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القليعة

Final study dissertation

¨ Master in quality management ¨

Application of quality tools to solve the problem of inadequate management of chemical products

case study: SONATRACH Maintenance Directorate – Laghouat

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Abstract

This research aims at applying a problem-solving methodology by using quality tools to solve the non-conformities related to the management of chemical products at the Sonatrach Maintenance Directorate (DML) in Laghouat. The problem is related to the lack of safety data sheets (SDS) and the ambiguity of the expiration dates for the product (WD-40). We based ourselves on a qualitative, analytical study. We conducted a field case study within the organization, through semi-structured interviews, observation and analysis of documents, which allowed us to have an in-depth understanding of the current situation and to make an accurate diagnosis of the problem.

The research was based on a series of basic quality tools that are used in the problem-solving methodology, such as: 5W2H tool, Brainstorming, Ishikawa diagram, and "5 Whys" method. The Action plan and findings of the research, it was found that the problem is mainly due to poor organization, weak mechanisms for controlling the inventory, and lack of awareness of the safety requirements. The results also showed that the absence of a clear problem-solving methodology contributes to the recurrence of the same problems without an effective solution.

Based on this, a set of immediate and corrective actions was proposed and structured in an Action plan with the aim of correcting the current situation and preventing the recurrence of non-conformities, through the strengthening of controls, the improvement of the documentation system and the intensification of awareness and training. This study highlights the importance of integrating quality tools into the daily practices of organizations, as they have an effective role in supporting decision-making and improving performance.

Keywords: quality tools, problem-solving approach, chemical products, non-conformity, inventory management, corrective actions

Résumé

Le but de cette étude est d'appliquer une méthodologie de résolution de problèmes basée sur des outils qualité ; l'objectif est de traiter la non-conformité, qui se manifeste dans la mauvaise gestion des produits chimiques au département de maintenance de Laghouat (DML). Sonatrach Le problème concerne l'absence de fiches de données de sécurité et le manque de clarté des dates d'expiration des produits (WD-40). Nous sommes appuyés sur une étude qualitative, et à travers une étude de cas de terrain au sein de DML, nous avons collecté des données par les entretiens semi-structurés, d'observations, et d'analyses documentaires. Cela a permis une compréhension globale de la situation actuelle et un diagnostic précis du défaut.

L'étude s'est appuyée sur l'utilisation d'un ensemble de base d'outils de qualité dans le cadre de la méthodologie de résolution de problèmes, en utilisant l'outil 5W2H, le Brainstorming, le diagramme d'Ishikawa et le « 5 Why ». Le plan d'action et les résultats de l'étude ont montré que le problème était principalement dû à une défaillance organisationnelle, à des mécanismes inadéquats de contrôle des stocks et à un manque de sensibilisation aux exigences de sécurité. Les résultats ont également montré que l'absence d'une méthodologie claire pour résoudre les problèmes contribue à la récurrence des mêmes déséquilibres sans traitement efficace.

En conséquence, un ensemble des actions correctives et immédiates structurées a été proposé dans le plan d'action visant à remédier à la situation actuelle et à prévenir la récurrence des cas de non-conformité en renforçant la surveillance, en améliorant le système de documentation et en intensifiant la sensibilisation et la formation.

Cette étude démontre l'importance d'intégrer des outils de qualité dans les pratiques quotidiennes des organisations, car ils jouent un rôle efficace pour soutenir la prise de décision et améliorer la performance.

Mots-clés : outils de qualité, approche de résolution de problèmes, produits chimiques, non-conformité, gestion des stocks, actions correctives.

الملخص

الهدف من هذه الدراسة هو تطبيق منهجية حل المشكلات بالاعتماد على أدوات الجودة وذلك لمعالجة عدم المطابقة والتي تتمثل في سوء تسيير المنتجات الكيميائية على مستوى مديرية الصيانة بالأغواط (DML) السوناطراك، تتضمن المشكلة غياب بطاقات بيانات السلامة وعدم وضوح تواريخ الصلاحية للمنتج(WD-40) وقد تم الاعتماد على دراسة نوعية ومن خلال دراسة حالة ميدانية داخل المؤسسة قمنا بجمع البيانات عن طريق المقابلات شبه المهيكلة والملاحظة وتحليل الوثائق مما أتاح فهم معمق للوضعية الحالية وتشخيص دقيق للخلل.

