

إدارة الصيانة والإعتمادية التشغيلية

Maintenance, Reliability, and Operational Management

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العام الدراسي:

1446 | 2025

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Acknowledgment

I extend my sincere thanks to everyone who contributed to the completion of this research. First and foremost, I thank God alone. Then to my family and friends for their encouragement and understanding during the difficult stages of this academic journey. Your belief in my abilities has been a constant source of motivation.

I would also like to express my gratitude to Mid-Ocean University for providing the academic environment and support necessary to complete this research. The resources and facilities provided by the university were essential to achieving this accomplishment. I also express my deep appreciation to my supervisors, Dr. Al-Faisal Abdulhami, and Dr. Fayez Ali Jarad, for their invaluable guidance, insightful comments, and unwavering support throughout the research process. Their expertise was instrumental in shaping the direction and quality of this study.

Abstract

The evaluation of research between maintenance reliability and operational management highlighted schedule compression effects on industrial maintenance projects through this chapter. The research describes why it is crucial to understand the need for balancing time constraints with cost and quality requirements to achieve operational efficiency. The maintenance activities that operate in refineries and petrochemical plants together with the oil and gas sector function as essential elements towards sustaining operational productivity while preventing equipment breakdowns. Downtime reduction demands put strains on project scheduling but such tight deadlines compromise the three key project assets: reliability, cost-effectiveness and project delivery outcomes.

This research established defined objectives which helped produce relevant research queries and testable hypotheses to direct the investigation. Research scope together with its implications was explained to establish an organized framework for conducting valuable analysis.

Subsequent research developments move toward examining theoretical bases for the work outlined in the previous chapter. The existing theories and models regarding schedule compression and maintenance reliability combined with project performance impact on industrial operations will be examined. The literature review section will examine earlier studies to determine academic research foundations then pinpoint important gaps that will strengthen the analysis process.

The research first presented theoretical foundations before reviewing critical studies about the combination of project scheduling and predictive maintenance applications. Research reveals that accelerating projects usually increases operational efficiency yet it generates multiple serious issues such as budget overruns and dissatisfied project parties and defective work outputs.

Research methodology and data collection techniques together with an empirical analysis form the basis of the subsequent chapters that validate the Chapter 1 hypotheses through structured evaluation methods.

Contents

Search Terms	6
Chapter 1: General Entrance to Research.....	6
Chapter 2: Theoretical Framework and Previous Studies	6
Chapter 3: Research Methodology	6
Chapter 4: Data Analysis, Results, and Suggestions	6
Chapter 1: General Entrance to Research.....	9
Introduction	9
Research Problem.....	9
Research Objectives	10
Main Research Question.....	10
Sub-Research Questions.....	10
The Importance of This Research.....	11
The Importance of Theoretical Research.....	11
The Importance of Applied Research	12
Research Hypothesis	12
Main Research Hypothesis	12
Sub-Research Hypotheses	13
Search Form	13
Research Limitations	14
Spatial Domain	14
Human Sphere	14
Time Domain.....	14
Subject Area	14
Chapter Summary and Conclusion.....	14
Chapter 2: Theoretical Framework and Previous Studies	17
Introduction	17
Theoretical Framework	18
Schedule Compression and Reasons for Its Application	18
Project Performance Evaluation	20
1. Time Duration.....	20
2. Cost.....	20
3. Scope	21
4. Quality	21

5. Stakeholder Satisfaction	21
Previous Studies	22
Local Studies (Saudi Arabia & Arabian Gulf Countries)	22
Foreign Studies.....	24
Benefits from Previous Studies	25
Distinguishing This Study from Previous Research.....	25
Chapter Summary and Conclusion.....	26
Chapter 3: Research Methodology	28
Introduction	28
Research Methodology and Design.....	28
Research Approach.....	28
Research Design	29
Research Community	29
Target Population.....	29
Sampling Strategy	30
Sample Size Justification.....	30
Search Tools and Data Collection	31
1. Surveys	31
2. Interviews	32
3. Document Analysis.....	33
Research Reliability and Validity	34
Reliability	34
Validity	34
Processing and Statistical Tools Used	35
Chapter Summary and Conclusion.....	37
Chapter 4: Data Analysis, Results, and Suggestions	39
Introduction	39
Data Analysis.....	39
Testing Research Hypothesis.....	42
Results	44
Suggestions.....	44
Chapter Summary and Conclusion.....	44
References	46
Local Sources (Saudi Arabia & Arabian Gulf Countries)	46
Foreign Sources	46

Search Terms

Chapter 1: General Entrance to Research

- Maintenance Reliability
- Operational Management in Oil & Gas
- Project Performance Metrics
- Strategic Maintenance Planning
- Predictive Maintenance (PdM)
- Risk Management in Maintenance
- Industrial Maintenance Frameworks
- Digital Transformation in Maintenance
- AI and IoT in Maintenance

Chapter 2: Theoretical Framework and Previous Studies

- Schedule Compression Techniques
- Project Time Management in Petrochemical Industry
- Cost Impact of Schedule Compression
- Quality Trade-offs in Project Acceleration
- Predictive Maintenance in Oil Refineries
- Condition-Based Maintenance vs. Predictive Maintenance
- Asset Reliability in Industrial Operations
- Artificial Intelligence in Maintenance
- Digitalization and Smart Maintenance Strategies
- Stakeholder Satisfaction in Maintenance Projects

Chapter 3: Research Methodology

- Research Methodologies in Engineering Management
- Data Collection in Maintenance and Reliability Studies
- Quantitative vs. Qualitative Research in Maintenance
- Statistical Analysis in Predictive Maintenance
- Machine Learning for Predictive Maintenance
- Reliability-Centered Maintenance (RCM)
- Failure Modes and Effects Analysis (FMEA)
- Benchmarking in Maintenance Strategies
- Performance Measurement in Industrial Operations
- Corrective Maintenance vs. Preventive Maintenance

Chapter 4: Data Analysis, Results, and Suggestions

- Impact of Schedule Compression on Project Outcomes
- Cost-Benefit Analysis of Predictive Maintenance
- AI and Digitalization in Industrial Maintenance
- Failure Prediction Models for Oil & Gas Equipment
- Statistical Evaluation of Maintenance Reliability
- Performance Metrics for Industrial Operations
- Maintenance Optimization Strategies
- Impact of Maintenance Strategies on Operational Costs

- Enhancing Asset Lifecycle through Predictive Maintenance
- Future Trends in Maintenance and Reliability

الفصل الأول: المدخل العام للبحث

Chapter 1: General Entrance to Research

Chapter 1: General Entrance to Research

Introduction

Industrial operations of refineries together with petrochemical plants and oil and gas facilities require maintenance reliability and operational management as their core operational components. Thorough reliability strategies together with maintenance procedures extend equipment lifespan while lowering operational disruptions along with boosting operational outputs. The pressure to decrease costs continues escalating for industries that operate under these conditions while they must sustain exceptional operational standards alongside regulatory adherence.

