E.N.S.T
المدرسة الوطنية العليا للتكنولوجيا
École Nationale Supérieure de Technologie

الجمهورية الجزائرية الديمقراطية الشعبية

People' Democratic Republic of Algeria

وزارة التعليم العالي والبحث العلمي

Ministry of Higher Education and Scientific Research

Department of Industrial Engineering & Maintenance

Industrial and Maintenance Engineering Department

Thesis submitted in fulfillment of the requirements for the degree of

State Engineering

Field

Industrial Engineering

Specialty

Management and Industrial Maintenance Engineering

Title

FORMAINT Software

Realized by

Madjidi

Abderraouf

Jury members:

MESSEKHER SALAH EDDINE	President
SALHI NEDJMA	Advisor
/	Co-advisor
SI AHMED BOUALEM	Examiner

Algiers, in 26 – 06 - 2023

Academic year: 2022–2023

Acknowledgment

I would like to express our gratitude to Allah for blessing me with good health, determination, courage, and patience during our academic journey.

I would like to thank everyone who has contributed to the successful completion of my final year project, whether directly or indirectly.I am deeply grateful to our parents for their unwavering support, encouragement, and guidance.

My sincere thanks go to my supervisor, Mrs. NEDJMA SALHI, for her guidance, understanding, feedback, and encouragement throughout this work.

I would also like to thank Mr. Fateh and all the employees of the company, FORAID ALGERIE at Hassi Messoud, particularly the technicians of the maintenance workshop, who provided me with technical support and guidance throughout my project. Their expertise and assistance were crucial in helping me overcome the various challenges I encountered during the project.I am truly grateful for their invaluable contributions to our work. I am also grateful to Attali Ayoub for helping me in programming our software.

Finally, I extend my appreciation to the members of the jury for their interest in my work and for their valuable feedback, which helped me improve the quality of my work.

Dedications

To my dear father and mother for paving the way for my success through every possible means.

To my brothers

To my sisters

To my supervisor Ms. Salhi Nedjma

To Mr. Madjidi Fateh and the whole FORAID ALGERIE team

To Atalli Ayoub

To all the teachers and employees of ENST.

Madjidi Abderraouf.

Contents

List of Figures

List of Tables

Liste des abréviations

KPI	Key Performance Indicator.
VR & AR	Virtual Reality & Augmented Reality .
PSV	Pressure Safety Valve.
SQL	Structured Query Language.
CMMS	Computerized Maintenance Management System.
EAM	Enterprise Asset Managemen.
IoT	Internet of Things.
OEE	Overall Equipment Effectiveness.
SAP	Systems, Applications, and Products in Data Processing.
ML	Machine Learning.
AI	Artificial Intelligence.
ISO	International Organization for Standardization.
FDA	Food and Drug Administration.
IFS	International Featured Standards.
OHSAS	Occupational Health and Safety Assessment Series.
MRO	Maintenance, Repair and Overhaul.
SOA	Service-Oriented Architecture.
SP	Spare Parts.
MTBF	Mean Time Between Failure.
IT	Information Technology.
FMECA	Failure Modes, Effects and Criticality Analysis.
API	Application Programming Interface.
UI	User Interface.
BPMN	Business Process Model and Notation.

General introduction

In today's rapidly evolving economic landscape, efficient management of assets has become a critical factor for businesses [1], especially when it comes to ensuring the proper functioning and maintenance of diverse assets. Industrial enterprises face significant losses due to poor maintenance management, as even minor obstacles can have adverse indirect consequences for their overall operations [1]. Recognizing the growing importance of the maintenance function, there is a need to enhance and streamline its processes. This thesis aims to address this need by introducing an innovative asset management software, namely Asset Management, specifically designed for FORAID ALGERIE.

FORAID ALGERIE, a leading company providing maintenance services for pressure safety valves in various companies located in Hassi Messoud, Ouargla state [2], identified the need for an advanced software solution to optimize their maintenance operations. To meet this demand, the Asset Management software has been developed, enabling the calculation of asset reliability, criticality, and mean time between failures. Furthermore, it facilitates the generation of maintenance activity plans and utilizes color-coded alerts to highlight approaching maintenance dates. These valuable insights and data are presented through a user-friendly dashboard.

This thesis delves into the development, implementation, and evaluation of the Asset Management software, providing an in-depth analysis of its features, functionalities, and benefits. The research explores the effectiveness of the software in improving asset management practices, enhancing maintenance efficiency, and ultimately minimizing downtime and associated costs.

By investigating the real-world application of the Asset Management software in the context of FORAID ALGERIE and its clients, this thesis aims to contribute to the field of asset management and provide valuable insights into the advantages and potential impact of implementing such a solution. The findings of this study will serve as a basis for further improvements and the adoption of asset management software in similar industries and organizations.

Through this research, we strive to showcase the significance of technology-driven solutions in optimizing asset management processes, ensuring the smooth functioning of critical assets, and ultimately enhancing overall business performance.

Chapter 1

Overview of Assets

1.1 Introduction

This chapter explores the current state of asset management, focusing on key trends, methodologies, and technologies that shape the field. Assets are crucial for operational efficiency, cost reduction, and reliable performance.

Data-driven asset management is a prominent trend, utilizing analytics, machine learning, and AI to optimize maintenance strategies. Lifecycle management, digital twins, and sustainability considerations are also important.

Advanced test equipment plays a vital role in asset management, enabling accurate assessment, issue diagnosis, and informed maintenance decisions. Comprehensive tests help prevent failures, minimize downtime, and extend asset lifespan.

By embracing these trends and utilizing advanced test equipment, organizations enhance asset performance, reduce costs, and gain a competitive edge. The chapter delves deeper into asset management best practices, case studies, and practical applications.

1.2 Types of assets

1.2.1 Financial Assets

Financial assets are valuable resources used by business entities to generate benefits. Efficient utilization of assets leads to their expansion in quantity, value, and types. However, inconsistencies in terminology and limited research create confusion. Financial assets, such as cash, securities, and investments, represent rights to income from tangible or intangible assets. Comprehensive studies and separate analysis of financial assets are needed to improve decision-making and enhance the understanding of asset status. Adjustments in accounting and analysis are necessary to meet global market requirements [3].

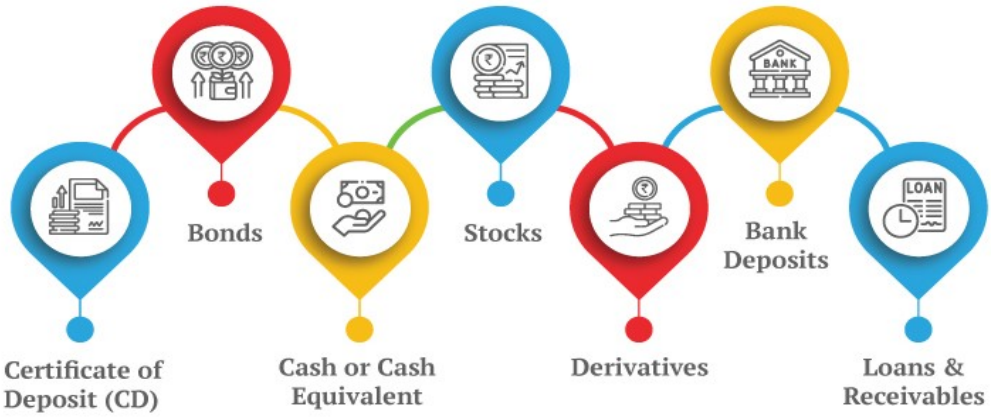


Figure 1.1: Finantial Assets Types [3]

1.2.2 Tangible Assets

Tangible assets are physical assets that have a physical form and can be touched or seen. Examples include real estate, machinery, vehicles, equipment, and inventory. These assets contribute directly to the production or operation of a business[4].

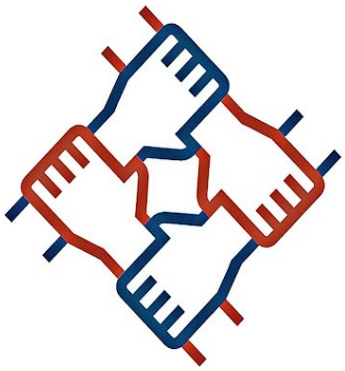
1.2.3 Intangible Assets

Intangible assets are non-physical assets that lack a physical form but hold value. They include intellectual property such as patents, trademarks, copyrights, and software. Intangible assets often contribute to a company's competitive advantage and can be highly valuable [5].

Figure 1.2: Intangible Assets

1.2.4 Human Assets

Human assets refer to the knowledge, skills, experience, and capabilities of individuals within an organization. They include the collective talent, expertise, and intellectual capital of employees. Human assets are vital for driving innovation, productivity, and overall organizational success [6].



1.2.5 Digital Assets

Digital assets are intangible assets stored or transmitted in digital formats. They include digital files, documents, databases, software, websites, and digital media such as images, videos, and audio recordings. Digital assets are essential for information storage, communication, and digital business operations [7].

1.3 Leveraging Assets for Improved Maintenance

In today's dynamic and competitive business landscape, effective maintenance practices are crucial for organizations to ensure optimal performance and reliability of their assets. To achieve this, organizations are increasingly turning to their assets as valuable resources that can contribute to the improvement of maintenance activities. By harnessing the capabilities of their assets, organizations can enhance their maintenance practices and drive operational excellence. So here we will explore how assets play a vital role in improving maintenance and highlight the benefits of leveraging asset capabilities for optimizing maintenance processes.

1.3.1 The role of Financial Assets

Financial assets provide the necessary funds for maintenance activities through their monetary value and liquidity. Here's how they support maintenance [3]:

Investment Returns:

Financial assets, such as stocks and bonds, have the potential to generate investment returns. The income or profits earned from these assets can be used to fund maintenance

activities. Organizations can allocate a portion of their investment returns specifically for maintenance purposes, ensuring a dedicated pool of funds for upkeep and repairs.

Cash Reserves:

Holding cash as a financial asset provides immediate access to funds. Businesses can maintain cash reserves specifically earmarked for maintenance expenses. These reserves act as a readily available source of funding for both planned and unplanned maintenance needs, allowing organizations to address maintenance issues promptly without disrupting operations.

Asset Liquidation:

Financial assets can be readily liquidated, meaning they can be sold or converted into cash relatively quickly. In situations where significant maintenance costs arise unexpectedly or require substantial funding, organizations can choose to sell some of their financial assets to generate the necessary funds. This flexibility allows for swift access to capital when urgent maintenance requirements arise [3].

Borrowing Power:

Financial assets can also serve as collateral or a basis for obtaining loans or lines of credit. When businesses need additional funds for maintenance activities, they can leverage their financial assets to secure financing. Lenders or financial institutions may be more willing to provide loans or credit facilities if the borrower has substantial financial assets, increasing the available resources for maintenance purposes.

By leveraging their financial assets effectively, organizations can ensure a consistent flow of funds to support maintenance activities. Whether through investment returns,

cash reserves, asset liquidation, or borrowing power, financial assets provide the necessary financial resources to maintain and preserve the physical assets and infrastructure of a business.

1.3.2 The role of Tangible Assets

Tangible assets play a crucial role in improving maintenance activities within organizations. The utilization of modern test assets, such as the modern test cabin and modern diagnostic materials, further enhances maintenance processes and outcomes. Here's how tangible assets ensure the improvement of maintenance activities [4], with a focus on modern test assets:

Accurate and Precise Testing:

Tangible assets enable accurate and precise testing, ensuring maintenance activities are based on reliable data and measurements.

Early Detection of Problems:

Utilizing modern test assets1.3 facilitates early problem detection, preventing breakdowns and reducing repair costs.

(a) Test Control Panel (b) PSV being Tested

Figure 1.3: PSV mobile Workshop at FORAID Algerie Company

Streamlined Maintenance Workflows:

Modern test assets automate tasks, improve efficiency, and provide real-time data analysis for faster assessments.

Figure 1.4: Modern control panel for testing workshop

Optimal Performance and Longevity:

Utilizing modern test assets supports optimal performance and longevity by maintaining assets in their optimal condition, maximizing efficiency and reducing long-term costs.

Briefly, tangible assets enable accurate testing, early problem detection, streamlined workflows, improved preventive maintenance, optimal performance, and longevity. Modern test assets enhance these benefits, providing organizations with more efficient and effective maintenance processes.

1.3.3 The role of Intangible Assets

In maintenance optimization, knowledge management and expertise utilization are critical. Organizations recognize the importance of capturing and sharing knowledge to enhance performance and decision-making.

Knowledge sharing platforms centralize maintenance-related information, best practices, and lessons learned. They enable easy sharing of expertise and innovative solutions, avoiding redundancy and fostering collaboration.

Training programs enhance the skills of maintenance personnel in areas like equipment maintenance, troubleshooting, safety, and emerging technologies. Continuous learning empowers teams to handle complex tasks efficiently.

Effective communication channels facilitate knowledge transfer through open dialogue, discussions, and real-time collaboration. They enable personnel to exchange insights and learn from each other's experiences.

Overall, knowledge management and expertise utilization tap into collective intelligence. Platforms, training, and communication channels drive continuous improvement and enhance maintenance practices.

1.3.4 The role of Human Assets

Human assets, also known as human resources or personnel, play a critical role in improving maintenance activities in the industry. The knowledge, skills, experience, and dedication of individuals involved in maintenance have a direct impact on the effectiveness and efficiency of maintenance operations. Here are some ways in which human assets contribute to enhancing maintenance practices in the industry [8]:

Expertise and Technical Knowledge:

Maintenance personnel possess specialized expertise and technical knowledge required for effective equipment maintenance, troubleshooting, and repair. Their in-depth understanding of machinery, systems, and processes enables them to identify issues, implement preventive measures, and ensure optimal performance. Leveraging the expertise of maintenance professionals helps minimize downtime, reduce equipment failures, and increase overall operational efficiency [8].

Training and Skill Development:

Continuous training and skill development programs are essential for equipping maintenance personnel with the latest industry knowledge, technological advancements, and best practices. Training initiatives cover areas such as equipment maintenance techniques, safety protocols, emerging technologies, and regulatory compliance. By investing in the professional development of maintenance staff, organizations empower them to handle complex maintenance tasks with confidence and competence.

Collaboration and Communication:

Effective collaboration and communication among maintenance teams and other departments within the organization are crucial for successful maintenance activities. Human assets contribute to fostering a culture of collaboration, teamwork, and knowledge sharing. By facilitating open dialogue, sharing insights, and coordinating efforts, maintenance personnel ensure seamless coordination and cooperation, leading to improved maintenance outcomes.

Problem-Solving and Decision-Making:

Maintenance personnel are responsible for identifying and resolving equipment malfunctions, failures, and other maintenance-related challenges. Their problem-solving skills and decision-making abilities are vital for diagnosing issues, implementing appropriate solutions, and minimizing downtime. The experience and expertise of maintenance professionals enable them to make informed decisions, prioritize tasks, and optimize maintenance processes [8].

Safety and Risk Management:

Human assets play a crucial role in ensuring safety and mitigating risks associated with maintenance activities. Maintenance personnel adhere to safety protocols, follow proper procedures, and identify potential hazards to create a safe working environment. Their vigilance and attention to detail contribute to preventing accidents, reducing injuries, and maintaining compliance with safety regulations.

Continuous Improvement:

Human assets are at the forefront of driving continuous improvement in maintenance practices. Through feedback mechanisms, performance evaluations, and lessons learned, maintenance personnel contribute to identifying areas for improvement and implementing process enhancements[8]. Their insights and suggestions help optimize maintenance procedures, enhance equipment reliability, and increase overall operational efficiency.

Recognizing the value of human assets and investing in their development, collaboration, and well-being is essential for improving maintenance activities in the industry. By leveraging the expertise, skills, and dedication of maintenance personnel, organizations can achieve higher equipment reliability, reduced downtime, and increased productivity, ultimately leading to improved operational performance.

1.3.5 The role of Digital Assets

Digital assets play a significant role in improving maintenance activities in the industry by leveraging advanced technologies and digital systems. These assets encompass a wide range of digital tools, software, and data-driven solutions that enhance efficiency, accuracy, and effectiveness in maintenance operations. Here are some ways in which digital assets contribute to improving maintenance activities [9] in the industry:

Data-Driven Decision-Making:

Digital assets enable maintenance personnel to collect, analyze, and interpret vast amounts of data related to equipment performance, maintenance history, and operational parameters. By utilizing data analytics and machine learning algorithms, maintenance teams can make data-driven decisions regarding maintenance strategies, scheduling, and resource allocation. This helps in optimizing maintenance activities, predicting equipment failures, and maximizing uptime.

Condition Monitoring and Predictive Maintenance:

Digital assets facilitate real-time condition monitoring of equipment through sensors, IoT devices, and connectivity solutions. By continuously monitoring equipment health, performance, and operating conditions, maintenance personnel can detect anomalies, identify potential failures, and take proactive measures to prevent breakdowns. Predictive maintenance techniques based on data analysis enable maintenance teams to schedule maintenance activities before failures occur, reducing downtime and minimizing costs.

