34			

From the above table NO.14 we found ($0.00 < 0.5$) that lead us to accept the alternative hypothesis and reject the H_0 which mean there is a relationship between the reliability and the efficiency in production lines.

The Result:

Table No. 15:

		Statistics								
		The management methods effect on the reliability of production lines.	The application of TQM methods increase the reliability of production lines?	Does your company use TQM methods in your production lines?	Does your company measure the reliability of production lines?	Hard to apply TQM methods to increase the reliability in your production lines?	Leadership efficiency is important for increasing the reliability of production lines?	Are the supervisors trained to manage production lines?	Are the supervisors and technical team handling problems and challenges in production lines propre?	Does your company have training programs for the engineer and technical team?
N	Valid	35	35	35	35	35	35	35	35	35
	Missing	1	1	1	1	1	1	1	1	1
Mean		4.7143	4.8571	3.9143	3.7143	1.4286	5.0000	4.6571	4.7143	3.7143
Median		5.0000	5.0000	4.0000	4.0000	1.0000	5.0000	5.0000	5.0000	4.0000
Mode		5.00	5.00	4.00	4.00	1.00	5.00	5.00	5.00	4.00
Std. Deviation		.45835	.35504	.78108	.98731	.65465	.00000	.48159	.45835	.95706
Variance		.210	.126	.610	.975	.429	.000	.232	.210	.916
Percentiles	25	4.0000	5.0000	3.0000	3.0000	1.0000	5.0000	4.0000	4.0000	3.0000
	50	5.0000	5.0000	4.0000	4.0000	1.0000	5.0000	5.0000	5.0000	4.0000
	75	5.0000	5.0000	4.0000	4.0000	2.0000	5.0000	5.0000	5.0000	4.0000

Table No. 16:

Descriptive Statistics									
	N	Minimum	Maximum	Mean		Std. Deviation	Variance	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error
The management methods effect on the reliability of production lines.	35	4.00	5.00	4.7143	.07748	.45835	.210	-1.082	.778
The application of TQM methods increase the reliability of production lines?	35	4.00	5.00	4.8571	.06001	.35504	.126	2.705	.778
Does your company use TQM methods in your production lines?	35	2.00	5.00	3.9143	.13203	.78108	.610	-.377	.778
Does your company measure the reliability of production lines?	35	2.00	5.00	3.7143	.16689	.98731	.975	-.802	.778
Hard to apply TQM methods to increase the reliability in your production lines?	35	1.00	3.00	1.4286	.11066	.65465	.429	.543	.778
Leadership efficiency is important for increasing the reliability of production lines?	35	5.00	5.00	5.0000	.00000	.00000	.000	.	.
Are the supervisors trained to manage production lines?	35	4.00	5.00	4.6571	.08140	.48159	.232	-1.617	.778
Does your company have training programs for the engineer and technical team?	35	1.00	5.00	3.7143	.16177	.95706	.916	.837	.778
Are the supervisors and technical team handling problems and challenges in production lines propre?	35	4.00	5.00	4.7143	.07748	.45835	.210	-1.082	.778
Valid N (listwise)	35								

The result of management methods effect on the reliability of production lines: Data analysis confirms a statistically positive impact of using management methodologies on the reliability of production lines and in operational performance with “Strongly Agree”, an arithmetic mean of (4.7) and 94 % . Specifically participants who using the methodologies like preventive and predictive maintenance reported performance improvements.

The result of application of TQM methods increase the reliability of production lines: Yes, the data showed that Applying the TQM methods increase the reliability of production lines with “Strongly Agree”, an arithmetic mean of (4.8), and 96 % .

The result of does your company use TQM methods in your production lines: Yes, the data showed that companies are using TQM methods with “Agree”, an arithmetic mean of (3.9) and 78 % .

The result of does your company measure the reliability of production lines: Yes, the data showed that companies are measuring the reliability of production lines with “Agree”, an arithmetic mean of (3.7) and 74 %.

The result of hard to apply TQM methods to increase the reliability in your production lines: No, the data showed that it is not hard to apply TQM methods to increase the reliability with “Strongly Disagree”, an arithmetic mean of (1.4) and 28 % .