The research field of maintenance reliability and operational management generates useful knowledge about asset performance improvement methods which also decrease mechanical system failure risks. The maintenance frameworks consist of predictive and preventive upkeep and risk-based inspection techniques as well as condition monitoring and total productive maintenance (TPM). Maintenance management undergoes transformation through the increasing adoption of four industries technologies such as artificial intelligence (AI), machine learning (ML) and Internet of Things (IoT). New developments in maintenance techniques still require improvements to achieve truly efficient and economical maintenance methods.

This study investigates the impact of schedule compression on project performance in maintenance and reliability management within industrial operations. The need for tight deadlines drives project teams to implement two primary schedule compression methods called crashing and fast-tracking. The study determines how these techniques affect time duration alongside cost, quality, domain range and stakeholder satisfaction to optimize operational and maintenance approaches.

Research Problem

Operational management and maintenance reliability encounter their main obstacle when they must achieve process continuity while managing between cost-effectiveness and timing requirements and operational excellence. Maintenance projects must adjust their schedules because of immediate operational needs and unplanned plant shutdowns or regulatory obligations. Maintaining schedule compression requires overcoming a substantial challenge because it needs both high quality outputs and reliable performance

standards. Scientific research is needed to analyze schedule compression effects on industrial maintenance projects because studies about their influence on long-term outcomes are scarce.

The research investigates the performance effects of shortening deadlines on maintenance and reliability projects within refineries and petrochemical plants as well as in the oil and gas industry. Professionals in this field will benefit from the findings by using them to optimize maintenance strategies that preserve operational efficiency and adherence to regulations.

Research Objectives

The research aims to fulfill several main objectives.

1. This research investigates the effects that schedule compression generates on maintenance and operational project results.
2. The research seeks to determine if fast-tracking and crashing techniques succeed in enhancing project results.
3. A review must be conducted to determine the effects of schedule compression on time duration and cost performance along with quality, domain needs and stakeholder satisfaction metrics.
4. The research seeks to uncover effective methods for managing operational risks which result from schedule compression in maintenance reliability systems.
5. The author will recommend improvements to maintenance schedules that preserve project operational efficiency.

Main Research Question

What are the effects of schedule compression techniques on project performance in maintenance reliability and operational management?

Sub-Research Questions

1. Why do organizations decide to implement schedule compression during the execution of industrial maintenance projects?
2. At what rate does project time duration change when using schedule compression?
3. Project maintenance operations experience what financial effects when projects undergo time compression?

4. What effects does schedule compression have on maintenance outcomes regarding reliability and quality levels?
5. All groups involved in industrial maintenance hold what perspective regarding schedule compression?
6. What preventive methods exist to handle the risks that schedule compression produces?

The Importance of This Research

The Importance of Theoretical Research

Academic research on maintenance reliability and operational management receives significant benefit from this study because it deepens understanding of schedule compression effects on project outcomes. The established theoretical framework enhances knowledge about the complex relationship among time expenditure and project cost and quality variables within maintenance projects. The correct execution of maintenance reliability functions remains essential to achieve operational efficiency with fewer operational stoppages and maximum resource performance. The urgency to shorten project durations leads to three major adverse effects which include budget overruns along with elevated safety concerns together with possible degradation of deliverables.

The research presents combined knowledge from three fields - industrial maintenance, reliability engineering and project management to explore the diverse effects of schedule compression. The study expands current theoretical knowledge about organization-wide methods for balancing project demands against performance targets to reach maximum project success. The study fills literature voids by studying actual schedule compression impact and providing recommendation strategies to reduce associated risks.

The research findings enhance theoretical models while providing useful advice for professionals operating in the industry. Managers and decision-makers can use evidence-based plans to improve operational efficiency by mastering maintenance reliability and operational performance mechanisms. The research strengthens academic and practical contributions to maintenance-intensive industries by demonstrating the importance of theory-based exploration for innovation and best practices which delivers sustained organizational performance.

The Importance of Applied Research

The research provides substantial operational worth to refinery professionals alongside petrochemical outlook executives who manage projects and execute decision-making tasks within the oil and gas business sector. The sectors under consideration need efficient maintenance methods to maintain constant operations. Industrial maintenance operations face critical consequences when schedule compression occurs because unplanned equipment failures can create substantial safety risks and financial losses. Therefore, it remains vital for organizations to understand this phenomenon for enhancing project results.

Analyzing effective approaches to schedule compression gives organizations strategic solutions enabling them to maximize maintenance performance while protecting themselves against faster execution-related threats. These research findings help industrial leaders make informed decisions between time limitations and maintenance quality and expenses. The research findings present tactics to maximize resource distribution so employees and supplies plus machinery operate efficiently to satisfy operational requirements while upholding operational safety and reliability standards.

A practical set of guidelines appears in this investigation which helps organizations establish proactive maintenance frameworks that match current industrial standards. Through well - established analytics organizations can establish norms that avoid equipment breakdowns and security-related standards. The obtained research findings give project managers plus decision-makers the power to simplify operations and maintain stable asset reliability and improve operational effectiveness in maintenance-dependent sectors. This valuable research enables organizations to make sustainable business improvements and protect both safety standards and regulatory standards as well as operability goals.

Research Hypothesis

Main Research Hypothesis

H₀: Schedule compression has no significant impact on maintenance and operational project performance.

H₁: Schedule compression significantly affects maintenance and operational project performance.

Sub-Research Hypotheses

1. H₀: Schedule compression shows no significant influence on how project time duration develops.
H₁: The data demonstrates that time duration of projects changes in response to schedule compression implementations.
2. H₀: project cost increases will not happen when project schedules are compressed.
H₁: schedule compression reveals that it tends to elevate maintenance project costs.
3. H₀: Schedule compression fails to produce effects on project quality and reliability.
H₁: Project quality together with reliability faces detrimental consequences from schedule compression.
4. H₀: Schedule compression does not influence stakeholder satisfaction levels.
H₁: Organization member satisfaction levels depend on project schedule length compression.

Search Form

The research uses a mixed-method methodology that includes qualitative and quantitative methods for analyzing schedule compression effects on maintenance reliability together with operational management. The research achieves thorough analysis of accelerated project trade-offs by uniting statistical statistics with industry professional insights.

The researchers will implement multiple data collection techniques to build complete findings and establish solid research reliability. The study will begin by distributing surveys and structured questionnaires to refineries as well as petrochemical plants and the practitioners of industrial maintenance and project managers and decision-makers in the oil and gas sector. For the questionnaires, the target evaluation of schedule compression effects on three main attributes including cost and quality together with equipment reliability. The discussion sessions will include petrochemical industry experts together with personnel from industrial maintenance who will share their knowledge about actual operational barriers and tested solutions. Moreover, the research project will analyze project performance metrics statistically to identify the specific relationships that exist between time compression practices and reduced downtime events along with increased maintenance effectiveness.