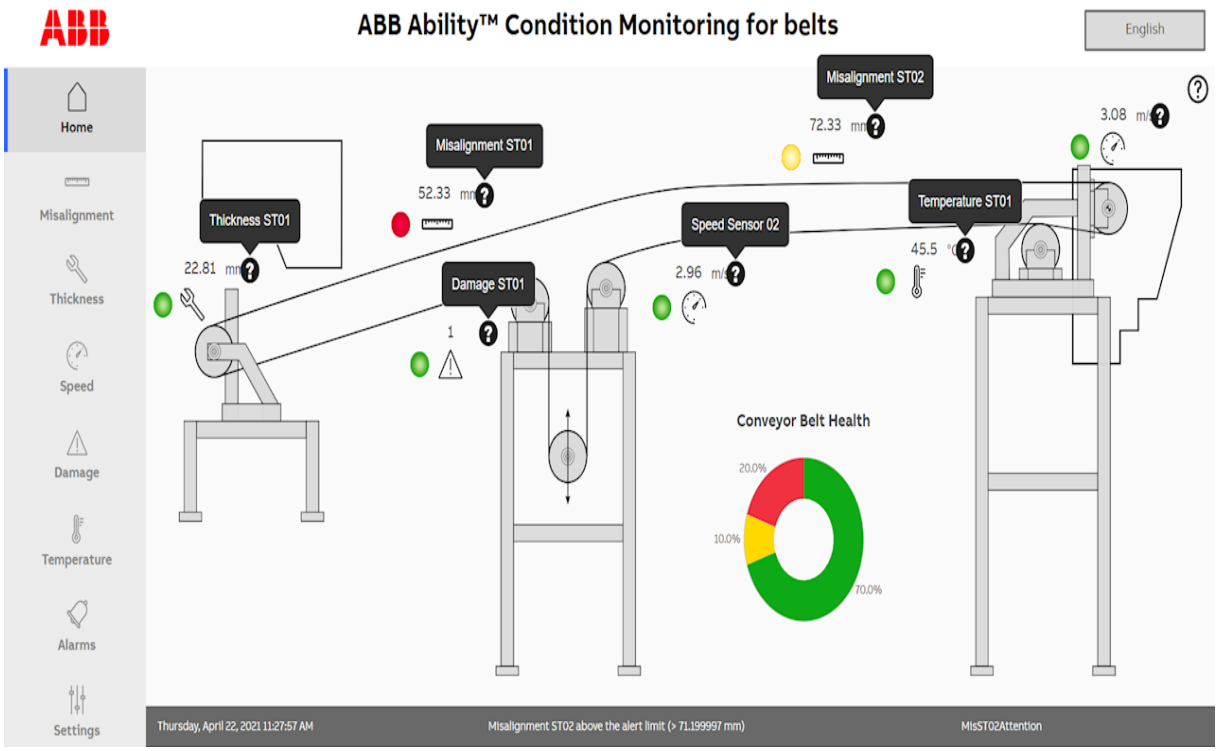


Figure 1.5: ABB's New Condition Monitoring Digital Service for Predictive Maintenance of Conveyor Belts [10]

Asset Performance Optimization:

Digital assets provide tools and platforms for tracking and optimizing asset performance. Performance management systems collect and analyze data to measure key performance indicators (KPIs), such as equipment reliability, availability, and overall equipment effectiveness (OEE).

By monitoring and benchmarking asset performance against set targets, maintenance teams can identify areas for improvement, implement optimization strategies, and en-

hance overall equipment performance.

Figure 1.6: Manufacturing KPIs Dashboard

Maintenance Management Systems:

Digital assets encompass computerized maintenance management systems (CMMS) and enterprise asset management (EAM) software, which streamline maintenance processes, work orders, and resource management. These systems provide centralized databases for asset information, maintenance history, spare parts inventory, and documentation. By automating workflows, tracking maintenance activities, and generating reports, maintenance management systems enhance productivity, improve resource utilization, and ensure compliance with maintenance schedules.

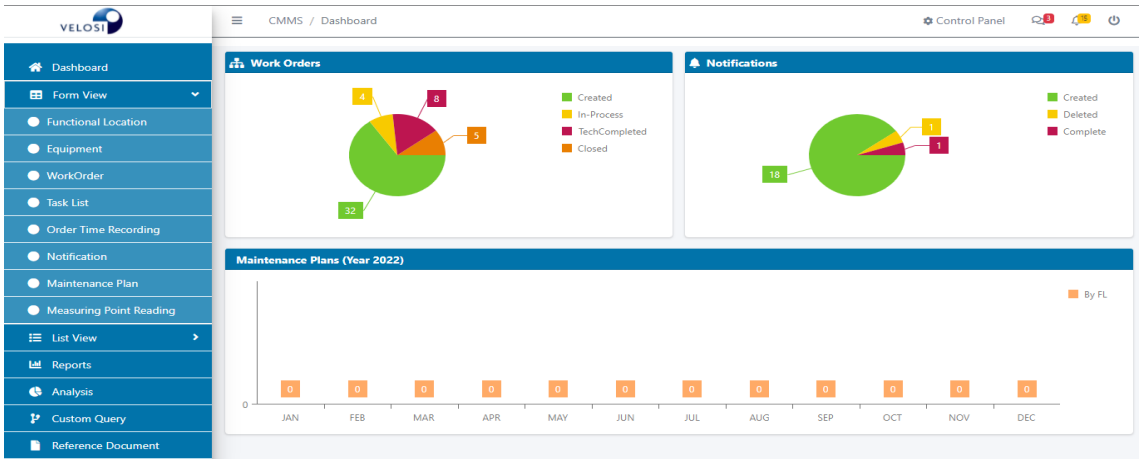


Figure 1.7: VAIL-CMMS software

Augmented Reality and Virtual Reality:

Digital assets like augmented reality (AR) and virtual reality (VR) technologies are increasingly being used in maintenance activities. AR overlays digital information onto real-world views, enabling maintenance personnel to access equipment manuals, instructions, and visual guides in real-time. VR simulates realistic environments for training purposes, allowing maintenance teams to practice complex procedures in a safe and controlled setting. These technologies enhance maintenance skills, reduce errors, and improve overall maintenance effectiveness.

Figure 1.8: Expanding the scope of remote work using VR/AR

Digital assets have revolutionized maintenance practices in the industry by leveraging advanced technologies and data-driven approaches. By harnessing the power of digital tools, software solutions, and data analytics, maintenance teams can optimize maintenance strategies, improve asset performance, and achieve higher levels of efficiency and reliability. Incorporating digital assets into maintenance processes can lead to cost savings, increased equipment uptime, and improved overall operational performance [9].

1.4 Conclusion

In conclusion, effective asset management is crucial for organizations to optimize maintenance activities and achieve operational excellence. Key types of assets include financial assets, tangible assets, intangible assets, human assets, and digital assets. Leveraging these assets brings several benefits to maintenance processes.

- Financial assets provide necessary funds through investment returns, cash reserves, asset liquidation, and borrowing power.
- Tangible assets enable accurate testing, early problem detection, streamlined workflows, preventive maintenance, and optimal performance.
- Intangible assets facilitate knowledge sharing, training programs, and effective communication for continuous improvement.
- Human assets contribute expertise, technical knowledge, collaboration, problem-solving, safety management, and continuous improvement.
- Digital assets enable data-driven decision-making, condition monitoring, predictive maintenance, and automation.

By harnessing the capabilities of these assets, organizations can enhance maintenance practices, reduce costs, minimize downtime, and improve overall operational performance.

Chapter 2

Market Study and Positioning Analysis

2.1 Introduction

In this chapter, we will conduct an in-depth market study to analyze three key software solutions that offer asset management functionalities similar to the one developed for FORAID ALGERIE. The software products under scrutiny are Maximo Software, Fiix Software, and MainWinWin software.

The primary objective of this market study is to thoroughly evaluate the capabilities and offerings of Maximo Software, Fiix Software, and MainWinWin software in the context of asset management. By conducting a comprehensive analysis of these solutions, including their features, functionalities, market positioning, and customer feedback, we aim to gain valuable insights into the current state of the industry and identify potential areas of improvement.

Furthermore, as our software is specifically tailored to address the asset management challenges and unique requirements of FORAID ALGERIE, we will explore how each of these solutions aligns with the organization's needs. By showcasing how our software excels in calculating asset reliability, determining criticality, and facilitating maintenance planning, we aim to demonstrate its value proposition and competitive advantage over the existing solutions in the market.

This chapter will provide a detailed examination of both direct and indirect com-

petitors within the asset management software market. By analyzing the strengths and weaknesses of Maximo Software, Fiix Software, and MainWinWin software, we can identify opportunities to differentiate our software and tailor it precisely to cater to FORAID ALGERIE's specific needs and requirements. By understanding the market landscape and strategically positioning our software, we can develop effective marketing strategies that ensure successful adoption and usage within the organization.

2.2 The Best Software in the International and National Market

I chose to focus on these three software solutions, ManWinWin, Fiix Software, and Maximo Software, for several reasons related to my asset management software development project. I conducted thorough research to extract the key points on which I needed to focus in my own software. Here's why I chose these software solutions:

- Reputation in the international and national market: These three software solutions are recognized and well-established in both the international and national market. They have a strong presence and have been adopted by numerous organizations. Their reputation reflects their quality and ability to meet the needs of businesses in asset management.

- Comprehensive features: ManWinWin, Fiix Software, and Maximo Software offer comprehensive asset management solutions. They provide a wide range of features, such as asset tracking, maintenance planning, inventory management, work order management, and more. I studied these features to identify the ones that are essential to include in my software.

- Customer satisfaction: I examined customer feedback on these software solutions to assess their level of satisfaction. Positive user reviews have confirmed the effectiveness and reliability of these software solutions in asset management. I took these feedback into account to ensure that I meet the expectations of potential users of my own software.

- Customer satisfaction: I examined customer feedback on these software solutions to assess their level of satisfaction. Positive user reviews have confirmed the effectiveness and reliability of these software solutions in asset management. I took these feedback into account to ensure that I meet the expectations of potential users of my own software.

By studying these three software solutions, I will extract best practices, essential features, and key aspects on which I should focus in the development of my own asset management software.

2.3 Fiix Software

2.3.1 Description

Fiix Software is a cloud-based computerized maintenance management system (CMMS) designed to streamline and optimize maintenance operations. With its user-friendly interface and powerful features, Fiix helps organizations efficiently manage assets, track work orders, schedule preventive maintenance, and gain valuable insights into maintenance processes. It offers comprehensive asset management, work order management, preventive maintenance scheduling, reporting and analytics, and mobile capabilities. Fiix Software empowers maintenance teams to enhance asset performance, improve operational efficiency, and achieve maintenance goals [11].

2.3.2 Market Overview

The market for computerized maintenance management system (CMMS) software has been experiencing significant growth in recent years. As organizations increasingly rec-

ognize the importance of efficient maintenance management and asset optimization, the demand for robust CMMS solutions has risen. Fiix Software has emerged as a key player in this market, catering to a wide range of industries and organizations seeking to streamline their maintenance operations.

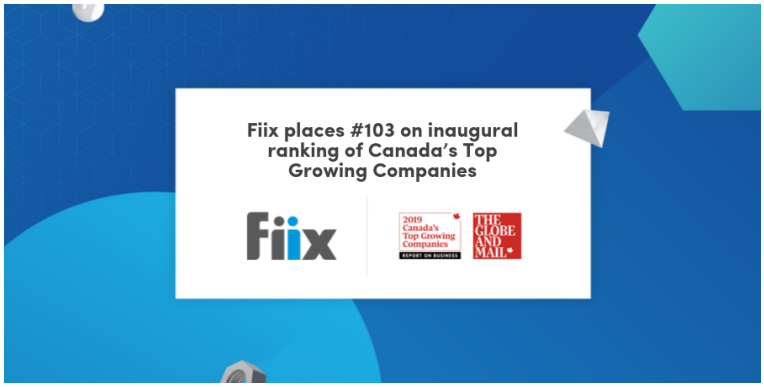


Figure 2.1: Inaugural ranking of Canada's top growing companies [11]

2.3.3 Price of license

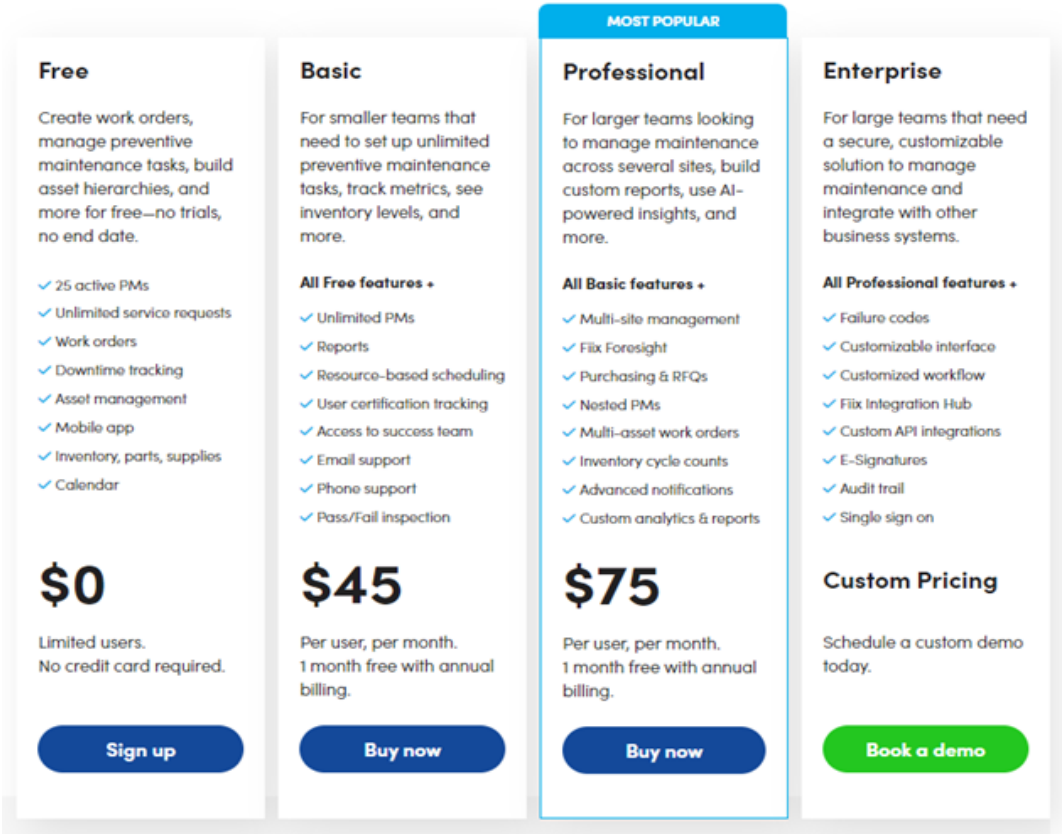


Figure 2.2: The pricing plan of Fiix Software [12]

2.3.4 Competitive Landscape

Fiix Software faces competition from both established players and emerging vendors in the CMMS software market. Competitors include well-known companies like IBM Maximo, SAP EAM, Maintenance Connection, and eMaint, among others. These competitors offer similar functionalities and target similar industries, making the market highly competitive. Fiix Software differentiates itself through its user-friendly interface, ease of implementation, excellent customer support, and focus on cloud-based solutions.

2.3.5 Target Market Segments

Fiix Software caters to various industry verticals, including manufacturing, facilities management, transportation, energy, and healthcare. These industries have a diverse range of maintenance requirements and asset types, making the flexibility of the software a key selling point. Fiix Software's solutions are scalable and can be tailored to the needs of small, medium, and large enterprises, allowing it to capture a wide market segment [12].

Figure 2.3: The Domains Utilizing Fiix Software

2.3.6 Key Features and Functionalities

Fiix Software offers a comprehensive set of features and functionalities to support maintenance management and asset optimization [11]. These include:

- Work order management: Tracking and managing maintenance tasks, assigning work orders, and monitoring progress.
- Preventive maintenance scheduling: Creating and managing maintenance schedules based on time, usage, or condition-based triggers.

- Asset tracking: Managing and tracking assets throughout their lifecycle, including maintenance history, performance data, and warranty information.
- Inventory management: Optimizing inventory levels, managing spare parts, and streamlining procurement processes.
- Reporting and analytics: Generating reports and gaining insights into maintenance performance, asset reliability, and resource utilization.
- Mobile accessibility: Allowing technicians to access and update maintenance data from mobile devices in the field.
- Integrations: Enabling seamless data exchange with other business systems such as ERP, accounting, and asset management software.

Figure 2.4: Appearance of Fiix Software on Different Screen Devices

2.3.7 Customer Satisfaction and Testimonials

Fiix Software has received positive feedback and high customer satisfaction ratings. Customers appreciate the software's ease of use, intuitive interface, and powerful features. The ability to improve maintenance efficiency, reduce downtime, and increase asset reliability has been highlighted as key benefits. Fiix Software's customer support and training programs have also been commended for their responsiveness and effectiveness [13].