The result of leadership efficiency is important for increasing the reliability of production lines: Yes, the data showed that leadership efficiency is important for increasing the reliability of production lines with “Strongly Agree”, an arithmetic mean of (5) and 100 % .

The result of are the supervisors trained to manage production lines: Yes, the data showed that the supervisors trained to manage production lines with “Strongly Agree”, an arithmetic mean of (4.6) and 92 % .

The result of does your company have training programs for the engineer and technical team: Yes, the data showed that companies have training programs for the engineer and technical team with “Strongly Agree”, an arithmetic mean of (4.7) and 94 % .

The result of are the supervisors and technical team handling problems and challenges in production lines proper: Yes, the data showed that supervisors and technical team handling problems and challenges in production lines properly with “Agree”, an arithmetic mean of (3.7) and 74 % .

Table No. 17:

		Statistics													
		The management strategy effect on the efficiency of production lines.	Applying the management methods will increase the efficiency of production lines?	Does your company or management measure the efficiency of production lines?	Does your management use overall equipment effectiveness (OEE) for efficiency measurement ?	Does your company need to improve the efficiency of production lines?	Is the Kaizen system applied for improvement?	The automation level and new technology affects the efficiency of production lines?	Dose the technology updated in your production lines?	Are programs used for analyze data and improve the efficiency?	Is data analysis done automatically from production lines?	Hard to measure efficiency in your production lines?	Training and Development Programs affect the workers efficiency on production lines?	Does training programs provided for operators and workers in production lines?	Does training have an impact on employee productivity?
		Valid	Missing	Valid	Missing	Valid	Missing	Valid	Missing	Valid	Missing	Valid	Missing	Valid	Missing
N		35	1	35	1	35	1	35	1	35	1	35	1	35	1
Mean		4.8857		4.9429		4.6571		4.5429		3.8286		4.4857		3.1429	
Median		5.0000		5.0000		5.0000		5.0000		4.0000		5.0000		5.0000	
Mode		5.00		5.00		5.00		4.00		5.00		4.00		5.00	
Std. Deviation		.32280		.23550		.63906		.87447		.85722		.80753		.00000	
Variance		.104		.055		.408		.765		.432		.652		.000	
Percentiles	25	5.0000		5.0000		5.0000		5.0000		5.0000		5.0000		5.0000	
	50	5.0000		5.0000		5.0000		5.0000		5.0000		5.0000		5.0000	
	75	5.0000		5.0000		5.0000		5.0000		5.0000		5.0000		5.0000	

Table No. 18:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
The management strategy effect on the efficiency of production lines.	35	4.00	5.00	4.8857	,32280
Applying the management methods will increases the efficiency of production lines?	35	4.00	5.00	4.9429	,23550
Does your company or management measure the efficiency of production lines?	35	3.00	5.00	4.6571	,63906
Does your management use overall equipment effectiveness (OEE) for efficiency measurement?	35	2.00	5.00	4.0000	,87447
Does your company need to improve the efficiency of production lines?	35	3.00	5.00	4.5429	,65722
Is the Kaizen system applied for improvement?	35	2.00	5.00	3.6286	,80753
The automation level and new technology affects the efficiency of production lines?	35	5.00	5.00	5.0000	,00000
Dose the technology updated in your production lines?	35	2.00	5.00	3.8286	,85700
Are programs used for analyze data and improve the efficiency?	35	3.00	5.00	4.4857	,65849
Is data analysis done automatically from production lines?	35	1.00	5.00	3.1429	1.30931
Hard to measure efficiency in your production lines?	35	3.00	5.00	3.6571	,68354
Training and Development Programs affect the workers efficiency on production lines?	35	5.00	5.00	5.0000	,00000
Does training programs provided for operators and workers in production lines?	35	4.00	5.00	4.9143	,28403
Does training have an impact on employee productivity?	35	3.00	5.00	4.4286	,73907
Valid N (listwise)	35				

The result of The management strategy effect on the efficiency of production lines: Data analysis indicate a statistically positive impact of using management strategy for improvements on the efficiency of production lines with “Strongly Agree”, an arithmetic mean of (4.8) and 96 % .