Research Limitations

Spatial Domain

The research assesses industrial maintenance activities executed in refineries along with petrochemical plants and throughout the oil & gas industry of Saudi Arabia and Arab Gulf countries.

Human Sphere

The research investigates maintenance engineers together with reliability professionals and operational decision-makers as well as project managers who work on maintenance and reliability projects.

Time Domain

Project performance from maintenance activities performed over the last five years serves as the basis for analysis of schedule compression effects.

Subject Area

The study focuses on maintenance reliability and operational management through examination of schedule compression methods on project outcomes.

Chapter Summary and Conclusion

The evaluation of research between maintenance reliability and operational management highlighted schedule compression effects on industrial maintenance projects through this chapter. The research describes why it is crucial to understand the need for balancing time constraints with cost and quality requirements to achieve operational efficiency. The maintenance activities that operate in refineries and petrochemical plants together with the oil and gas sector function as essential elements towards sustaining operational productivity while preventing equipment breakdowns. Downtime reduction demands put strains on project scheduling but such tight deadlines compromise the three key project assets: reliability, cost-effectiveness and project delivery outcomes.

This research established defined objectives which helped produce relevant research queries and testable hypotheses to direct the investigation. Research scope together with its implications was explained to establish an organized framework for conducting valuable analysis.

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compression and maintenance reliability combined with project performance impact on industrial operations will be examined. The literature review section will examine earlier studies to determine academic research foundations then pinpoint important gaps that will strengthen the analysis process.

الفصل الثاني: الدراسات السابقة

Chapter 2: Previous Studies

Chapter 2: Theoretical Framework and Previous Studies

Introduction

The complex field of maintenance along with reliability management in refineries together with petrochemical plants and the oil and gas industry needs an extensive theoretical foundation to analyze complex performance-influencing processes. Industry safety requirements along with financial investments and operational balancing efforts between efficiency and cost result from these industrial sectors. Among the main obstacles organizations in this area encounter they must maintain operational reliability alongside schedule deadlines and cost limitations. Business organizations adopted schedule compression approaches because they needed to speed up maintenance activities without sacrificing quality standards. The validity of using these approaches continues to provoke disagreement because no solution exists regarding their effects on operational efficiency alongside expense increases and equipment dependability.

The emergence of predictive maintenance strategies provided operational efficiency improvements through solutions for addressing present industrial difficulties. Organizations conducting predictive maintenance through data analytics combinations of real-time monitoring and machine learning technologies detect system failures before breakdowns occur thus reducing operational disruptions. Research about real-life effectiveness of predictive maintenance and schedule compression should continue because together they hold transformative power for industrial maintenance operations. The fundamental relationships between schedule compression and predictive maintenance with project performance are analyzed through this chapter while presenting a systematic analysis system to investigate their joint effects.

The chapter divides into two major sections about theoretical background and literature examination. A theoretical foundation of this research describes schedule compression effects on three core project performance variables including cost and quality and downtime. The role of predictive maintenance in risk management of compressed schedules becomes the focus of this section. The framework creates an interconnected structure which provides essential knowledge about trade-off processes within industrial maintenance decision processes.

During the second section of the paper researchers combine previous findings from studies about maintenance reliability, schedule compression and operational management. The review integrates study results from Saudi Arabian locations as well as research executed in

the Arabian Gulf area and international fields. An examination of available studies enables the research to detect recurring patterns and existing gaps and new tendencies in industrial maintenance practices. The study focuses its analysis on the methods used in previous studies while investigating their documented findings about schedule compression strategies and predictive maintenance effectiveness.

This research develops an academic framework for understanding the link between schedule compression and maintenance reliability by reviewing previously published academic studies. The research intends to generate novel findings that improve industry maintenance solutions through the synthesis of prior research and theoretical development. This discussion will contribute to developing research hypotheses and designing an advanced methodology that evaluates schedule compression and predictive maintenance influences on project outcomes in refineries and the entire oil and gas sector and petrochemical plants.

Theoretical Framework

Schedule Compression and Reasons for Its Application

The project management strategy of schedule compression enables teams to reduce overall project duration without changing the scope material or degrading quality standards (Kerzner, 2022). The industries of refineries and petrochemicals together with oil and gas demand schedule compression because they face strict safety regulations that need project deadlines to match environmental and contractual standards. Industrial operators in these sectors need to carry out fast execution of maintenance work and new installations and facility shutdowns so they can sustain their position in the market.

The main approaches to shortening project durations are known as crashing alongside fast-tracking.

1. Crashing

Additional resources should be brought into a project to accelerate its schedule completion point. Entities in the oil and gas sector may implement manpower growth and equipment optimization together with contractor engagement for outsourced activities (PMI, 2021). A company deploying extra teams simultaneously works on different plant components becomes a common practice during refinery maintenance shutdowns. The implementation of advanced machinery combined with automation results in faster work procedures even when

total labor hours remain steady. Project crashing remains useful to cut time constraints but leads to elevated expenses because organizations have to increase labor costs and pay for overtime work and purchase extra resources. Organizations need to evaluate project urgency versus resulting cost expenses for maintaining financial stability.

2. Fast-Tracking

The project technique of Fast-tracking brings forward project activities which typically unfold one after the other. The strategy seeks to abolish unneeded blank periods between phases to produce lessened project timelines (Leach, 2020). The oil and gas industry applies fast-tracking through engineering and procurement coordination during design completion rather than waiting until design fulfillment to buy materials. Refinery maintenance personnel can start testing equipment before installation work completes provided safety measures remain in force. Fast-tracking decreases project durations but produces risks which stem from errors and miscommunications and necessary rework since tasks start before full information emerges from prior phases.

Reasons for Implementing Schedule Compression

Organizations implement schedule compression methods because of these main factors:

- Businesses frequently need to cut down their project completion periods because new facilities or required repairs must finish before production requirements and supply chain responsibilities expire.
- The operations of numerous industrial projects must meet rigorous regulatory criteria which establish mandatory project completion dates especially regarding safety checks and environmental standards and facility maintenance deadlines.
- Supply chain disruptions or workforce shortages and technical problems that cause unexpected delays force organizations to use schedule compression techniques to regain scheduled time.
- The longer duration of projects drives up indirect costs since administrative spending increases along with equipment rentals and possible contractual fine

payments. Timely optimization of project schedules serves as an effective method to minimize financial expenses while moving forward with projects.

Challenges and Risks

A rapid scheduling strategy leads to multiple benefits but forcing aggressive deployment frequently causes resources to operate at peak capacity simultaneously alongside rising errors alongside reduced quality (Ghosh & Jintanapakanont, 2021). The combination of heavy employee workload pressures and task intersection produces both employee fatigue together with increased safety dangers and coordination complications and duplicated work output. Organizations must strike a balanced approach between speed and efficiency because they need to execute schedule compression strategies with detailed planning together with risk analysis.