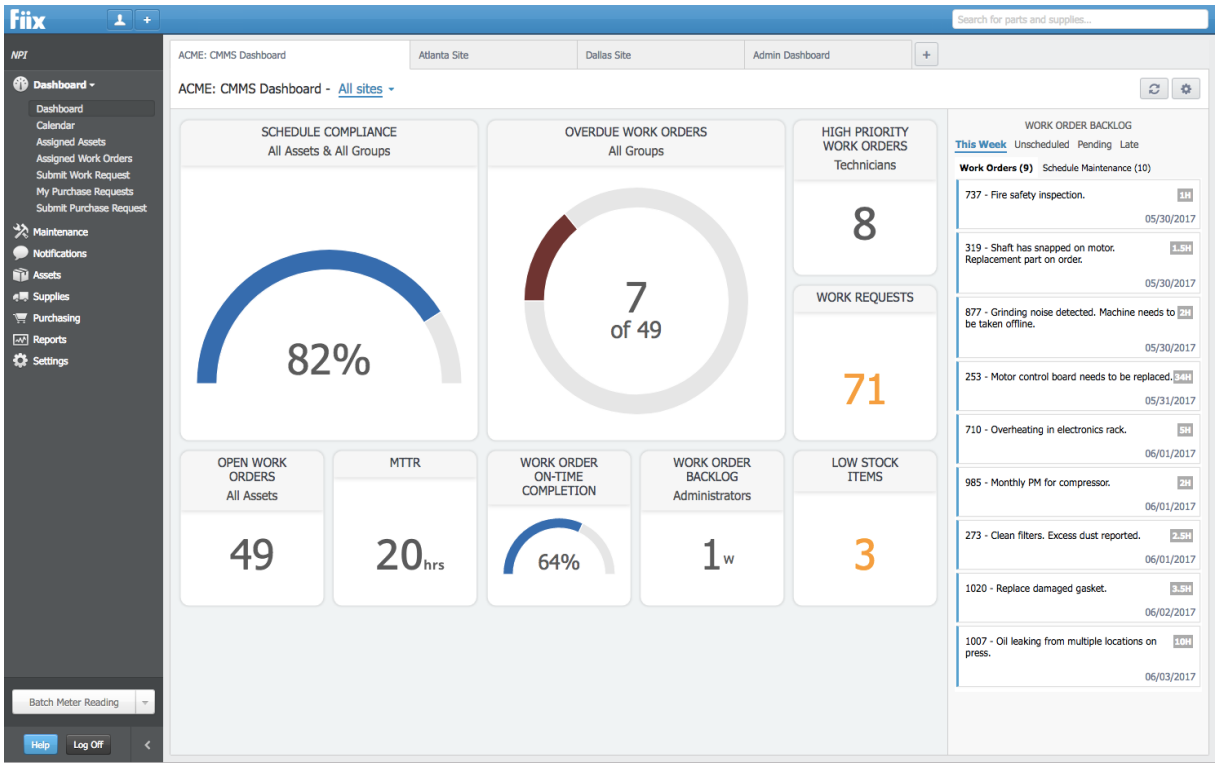


Figure 2.5: Fiix Software Dashboard

2.3.8 Market Trends and Future Outlook

The CMMS software market is expected to continue growing as organizations increasingly prioritize maintenance optimization and asset management. Key trends within the market include the adoption of cloud-based solutions, the integration of CMMS with IoT devices for predictive maintenance, and the incorporation of artificial intelligence (AI) and machine learning (ML) technologies for advanced analytics and decision-making [11].

As Fiix Software expands its market reach and enhances its product offerings, it will likely benefit from the growing demand for CMMS solutions. Continual innovation, stay-

ing ahead of emerging technologies, and understanding evolving customer needs will be essential for maintaining a competitive edge in the market.

2.4 ManWinWin Software

ManWinWin (Navaltik Management, Lda) is a renowned Portuguese software company established in 1981. With a rich history spanning 40 years, they have developed a strong presence in the industry, serving thousands of users across more than 100 countries with their software solutions (boasting around 400 worldwide clients) [14].

Specializing in computerized maintenance management system (CMMS) solutions, ManWinWin is at the forefront of providing cutting-edge software that optimizes maintenance operations and improves asset performance. Their comprehensive and user-friendly software offers a range of features designed to streamline processes, schedule preventive maintenance tasks, track work orders, and provide advanced analytics tools for data-driven decision-making.

This study will delve into the market dynamics of ManWinWin Software, exploring aspects such as customer satisfaction, the competitive landscape, and key features. By examining these factors, organizations considering the implementation of a CMMS solution can gain valuable insights to inform their decision-making process and ensure successful adoption of ManWinWin Software.

2.4.1 Market Overview

The asset management software market has experienced significant growth in recent years, driven by the increasing need for organizations to streamline their maintenance processes, improve productivity, and reduce costs.

Their distribution (ManWinWin) of sales is approximately 36% international and 64% national. Its mission is to provide a sustainable experience to its customers by providing reliable and innovative software and services.

In terms of industry, they operate in the consulting sector, more specially in the engineering/maintenance management sector. In 2017 was recognized as one of the top-performing products in the computerized maintenance management system (CMMS) market, and over the last five years, ManWinWin has been growing (on average) 10,50% per year[14].

2.4.2 Price of license

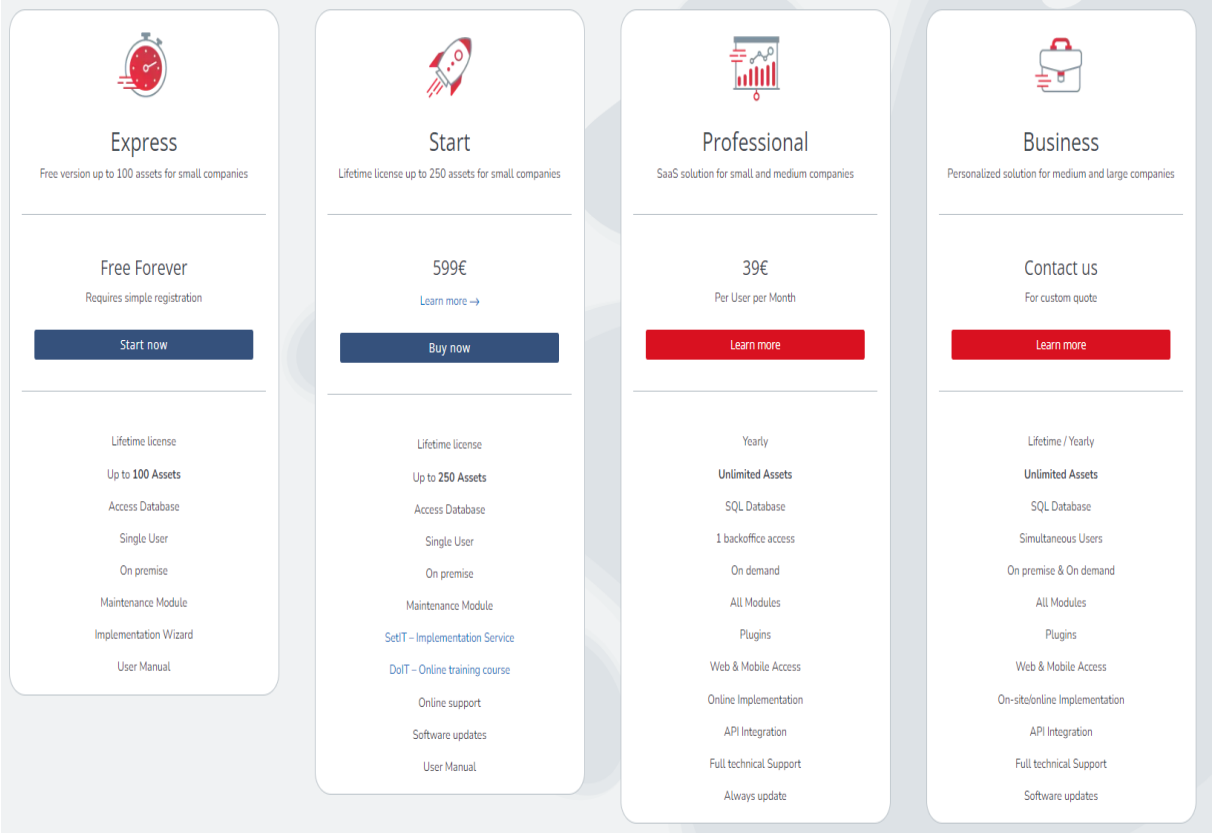


Figure 2.6: The pricing plan of ManWinWin Software [15]

2.4.3 Key Features and Capabilities

ManWinWin Software provides maintenance teams with a robust set of features for asset management, preventive maintenance scheduling, work order tracking, and performance analysis. Its intuitive interface and customizable workflows cater to specific maintenance requirements.

Additionally, the software offers advanced analytics and reporting tools, enabling organizations to gain valuable insights. By tracking KPIs, analyzing trends, and identifying improvement areas, users can make data-driven decisions and optimize their maintenance strategies.

ManWinWin's product focuses on daily maintenance operations across various industries and equipment types. It is known for its user-friendly interface, low investment, and smart configuration capabilities (ManWinWin, 2021) [14].

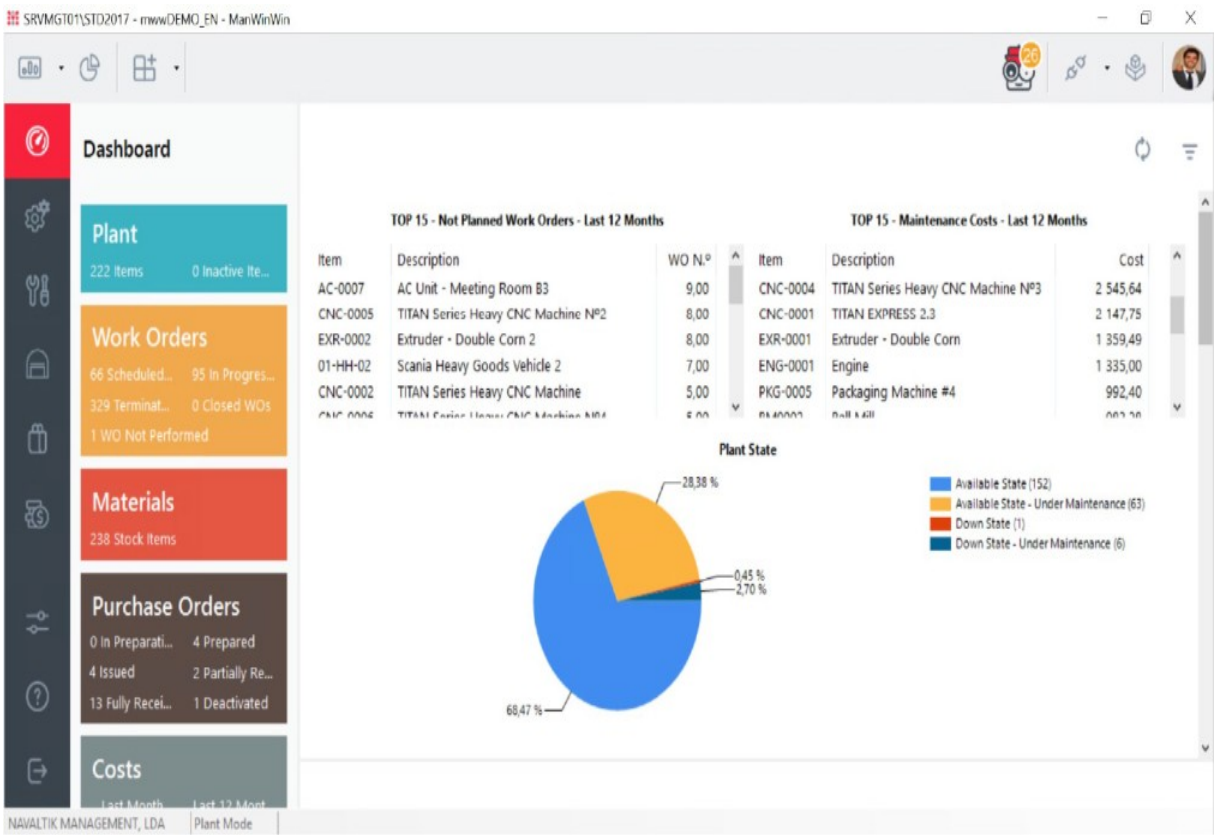


Figure 2.7: ManWinWin Software Dashboard

2.4.4 Target Industries and Customers

ManWinWin Software serves a wide range of industries, including manufacturing, facilities management, energy, transportation, and others. Its flexible and scalable solution is designed to meet the needs of organizations of all sizes, from small businesses to large enterprises. The software is suitable for both private and public sectors, offering a versatile solution for various industries [14].

2.4.5 Customer Satisfaction and Reviews

ManWinWin software has garnered positive customer satisfaction and reviews, establishing itself as a trusted asset management solution. Users value its user-friendly interface, extensive functionality, and responsive customer support [16]. The software effectively streamlines operations, enhances efficiency, and readily adapts to users' specific requirements. With an average reported cost reduction of 25% after implementation, and 58% of users considering it a critical compliance tool for ISO, FDA, IFS, and OHSAS audits, ManWinWin stands as a reliable and impactful choice for asset management needs [14].

2.5 Maximo Software

Maximo is an enterprise asset management software initially developed by Project Software & Development (later MRO Software). It was first released in 1985 and subsequently acquired by IBM in 2005, rebranded as IBM Maximo Asset Management. In July 2021, the product underwent a name change to IBM Maximo Manage with the release of version 8.

The primary purpose of Maximo is to assist organizations in managing their assets, including buildings, vehicles, fire extinguishers, and equipment. It enables users to capture asset details, create maintenance schedules, and participate in workflows for efficient asset management and maintenance operations.

2.5.1 Market Overview

The EAM market has witnessed significant growth in recent years, driven by the increasing need for organizations to effectively manage their assets and ensure operational efficiency. Maximo Software has emerged as a prominent player in this market, catering to a wide range of industries including manufacturing, energy, utilities, transportation, and more. The software's scalability and flexibility make it suitable for organizations of all sizes, from small businesses to large enterprises [17].

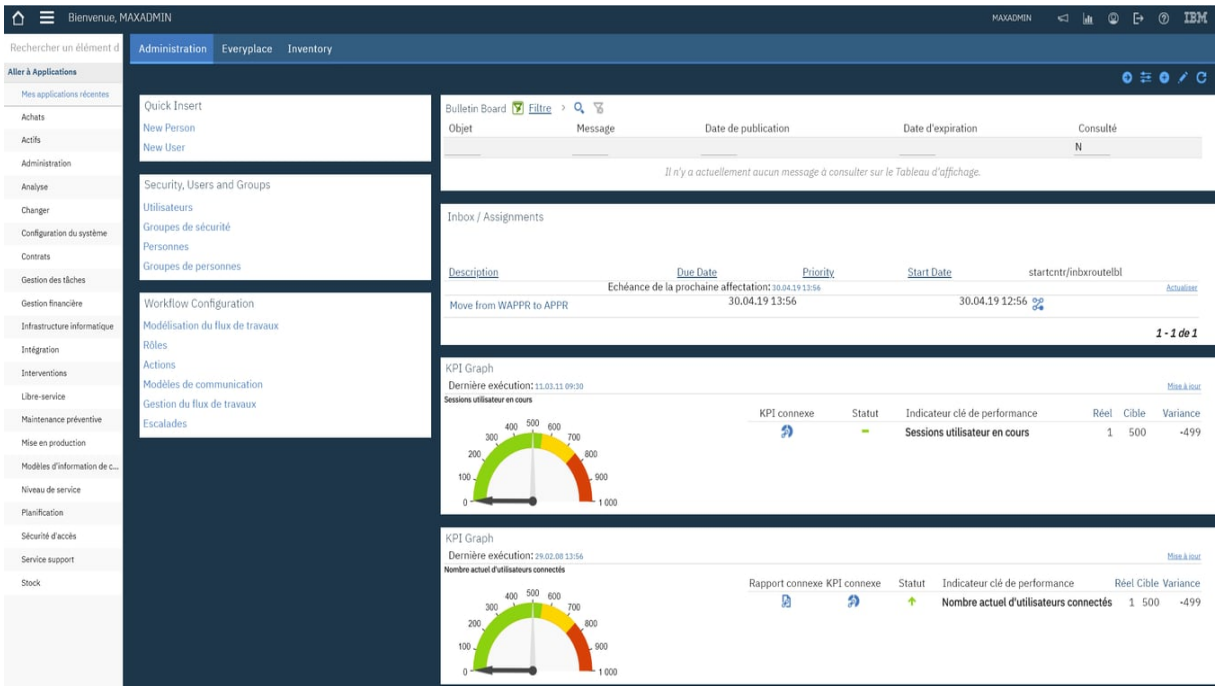


Figure 2.8: Maximo Software Dashboard

2.5.2 Price of license

The company offers the most basic license for about $250 per user per month. However, IBM Maximo corporation also charges a license fee for an entity to use it; around $1,500 per month. Administrative licenses can cost over $600 per user per month [18].

2.5.3 Key Features and Capabilities

IBM has successfully advanced the Maximo platform with significant developments. This includes an enhanced service-oriented architecture (SOA) for seamless integration and scalability, a dynamic user interface, improved deployment management capabilities, extended asset management features. IBM's commitment to technical and industry expertise has addressed unique requirements and accelerated industry-specific functionalities. The future of Maximo is a comprehensive asset management solution driving operational excellence and delivering tangible business value [17].