اعتمدت الدراسة على توظيف مجموعة من أدوات الجودة الأساسية في إطار منهجية حل المشكلات حيث تم استخدام أداة 5W2H والعصف الذهني ومخطط عظمة السمكة"5 لماذا" و. خطة العمل وغيرها واما نتائج الدراسة فقد بينت أن المشكلة تعود أساسًا إلى ضعف التنظيم، وضعف في آليات الرقابة على المخزون، ونقص في الوعي بمتطلبات السلامة كما أظهرت النتائج أن غياب منهجية واضحة لحل المشكلات يساهم في تكرار نفس الاختلالات دون معالجة فعالة.

بناءً على ذلك، تم اقتراح مجموعة من الإجراءات الفورية والتصحيحية المهيكلة في خطة العمل تهدف إلى معالجة الوضع الحالي ومنع تكرار عدم المطابقة من خلال تعزيز الرقابة والتوعية والتدريب وتبين هذه الدراسة أهمية دمج أدوات الجودة ضمن الممارسات اليومية للمؤسسات لان لها من دور فعّال في دعم اتخاذ القرار، وتحسين الأداء.

الكلمات المفتاحية: أدوات الجودة، نهج حل المشكلات، المنتجات الكيميائية، عدم المطابقة، تسيير المخزونات، إجراءات تصحيحية.

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«من لا يشكر الناس لا يشكر الله»

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LIST OF ABBREVIATIONS

DML	Maintenance Directorate Laghouat
MNL	Maintenance Directorate Laghouat (the new name)
ISO	International Organization for Standardization
QMS	Quality Management System
5M (Ishikawa)	Machinery (Equipment), Method, Manpower, Environment, Material
5W2H	What, why, Where, When, Who How, how much
AFNOR	French Standards Association
SAP	Systems, Applications, and Products in Data Processing
QHSE	Quality, Health, Safety, Environment
HSE	Health, Safety, and Environment
IMS	Integrated Management System

INTRODUCTION

INTRODUCTION

We face many problems in our daily life either at work or at home and to solve these problems, we usually follow some steps either automatically without realizing it or in a systematic and careful way. Such steps include understanding the problem, identifying its causes and the root cause, and applying solutions to the problem. The same way is applied in the workplace, where some enterprises apply steps to solve their problems and also use quality tools that help them solve these problems. Every tool is used for a specific purpose, some tools are used for simple problems, and others for complex problems. That is why it is important to know some of these tools, How and when to use them, and for what type of problems they are used. In our study, we will focus on some of these tools, such as Ishikawa, Brainstorming, 5W2H, 5Why, and others to solve a specific problem.

we studied a real non-conformity case proposed by DML. This case concerns inadequate chemical product management (WD-40) that were found without SDS and without clear expiration dates.

1. Objective of the study:

The main objective of this study is to « Apply quality tools to solve the problem in SONATRACH Maintenance Directorate DML ».

From this main objective, the following sub-objectives are:

- identify the available and appropriate quality tools to solve the problem.
- propose and implement concrete corrective actions to resolve the problem.

2. Research Question:

As part of our research, we base our study on the following research question:

« How can quality tools be applied to solve the inadequate management of chemical products in SONATRACH DML? »

From this main research question, the following sub-questions are:

- What are the quality tools used to solve this problem?
- What are the steps for applying these tools within the existing problem-solving approach?

- How can the causes of the problem be identified and prioritized using these tools?
- What corrective actions can be proposed?

3. Research methodology:

In this study, we adopted a qualitative approach based on understanding and interpreting the problem known as "interpretivism." Instead of focusing only on numbers, we focused on understanding why the problem happened at Sonatrach and We chose a case study in DML the data were collected using observation, interviews, and document analysis, after collecting the data, we used quality tools such as 5W2H, Ishikawa diagram, and 5 Whys to identify the causes of the problem and propose a suitable solution.

4. Importance of the Study

The importance of this study can be summarized in three points:

- The study addressed a real non-conformity related to a chemical issue in DML.
-This study helped introduce a culture of problem-solving using quality tools to the DML.
-We have proven that the theoretical tools we study at the University can change the reality of work in companies such as Sonatrach

5. Structure of the study

The study is structured into 3 chapters:

- **Chapter I:** Theoretical Framework:

This chapter divided into two sections. The first section presents the literature review. The second section explains the main concepts such as problem, non-conformity, chemical product management, and quality tools.