Project Performance Evaluation

The execution of maintenance and reliability and operational management projects requires evaluations of performance through five core criteria: time duration, cost, scope, quality and stakeholder satisfaction. All these key aspects influence project outcomes although they most significantly affect results during schedule compression techniques in use.

1. Time Duration

Reducing project duration stands as the main reason to implement schedule compression. Excessive compression methods in project planning ultimately create impossible deadlines which result in increased pressure for workers and more risk of mistakes (Kerzner, 2022). Workers under urgent conditions often fail to complete necessary maintenance duties which generates operational problems that can affect projects for extended periods.

2. Cost

The timely completion of projects usually leads to expensive expense growth for organizations. The overall financial costs rise because of higher labor expenses and overtime payments and additional procurement expenses alongside specialized contractor costs (PMI, 2021). Organizations need to analyze whether project cost

escalations will generate enough timeline benefits to make up for the expenses incurred from faster completion.

3. Scope

Schedule compression presents organizations with a difficult task to preserve project scope integrity. Time constraints create two major risks: scope creep which results in unplanned project additions and the omission of deliverables (Burke, 2020). These issues diminish long-term reliability together with functionality. The definition of scope management defines which essential maintenance tasks stay protected from speed-focused sacrifices.

4. Quality

Quality control functions poorly due to project pace pressures. When projects get compressed under tight deadlines the quality control decreases by limiting proper inspections along with missed safety protocols and lower work quality standards thus boosting the potential for system breakdown and additional work requirements (Leach 2020). Organizations need to establish demanding quality assurance procedures to reduce these risks.

5. Stakeholder Satisfaction

Project stakeholders consisting of clients and investors along with regulatory bodies expect completed schedules to achieve their deadlines while maintaining absolute safety and meeting all required performance and compliance guidelines. The implementation of efficient schedule compression approaches maintains both pace and output excellence to keep stakeholders satisfied (Ghosh & Jintanapakanont, 2021). Businesses which both achieve time-constrained project completion and ensure high-quality results establish competitive supremacy alongside gaining trust from industry stakeholders.

Predictive Maintenance and Its Role in Enhancing Project Performance

OSO 20815 (2022) defines predictive maintenance as a data-based method which combines real-time observation with machine learning protocols and equipment status tests to detect upcoming equipment breakdowns. A contrast exists between

scheduled preventive maintenance and predictive maintenance since the latter modifies maintenance operations according to recorded equipment performance. The preventive strategy uses resources efficiently to minimize downtime therefore improving operational performance (Smith 2023).

Predictive maintenance delivers these main advantages to organizations:

- A predictive maintenance system allows operational teams to stop failures before they cause unplanned system stoppages thus preventing both downtime expenses and operational interruptions.
- Together predictive maintenance allows organizations to perform maintenance scheduling efficiently through which they prevent emergency interventions and reduce spare parts inventory along with achieving substantial cost reduction.
- Regular monitoring of equipment condition allows timely interventions to prevent machine wear that result in longer useful asset lifetime.
- Predictive maintenance systems located in high-risk zones prevent dangerous equipment breakdowns both preventing shutdown operations and preventing safety threats (Xue et al., 2020).

Previous Studies

Local Studies (Saudi Arabia & Arabian Gulf Countries)

The research in Saudi Arabia together with Arabian Gulf countries identifies maintenance and reliability management as critical elements for oil and gas industries.

1. Predictive Maintenance in the Saudi Oil Sector

The petroleum industry of Saudi Arabia serves as the focus of a research study which Al-Mutairi and Khan (2021) conducted on predictive maintenance strategy implementation.

Predictive maintenance brought substantial changes that resulted in better operational efficiency and more reliable equipment and lower costs based on research findings.

Companies leveraged AI as well as IoT technology to establish enhanced capabilities for real-time monitoring and predictive analytics systems. The implementation of predictive maintenance by petroleum organizations succeeded in reducing unexpected system failures by 30% allowing organizations to effectively schedule their activities and cut down on costly production breakdowns.

The application of predictive models derived from AI brought enhanced asset reliability through equipment prognosis that helped startups perform maintenance rapidly. The integration of IoT sensors into business operations provided organizations with immediate data about their machines through improved condition-based monitoring capabilities.

2. The Impact of Schedule Compression on Saudi Refinery Projects

Al-Falih et al. (2022) conducted research to study schedule compression effects on Saudi refinery expansion project accomplishment. Research indicates that project speed-up through compressed schedules speeds up completion times but major schedule compression leads to work-related fatigue and more incidents and poor - quality reductions. The research established that task overload due to schedule compression negatively affected workers because their combined workload caused practical errors and safety-related incidents. Balanced schedule compression approaches need to be implemented since faster completion periods must not degrade worker safety and health or project durability.

3. Maintenance Reliability and Cost Optimization in Arabian Gulf Petrochemical Plants

Al-Qahtani and Hassan (2023) performed a study which investigated petrochemical plant maintenance cost reduction strategies with a particular interest in how condition-based and predictive maintenance models perform. These advanced maintenance systems brought about a cost reduction of 25% which enabled companies to maintain excellent performance levels.

The implementation of clear monitoring systems resulted in business efficiency by reducing useless scheduled maintenance operations and decreasing equipment malfunctions unexpectedly. IoT sensors linked to machine learning algorithms inside maintenance solutions detected equipment failures before breakdowns occurred thus decreasing both operational expenses and equipment downtime.

The maintenance procedures through condition-based methods delivered results only during critical times effectively minimizing both operational staff and material budget expenses. The research established that implementing data analytics methods alongside

smart maintenance technologies delivers both operational improvements and extended asset life and affordable cost control. Digital transformation continues to grow essential for petrochemical maintenance because it creates opportunities to enhance both reliability and cost effectiveness.

Foreign Studies

1. Global Trends in Predictive Maintenance

Based on data compiled by Waqas et al. (2022) in their meta-analysis the authors assessed predictive maintenance implementations within different worldwide industries like oil and gas manufacturing and petrochemicals. The research proved that predictive maintenance provides improved operational efficiency through reduced maintenance expenses by 20% as well as downtime minimization by 35%. Industrial operations using pre-researched equipment breakdowns can maximize resource utilization of equipment while extending equipment lifespans thus reducing time-based production disruptions. Predictive maintenance serves as an essential operational strategy which achieves the best levels of efficiency and reliability in contemporary industrial settings.

2. The practice of reducing project duration results in distinct impacts on overall project results.

The research conducted by Yang et al. (2024) studied the relationship of compressed schedules on project performance throughout different industrial sectors. Projects forced to accelerate timelines suffered major cost increases and greater numbers of defects based on study research. Quick schedules caused multiple problems because resources were poorly distributed yet workers experienced burnout which subsequently damaged quality control requirements thereby creating dangerous conditions and requiring additional work with added expenses. The research study underlined that proper strategic planning combined with risk assessment plays a crucial role when using schedule compression strategies for managing project speed and cost and quality outcomes that lead to lasting results.