2.5.4 Market Trends and Future Outlook

- IBM's global consulting practice and support organizations are positioned to deliver services and support that go beyond the expectations of Maximo users.

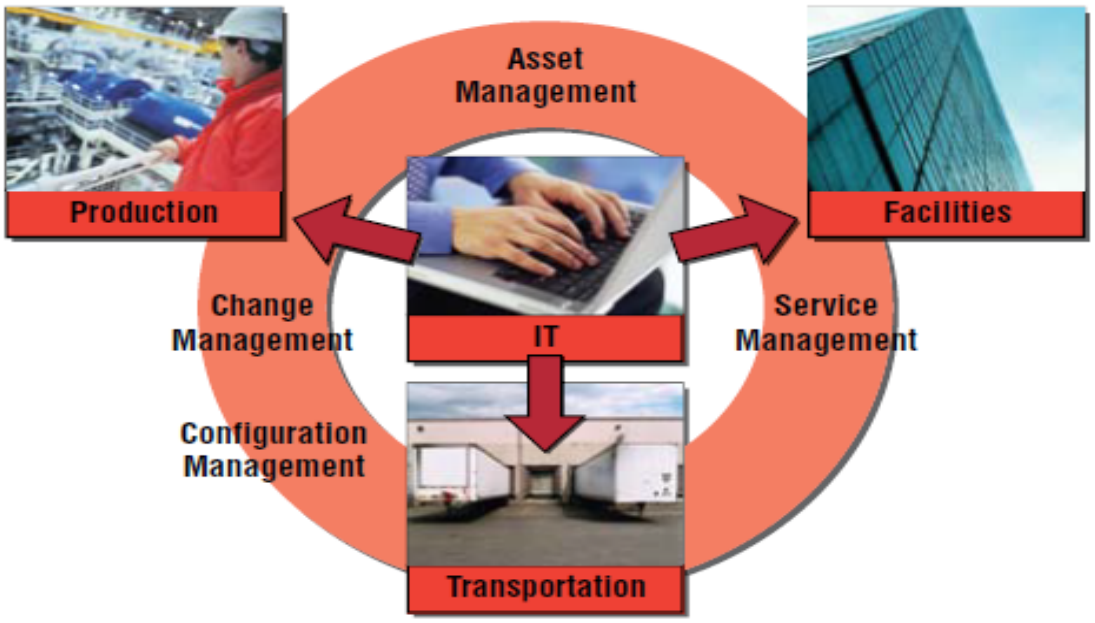


Figure 2.9: Key Features and Capabilities of Maximo Software [17]

- The existing relationship between IBM's Global Services and MRO Software services will be extended, strengthening their commitment to the Maximo customer base [17].
- Leveraging IBM's extensive technology and business expertise, the Maximo services and support teams will be able to offer a wider range of services, catering to diverse requirements.
- Integration with operational and enterprise applications, as well as the deployment of enterprise portals and enterprise business process automation, will be key areas of focus [17].
- IBM Global Services will enhance Maximo deployment by providing business process improvement services and sharing industry best practices.
- The future outlook for Maximo includes continued growth and expansion, driven by IBM's dedication to delivering exceptional services and support to its customers [17].

2.6 Comparative Analysis of ManWinWin, Maximo, and Fiix Software

Software	**ManWinWin Software**	**Maximo Software**	**Fiix Software**
Established	1981	1985	2008
Type	Engineering/ Maintenance Management	Asset Management	CMMS
Market Share	Around 400 worldwide clients	Wide customer base across Industries	Growing presence in the CMMS software market
Target Users	Organizations of all sizes	Organizations of all sizes	Organizations of all sizes
Deployment	On-premise	on-premise and Cloud-based	Cloud-based
Key Features	Maintenance module, Scheduling, Analytics	Assets management, Maintenance scheduling	Assets management, work order tracking
Pricing	free forever, lifetime license, subscription	license free and subscription-based pricing	free, basic, professional, Enterprise
Customer satisfaction	Positive customer satisfaction and reviews	lPositive customer satisfaction and reviews	Positive customer satisfaction and reviews

Table 2.1: Comparison between 3 softwares

2.6.1 Maximo Software (IBM Maximo Asset Management)

- Developed by Project Software & Development, later acquired by IBM.
- Provides enterprise asset management solutions for managing buildings, vehicles, equipment, etc.
- Scalable and flexible, suitable for organizations of all sizes.

- Offers features like asset details capture, maintenance scheduling, and workflow participation.
- Price of license: Basic license starts at around $250 per user per month, with additional fees for entity usage and administrative licenses.
- Key features and capabilities include enhanced service-oriented architecture (SOA), dynamic user interface, improved deployment management, and extended asset management features.
- Market trends and future outlook focus on delivering exceptional services, support, and integration with operational and enterprise applications.

2.6.2 ManWinWin Software

- Developed by Navaltik Management, a Portuguese software company.
- Specializes in computerized maintenance management system (CMMS) solutions.
- Offers features for asset management, preventive maintenance scheduling, work order tracking, and performance analysis.
- Market overview indicates international and national distribution, serving industries like manufacturing, facilities management, energy, and transportation.
- Price of license: Free version available for up to 100 assets for small companies, lifetime licenses available starting from €599, and SaaS solution for small and medium companies starts at €39 per user per month.
- Customer satisfaction and reviews are positive, with users valuing the user-friendly interface, functionality, and customer support.

2.6.3 Fiix Software

- Provides maintenance management software solutions.
- Focuses on asset and work order management, preventive maintenance, and reporting.

- Offers features like asset tracking, scheduling, inventory management, and mobile access.
- Market overview indicates a focus on manufacturing, facilities management, and other industries.
- Price of license: Pricing plans are not mentioned in the provided information.
- Key features and capabilities include asset tracking, work order management, inventory management, and reporting.

2.7 Conclusion

In conclusion, the CMMS software market offers strong contenders such as ManWinWin and Fiix Software, which have received positive customer satisfaction ratings. It is worth noting that Maximo Software (IBM Maximo Manage) is also a prominent player, albeit with higher pricing. However, these software solutions lack a direct working relationship with their clients. This presents a unique opportunity for a service-oriented company like FORAID Algerie to integrate a management software that can establish a working connection with clients. Such integration would significantly enhance efficiency and usefulness, especially considering that no other maintenance service providers in Algeria currently utilize this type of management software. Consequently, FORAID Algerie holds a competitive advantage in this aspect.

Chapter 3

Conceptual Study of the Future Information System

3.1 Introduction

Through the analysis of FORAID ALGERIA's requirements, we have identified the essential aspects to be taken into account during the development of the future information system. This chapter focuses on the conceptual study of the upcoming asset management system, aiming to define and document the system's characteristics in line with the company's needs and requirements. We will explore the functional and non-functional features of the system, along with the Horned Beast diagram, and introduce a project task organization tool known as the Gantt project. Furthermore, we will utilize the UML modeling language to create use case diagrams, sequence diagrams, and conclude with the class diagram.

3.2 Gantt Project

Gantt Project is a popular project management software that allows users to create and manage project schedules using Gantt charts. It provides a visual representation of project tasks, their dependencies, and their timelines. With Gantt Project, users can define project tasks, assign resources, set task durations and dependencies, and track progress. The software offers features such as task scheduling, resource management, milestone tracking, and critical path analysis. It is widely used in various industries and is especially helpful for planning and tracking complex projects. Gantt Project is an open-source tool, available for free, and is compatible with different operating systems, including Windows, macOS, and Linux.

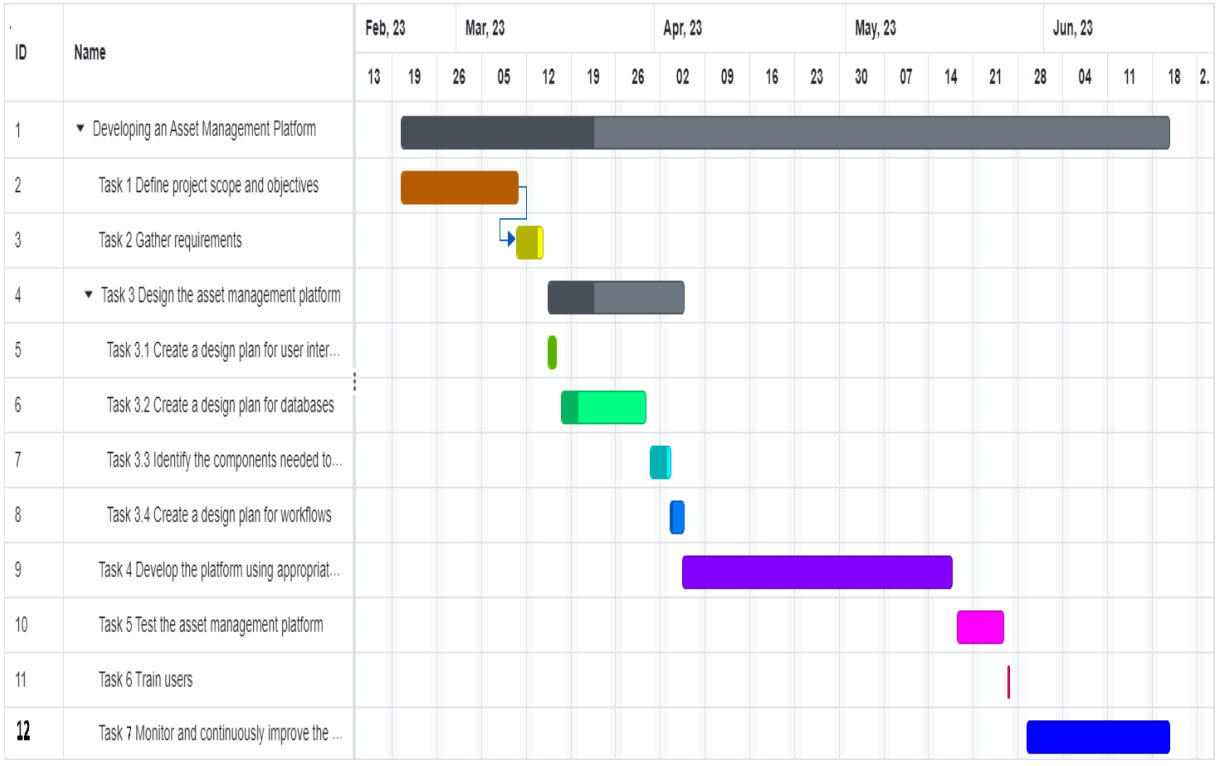


Figure 3.1: Project schedules using Gantt charts [19]

ID	Name	Start Date	End Date	Duration	Color
1	Developing an Asset Management Platform	febr 20, 2023	juin 20, 2023	87 days	
2	Task 1 Define project scope and objectives	febr 20, 2023	mars 10, 2023	15 days	
3	Task 2 Gather requirements	mars 10, 2023	mars 14, 2023	3 days	
4	Task 3 Design the asset management platform	mars 15, 2023	apr 05, 2023	16 days	
5	Task 3.1 Create a design plan for user interfaces	mars 15, 2023	mars 16, 2023	2 days	
6	Task 3.2 Create a design plan for databases	mars 17, 2023	mars 30, 2023	10 days	
7	Task 3.3 Task 3.3 Identify the components needed to develop the platform "programming languages, frameworks, tools...".	mars 31, 2023	apr 03, 2023	2 days	
8	Task 3.4 Create a design plan for workflows	apr 03, 2023	apr 05, 2023	3 days	
9	Task 4 Develop the platform using appropriate programming languages, frameworks, and tools...	apr 05, 2023	mai 17, 2023	31 days	
10	Task 5 Test the asset management platform	mai 17, 2023	mai 25, 2023	6 days	
11	Task 6 Train users	mai 26, 2023	mai 26, 2023	1 day	
12	Task 8 Monitor and continuously improve the platform (ongoing)	mai 27, 2023	juin 20, 2023	17 days	

Table 3.1: The table that explains the sequence of project tasks

3.3 Functional characteristics of the proposed system

- PSV management: add PSVs, track and control them, and record all related information.
- SP management: add parts, track and control parts, update the list of SPs, and set a notification for reordering each SP.
- Intervention planning: manage any intervention, whether preventive or corrective, that will occur on equipment, including dates, etc.
- Historical management: display planned and unplanned interventions for each PSV, with the ability to add unplanned interventions.
- Employee management: add employees and all their information, modify their information, and set permissions for each employee.
- Calculate the reliability of PSVs and the MTBF.
- Calculate the criticality.

3.4 Non-Functional requirements

- The Software should be secure and protect the privacy of customer data.
- The Software should be scalable to handle a large number of customers and assets.
- The Software should be responsive and provide a seamless user experience.
- The Software should be compatible with different operating systems.
- The Software should have a fast and reliable performance.
- The Software should comply with relevant safety standards and regulations.
- The Software should provide customer access controls to ensure that sensitive data is only visible to authorized personnel.
- The Software should be designed with user-friendly interfaces and visualizations to facilitate customer understanding of asset performance and maintenance activities.

- The Software should be designed with data quality controls to ensure accuracy and completeness of customer asset data.
- The Software should be highly available and designed for disaster recovery to minimize downtime and data loss.
- The Software should be designed for ease of use and accessibility for customers with varying levels of technical expertise.
- The Software should be designed with user feedback mechanisms to continuously improve user experience and functionality.
- The Software should be designed with advanced analytics capabilities to facilitate data-driven decision making.
- The Software should allow the company to export data and reports to external systems or applications.
- The software should provide real-time updates.

3.5 The Horned Beast Diagram

The Horned Beast diagram is a tool used in functional design and project management to address three key questions:

- Whom will the project serve?
- What does it affect or interact with?
- For what goal?

In our project, the project will serve FORAID ALGERIA customers, interact with assets (PSVs), and the goal of the project is to make better decisions based on reliable data.

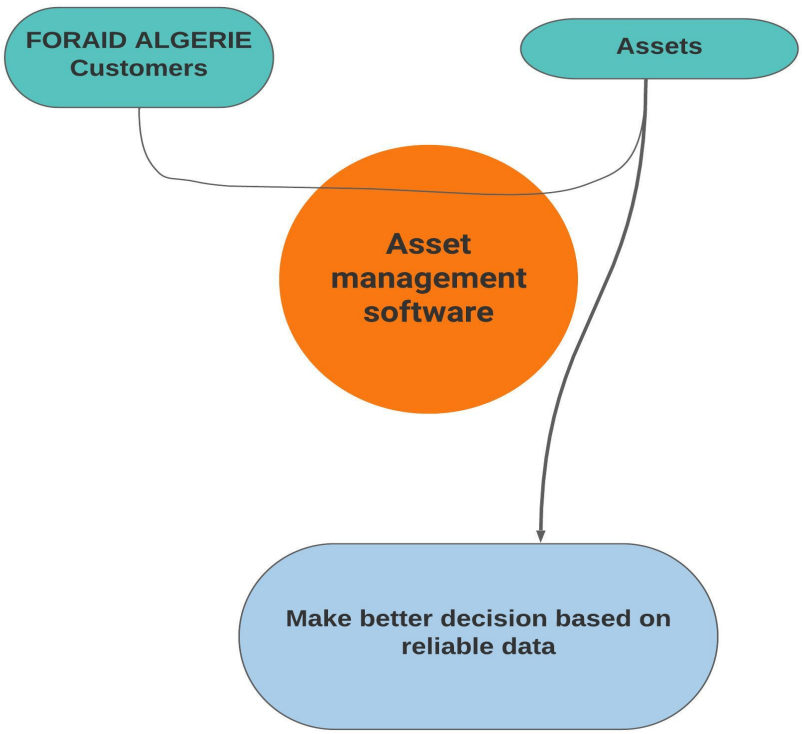


Figure 3.2: Horned Beast diagram of Asset management software

3.6 Presentation of the Object-Oriented Modeling Language UML

A conceptual data model is defined as "a representation of data needs for an information system that highlights entities, their attributes, associations, and constraints between these entities for a given domain". For the design of our system, we chose to use UML, or Unified Modeling Language, because of its suitability for IT projects, and for its flexibility, performance, and versatility [20].

UML is a standardized modeling language consisting of several diagrams that facilitate the visual representation of objects, states, and processes in software or a system. Its diagrams allow the representation of the software to be developed, its operation, implementation, the actions that can be performed by the software, and the actors who use it. Creating these diagrams thus involves modeling the needs of the software to be developed. UML is used as a means of communication between conceptual specification stages and technical specification stages.

There are several diagrams within the UML formalism, the main ones being:

- The class diagram, which describes the classes that are types of objects in the information system.
- The sequence diagram, which describes the different interactions between the elements of software in response to a request.
- The use case diagram, which represents the major functionalities needed by system users.

3.6.1 Use case diagram

The use case diagram is a UML diagram used to provide a high-level, easily understandable overview of the functional behavior of a software system. It defines the relationship between the user and the elements that the system implements, and also indicates the actors involved in each part. The use case diagram represents the functionalities required by the users.

Figure 3.3: Use case diagram for FORAID GROUP Customers

The diagram above illustrates the structure of the FORMAINT program, which offers a comprehensive set of features for users. Upon entering the welcome window, the user is prompted to log in with their username and password. The program then verifies the credentials of the client or employee, granting access to specific pages based on their permissions.