- **Chapter II:** Methodological Framework and Organizational Context:

This chapter is also divided into two sections. The first section explains the methodology used (approach, data collection methods). The second section presents the company and its activities.

- **Chapter III**: Results and Discussion:

This chapter is divided into two sections. The first section describes the current situation. The second section analyzes the problem using quality tools The third section presents the solutions and discusses the results.

CHAPTER I

THEORETICAL FRAMEWORK

CHAPTER I: THEORETICAL FRAMEWORK

This chapter presents the theoretical framework of the study and introduces the essential foundations for understanding the research subject. The chapter is divided into two sections: the first section presents a literature review of relevant studies, while the second section introduces the conceptual framework.

Section 01: Literature Review

This section presents an overview of previous studies related to the application of quality tools. Several researchers have examined the use of these tools in different sectors. For example, Ghali et al. (2025), (MH, et al., 2023), (Gillet-Goinard, 2021),and (silambi & indiyanto, 2024) have studied how quality tools are applied in different sectors and provide important information for this study.)

1. Inadequate Management of Chemical Products

Improper management of chemical products, particularly products without expiration dates and missing Safety Data Sheets (SDS), can pose serious safety risks. Several studies have focused on the risk of inadequate management of chemical products.

1.1. Poor Storage of Expired Chemicals

According to the Queensland Government, (2018) poor storage of expired chemicals significantly increases the risk of accidents and hazardous incidents. This case illustrates the serious consequences of inadequate chemical inventory management in educational institutions. In a public school in Queensland, a science operations officer discovered peroxide crystals forming around the lids of time-sensitive chemical containers stored in a storeroom. These chemicals had been purchased in 1993, although their recommended shelf life is limited to 18 months when unopened and 12 months once opened. The presence of unstable peroxide formations created a potential explosion risk and required the intervention of emergency services. To prevent a possible incident, the chemicals were safely disposed of onsite through controlled ignition.

This situation highlights the importance of implementing effective chemical storage procedures, regular monitoring of expiration dates, and strict compliance with safety regulations.

In a similar context, Arbiana et al (2020) conducted a study about management of expired chemicals in the chemistry laboratory of Gunung Batu at the Health Polytechnic of the Ministry of Health Bandung. This study used a descriptive case study using a total sampling method that included all chemistry lab managers and expired liquid chemicals. The total volume of expired liquid chemicals was 108,138 milliliters.

Ochieng et al. (2025) conducted a study on Expired Laboratory Chemicals in 10 selected secondary schools across Unguja and Pemba Islands Zanzibar, the objective of the research was to document the prevalence, physical condition, and management practices of expired chemical stockpiles.

It also aimed to assess the physical transformations of long-stored chemicals, evaluate the laboratory storage conditions, and identify potential health and environmental risks from improper disposal.

The researchers used a mixed-method design to capture both quantitative data and qualitative insights. Data collection tools included 20 respondents, Field Observations, Semi-Structured Interviews, and Document Review.

The study identified that there are no specific national guidelines or standardized disposal protocols for school-based chemical waste in Zanzibar, Safety Risks the Results revealed that 62.9% of the 372 chemicals documented were expired and 72% of storage standards) were classified as "very poor". these results highlight the serious risk related to inadequate chemical management also demonstrate the importance of proper storage conditions and safety documentation in laboratories.

Beyond physical storage, the availability of technical safety information is a critical factor in chemical management.

1.1. Missing Safety Data Sheets

Safety Data Sheets (SDS) are used to inform downstream users of any danger in chemical products and guide them on how to manage the risks from using these products. The study of Lee et al. (2024) examines the accuracy and consistency of danger information included in the SDSs of cleaning products used in the healthcare sector in the National Health Service (NHS) in England. Data on cleaning products used and their chemical composition were collected from the products' SDS obtained from the NHS supply online catalogue they found

229 unique chemical substances in 473 cleaning products' SDS. 56% of respiratory irritants were consistently classified.

Furthermore, substantially incorrect and inconsistent health hazard information for the same substances was identified across SDSs.