The result of applying the management methods will increases the efficiency of production lines: Yes, Management methodology helped to increase the efficiency of production lines and data showed that “Strongly Agree”, an arithmetic mean of (4.9) and 98 % .

The result of does your company or management measure the efficiency of production lines: Yes, the data showed that companies or managements measure the efficiency of production lines with “Strongly Agree”, an arithmetic mean of (4.6) and 92 % .

The result of does your management use overall equipment effectiveness (OEE) for efficiency measurement: Yes, the data showed that management use overall equipment effectiveness (OEE) for efficiency measurement with “Agree”, an arithmetic mean of (4) and 80 % .

The result of does your company need to improve the efficiency of production lines: Yes, the data showed that companies need to improve the efficiency of production lines with “Strongly Agree”, an arithmetic mean of (4.5) and 90 % .

The result of Kaizen system applied in your company for improvement: Yes, the data showed that companies are using Kaizen system for improvement with “Agree”, an arithmetic mean of (3.6) and 72 % .

The result of automation level and new technology affects the efficiency of production lines: Yes, the data showed that automation level and new technology affects the efficiency of production lines with “Strongly Agree”, an arithmetic mean of (5) and 100 % .

The result of does the technology updated in your production lines: Yes, the data showed that production lines are updated by new technology with “Agree”, an arithmetic mean of (3.8) and 76 % .

The result of are programs used for analyze data and improve the efficiency: Yes, the data showed that programs used for analyze data and improve the efficiency with “Strongly Agree”, an arithmetic mean of (4.4) and 88 % .

The result of data analysis done automatically from production lines: NO, the data showed that data analysis may collected automatically from production lines with “Not Sure”, an arithmetic mean of (3.1) and 62 % .

The result of hard to measure efficiency in your production lines: Yes, the data showed that measuring efficiency could be hard in production lines with “Agree”, an arithmetic mean of (3.6) and 72 % .

The result of training and development programs affect the workers efficiency on production lines: Yes, the data showed that there is improvements on the employees efficiency who got technical or training programs with “Strongly Agree”, an arithmetic mean of (5) and 100 % .

The result of training programs provided for operators and workers in production lines: Yes, the data showed that operators and workers in production lines provided with training programs and course with “Strongly Agree”, an arithmetic mean of (4.9) and 98 % .

The result of training have an impact on employee productivity: Yes, the data showed that training have an impact on employee productivity with “Strongly Agree”, an arithmetic mean of (4.4) and 88 % .

Table No. 19:

Statistics									
		There is a relationship between the reliability and the efficiency in production lines	Increased reliability will increase the efficiency in production lines?	Have you noticed a relationship between the reliability of production lines and their efficiency?	Failures and stoppages affect the production efficiency?	Scheduled and preventive maintenance reduce sudden failures?	Improving the efficiency affects the reliability of production lines?	Does improving the efficiency increase pressure on production lines?	Do you think that focusing on increasing the efficiency only will reduced the reliability?
N	Valid	35	35	35	35	35	35	35	35
	Missing	1	1	1	1	1	1	1	1
Mean		4.5143	4.9143	4.7143	3.7714	4.7714	4.3143	1.4571	4.0286
Median		5.0000	5.0000	5.0000	4.0000	5.0000	5.0000	1.0000	4.0000
Mode		5.00	5.00	5.00	4.00	5.00	5.00	1.00	5.00
Std. Deviation		.74247	.28403	.51856	.68966	.42604	.83213	.61083	1.15008
Variance		.551	.081	.269	.476	.182	.692	.373	1.323
Percentiles	25	4.0000	5.0000	4.0000	3.0000	5.0000	4.0000	1.0000	3.0000
	50	5.0000	5.0000	5.0000	4.0000	5.0000	5.0000	1.0000	4.0000
	75	5.0000	5.0000	5.0000	4.0000	5.0000	5.0000	2.0000	5.0000