One of the main pages available to employees is the display page, where they can view the reliability and criticality of each valve. Planned maintenance tasks are prioritized, allowing employees to monitor the progress of maintenance work for each valve. These functions, along with valve information, valve history, and the planning page, are accessible from the staff pages.
Furthermore, the Form View group pages provide a Form view of PSV related information. Users can access general details about each valve, including its connection to FMECA analytics. Additionally, the planning page and valve history page are available, enabling users to calculate reliability from the history page and schedule preventive tasks from the FMECA page.

3.6.2 Class diagram

The class diagram is a model that provides an overall view of a system by presenting its classes, the relationships (associations) between them, attributes, and methods. Class diagrams are static: they show what interacts but not what happens during the interaction. While the use case diagram shows a system from the perspective of actors, the class diagram shows its internal structure. It provides an abstract representation of the objects in the system that will interact together to fulfill the use cases.
The class diagram consists of:

Class: a formal description of a set of objects that have common semantics and properties. An instance of a class is called an "object." It is a discrete entity with an identifier, state, and behavior. Classes are connected to each other through associations.
Attribute: a property that describes the state of an object.
Operation: any action that the class can perform.

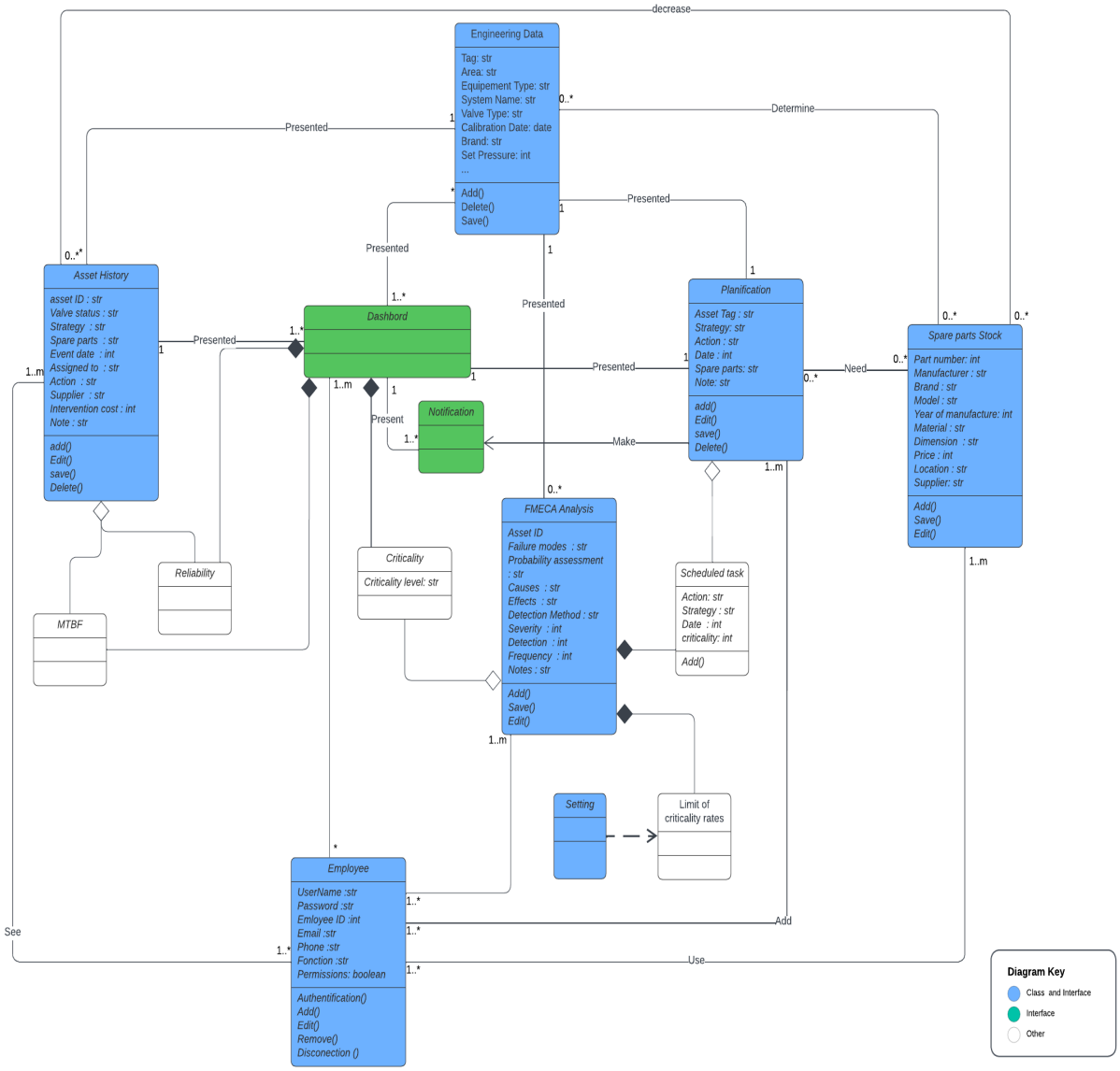


Figure 3.4: Class diagram of FORMAINT Software

Figure 3.4 illustrates the class diagram of the future Information System (SI). The "Dashboard" class serves as the main class of the application, which is related to other essential classes that provide information on the criticality and reliability of each PSV, the associated equipment, planned activities, as well as executed and non-executed activities. For instance, the Dashboard class displays all the Key Performance Indicators (KPIs), so it needs to be connected with classes that provide these KPIs, such as FMECA Analysis, Asset History, and others.The "Engineering Data" class also needs to be linked with other classes that require the display of general information for each PSV, such as the

Planning class, Asset History, Dashboard, FMECA Analysis, and especially the Spare Parts class. When the user enters information for each equipment, it is necessary to specify the specific spare parts associated with that equipment. These classes have their own distinct characteristics.

3.6.3 Sequence diagram

Sequence diagrams are behavioral diagrams that show the sequential flow of interactions between objects and actors in the system over a time scale.
In the following section, we will present some of sequence diagrams:

Authentication sequence diagram

This diagram illustrates the sequence of interactions for user authentication, showcasing the steps involved in the authentication process. It demonstrates how a user interacts with the system to provide credentials, how the system verifies the authenticity of the credentials, and the response returned to the user indicating successful or failed authentication. The diagram captures the chronological order of these interactions, providing a clear visual representation of the authentication process.

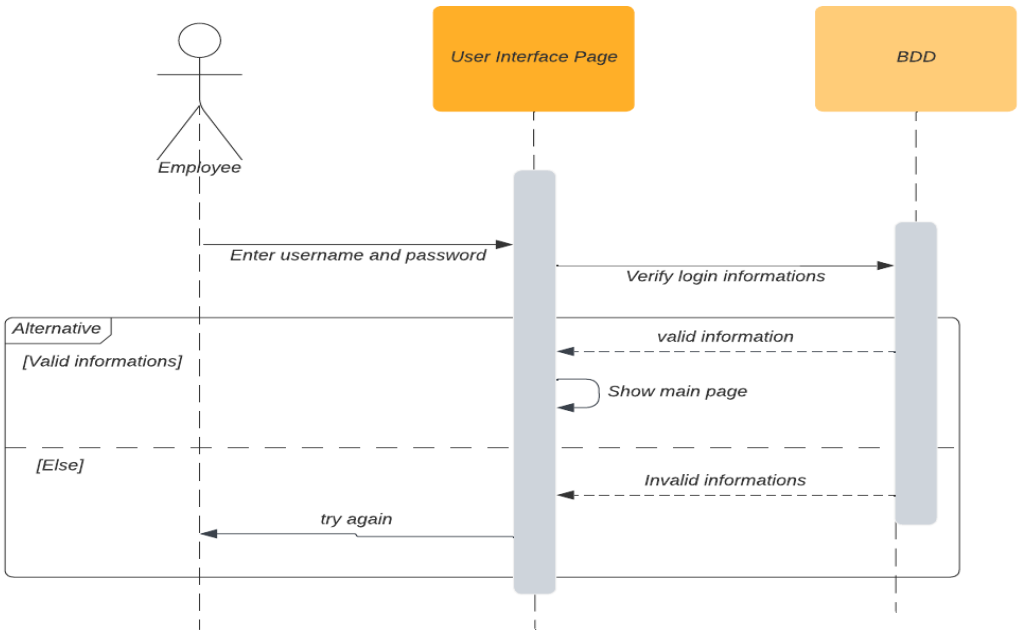


Figure 3.5: Authentication sequence diagram

To access their account, the employee needs to first authenticate by using their login information. After successful authentication, the employee selects the corresponding workspace based on their requirements, as depicted in Figure 3.5.

Sequence diagram of calculation the criticality

This diagram provides a clear visual representation of the process involved in calculating the criticality of a failure mode and presenting it with an appropriate color code. It illustrates the sequence of interactions between the user and the system, showcasing the steps from setting thresholds to verifying criticality intervals on the setting page, and ultimately returning a color code response to the user. By capturing the chronological order of these interactions, the diagram effectively conveys the calculation of criticality process.

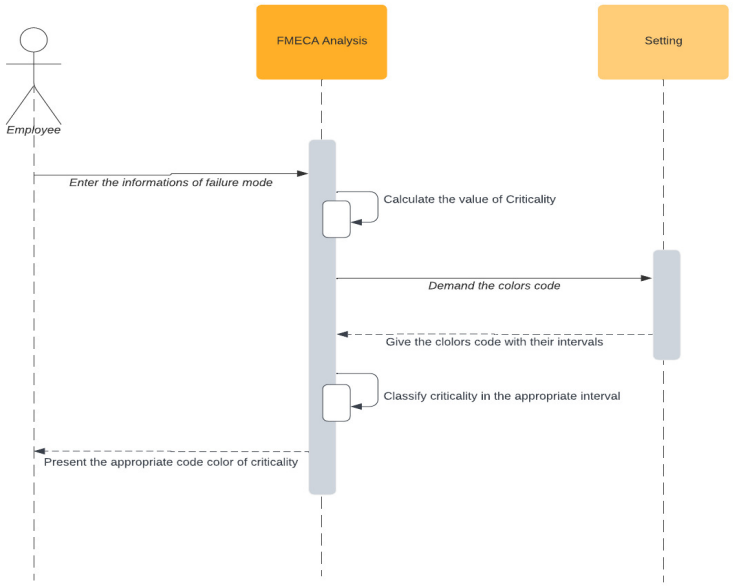


Figure 3.6: Criticality calculation sequence diagram

Sequence diagram of calculation the Planification

This diagram illustrates the planning processes involved when an employee schedules an intervention for a specific PSV (Pressur Safety Valve). The employee begins by selecting the desired PSV and initiating the planning process by clicking on "Add Event Plan." They then provide all the necessary information for the intervention, including the date, required action, and other relevant details. Once the intervention plan is saved, the employee awaits the scheduled intervention date. When the date arrives, they proceed with the actual intervention. After completing the intervention, the employee navigates to the event and marks it as "Complete." They also have the option to add any necessary spare parts. Finally, by clicking on "Done," the event is moved to the PSV history.

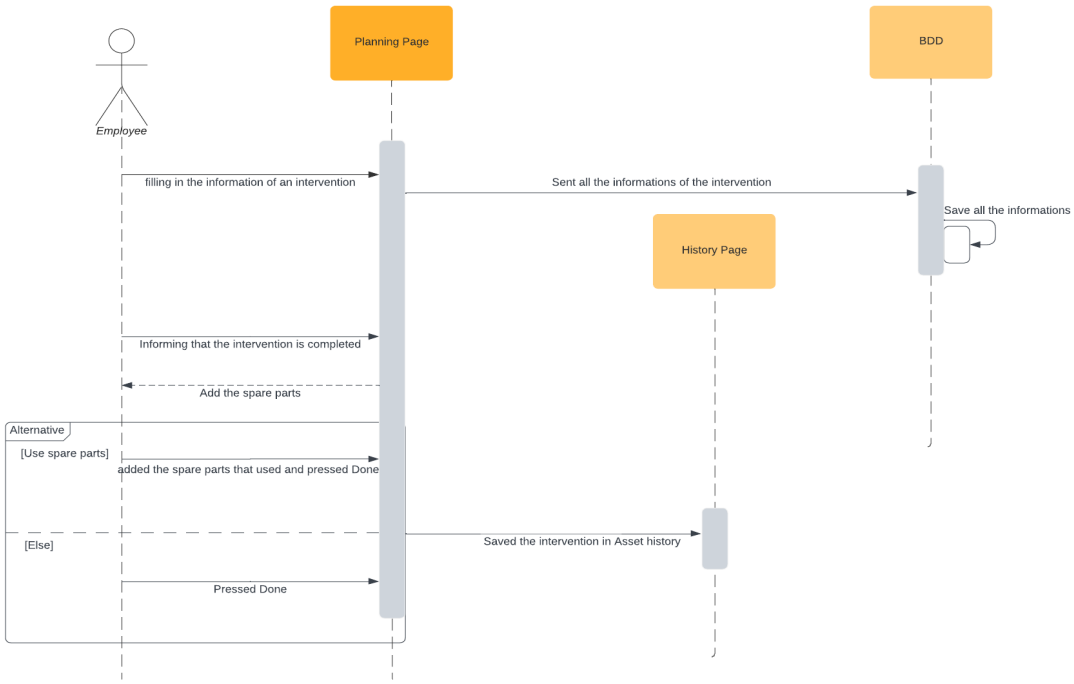


Figure 3.7: Event Planification sequence diagram

3.7 Conclusion

In this chapter, we have conducted a detailed conceptual study of our system, focusing on the identified problem statement. We have provided an overview of the system and described its functional characteristics using the UML language, presenting various diagrams such as the use case diagram, class diagram, and sequence diagram.

The next chapter will focus on the realization and implementation of our application based on the conducted conceptual study.

Chapter 4

Software implementation

4.1 introduction

Following the completion of the conceptual study for our solution, the Asset Management Software, we now move forward to the crucial stage of its realization and implementation. This chapter aims to provide insights into the development tools we have carefully selected. Additionally, we will showcase screenshots of the graphical interfaces for the key windows of our application, accompanied by concise descriptions outlining their respective functionalities. By delving into these details, we aim to offer a comprehensive overview of the progress made thus far.

4.2 The development tools

4.2.1 Flutter

Flutter is an open-source UI toolkit and framework developed by Google. It enables developers to build beautiful and high-performance applications for mobile, web, and desktop platforms using a single codebase. With Flutter, developers can write code once and deploy it across multiple platforms, saving time and effort in the development process.

One of the key features of Flutter is its hot reload capability, which allows developers to see the changes they make to the code immediately reflected in the app without the need for a full app restart. This feature greatly speeds up the development cycle and enables rapid iteration and experimentation.

Flutter provides a rich set of customizable widgets that help developers create stunning user interfaces. These widgets are designed to be expressive and flexible, allowing for pixel-perfect designs and smooth animations. The framework also offers a wide range of libraries and packages that extend its capabilities and enable access to native device features and APIs.

Under the hood, Flutter uses a reactive and composable architecture. Everything in Flutter is a widget, from basic UI elements to complex layouts and animations. Widgets are declarative, meaning developers describe how the UI should look and behave based on the current state, and Flutter takes care of updating the UI accordingly.
Flutter has gained significant popularity among developers due to its fast development cycle, performance, and ability to create visually appealing and responsive applications. It provides a comprehensive ecosystem with a vibrant community, extensive documentation, and a rich set of tools and resources to support developers in building high-quality apps.

4.2.2 Dart Language

Dart is a programming language developed by Google for building high-performance, cross-platform applications. It is the primary language used with Flutter, a popular UI toolkit for developing native-looking apps on mobile, web, and desktop platforms. Dart's features, such as its strong type system and asynchronous programming support, make it expressive and efficient.
The integration between Dart and Flutter enables developers to write code once and deploy it across multiple platforms (such as Android and iOS), resulting in visually appealing and performant applications.

4.2.3 SQLite

SQLite is a lightweight and self-contained relational database management system that is widely used in software development, including with Flutter. It provides a simple and efficient way to store and manage structured data within an application.

With SQLite, you can create tables, define relationships between them, and perform various operations such as inserting, updating, and querying data. It supports standard SQL syntax, allowing you to leverage familiar database concepts and techniques.

In the context of Flutter, SQLite is commonly used as a local database solution for storing and retrieving data within the app. It offers a reliable and efficient storage mechanism, especially for applications that require offline functionality or need to manage a large amount of structured data.

By integrating SQLite into your Flutter app, you can easily persist and retrieve data, perform complex queries, and ensure data consistency. It provides a flexible and scalable solution for managing data within your application, enhancing the overall user experience and functionality.

4.3 Application interface and features

To model Authentication and Home Page Access Process within our software, we will utilize the "Signavio" tool. This site enables us to create BPMN diagrams (Business Process Model and Notation) to depict the software usage processes. BPMN is a widely accepted standard for process modeling and scoring, providing a standardized notation for visualizing processes.