Therefore, healthcare workers and their managers may not receive accurate information on the presence of potential exposure to hazardous substances in the cleaning products they are using. These findings demonstrate weaknesses in chemical information management systems and underline the need for systematic quality control mechanisms to ensure accurate hazard communication.

In this context, before solving any problem, it is essential to identify the root causes and implement appropriate measures to ensure a lasting resolution and prevent the recurrence of the problem, this principle underlines the importance of using quality tools to solve the problems. (Gillet-Goinard, 2021)

These finding highlight the need for structured problem-solving approaches using quality tools.

2. Problem Solving Using Quality Tools

Several studies have applied quality tools in different contexts to improve processes and solve problems. Tools such as the Ishikawa diagram, Pareto chart, Brainstorming, and 5 whys are widely used to identify root causes, prioritize problems, and implement corrective actions. Their systematic application helps organizations improve operational performance, reduce defects, and enhance overall efficiency. Some studies have proposed structured approaches for solving problems using quality tools, Ghali Et al. (2025) study at National Paint Company (ENAP) in Algeria. Reported a significant reduction in customer complaints after applying Pareto and Ishikawa diagrams and other quality tools.

Table 01 :Steps of the problem-solving approach

Stages of the process	Tools used
Choosing the problem	Pareto Diagram
Identification and clarification of the problem	5 whys
Identification of the underlying causes of the problem	Brainstorming Ishikawa Diagram Weighted Voting
Searching for possible Solutions	Brainstorming Decision Matrix Action plan
Follow-Up on the solution	Dashboard

Source: Ghali Et al. (2025)

The most critical issue was product non-conformities, which represent 63% of total complaints.

Main root causes identified:

- Soft deposits in paint,
- Floating materials
- Internally defective products (appearing conforming externally)

A descriptive and analytical methodology was used, observations, semi-structured interviews, and document analysis.

After using quality tools and following the suggested Action plan, the results showed a marked reduction in complaints, better quality, and a big rise in customer satisfaction and loyalty

- Significant reduction in customer complaints
- Customer satisfaction increased from 80% to 90%
- Complaint processing time reduced from 21 days to 10 days
- Improved product quality
- Increased revenue from industrial customers.

However, this study focused mainly on customer complaints and product non-conformities in the paint industry, while the present study chemical product management and safety-related non conformities in an industrial maintenance environment.

2.1. Ishikawa Diagram and Brainstorming

The Ishikawa diagram, also called the fishbone diagram or cause-and-effect diagram. Oancea et al. (2024) showed how the Ishikawa diagram could be used to find the causes of the problem in the laser cutting process of S235JRH structural steel pipes. After defining the problem using the "WHO, WHAT, WHERE, WHEN, HOW MUCH, HOW, WHY" method, all possible causes were found using the "5 Whys" method and Brainstorming. The analysis found 11 possible causes. After more study, it was determined that 3 of them were already present in the process, which affected the laser cutting of the pipes and caused quality problems. This study highlights the effectiveness of Ishikawa and brainstorming tools in identifying technical causes; similarly, the current study applies these tools to investigate organizational and safety-related causes. The Ishikawa diagram with 7Ms was made up of all the causes that were found.

Adib et al (2024) focuses on the application of the Ishikawa diagram to study annual fatal truck accidents in El Hajeb province Morocco, the study identified that steep road slopes and brake failures were among the main causes of these accidents. Although this study focuses on road safety, it demonstrated the effectiveness of the Ishikawa diagram in identifying the root causes of complex problems. This highlights the relevance of this tool for analyzing operational problems in different contexts, including chemical product management.

Also, (MH, et al., 2023) applied both the Fishbone and Pareto methods to resolve problems that happened when metal chips and dust particles in deposition in industrial meters. The approach reduced downtime and made the process more efficient, showing how well combining quality tools can work. Presents a methodology of problem-solving, the integration of the fishbone and Pareto model methodologies, and the findings indicate that iron chips and dust particle deposition, resulting in the problem of stopped needles in the metre, yielded better results and saved significant time. Although the study demonstrated the effectiveness of combining quality tools in manufacturing processes, it did not address safety management or chemical product control issues, which are central to the current study

According to Neyestani, (2017)Problem-solving with quality tools was anchored in the seven “basic” tools originally promoted by Kaoru Ishikawa (check sheet, histogram, Pareto chart, cause-and-effect diagram, scatter diagram, flow chart, control chart).
These tools serve both identification (flow chart, cause-and-effect, Pareto) and analysis (histogram, scatter, control chart) of process deficiencies. This study found that it is essential for organizations to use all seven QC tools to fix problems that come up in their production processes. Management should think about and use all the quality tools to find and fix quality problems.