Table No. 20:**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
There is a relationship between the reliability and the efficiency in production lines	35	3.00	5.00	4.5143	.74247
Increased reliability will increase the efficiency in production lines?	35	4.00	5.00	4.9143	.28403
Have you noticed a relationship between the reliability of production lines and their efficiency?	35	3.00	5.00	4.7143	.51856
Failures and stoppages affect the production efficiency?	35	3.00	5.00	3.7714	.68966
Scheduled and preventive maintenance reduce sudden failures?	35	4.00	5.00	4.7714	.42604
Improving the efficiency affects the reliability of production lines?	35	2.00	5.00	4.3143	.83213
Does improving the efficiency increase pressure on production lines?	35	1.00	3.00	1.4571	.61083
Do you think that focusing on increasing the efficiency only will reduced the reliability?	35	1.00	5.00	4.0286	1.15008
Valid N (listwise)	35				

The result of relationship between the reliability and the efficiency in production lines. Yes, data analysis indicate there is relationship between the reliability and the efficiency in production lines with “Strongly Agree”, an arithmetic mean of (4.5), and 90 % .

The result of increased reliability will increase the efficiency in production lines. Yes, the data showed that increasing reliability would increase the efficiency in production lines with “Strongly Agree”, an arithmetic mean of (4.9) and 98 % .

The result of have you noticed a relationship between the reliability of production lines and their efficiency: Yes, the data showed that there is a relationship between the reliability of production lines and efficiency with “Strongly Agree”, an arithmetic mean of (4.7) and 94 % .

The result of failures and stoppages affect the production efficiency: Yes, the data showed that failures and stoppages will affecting the production efficiency with “Agree”, an arithmetic mean of (3.7) and 74 % .

The result of scheduled and preventive maintenance reduce sudden failures: Yes, the data showed that scheduled and preventive maintenance will reduce sudden failures with “Strongly Agree”, an arithmetic mean of (4.7) and 94 % .

The result of improving the efficiency affects the reliability of production lines: Yes, the data showed that Improving the efficiency will affects the reliability of production lines and would not reduce the reliability with “Strongly Agree”, an arithmetic mean of (4.3) and 86 % .

The result of does improving the efficiency increase pressure on production lines: No, the data showed that improving the efficiency will not increase pressure on production lines a with “Strongly Disagree”, an arithmetic mean of (1.4) and 28 % .

The result of do you think that focusing on increasing the efficiency only will reduced the reliability: Yes, the data showed that focusing on increasing the efficiency only will reduced the reliability with “Agree”, an arithmetic mean of (4) and 80 % .

Recommendations:

Based on the study's findings, which were derived from the data analysis of interviews with maintenance managers and specialists in Saudi companies in Jeddah, the recommendations were identified to improve and activate the maintenance management strategies, as follows:

1. It is recommended to use data analytics and the AI techniques in maintenance management to help analyze the equipment data and predict the failures and contributing to proactive maintenance decisions.
2. Industrial companies should invest in the internet of things (IoT) and equipment's that connected to internet for monitor the equipment status continuously. And this will help

technical teams to intervene before the failures and improving the operational efficiency and reducing downtime in production lines.

3. It is recommended to use computerized maintenance management systems (CMMS) for the maintenance scheduling, track completed work and manage the inventory. These systems will help production lines to improve the work efficiency and resource planning.
4. Companies should focus on providing advanced training and development programs for their employees and using simulations and interactive software. This will help the workers to gain skills faster and more effectively to improve the performance of maintenance teams.
5. It is recommended to Improve the communication between the employees by using digital and new platforms. This will exchange the information faster, Improving the coordination between departments.
6. It is recommended from companies to using modern technology in the maintenance management methodologies these practices as a competitive advantage in the market and improved performance and increased quality will enable them to meet customer needs.
7. It is recommended to invest in the training employees in the maintenance fields to improve their skills and enabling them to deal with new equipment and technologies effectively.
8. The employees should learn about the latest and best practices and techniques for maintenance management to increase productivity.
9. It is also recommended to improve the safety awareness by the training programs and understanding the risks and how to deal with them and it will contribute to reducing the accidents and injuries.