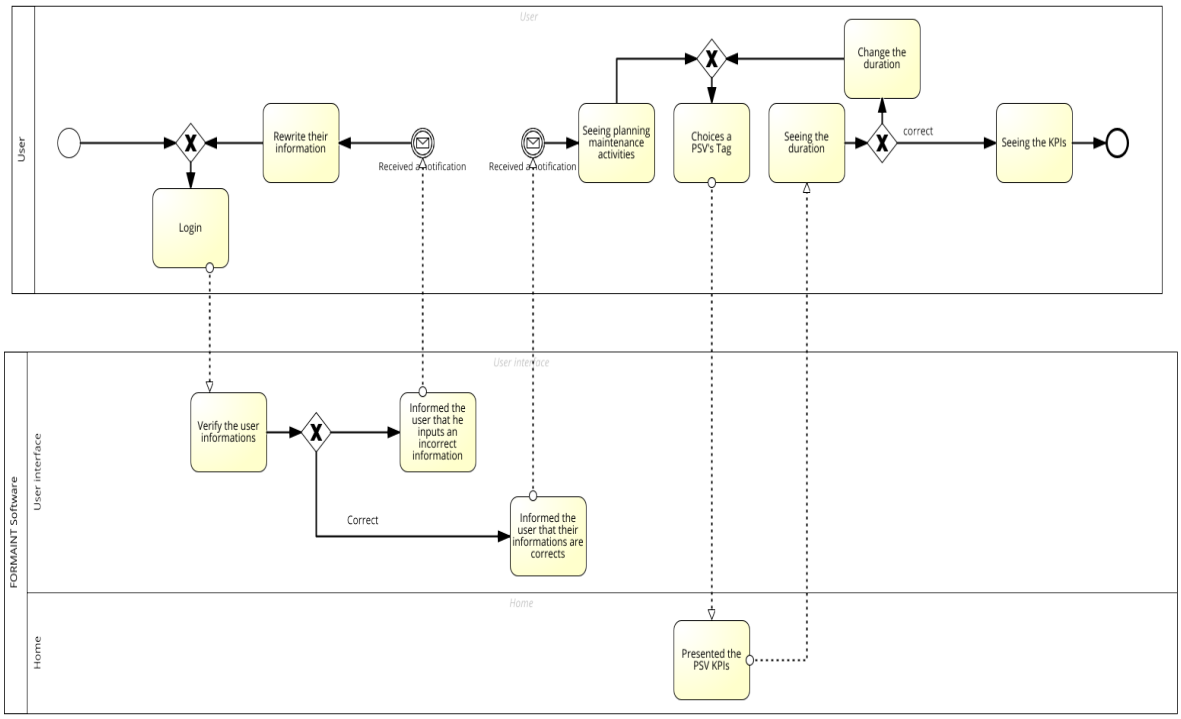


Figure 4.1: Authentication and Home Page Access Process

4.3.1 User interface page

In this window, it is necessary to input the appropriate username and corresponding password to successfully log into the software.

y

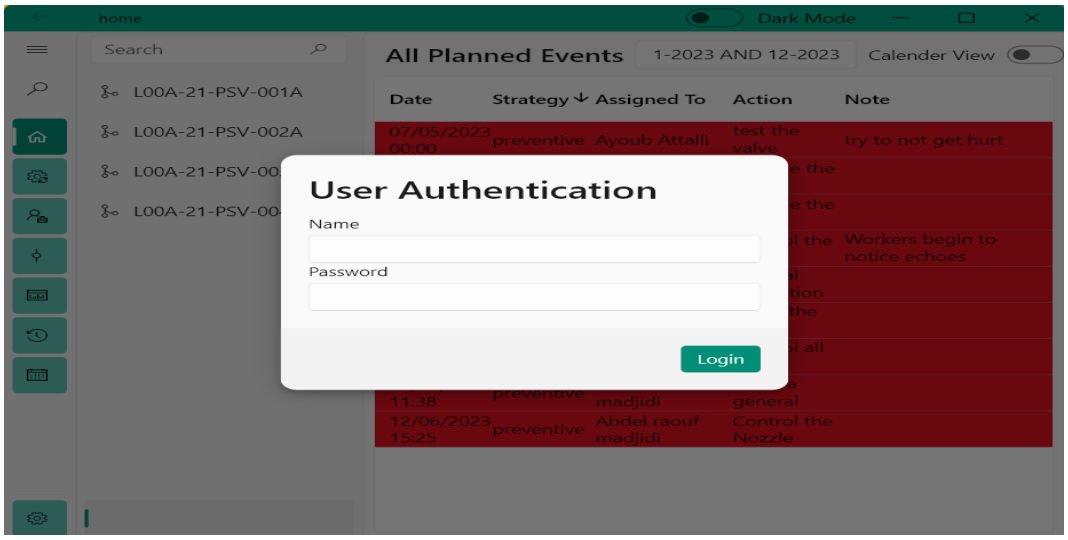


Figure 4.2: Authentication Page window

4.3.2 Home page

The home page, as depicted in Figure 22, presents a bar chart showcasing statistics related to the execution status of planned activities, the criticality and reliability of each Pressure Safety Valve (PSV), the Mean Time Between Failures (MTBF), and the planned activities that were not executed. The latter is visually represented using a color code based on the approaching intervention date.

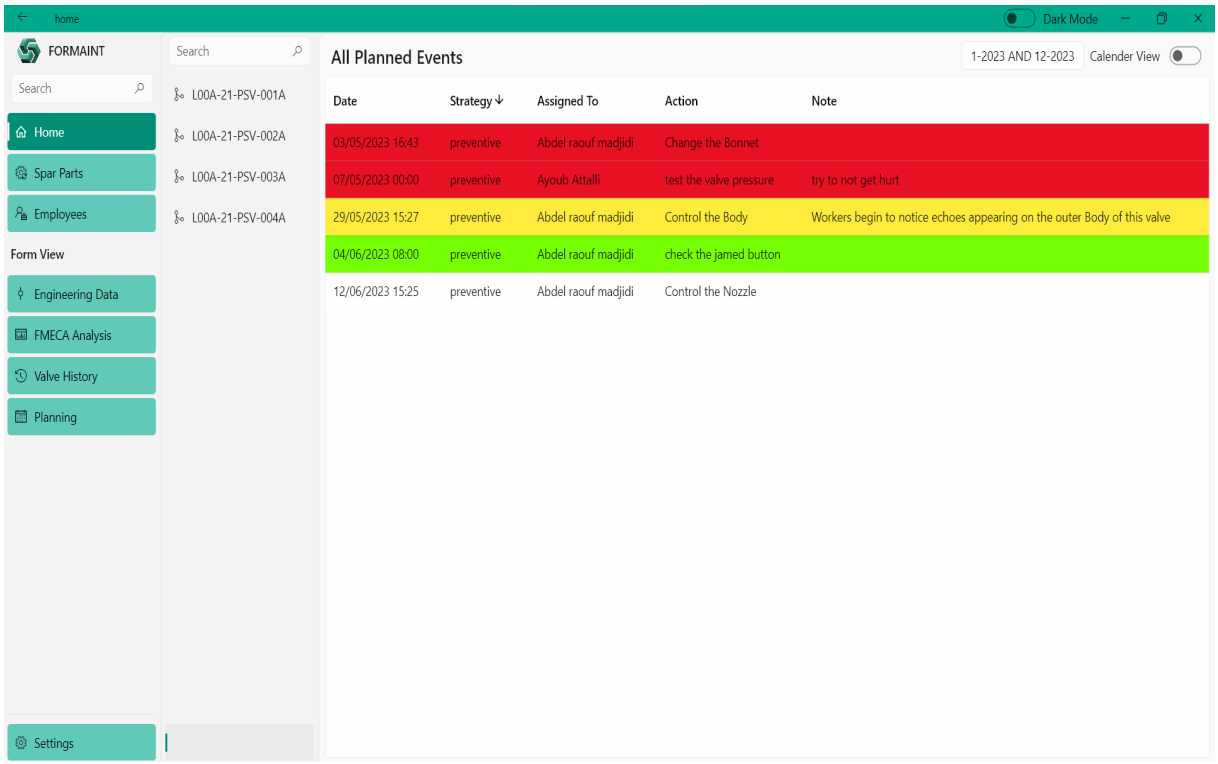


Figure 4.3: Welcome page window

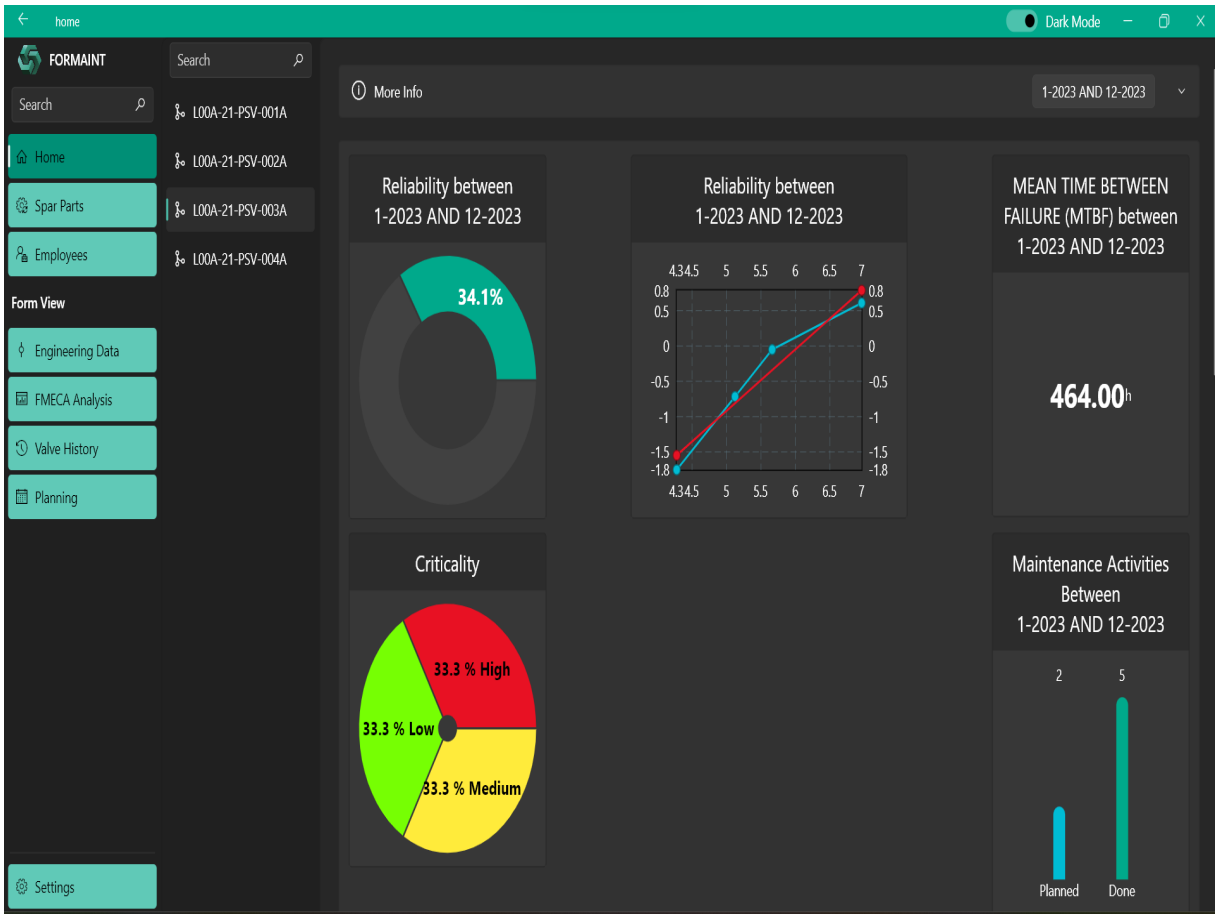


Figure 4.4: Dashbord page window in Dark mode

4.3.3 Spare parts page

The spare parts window is a platform where we can input the necessary spare parts for our interventions along with their corresponding information.

Additionally, it enables us to calculate the alert threshold for ordering purposes.

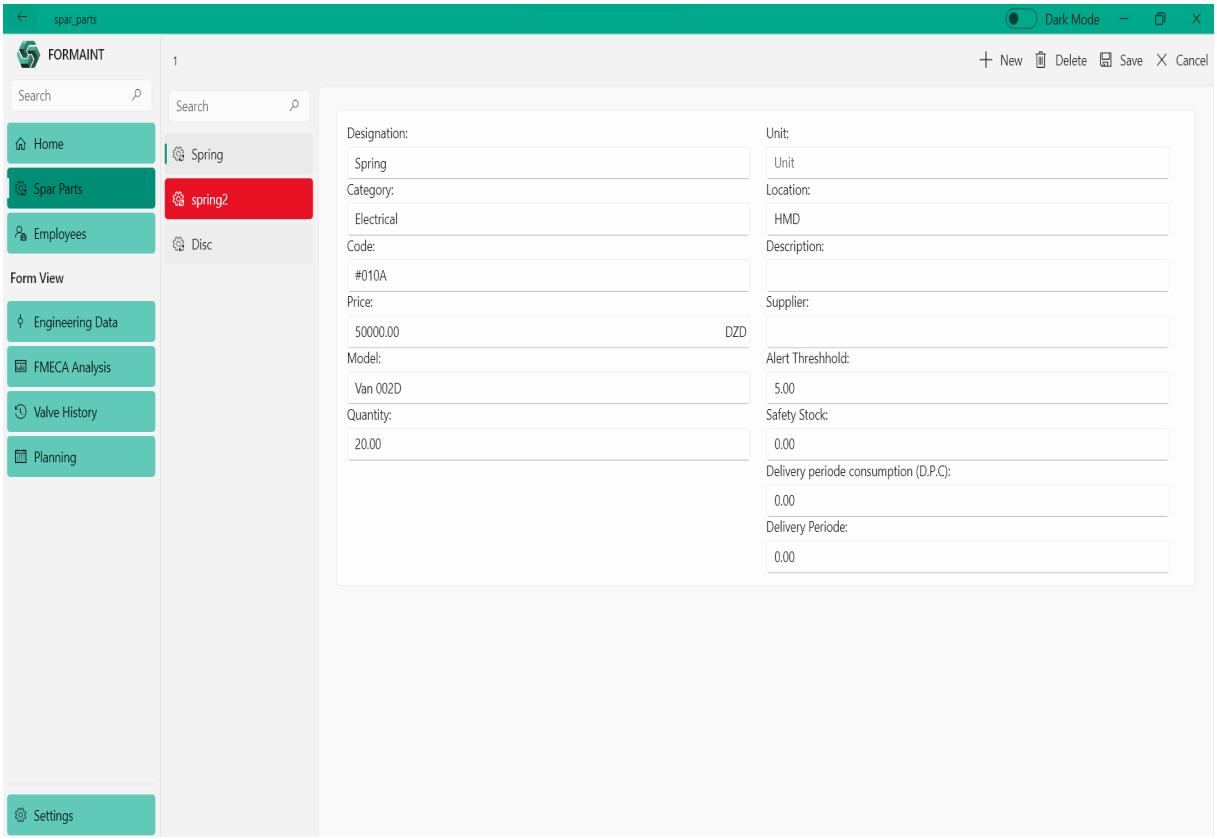


Figure 4.5: Spare parts page window

4.3.4 Employee page

This page serves as a platform for adding and modifying the employee list within the company. Additionally, it plays a crucial role in determining the level of access and permissions granted to each employee within the application.

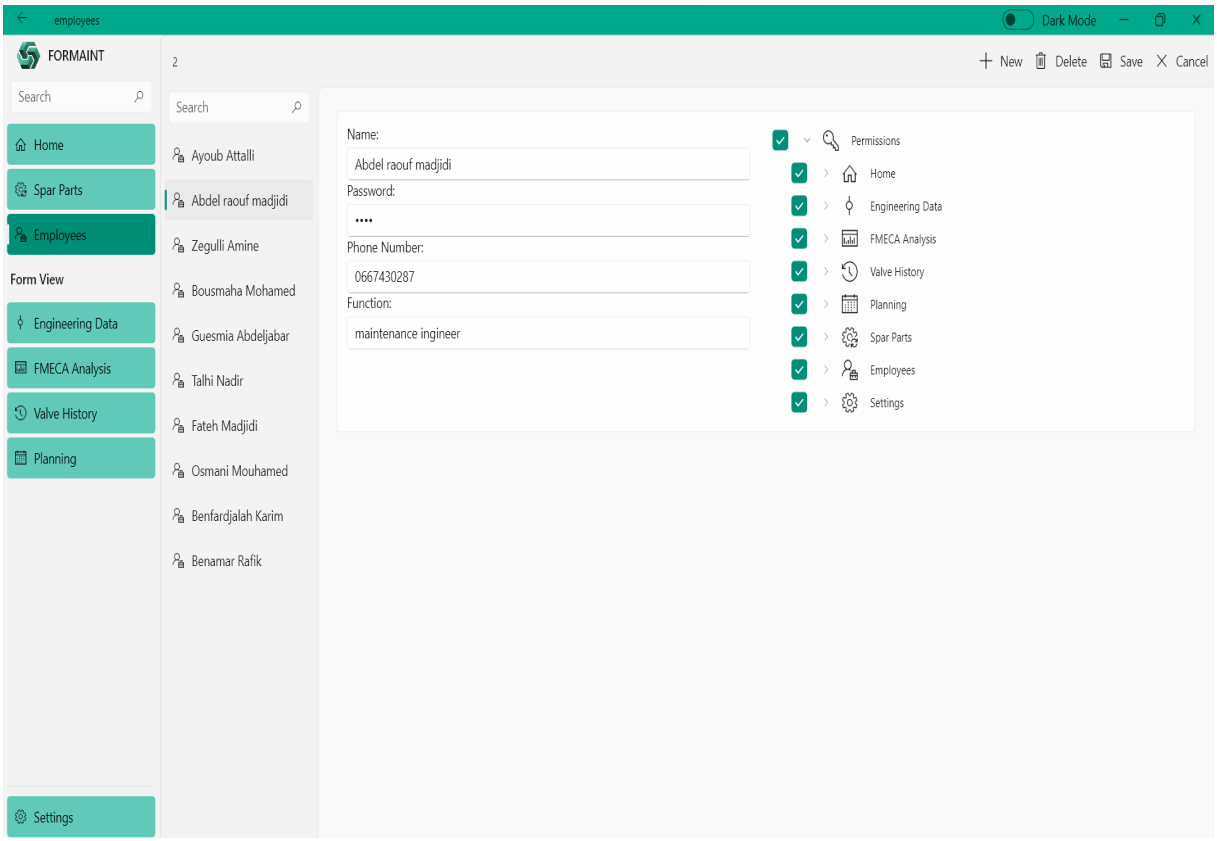


Figure 4.6: Employee page window

4.3.5 Engineering Data Page

On this page, users have the ability to view and modify the information of each Valve. Furthermore, they can also add and modify the types of spare parts associated with each valve.