Salcido, et al., (2019)study showed quality tools have been used in manufacturing companies in Ciudad Juarez, Mexico, to solve problems and improve processes, a total of 84 projects were analyzed from 2006 to 2016 that were applied in some manufacturing industries located in Cd, and 40 different tools were identified. The method they use is meta-analysis. Tools such as Ishikawa diagrams, Brainstorming, Pareto charts, and double sampling tests were mainly applied during the analysis and implementation phases.
The quality tools helped to solve the problem, there are some gaps, such as limited use of tools. The study also focused on the impact of human and organizational factors on the success of these tools, this study confirms the wide applicability of quality tools in industrial contexts; however, it did not specifically examine non-conformities related to chemical product management and safety documentation. Other studies provide more evidence, Sakovich, et al. (2009) demonstrated the effectiveness of the seven basic quality tools in solving production problems. also, salami & indiyanto, (2024) utilized flexible manufacturing and additional quality tools to minimize waste in fish production Teplická et al. (2023) applied Lean production methods in a Slovak company in Indonesia whose research methods focused on the use of economic analysis and quality management tools such as the Ishikawa diagram and Pareto analysis. sector also the study by Pramono, et al., (2018) demonstrates the effective application of quality management techniques effectively at PT Zenith Pharmaceuticals in Semarang, Indonesia. The company encounters a problem with production. There are a large number of products that are not associated with customer specifications. The new seven tools are applied to identify and recognize the factors. The quality improvement design is proposed to minimize the number of product defects.

Chiromo & Moagi (2014) study at a battery manufacturing company in Southern Africa. The company manufactures lead acid batteries for the manufacturing, mining and automotive,

applied these tools across different departments and operational processes. The study analyzed how the tools were used to identify root causes of the problems and evaluate their impact on process improvement. They revealed that the tools were applied throughout the organization, from raw material sourcing to final product delivery. The deployment helped to reduce rejections and rework, improved teamwork among employees, and customer satisfaction. However, this indicates that while quality tools are effective, their impact depends largely on the consistency and methodological rigor of their implementation. Sokovic, et al. (2009) links each tool to the PDCA stages: planning (flow chart, cause-and-effect (Ishikawa), check sheet, Pareto, histogram, control chart), doing/analysis (cause-and-effect, check sheet, Pareto, scatter, control chart), solution development (flow chart, scatter), and results evaluation (check sheet, Pareto, histogram, scatter, control chart).The tools are easy to learn. However, staff can misuse them if they don't get enough training or use them on the wrong problems.

Table 2 Seven basic quality tools in correlation with pdca-cycle steps

Seven basic quality tools (7QC tools	Steps of PDCA-cycle				
	Plan	Do	Plan Check	Plan Act	Check
	Problem identification	Implement solutions	Process analysis	Solutions development	Result evaluation
Flow chart	✓			✓	
Cause-and effect diagram	✓		✓		
Check Sheet	✓		✓		✓
Pareto Diagram	✓		✓		✓
Histogram	✓		✓		✓
Scatter plot	✓		✓	✓	✓
Control charts	✓		✓		✓

Source: Soković et al. (2009)

Each phase of the PDCA cycle is supported by specific quality tools, depending on the objective of the stage.

2.2. 5W2H, 5 whys, and Action plan

Hamza & Rebib, (2021) Applied lean management in the pharmaceutical company in Algeria, Sidal Group they used tools such as the Ishikawa diagram, Pareto, 5S and 5 whys more. The company was facing Production inefficiencies, Waste in processes (time, movement, stock, defects) Long production lead times, Lack of process standardization, Reduced overall performance.