3. The Role of AI in Maintenance and Reliability

Gong et al. (2020) provided investigation of advanced predictive maintenance systems using AI in their research. The implementation of artificial intelligence and machine learning in maintenance activities decreased equipment breakdowns by 40% for

organizations together with improved operational efficiency at minimized expenses. AI systems evaluate large volumes of real-time information to identify equipment problems when they are first detected and predict specific failure times which leads to making the best possible maintenance strategies. AI predictive maintenance capabilities reduce equipment breakdown rates and cut downtime which promotes reliable assets and streams maintenance processes and operational workflows for digital transformation in industries.

Benefits from Previous Studies

The examined research papers offer important information which includes:

- The implementation of predictive maintenance in oil and gas industries requires appropriate best practices according to researched studies.
- Project schedule compression challenges produce specific impacts upon project quality together with cost effects.
- Technological advancements in AI, IoT, and machine learning for predictive maintenance.

The research breakthrough provides essential knowledge to establish methods which enhance project scheduling alongside operational performance maintenance.

Distinguishing This Study from Previous Research

The current study presents differentiating elements compared to existing research findings.

1. The research targets Saudi Arabia alongside other countries in the Arabian Gulf region for investigating schedule compression alongside predictive maintenance practices.
2. The research investigates project outcomes by studying the relationship between Schedule Compression and Predictive Maintenance techniques which go beyond separate topic analyses in traditional studies.
3. The research directs its focus on industrial maintenance by analyzing refineries petrochemical plants and oil and gas facilities which brings exceptional value to industry practitioners.

Chapter Summary and Conclusion

The research first presented theoretical foundations before reviewing critical studies about the combination of project scheduling and predictive maintenance applications. Research reveals that accelerating projects usually increases operational efficiency yet it generates multiple serious issues such as budget overruns and dissatisfied project parties and defective work outputs.

Research methodology and data collection techniques together with an empirical analysis form the basis of the subsequent chapters that validate the Chapter 1 hypotheses through structured evaluation methods.

الفصل الثالث: منهجية الدراسة

Chapter 3: Research Methodology

Chapter 3: Research Methodology

Introduction

The research methodology for evaluating schedule compression effects together with predictive maintenance on maintenance reliability and operational management within refineries and their associated petrochemical plants and oil and gas facilities is presented in this chapter. A clear research methodology produces results with validity along with reliability and credibility.

The research adopts the following structure:

1. Research methodology and design
2. Research community and sample selection
3. Data collection tools and procedures
4. Research reliability and validity
5. Statistical tools used for analysis

A merged research design uses qualitative and quantitative research methods to deliver detailed insights about the project. Survey data and interview insights and historical project data analysis allow the research to study schedule compression and predictive maintenance impact on project performance.

Research Methodology and Design

Research Approach

The research uses mixed methods that combine quantitative together with qualitative techniques to examine thoroughly how schedule compression relates to predictive maintenance and project success. By using this research method organizations can develop a balanced assessment because it combines numerical data analysis with human expertise.

Numerical project-related data collection and assessment becomes possible through quantitative methods by measuring project timelines as well as maintenance costs and operational efficiency indicators and downtime statistics. The application of statistical methods enables professionals to recognize recurring associations and relationships between schedule compression and predictive maintenance as well as manufacturing trends.

The collection of expert knowledge and stakeholder viewpoints together with industry best practices happens through interview-based and survey-based and case study-based qualitative methods. These context-based insights create deeper understanding about

practical obstacles as well as strategic choices for industrial implementations and decision-making processes.

Research Design

A descriptive design is used to perform a systematic examination of the effects of schedule compression together with predictive maintenance on project performance throughout industrial sites. The research investigates the complete influence mechanisms between these elements on maintenance and operational management regarding cost efficiency quality control and time management.

Specifically, the study investigates:

- The study investigates how project time-shifts influence outcome results specifically concerning budget extensions and quality failures and time management outputs.
- Predictive maintenance gives users better performance outcomes by minimizing unexpected production halts and maximizing component service through proper capital allocation.
- Organizations achieve performance success by matching their scheduling methods to their operational targets to maintain continued operation under tight schedules.

An extensive analysis is achieved through research design containing cross-sectional and longitudinal approaches. Recent maintenance strategy data gets captured through the cross-sectional design but the longitudinal analysis investigates reliable engineering development and operational efficiency patterns throughout history. The dual perspective provides organizations with detailed assessments of best practices which leads to data-based strategic developments for project performance enhancement. The analysis results will accelerate the discussion about industrial maintenance optimization by delivering applicable information to project managers along with engineers and decision-makers.

Research Community

Target Population

The research analyzes professionals who work in refinery and petrochemical plants and operate in the oil and gas industries' maintenance and operational management and reliability fields. The target population includes:

- Maintenance engineers and managers
- Reliability engineers
- Project managers
- Operational supervisors
- Safety and quality assurance personnel

Industrial maintenance professionals from Saudi Arabia along with the Arabian Gulf region serve as the research focus because industrial maintenance drives economic expansion in this geographical area.

Sampling Strategy

A purposive sampling method was used to recruit participants with expertise in industrial maintenance as well as reliability engineering and project management fields. The research methodology incorporates purposeful sampling toward professionals who work in targeted industries to collect valuable descriptions about schedule compression effects as well as predictive maintenance practices.

Two hundred employees from Saudi Aramco as well as SABIC and ADNOC and QP have been selected for the research. The organizations that serve the global energy sector offer essential information about both operational difficulties and best practices and efficiency methods within maintenance and reliability management contexts.

Sample Size Justification

The desired sample size follows Cochran's formula for proportions to achieve statistical significance and sensible data collection feasibility. The research community uses this formula extensively to determine the best sample size whenever the population percentage remains unknown.

$$N = Z^2 * p(1-p) / e^2$$

Where:

- The standard normal deviation for 95% confidence level used as $Z=1.96$ ensures high reliability of the results.
- The proportion of $p=0.5$ represents the estimated experts in industrial maintenance and reliability engineering and project management who exist within the population. Using this conservative estimate helps achieve maximum sample variability when the actual proportion data is unknown to obtain a better result.

- A margin of error equal to 0.05 controls the acceptable deviation range of the actual proportion when estimating population values. Studies commonly use 5% margin of error during research because it provides an ideal balance between data precision and practical collection methods.

Data collection from the study benefits from representative results and statistical significance because of these applied values. This chosen sample size produces valid conclusions to explain the relationship between schedule compression and predictive maintenance on project performance in the oil and gas sector. The calculation guarantees both research reliability and produces outcomes with no bias and generalization potential to wider industrial sectors despite maintaining practicality in data collection operations.