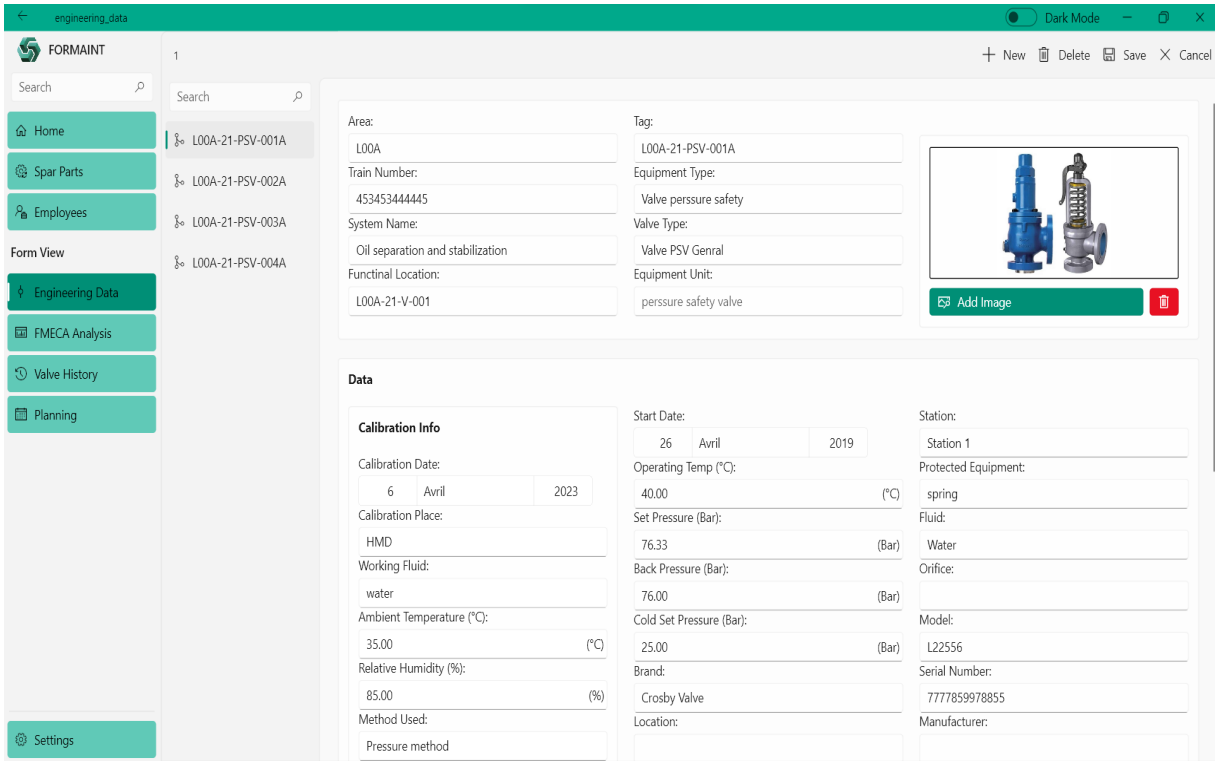


Figure 4.7: Employee page window

4.3.6 FMECA Analysis Page

On this page, the application provides criticality calculation tools for each valve. As a user, when accessing this page, you are required to input failure modes, reasons for failure, consequences, the affected valve's component, and the level of severity, occurrence, and detectability associated with the failure. This information enables the application to determine the level of criticality for each failure mode of the valve.

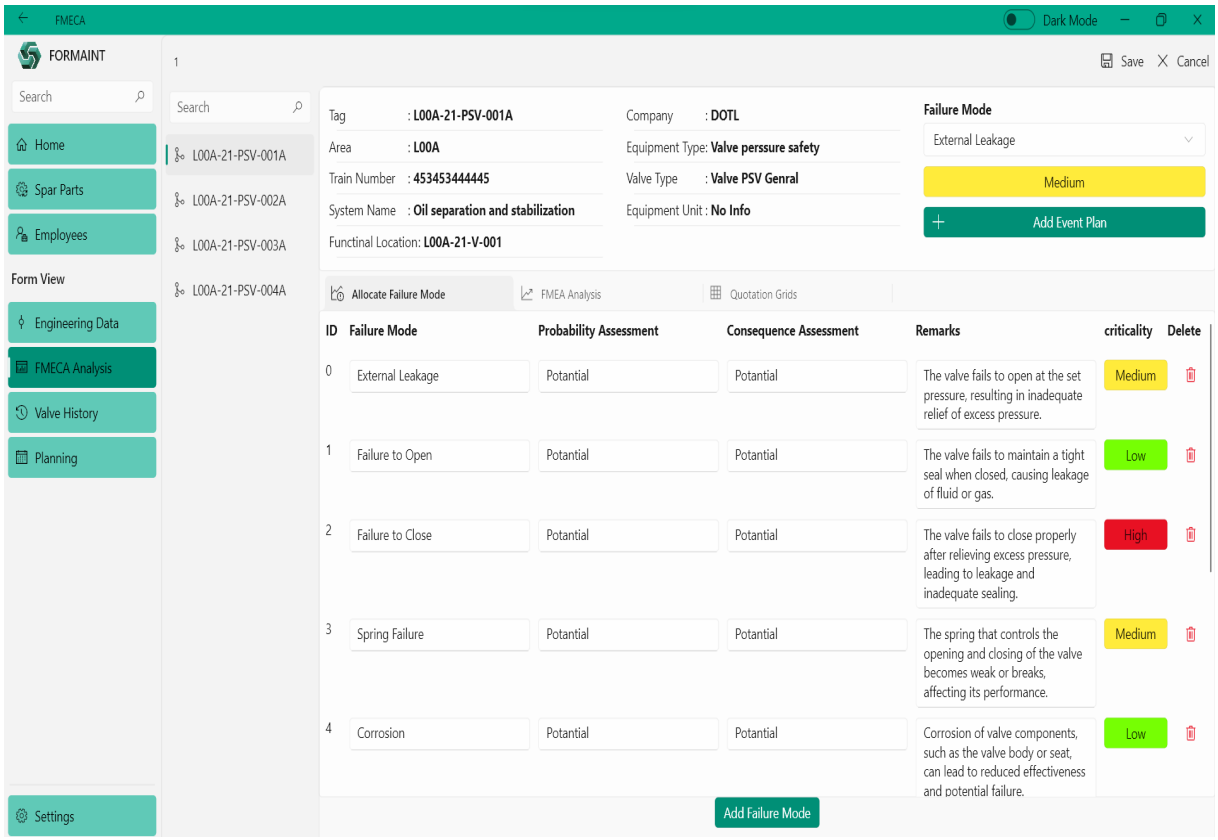


Figure 4.8: Allocation Failure Mode in FMECA Analysis Page window

On this page, users can enter information about a failure mode, including its type and the nature of the failure. They can also specify the likelihood of its occurrence and add any additional notes if desired. Once all the relevant information has been entered, users can view the criticality of this particular form of the failure on the same page.

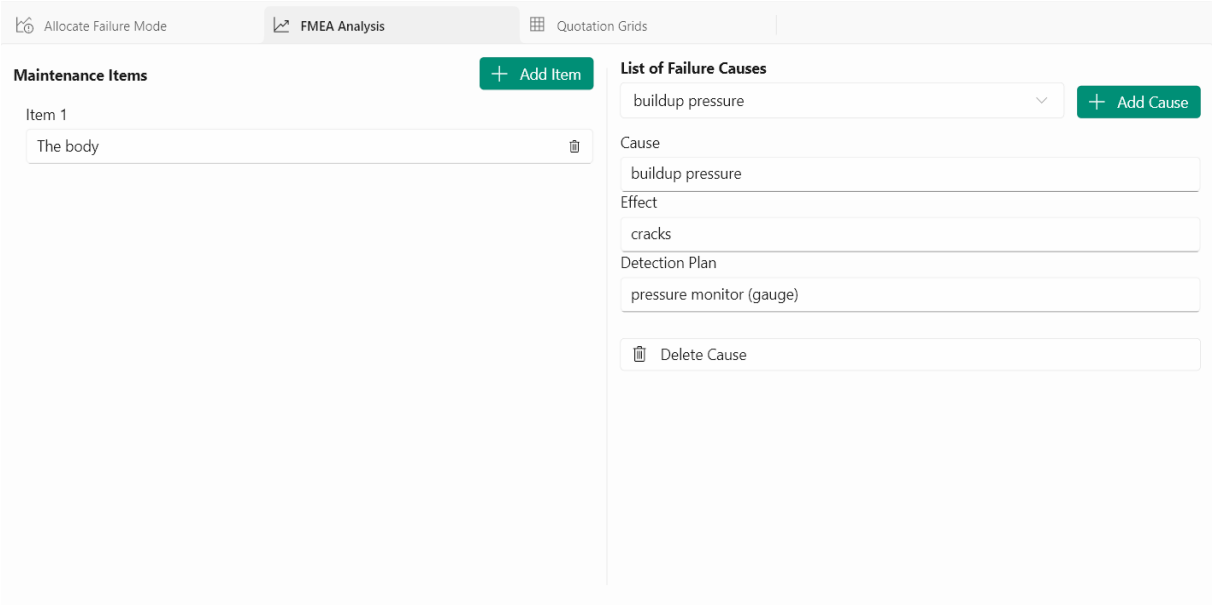
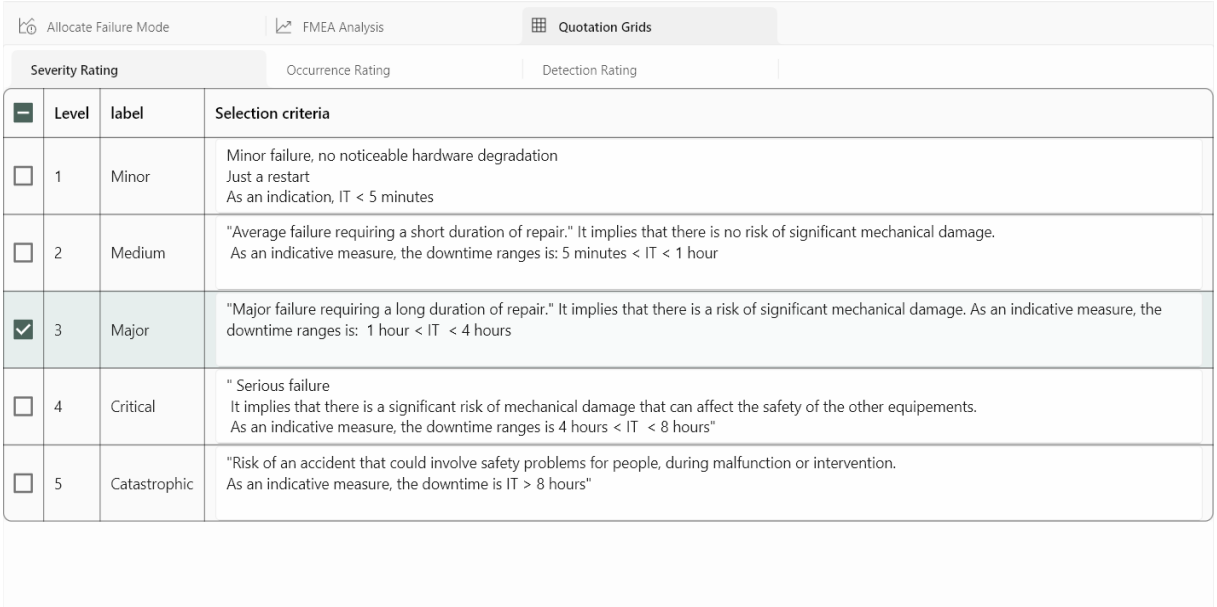


Figure 4.9: FMECA Analysis Page window 2

The above picture, shows that the users have the ability to enter the causes and effects associated with each failure mode, as well as specify the method of detection.



Level	label	Selection criteria
1	Minor	Minor failure, no noticeable hardware degradation Just a restart As an indication, IT < 5 minutes
2	Medium	"Average failure requiring a short duration of repair." It implies that there is no risk of significant mechanical damage. As an indicative measure, the downtime ranges is: 5 minutes < IT < 1 hour
3	Major	"Major failure requiring a long duration of repair." It implies that there is a risk of significant mechanical damage. As an indicative measure, the downtime ranges is: 1 hour < IT < 4 hours
4	Critical	" Serious failure It implies that there is a significant risk of mechanical damage that can affect the safety of the other equipements. As an indicative measure, the downtime ranges is 4 hours < IT < 8 hours"
5	Catastrophic	"Risk of an accident that could involve safety problems for people, during malfunction or intervention. As an indicative measure, the downtime is IT > 8 hours"

Figure 4.10: FMECA Analysis Page window 3

The above picture, shows that the users have the option to specify the severity level, frequency level, and detection level for a particular defect. Each level is accompanied by a simple definition to assist users in easily determining the appropriate level. Additionally,

certain users are granted the privilege to modify the definitions of these levels within the program.

4.3.7 History Page

The above picture, shows that the users have access to the asset history, including shutdown periods and scheduled preventive maintenance activities. The page also displays information about supplier involvement, spare parts utilized, intervention costs, responsible personnel, intervention dates, and any additional notes related to the asset.

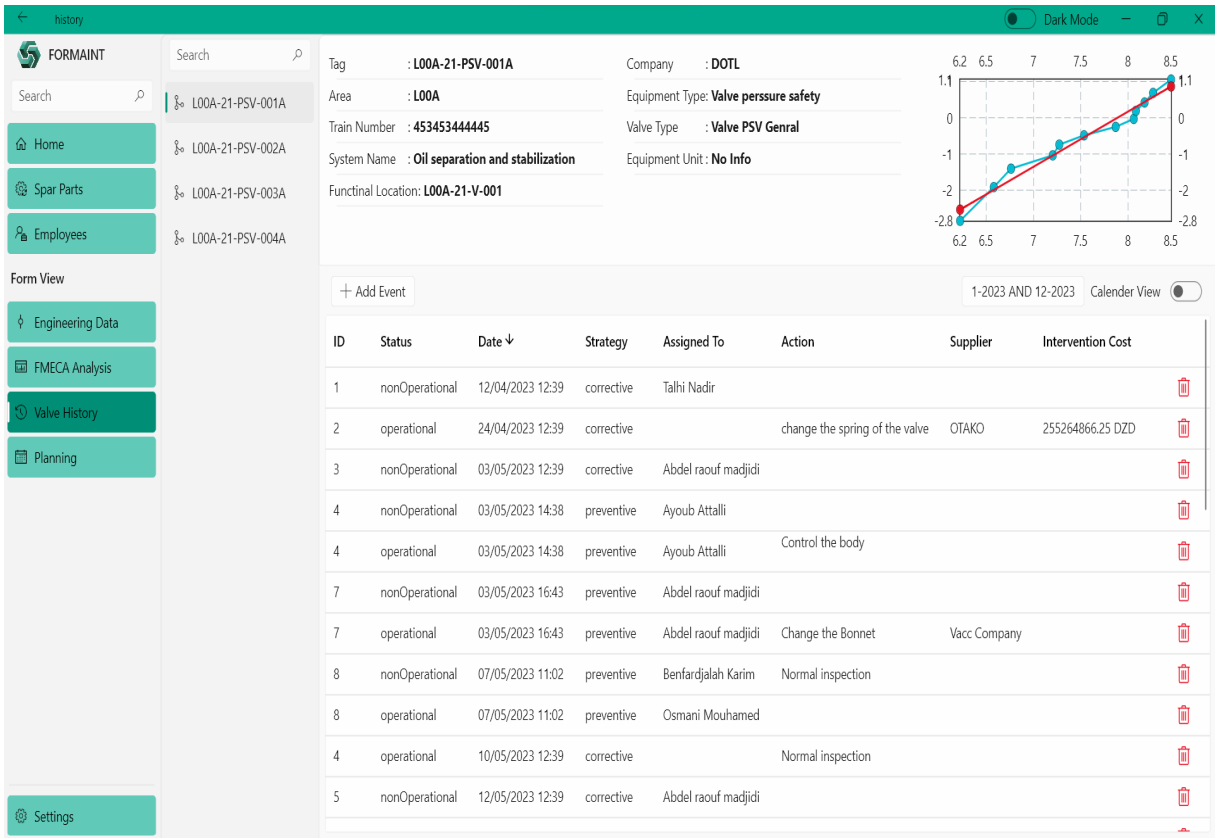


Figure 4.11: History Page window

4.3.8 Planning Page

In this page, users can plan maintenance interventions by assigning responsibility for the process. They have the ability to specify the work to be performed and identify any necessary spare parts. The page also provides the functionality to calculate intervention costs.