The objective was to improve productivity and operational performance using Lean principles. The quality Tools used to solve the problem:

- Ishikawa, Pareto.
- Value Stream Mapping (VSM) Used for recording the flow of production to discover waste and bottlenecks.
- The 5S Method: Sort, Set in Order, Shine, Standardize, and Sustain Applied to make the workplace more organized and productive.
- Kaizen An approach to continuous improvement that gets employees to make small changes every day.
- Finding waste (Muda Analysis) Found the seven types of waste: overproduction, waiting, transport, overprocessing, inventory, motion, and defects.
- Key Performance Indicators (KPIs) Used to measure improvements in productivity, quality, and lead time.

the results obtained After using Lean tools were Reduction in production lead time, less waste in operations, better organization of the workflow, more participation from employees, increase in productivity and performance. Unlike the present research, this study focused primarily on Lean management and production efficiency rather than the management of hazardous chemical products and safety compliance.

El Allaoui et al. (2024) GRUPO SIE in the automotive sector, applied continuous improvement within its Quality Management System (SMQ) and give a real practical idea of how continuous improvement is applied within the company they adopted a qualitative approach, interviews conducted with company officials, documentary analysis and an observations they used Cause-and-Effect Diagram (Ishikawa / Fishbone Diagram) ,5 Why Method, Check Sheets, Process Mapping , Flowcharts, PDCA Cycle (Plan–Do–Check–Act).

After applying these tools, the results were:

- Reduction of non-conformities
- Better identification of root causes
- Improvement of process control
- Increased efficiency in corrective actions
- Better organization of documentation

The authors applied some quality tools, such as 5w2h, Pareto, Action plan, and used the Ishikawa diagram to identify the root causes of malfunctions.

Because of these tools, the guidelines for establishing a continuous improvement department were known.

In terms of corporate culture, the added value was largely evident:

Easier and improved working methods, increased production rate...

About the 5W2H (Junior & Gonçalves, 2019) study applying it, the objective was to propose ways to make the potato chip production process better in the food industry in the Curitiba, Paraná state area. The project was mostly about collecting data and was divided into two parts:

- The first part was to check the company's current performance in terms of production levels and income.

-The second period was to check how well the plant was doing after the improvement plans from their work were put into action.

The result became possible by using the Cause-and-Effect Diagram, Brainstorming, and 5W2H tools in the process. Income went up from 68.1% to 81.8%, and the number of losses in the production of chips-type chips went down a lot. Krzysztof (2023)presented the use of selected quality management tools in a company producing parts for the automotive industry. The study focused on improving the core production process. And applied several quality tools, including the Pareto–Lorenz diagram, the Ishikawa diagram, and the 5 Why method. the study identified the non-conformities such as the disconnection of an element during assembly, which was linked to material damage in the warehouse, The Root cause analysis

showed that the fundamental issue was the lack of proper control of materials in accordance with the control plans established by the company.

As corrective actions, the study recommended reorganizing warehouse operations, strengthening supervision over material condition control, and introducing 100% inspection of manufactured products. The results demonstrate that the structured use of quality tools enables organizations to identify non-conformities, determine root causes, and implement effective corrective actions.

Nagyova et al. (2015) The use of the 5W2H method in analyzing the causes of nonconformity in the production of energy drinks, in which there occurred damage to both packaging material and the product contained in it. In this case, the customer was responsible for proving the nonconformity, even though it arose on the part of the manufacturer The author highlighted that quality management has an impact on almost all enterprise procedures**.** (Zach , 2018)undertook another important study on how quality management tools were employed in a Czech manufacturing company (called XY), particularly quality department quality department. The study aimed to identify production defects and understand the origins of technological issues by utilizing some known quality tools, among them Ishikawa (Fishbone) diagrams, Pareto charts, flowcharts, the results was significant reduction in defects, improvement in product quality and process efficiency The study shows how important it is to keep an eye on the production process to ensure customer satisfaction , reduce defects, and make the whole operation work more efficiently.

Jagusiak-Kocik (2017) used the Deming cycle in a manufacturing company in the plastics processing industry, specifically for small and medium-sized enterprises, and used other tools such as Ishikawa. The cycle was applied to fix quality problems that came up while making photo frames. When measures were taken to reduce the non-conformities, the number reduced by more than 60%. This shows how important it is to use structured quality tools to fix process problems. another study conducted Fernandes et al. (2013) a case study was done at a leather components production company in northern Portugal that was in the process of setting up. The main goal of their study was to use quality tools to make quality management processes more effective. The authors pointed out that the company's quality function was new, the study found that using quality tools in a strategic way, like Pareto analysis, Ishikawa diagrams, and the Taguchi method, helped find important defects, set

priorities for improvement actions, and reduce the nonconformities by 29% and critical component defects by 50%.