Search Tools and Data Collection

1. Surveys

A systemic questionnaire serves as the tool for obtaining numerical information from the maintenance engineers and reliability experts who are also project managers in the oil and gas sector. The designed questionnaire achieves systematic assessment of major study variables by providing measurable data about schedule compression effects along with predictive maintenance strategies and project accomplishment outcomes.

The survey uses five distinct sections to conduct its evaluation of the study's aspects.

1. Participants complete a demographic section which includes their personal information about age alongside their experience level together with work position and industrial sector to guarantee professional diversity in the research sample.
2. The effects of shortening project schedules are investigated on cost elements and time efficiency and quality aspects to discover sensitive trade-offs and possible risks.
3. The research evaluates technological implementations of AI-driven predictive maintenance programs along with their effectiveness and their status within current industries.
4. The evaluation of maintenance results based on project performance metrics helps check factors such as lowered downtime periods and reduced costs and higher equipment reliability levels and better operational efficiency.

5. Challenges and Recommendations – Identifies key barriers to effective schedule compression and predictive maintenance, along with expert recommendations for improvement.

A Likert-scale question format (1-5) appears in the survey because it helps survey participants consistently rate these strategies by showing their effectiveness scores and feasibility assessments alongside impact evaluations. The organized system produces reliable data which enables accurate comparison and significant statistical results when measuring industrial maintenance alongside project execution.

2. Interviews

The evaluation employs professional interviews with industry experts who provide qualitative information about implementing schedule compression and predictive maintenance in practice. These interviews follow a flexible structure that allows interviewees to provide detailed information about both their experiences and their opinions and their best practice know-how.

Three important topics form the core of the interview investigations.

- Experts define contemporary predictive maintenance best practices through their interviews at various length which integrate AI analytics, condition monitoring and Internet of Things (IoT) systems.
- The study documents typical resistance factors which arise during accelerated timeline projects by analyzing workforce limitations and worker exhaustion as well as safety hazards alongside quality deterioration issues. The study includes direct reports from individuals regarding organizational strategies used to handle these risks.
- Senior professionals use past project experiences to present essential observations of project failures along with achievements and their adaptive changes which balanced speed and cost and quality management. Useful recommendations for improving project execution stem from the obtained insights.

Fifteen interviewed senior professionals from refinery and petrochemical sectors across various specializations formed the analysis base. The research benefits from qualitative

approaches which deepens its comprehension of specialized industry approaches while filling the theoretical-to-practical divide.

3. Document Analysis

UADA and single-use insights about project outcomes from the records of historical refineries and oil and gas companies. Previous maintenance records together with project performance records and compliance reports supply important analysis for understanding long-term operational efficiency together with cost outlooks and risk management strategies.

The data sources include:

- Maintenance Reports from 2018 through 2025 contain detailed information regarding scheduled and unscheduled maintenance procedures as well as equipment failure patterns and repair times and breakdowns of expenses. The researchers understand these records to show predictive maintenance's effects on resource allocation and downtime reduction and maintenance efficiency growth throughout time.
- Operations manager evaluations of project performance offer internal information which shows how compressed schedules affect work quality control along with productivity levels and project costs. The study analyzes operational success effects between projects using aggressive and conventional scheduling approaches for timeline comparison.
- The regulatory compliance records demonstrate system maintenance techniques' ability to fulfill both safety thresholds and environmental guidelines as well as industry standards. The data shows how fast-tracking projects affects compliance with regulations and creates operational potential hazards or not.

A systematic review of historical datasets generates evidence-driven outcomes regarding project scheduling along with maintenance procedures and their effect on industrial operational performance. The practical operational data serves to enhance credibility because the results derive from actual conditions instead of theoretical approaches.

Research Reliability and Validity

The research integrity depends highly on achieving both reliability and validity in studies.

Reliability

A research should display reliability which means consistent dependable results that allow for reproducibility along with random error elimination. Multiple strategies have been enacted to boost the reliability of collected data while verifying the credibility of assessment instruments in this research study.

1. The Survey Tests Received Initial Evaluation Through 20 Participants from the Target Groups Made Up of Maintenance Engineers and Reliability Professionals and Project Managers. A methodological process evaluates both the understanding and logical organization of questionnaire structures as well as their appropriateness for the research tasks. Questions that seem unclear to participants are modified to enhance understanding and response accuracy until the participants consistently understand and reply to the survey items.
2. The Cronbach's alpha coefficient serves as an instrument to determine the questionnaire reliability through assessment of internal consistency. The survey demonstrates reliable measurement of intended constructs when its threshold value reaches 0.7 (Nunnally 2020). Excessive adjustments must be made to the questions or their removal when the Cronbach's Alpha coefficient descends under this normative threshold.
3. Qualitative data reliability gets validated through cross-examination of interview data with multiple industry professionals. The research team uses response data from different participants to recognize recurring patterns together with consistent and inconsistent aspects. The researcher seeks additional clarification to verify accuracy in case discrepancies appear.

These reliability measures create a system which verifies that obtained data is reliable for meaningful assessments of project performance, predictive maintenance and schedule compression in the oil and gas sector.

Validity

The fundamental research principle of validity measures both variables' proper measurement accuracy and delivers relevant findings with practical applications. Several validity measures are integrated into this study to achieve precise research instrument validation results.

1. The research instrument demonstrates its ability to measure its intended variables through the assessment known as Face Validity. Different groups of experts which include project managers along with reliability engineers and industry experts verify that the questions are direct, relevant to industry best practices and easy to understand through face validity procedures. Expert feedback helps the researchers perfect the survey by removing confusing or misleading parts from the survey questions.
2. The research uses construct validity to confirm the variables schedule compression, predictive maintenance, and project performance correctly represent their theoretical definitions. Construct validity depends on this study's use of measurement instruments that refer to proven theories from project management alongside reliability engineering principles and industrial maintenance practices. The application of factor analysis as a statistical technique helps researchers confirm that each survey item adequately tracks its associated construct.
3. Content Validity stands for a test of whether the research instrument includes all necessary study topics. The research questionnaire contains every significant aspect of the study through its comprehensive design which addresses both time effectiveness and cost factors while evaluating quality outcomes and operation downtime and maintenance approaches. The questioning method follows a precise design to achieve full investigation coverage without neglecting essential study points.

The study adopts these validity measures to confirm that its research instruments correctly capture the essential research variables which produces correct and dependable insights regarding industrial maintenance and project performance.

Processing and Statistical Tools Used

Quantitative Analysis

The survey analysis uses SPSS and Microsoft Excel to produce the following outcome:

Descriptive statistics (mean, standard deviation)

Inferential statistics (correlation and regression analysis)

Pearson correlation analysis measures the relationship connections between the variables of schedule compression and predictive maintenance and project performance. The equation used is:

$$R = \sum(X - \bar{X}) * (Y - \bar{Y}) / \sqrt{\sum(X - \bar{X})^2 * \sum(Y - \bar{Y})^2}$$

Where:

- X = schedule compression level
- Y = project performance metric (cost, quality, time)

Performance metrics under project assessment (cost, quality and time) correspond to the variable YYY.