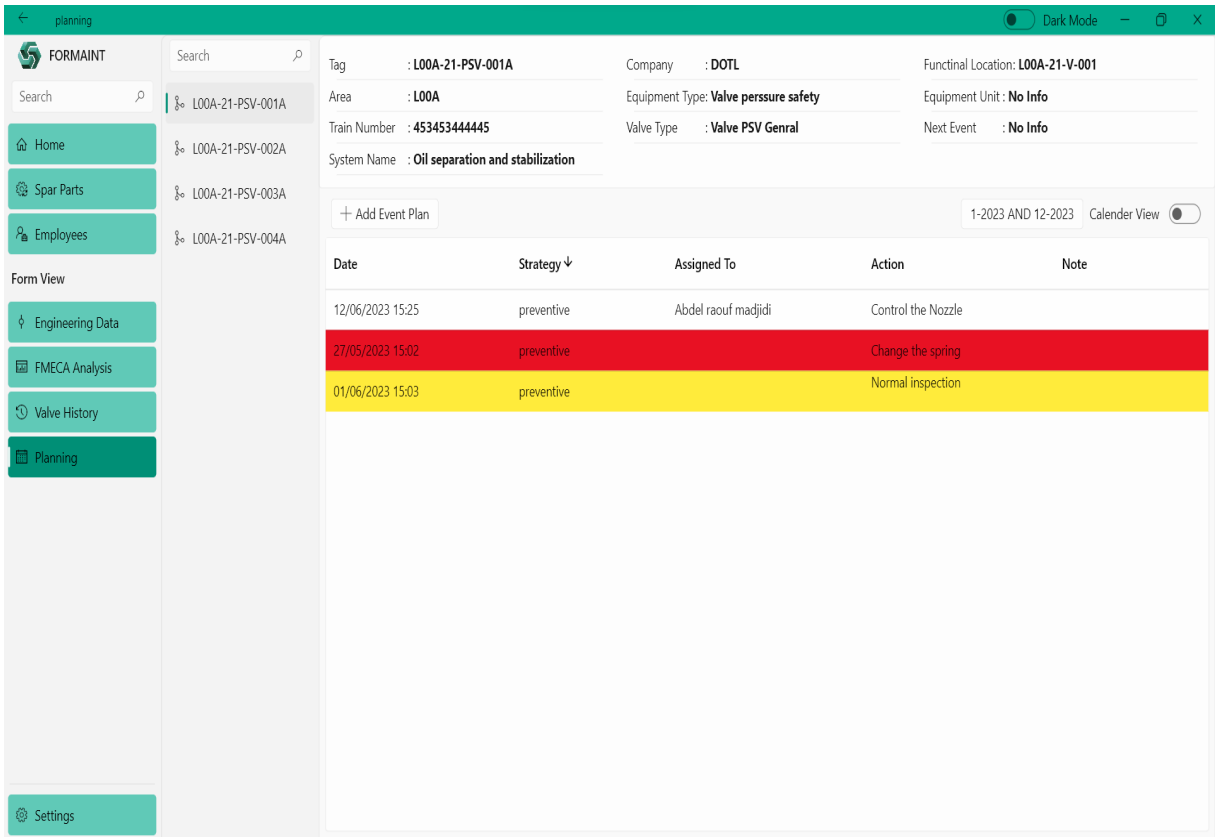


Figure 4.12: Planning Page window

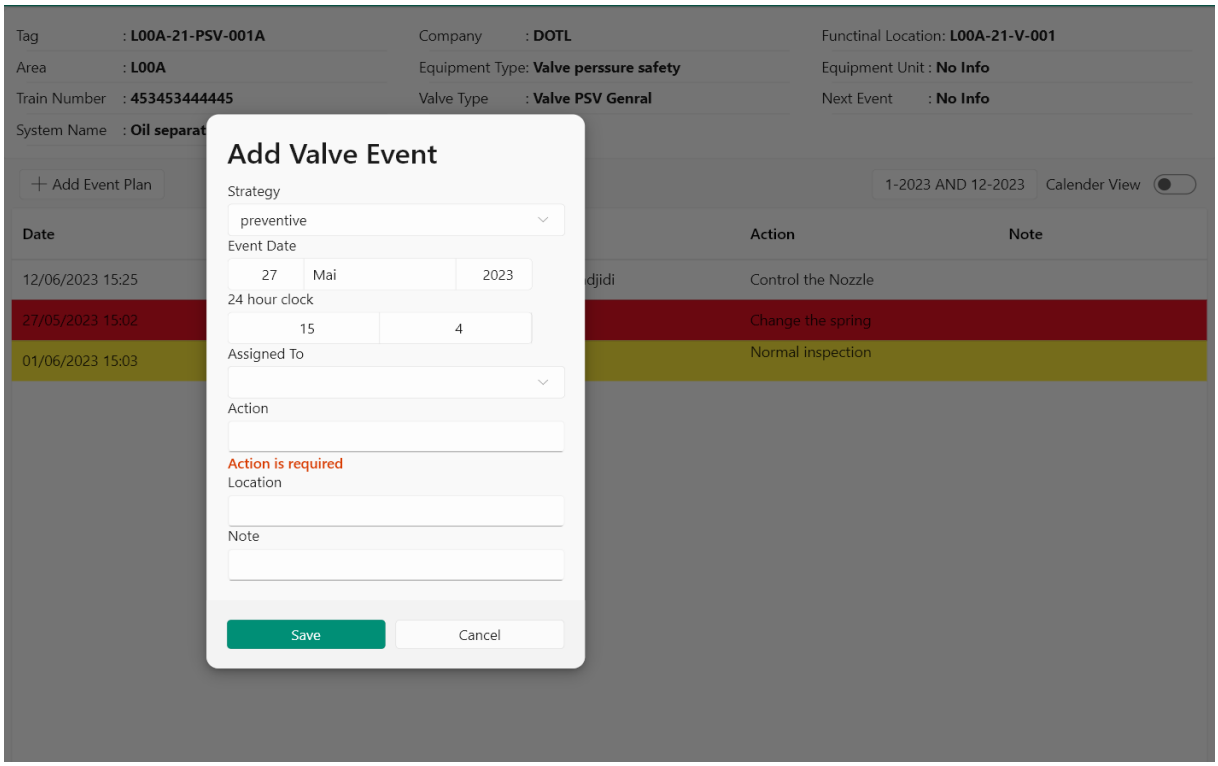


Figure 4.13: Planning Page window 2

4.3.9 Setting Page

In the settings page, users have the ability to specify the criticality threshold in the FMECA method. They can also choose the theme mode, navigation pane display mode, and adjust the window transparency.

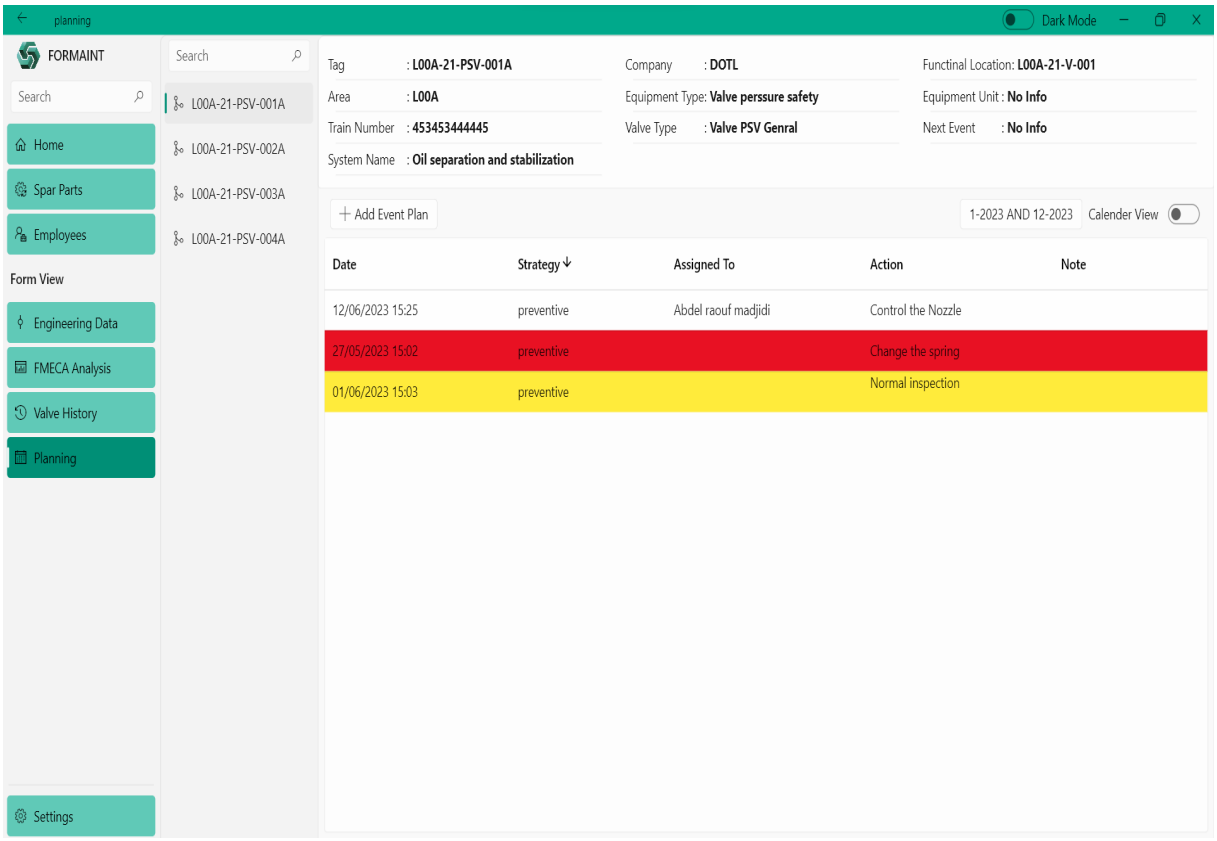


Figure 4.14: Setting Page window

4.4 Conclusion

In conclusion, this chapter provided an overview of our Asset Management solution, including its development tools and key features showcased through screenshots. We are pleased to report that FORAID Algerie Company has expressed satisfaction with our software, validating its effectiveness in meeting their needs. We remain dedicated to delivering value and exceeding client expectations as we continue to refine and enhance our solution.

General Conclusion

In conclusion, the development of this Asset Management Software represents a significant milestone for FORAID Algerie in the market. With the addition of this software and its maintenance services, FORAID Algerie will establish itself as the only company providing this comprehensive solution. This unique offering will give FORAID Algerie a competitive advantage over other companies in the industry.

By implementing the Asset Management Software, FORAID Algerie will be able to streamline maintenance management processes and enhance the efficiency of its machine park management. This will lead to improved operational effectiveness, reduced downtime, and increased productivity. The software's features, such as tracking assets, scheduling maintenance tasks,Calculate the reliability and criticality of assets, will provide FORAID Algerie with a comprehensive and integrated solution for optimizing maintenance operations.

Furthermore, the software's potential for future enhancements, such as incorporating predictive maintenance and decision support features, indicates FORAID Algerie's commitment to staying at the forefront of technological advancements in the field. This forward-thinking approach will not only benefit the company but also position FORAID Algerie as an industry leader and trusted partner for clients seeking advanced maintenance management solutions.

In addition, the software's Spare Parts window includes a Point of Command feature that facilitates inventory generation. This further enhances FORAID Algerie's ability to

effectively manage spare parts and ensure timely availability for maintenance interventions.

The successful development and implementation of the Asset Management Software demonstrate FORAID Algerie's dedication to innovation and its ability to adapt to the evolving needs of the market. By offering this unique service with their maintenance offerings, FORAID Algerie is poised to establish itself as a market leader and achieve long-term success in the industry.

Bibliography

[1]: Capturing Value from Knowledge Assets: THE NEW ECONOMY, MARKETS FOR KNOW-HOW, AND INTANGIBLE ASSETS, By David J. Teece, in 1998.

[2]: https://www.foraidgroup.com/copie-de-le-groupe, accessed 2023-05-16.

[3]: What are Financial Assets?, https://www.canarahsbclife.com/blog/financial-planning/what-are-financial-assets, accessed 2023-05-25.

[4]: Tangible Assets and Corporate Performance , by Dr. Gospel J. Chukwu and Celestine A. Egbuhuzor, In 2017.

[5]:What is intangible assets, https://www.quora.com/What-is-intangible-assets, accessed 2023-05-31.

[6]: On Human Capital – HR and Agile, By Peter, in 2015.

[7]: A New Asset Type: Digital Assets, By Alp Toygar, C. E. Tapie Rohm Jr.Jake Zhu.

[8]: Managing human assets in an uncertain world: applying real options theory to HRM, By Mousumi Bhattacharya & Patrick M. Wright, In 2007.

[9]: A New Asset Type: Digital Assets , Alp Toygar and C.E. Taipe Rohm and Jr. Jake Zhu, in 2013.

[10]: ABB launches new condition monitoring digital service, tailor-made for predictive maintenance of conveyor belts, https://new.abb.com/news/detail/79069/abb-launches-new-condition-monitoring-digital-service-tailor-made-for-predictive-maintenance-of-conveyor-belts, accessed 2023-06-01.

[11]: Fiix CMMS Software, https://www.rockwellautomation.com/en-us/products/software/facto , accessed 2023-05-16.

[12]: the pricing plan that fits your organization https://www.fiixsoftware.com/cmms/pricing/

, accédé le 16/05/2023.

[13]: Fiix Reviews, https://www.softwareadvice.com/cmms/fiix-profile/reviews/, accessed 2023-05-20.

[14]: Attracting and retaining employees as a Small Enterprise: Case study about ManWinWin company, by Maria Leonor Meirelles.

[15]: Maintenance Management Software, https://www.manwinwin.com, accessed 2023-05-20.

[16]: ManWinWin Reviews, https://www.softwareadvice.com/cmms/manwinwin-profile/reviews/ , accessed 2023-05-31.

[17]: The IBM Maximo roadmap: What it means for Enterprise Asset Management, IBM Corporation, In 2006.

[18]: How Much Does IBM Maximo Cost?, https://gimba.io/2022/06/17/how-much-does-ibm-maximo-cost/, accessed 2023-05-31.

[19]: https://www.onlinegantt.com.

[20]: Object-modeling language, https://en.wikipedia.org/wiki/Object-modeling-language, accessed 2023-05-16.

ملخص

لتعزيز إدارة الصيانة وتحسين إدارة الأصول في شركة فوراد الجيري ، قمنا بتنفيذ مشروع برمجة تطبيق. تضمن المشروع دراسة أولية عن أنواع المعدات ، ومقارنة بين ثلاثة تطبيقات ، ودراسة مفاهيمية لنظام المعلومات المقترح. كان هدفنا هو تبسيط أنشطة الصيانة ، ومراقبة موثوقية الجهاز وحرجيته ، وتحسين الكفاءة التشغيلية الإجمالية.

.كلمات مفتاحية: الصيانة، الاصول، تطبيق، المعدات، نظام المعلومات، الموثوقية، الحرجية

Abstract

To enhance maintenance management and optimize asset management at FORAID Algerie Company, we implemented an application programming project. The project involved a preliminary study on asset types, a comparison of three softwares, and a conceptual study of the proposed information system. Our goal was to streamline maintenance activities, monitor asset reliability and criticality, and improve overall operational efficiency.

Key words: Maintenance, Asset, A Reliability, Criticality, Software, Information System.

Résumé

Afin d'améliorer la gestion de la maintenance et d'optimiser la gestion des actifs au sein de l'entreprise FORAID Algérie, nous avons mis en œuvre un projet de programmation d'application. Le projet comprenait une étude préliminaire sur les types d'actifs, une comparaison de trois logiciels et une étude conceptuelle du système d'information proposé. Notre objectif était de rationaliser les activités de maintenance, de surveiller la fiabilité et la criticité des actifs, et d'améliorer l'efficacité opérationnelle globale.

Mots-clés : Maintenance,Actif, Fiabilité, Criticité, Logiciel, Système d'information.