This study shows how quality tools can make a real difference when they are used consistently on important processes. The methodology consisted of three primary steps: evaluation of quality management processes, comprehensive analysis of quality data, it also highlights the importance of first diagnosing the processes to choose the ones that need the most improvement. This makes sure that resources are used efficiently and problems are solved effectively.

These results are very important for the current study because they show how basic quality tools can help with decision-making, reduce mistakes, and make the whole process work better. using basic quality tools can help companies to solve problems in managing chemical products that Fernandes et al. looked at, companies that aren't very good at managing quality often don't use quality tools very well.

The Action plan is a structured document according to GARDES et al. (2007)in 1996, the CHU of Toulouse set up a sterilization plan that included an Action plan in response to remarks made during an internal audit about the absence of formal follow-up on corrective and preventive actions. To conduct this Action plan, a working group was set up; they used tools such as 5w2h, Brainstorming, the flowchart, and the Tree of Causes Action plan in their qualitative approach.

Despite the extensive use of quality tools in industrial contexts, their application in chemical product management remains limited. There are few studies that have tackled issues related to expired chemical products and the absence of safety documentation, such as SDS. This gap points out how basic quality tools can be utilized to analyze and solve problems related to chemical product management in industrial settings.

3. Positioning of the study

most of the previous studies confirm the effectiveness of quality tools in process improvement and problem-solving such as the Ishikawa (Fishbone) diagram, Pareto chart, Brainstorming, 5W2H, and 5 Why are a few examples of tools that proved to be useful in determining the root causes of problems, reducing defects, and improving customer satisfaction.

This table summarizes studies that used quality tools:

Table 3 Research summary

STUDY	QUALITY TOOLS	RESULTS
Ghali et al. (2025)	Pareto 5w2h Ishikawa Histogram Control Chart 5 whys Brainstorming Weighted Voting Decision Matrix Dashboard Action plan	Reduction in customer complaints and improvement in customer satisfaction. Complaint processing time reduced from 21 days to 10 days. Improved product quality. Increased revenue from industrial customers.
MH, et al., (2023)	Pareto chart Ishikawa diagram	integration Reduced downtime; improved operational efficiency; saved time In Manufacturing industry
Neyestani, (2017)	Seven Basic QC Tools Check Sheet Histogram Pareto Chart Ishikawa Diagram Scatter Diagram Flowchart Control Chart	Confirmed importance of systematic use of the seven tools to solve production problems effectively Production organizations
Soković et al. (2009)	Flow chart Pareto chart Check sheet Control chart Histogram	Seven QC Tools linked to PDCA cycle Improved structured problem-solving and continuous improvement processes Manufacturing sector

	Scatter plot Ishikawa diagram. PDCA Six sigma (dmaic)	
Salcedo et al. (2019)	Ishikawa Pareto Brainstorming 5 whys Histogram Six sigma (dmaic)	Sampling tools Demonstrated process improvement across 84 industrial projects; structured problem resolution Manufacturing industries – Mexico
Chiromo & Moagi (2014)	Seven Basic Quality Tools	Reduced rejects and rework; improved teamwork and customer relationships Battery manufacturing Southern Africa
Hamza & Rebib (2021)	Ishikawa, Pareto, PDCA, Value Stream Mapping (VSM) 5S Method Kaizen (Continuous Improvement) Waste Analysis (Muda – 7 types of waste) Key Performance Indicators (KPIs)	Waste reduction; process optimization; improved production efficiency pharmaceutical sector – Algeria (Sidal Group)
Pramono, et al., (2018)	Seven Quality Tools	Reduced product defects; improved conformity to customer specifications pharmaceutical company – Indonesia