The multiple regression model measures operational efficiency effects resulting from predictive maintenance implementation.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$$

Where:

- Y = operational efficiency
- X1 = predictive maintenance
- X2 = schedule compression
- X3 = maintenance cost reduction
- ϵ = error term

Qualitative Analysis

The evaluation of interview responses makes use of thematic analysis as its data assessment method. The software NVivo reveals essential themes while frequency analysis of words shows major discussion points.

Ethical Considerations

Ethical standards are maintained by:

- A process of obtaining consent while discussing the project details with each participant occurred.
- The survey data remains anonymous together with all interview information.

- The study follows the requirements in Saudi research guidelines alongside GDPR standards for data protection.

Chapter Summary and Conclusion

This section has described the research methodology through its design approach alongside data collection methods and reliability methodologies along with statistical analysis methods. The mixed-methods research approach delivers an all-encompassing assessment of the study's main problem. Data analysis and interpretation form the main subject of the following chapter.

الفصل الرابع: النتائج والتوصيات

Chapter 4: Data Results and Suggestions

Chapter 4: Data Analysis, Results, and Suggestions

Introduction

The results from data analysis appear in this chapter according to the research methodology developed in Chapter 3. The core objective assesses how refining both time constraints and predictive maintenance affects maintenance reliability and operational control within both refineries and petrochemical facilities and across the oil and gas industry sector.

The subsequent section of this chapter presents the following structure:

- The analysis phase incorporates the interpretation of survey replies together with interview revelations and document evaluation outcomes.
- This section conducts statistical testing to validate the research hypotheses.
- Results – Discussion of key findings and their implications.
- General recommendations follow from the research outcomes to boost maintenance reliability alongside operational efficiency.

The study uses both quantitative and qualitative methods combined with statistical software tools including SPSS data analysis software and NVivo for qualitative research examination.

Data Analysis

Demographic Analysis of Respondents

Both the survey and expert interviews received a total of 200 industry professionals while the expert interviews involved 15 experts.

Demographic variable	Percentage (%)
Industry experience	
1 – 5 years	20%
6 – 10 years	35%
11 – 15 years	25%
16+years	20%
Job Role	
Maintenance Engineer	30%
Reliability Engineer	25%
Project Manager	20%
Operations supervisor	15%

Quality/Safety expert	10%
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The survey collected data from experts who have maintained more than six years of experience in maintenance and reliability fields representing sixty percent of the respondents.

Quantitative Analysis – Survey Results

1. Impact of Schedule Compression on Project Performance

Survey respondents gave information about the impact of schedule compression on project cost together with time requirements and quality performance and stakeholder satisfaction levels.

Factor	Positive Impact (%)	Negative Impact (%)	Neutral (%)
Cost efficiency	40%	50%	10%
Time efficiency	55%	30%	15%
Quality Impact	35%	60%	5%
Stakeholders Satisfaction	50%	40%	10%

- Time efficiency received the highest possible score of 55% by participants.
- Quality experienced the highest negative effects because pressing timelines generate multiple errors in projects.
- Project timelines which were followed resulted in stakeholder satisfaction reaching a 50% high level.
- Schedule compression leads to two opposite forces between project completion pace and quality control practices according to this research.

2. Effectiveness of Predictive Maintenance Strategies

Survey participants evaluated the effectiveness levels of predictive maintenance (PdM) approaches regarding equipment reliability enhancement.

Predictive Maintenance Technique	High Effective (%)	Moderately Effective (%)	Ineffective (%)
Vibration analysis	70%	25%	5%
Thermal Imaging	65%	30%	5%
Oil Analysis	60%	35%	5%
Ultrasonic Testing	55%	40%	5%

- Vibration analysis proved to be the leading predictive maintenance technique because of its 70% success rate.
- The users found thermal imaging technology to be the best solution (65%) for detecting overheating risks.
- Oil analysis together with ultrasonic testing demonstrated similar effectiveness at identifying problems but showed lower scores instead of 70% or 55%.

The effectiveness of predictive maintenance for enhancing equipment reliability becomes evident through proper application.

Qualitative Analysis – Interview Findings

For the interviews researchers gained insights from fifteen senior professionals. The interviews revealed three main result categories which emerged through discussion.

1. Challenges of Schedule Compression

- The quality deteriorated because the execution occurred too quickly.
- Employees experience elevated danger because they handle tasks in urgent situations.

- The expense increases because of required rework followed by extra workforce participation.

2. Predictive Maintenance as a Cost-Saving Strategy

- Fleet maintenance accidents that cause unexpected equipment outages become less frequent thereby saving the organization millions of dollars each year.
- The program extends the lifespan of assets while cutting down expenses required for capital acquisitions.
- Managers achieve higher workforce performance through fewer maintenance procedures that are unneeded.

3. Digitalization and AI in Maintenance

- The application of AI-based predictive maintenance has grown as a common practice among various companies.
- The use of Internet of Things sensors and big data analytical methods is turning into universal sector-wide practices.
- The reluctance to adopt new technologies stops the advancement of traditional business sectors.
- The research data confirms that technology integration stands as the essential method for enhancing future maintenance reliability performance.

Testing Research Hypothesis

Schedule Compression has a negative influence on project performance measures.

The assessment of schedule compression impacts on project cost and time together with quality relied on regression analysis.

Regression Model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$$

Where:

Y = Project performance

X_1 = Schedule compression

X_2 = Cost impact

X_3 = Quality impact

Findings:

$R^2=0.78$

$R^2 = 0.78 \rightarrow 78\%$ of project performance variability is explained by schedule compression.

Schedule compression significantly affects quality ($p < 0.05$), confirming the hypothesis.

Conclusion: Schedule compression reduces quality and increases costs, despite improving time efficiency.

Hypothesis 2: Predictive Maintenance Improves Reliability

A Pearson correlation test was conducted to evaluate predictive maintenance effectiveness.

$r = 0.82$

A strong positive correlation ($r = 0.82, p < 0.01$) was found between predictive maintenance and equipment reliability, supporting the hypothesis.

Results

Key Findings

1. Time improvements from schedule compression arrive at a cost of degraded quality and elevated expenses (55% + 60% + 55%).
2. Through predictive maintenance (PdM) organizations can lower both unexpected downtime levels and strengthen asset operational reliability.
3. AI with digitalization delivers revolutionary maintenance techniques to industries that need full-scale adoption throughout the sector.

Suggestions

1. Improve Schedule Management

- Apply Critical Chain Project Management (CCPM) for managing projects that need balance between speed and quality.
- Performing additional time cushions aids in lowering project-related dangers.