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All sources used in the study, including academic journals, industry reports, and relevant publications, will be listed here:

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Appendices

Frequency Table

The management methods effect on the reliability of production lines.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	10	27.8	28.6	28.6
	5.00	25	69.4	71.4	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

The application of TQM methods increase the reliability of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	5	13.9	14.3	14.3
	Strongly Agree	30	83.3	85.7	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Does your company use TQM methods in your production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.8	2.9	2.9
	Not Sure	9	25.0	25.7	28.6
	Agree	17	47.2	48.6	77.1
	Strongly Agree	8	22.2	22.9	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Does your company measure the reliability of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	5	13.9	14.3	14.3
	Not Sure	8	22.2	22.9	37.1
	Agree	14	38.9	40.0	77.1
	Strongly Agree	8	22.2	22.9	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Hard to apply TQM methods to increase the reliability in your production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	63.9	65.7	65.7
	Disagree	9	25.0	25.7	91.4
	Not Sure	3	8.3	8.6	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Leadership efficiency is important for increasing the reliability of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	35	97.2	100.0	100.0
Missing	System	1	2.8		
Total		36	100.0		

Does your company have training programs for the engineer and technical team?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.8	2.9	2.9
	Disagree	3	8.3	8.6	11.4
	Not Sure	7	19.4	20.0	31.4
	Agree	18	50.0	51.4	82.9
	Strongly Agree	6	16.7	17.1	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Frequency Table**The management strategy effect on the efficiency of production lines.**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	4	11.1	11.4	11.4
	Strongly Agree	31	86.1	88.6	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Applying the management methods will increase the efficiency of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	2	5.6	5.7	5.7
	Strongly Agree	33	91.7	94.3	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Does your company or management measure the efficiency of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	3	8.3	8.6	8.6
	Agree	6	16.7	17.1	25.7
	Strongly Agree	26	72.2	74.3	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Does your management use overall equipment effectiveness (OEE) for efficiency measurement?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.6	5.7	5.7
	Not Sure	7	19.4	20.0	25.7
	Agree	15	41.7	42.9	68.6
	Strongly Agree	11	30.6	31.4	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Does your company need to improve the efficiency of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	3	8.3	8.6	8.6
	Agree	10	27.8	28.6	37.1
	Strongly Agree	22	61.1	62.9	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Is the Kaizen system applied for improvement?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	8.3	8.6	8.6
	Not Sure	11	30.6	31.4	40.0
	Agree	17	47.2	48.6	88.6
	Strongly Agree	4	11.1	11.4	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

The automation level and new technology affects the efficiency of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	35	97.2	100.0	100.0
Missing	System	1	2.8		
Total		36	100.0		

Dose the technology updated in your production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	8.3	8.6	8.6
	Not Sure	7	19.4	20.0	28.6
	Agree	18	50.0	51.4	80.0
	Strongly Agree	7	19.4	20.0	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Are programs used for analyze data and improve the efficiency?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	3	8.3	8.6	8.6
	Agree	12	33.3	34.3	42.9
	Strongly Agree	20	55.6	57.1	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Is data analysis done automatically from production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	11.1	11.4	11.4
	Disagree	9	25.0	25.7	37.1
	Not Sure	6	16.7	17.1	54.3
	Agree	10	27.8	28.6	82.9
	Strongly Agree	6	16.7	17.1	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Hard to measure efficiency in your production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	16	44.4	45.7	45.7
	Agree	15	41.7	42.9	88.6
	Strongly Agree	4	11.1	11.4	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Training and Development Programs affect the workers efficiency on production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	35	97.2	100.0	100.0
Missing	System	1	2.8		
Total		36	100.0		

Does training programs provided for operators and workers in production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	3	8.3	8.6	8.6
	Strongly Agree	32	88.9	91.4	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Does training have an impact on employee productivity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	5	13.9	14.3	14.3
	Agree	10	27.8	28.6	42.9
	Strongly Agree	20	55.6	57.1	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Frequency Table**There is a relationship between the reliability and the efficiency in production lines**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	5	13.9	14.3	14.3
	Agree	7	19.4	20.0	34.3
	Strongly Agree	23	63.9	65.7	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Increased reliability will increase the efficiency in production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	3	8.3	8.6	8.6
	Strongly Agree	32	88.9	91.4	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Have you noticed a relationship between the reliability of production lines and their efficiency?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	1	2.8	2.9	2.9
	Agree	8	22.2	22.9	25.7
	Strongly Agree	26	72.2	74.3	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Failures and stoppages affect the production efficiency?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Sure	13	36.1	37.1	37.1
	Agree	17	47.2	48.6	85.7
	Strongly Agree	5	13.9	14.3	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Scheduled and preventive maintenance reduce sudden failures?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	8	22.2	22.9	22.9
	Strongly Agree	27	75.0	77.1	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Improving the efficiency affects the reliability of production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.8	2.9	2.9
	Not Sure	5	13.9	14.3	17.1
	Agree	11	30.6	31.4	48.6
	Strongly Agree	18	50.0	51.4	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Does improving the efficiency increase pressure on production lines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	21	58.3	60.0	60.0
	Disagree	12	33.3	34.3	94.3
	Not Sure	2	5.6	5.7	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Do you think that focusing on increasing the efficiency only will reduced the reliability?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.8	2.9	2.9
	Disagree	4	11.1	11.4	14.3
	Not Sure	4	11.1	11.4	25.7
	Agree	10	27.8	28.6	54.3
	Strongly Agree	16	44.4	45.7	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

Midocean University

College of Management

Master of Business Administration



The Effect of Management on Reliability and Efficiency in Production
Lines within Saudi Arabia's Industrial Sector in the City of Jeddah

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First Trimester 2025



جامعة ميدأوشن

كلية الإدارة

ماجستير إدارة الأعمال

أثر الإدارة على الاعتمادية والكفاءة في خطوط الإنتاج الصناعي بالمملكة العربية السعودية في
مدينة جدة

إعداد الطالب / أحمد سالم يوسف

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د. الفيصل حسن

د. فايز جراد

الفصل الدراسي الأول لعام 2025

الملخص

تستكشف هذه الدراسة تأثير الممارسات الإدارية على الموثوقية و كفاءة خطوط الإنتاج في الصناعة داخل المملكة العربية السعودية. وهو قطاع يشهد تطور بسبب الثورة الصناعية الرابعة وزيادة الطلب من المستهلكين على منتجات بجودة عالية و امنه وقد تمت هذه الدراسة من خلال وجود خبرات سابقة للباحث اكثر من 11 سنة في مجال صيانة خطوط الإنتاج و من خلال المقابلات الشخصية مع مديري الصيانة و المتخصصين من المنشآت الصناعية في جدة وأيضاً من خلال البحث في الدراسات السابقة.

وهدفت هذه الدراسة الى تحديد العوامل الإدارية التي تؤثر على الأداء في خطوط الإنتاج و مراجعة الممارسات الإدارية الحالية و تقييم سلوكها على نتائج خطوط الإنتاج.

وأيضاً يؤكد البحث وجود تأثير إيجابي للاستراتيجيات الإدارية الفعالة مثل الصيانة الوقائية و التنبؤية و القيادة الاستراتيجية على موثوقية و كفاءة خطوط الإنتاج و كما أن الدراسة ركزت على الدور الهام للتقنيات الجديدة كلاتمة و البرامج التدريب في تعزيز الأداء التشغيلي كما انه لوحظ وجود علاقة قوية بين الزيادة في الموثوقية و الكفاءة حيث أكد 90% من المشاركين ان تحسين الموثوقية يؤدي مباشرة إلى تحسين الكفاءة بدون دون التأثير على استقرار خطوط الإنتاج.

كما تؤكد النتائج على أهمية تبني الذكاء الاصطناعي (AI) و تحليلات البيانات و إنترنت الأشياء (IoT) وأنظمة إدارة الصيانة الحديثة لتحسين استراتيجيات الصيانة و قدم هذا البحث توصيات عملية للصناعات السعودية لتقوية ممارسات إدارة الصيانة و تحسين الكفاءة التشغيلية مع الحفاظ على الميزة التنافسية في السوق مما ساعد لتحقيق رؤية السعودية 2030.