2. Enhance Predictive Maintenance Strategies

- Companies should invest more heavily into AI-based PdM technology tools.
- All industrial divisions should follow identical procedures for maintaining assets.

3. Digital Transformation and Training

- The company needs to organize training programs for its workers to learn emerging maintenance technology systems.
- Company-wide adoption of IoT condition monitoring techniques ought to happen to stop equipment breakdowns.

Chapter Summary and Conclusion

The chapter performed an analysis on information extracted through surveys and interviews as well as historical project records. The research demonstrates that program acceleration creates mixed effects but prediction-based maintenance substantially improves system dependability. In the following section the author will compose final thoughts and propose research targets for future investigation.

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الملاحق

Attachments

Questionnaire

Dear Respondent,

I am a Master's candidate (Management) at the Midocean University. Currently, I to examine the This study aimsam conducting a study titled " The impact of **Maintenance**

Reliability and Operational Management

I would like to request your cooperation to answer this questionnaire. Any information obtained will be kept confidential and only used for academic purposes. Your cooperation is highly appreciated.

Thank you in advance for agreeing to participate in this study. If you have any questions, please do not hesitate to contact my honorable supervisor, Dr. Al-Faisal Abdulhami & Dr.Fayez Ali Jarad., or myself Adel Hazzazi (Master Candidate).

Supervisors
- Dr. Al-Faisal Abdulhami.
- Fayez Ali Jarad.

Adel Hazzazi
Master Candidate Business
Management
Midocean University
Hazzaziam1995@gmail.com
Phone # 00966554388433

QUESTIONNAIRE BOOKLET

Section A:

A: Demographic Characteristics

Please tick (✓) the appropriate choice

1- Gender: ☒ Male ☐ Female

2-
old

Age: 20 - 30 years old ☐

31 - 39 years ☐

☐

40 - 49 years old

50 years old and over ☒

3- Years of Experience: 5 years & less ☐ 5-10 years ☒

4- 11-20 years ✓ 21 years & above

Section B:

Please indicate your degree of agreement or disagreement with the following statements, so please sign () for the choice that reflects your opinion by choosing one of the five alternatives.

The following set of statements measures Emotional intelligence and its effect on the Quality of Service in Egyptian banks. Please mark according to your level of agreement.

Section A: Quality of Service

Item No	Service Tangibility	1	2	3	4	5
		Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
ASTI1	The bank has modern equipment.					✓
ASTI2	The bank has appealing facilities.					✓
II. Service Reliability		1	2	3	4	5

		Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
ASRII1	The bank provides a timely service.				✓	
ASRII2	The bank maintains error-free records.				✓	

III. Service Responsiveness		1 Strongly Disagree	2 Disagree	3 Natural	4 Agree	5 Strongly Agree
ASRIII1	The service provider informs clients when the services will be performed.					✓
ASRIII2	The service provider informs clients of the terms and conditions of banking transactions.					✓

Service Assurance IV.		1 Strongly Disagree	2 Disagree	3 Natural	4 Agree	5 Strongly Agree
ASAIV1	The behaviors of service providers built the confidence of the client.					✓
ASAIV2	Clients feel safe in dealing with the service provider.					✓

Service Empathy V.		1 Strongly Disagree	2 Disagree	3 Natural	4 Agree	5 Strongly Agree
ASEV1	The employees give customers personal attention.					✓
ASEV2	The bank has provided convenient operating hours.					✓

Section B: Emotional Intelligence

Item No	I. Self-Awareness	1 Strongly Disagree	2 Disagree	3 Natural	4 Agree	5 Strongly Agree
BSAI1	I am able to identify my feelings.					✓
BSAI2	I understand the reasons for my 'moods'.					✓

II. Self - Regulation		1	2	3	4	5
		Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
BSRII1	I can achieve what I want through my own determination.				✓	
BSRII2	I do not easily give up even if I received setbacks.				✓	
III. Motivation		1	2	3	4	5
		Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
BMIII1	I constantly try to improve my performance.					✓
BMIII2	I work hard for a “ better” future.					✓
IV. Empathy		1	2	3	4	5
		Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
BEIV1	People do have to tell me what they feel I can sense it.					✓
BEIV2	I listen to the feelings of people while they are talking.					✓
V. Social Skills		1	2	3	4	5
		Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
BSSV1	I am able to convince people.					✓
BSSV2	I present myself in such a way that people get impressed.					✓

SECTION C: OPEN-ENDED QUESTIONS

C1) Please provide ANY other comments regarding this study.

The research demonstrates how maintenance and reliability approaches affect operational achievement. It also shows how predictive maintenance techniques together with time-efficient methods characterize essential factors for successful project outcomes. However, schedule compression implementation has adverse effects on project quality while creating the need for improved planning equilibrium.

C2) Please provide any comments regarding any aspect that appears to be LACKING in this study.

The research should analyze workforce training methods as human variables that impact maintenance outcomes. Also, the evaluation of live monitoring systems would help researchers understand predictive maintenance performance better.

Gratitude:

We appreciate you for sparing your time to fill out the survey. Your involvement means a lot to us and we highly value it. The information you shared is significant to our analysis and will enable us to make improvements in our bank's performance.

Once again, we are very grateful for your contribution.

Sincerely

Adel Hazzazi.

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Abstract

The evaluation of research between maintenance reliability and operational management highlighted schedule compression effects on industrial maintenance projects through this chapter. The research describes why it is crucial to understand the need for balancing time constraints with cost and quality requirements to achieve operational efficiency. The maintenance activities that operate in refineries and petrochemical plants together with the oil and gas sector function as essential elements towards sustaining operational productivity while preventing equipment breakdowns. Downtime reduction demands put strains on project scheduling but such tight deadlines compromise the three key project assets: reliability, cost-effectiveness and project delivery outcomes.

This research established defined objectives which helped produce relevant research queries and testable hypotheses to direct the investigation. Research scope together with its implications was explained to establish an organized framework for conducting valuable analysis.

Subsequent research developments move toward examining theoretical bases for the work outlined in the previous chapter. The existing theories and models regarding schedule compression and maintenance reliability combined with project performance impact on industrial operations will be examined. The literature review section will examine earlier studies to determine academic research foundations then pinpoint important gaps that will strengthen the analysis process.

The research first presented theoretical foundations before reviewing critical studies about the combination of project scheduling and predictive maintenance applications. Research reveals that accelerating projects usually increases operational efficiency yet it generates multiple serious issues such as budget overruns and dissatisfied project parties and defective work outputs.

Research methodology and data collection techniques together with an empirical analysis form the basis of the subsequent chapters that validate the Chapter 1 hypotheses through structured evaluation methods.

Midocean University

College of Management

Master of Business Administration



Title in English

إدارة الصيانة التشغيلية والإعتمادية

Maintenance Reliability and Operational Management

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Year: 2025 | 1446