Teplická et al. (2023)	Ishikawa, Pareto, Lean Tools	Improved economic performance; enhanced process efficiency Lean production – Industrial sector
Oancea et al. (2024)	Ishikawa diagram (7Ms), 5 Whys, Brainstorming	Identified 11 potential causes; isolated main factors affecting product quality Steel pipe laser cutting process
Adib et al. (2024)	Ishikawa Diagram	Identified main causes of fatal truck accidents (road slope & brake issues) Road safety – Morocco
El Allaoui et al. (2024)	Pareto Chart Diagram Ishikawa 5 Why Method Check Sheets Process Mapping / Flowcharts PDCA Cycle (Plan–Do–Check–Act)	Reduction of non-conformities Better identification of root causes Improvement of process control Increased efficiency in corrective actions Better organization of documentation Strengthening of the Quality Management System Improvement in overall performance Automotive industry (GRUPO SIE)

Source: Elaborated by the author

After a thorough analysis of the studies identified, the literature review indicates that most studies used qualitative methods such as the interviews El Allaoui et al. (2024), Ghali et al. (2025) Despite the use of basic quality tools in manufacturing and production sectors, few studies have addressed their application in chemical product management systems, particularly in the context of missing SDS and expired products in industrial environments For this reason, this study aims to fill this gap by presenting a case study that demonstrates the effectiveness of basic quality tools, including the Ishikawa diagram, 5 Whys,

Brainstorming, 5W2H, and the Action Plan, in analyzing non-conformities related to chemical product management. This study adopts a qualitative approach within SONATRACH-DML to address issues related to inadequate chemical product management, such as missing SDS and products stored without expiration dates

Section 02: Conceptual Framework

1. The Problem

1.1. Definition of problem

Before attempting to solve a quality problem, it is essential to clearly understand what a problem is:

Avrillon (2005) defines a problem as a difficulty that must be resolved in order to achieve a certain result, or the unstable or dangerous situation that requires a decision to be made.
While liker & Meier (2006) emphasize that the problem must be clearly defined before attempting any improvement. Without a clear understanding of the problem, it becomes impossible to determine what needs to be improved or how much effort is required to reach the desired goal. In such a situation, efforts may be directed toward an unclear or non-existent target.

Also, Boulsnane (2021) mentions the problem as a situation that is difficult or uncertain and needs to be resolved. When the current situation does not correspond to the desired one, a problem arises, which means there is a gap between the current state and the expected outcome. The larger the difference between these two states, the more significant the problem becomes.

1.2. The classification of the problems

Problems can be classified into four main categories:

- Problems that constitute a challenge (type A): these problems are particularly difficult because neither their causes nor their solutions are known
- Problems requiring high technology (type B): The causes have been identified, but it is not known how to solve the problem.
- Simple problems (type C): The causes are simple, and the solutions are obvious.
- Problems for which the solution is known but which require great attention (type D): we know what needs to be done but do not understand why (avrillon, 2005)

This classification helps identify the most appropriate quality tools for each type of problem. In quality management, the term ‘non-conformity’ is often used instead of the term ‘problem’. ISO 9001, (2015)

1.3. Quality problems

A quality problem arises when the expected quality characteristics fail to meet the required standards or specifications. In short, it indicates a lack of compliance with established standards or specifications. The gap between the current level of quality and the desired level is commonly referred to as a ‘quality gap’. (Boulsnane, 2021)

1.3.1. Types of Quality Problems

By identifying the various types of quality problems, enterprises can better address the challenges they encounter and can use this classification to choose the best tools to solve specific problems.

Five main types of quality problems can be identified:

- **Conformance Problems:**

Conformance problems appear when there is a clear established and correct method of doing a work, but when the system no longer operates to the established standard. In these cases, the system may have worked effectively in the past, but changes in data, processes, or activities can lead to results that do not satisfy the expected standards. Problem solving focuses on identifying the causes of these deviations and restoring the process to the required standard.

Identifying problems with adherence is greatly facilitated by having clear standards. Inputs, work in progress, and outputs can be compared against these standards, and any mismatch indicates the presence of a problem.

Statistical Process Control (SPC) is particularly useful in detecting such deviations. Although conformance problems are generally the easiest type of quality problems to identify and resolve, determining the exact causes of deviations in complex systems may still be challenging.

- **Unstructured Performance Problems:**

Unstructured Performance Problems (UPPs) arise in systems or processes that are not clearly defined by standards but fail to deliver satisfactory performance from the perspective of customers or other stakeholders. A typical example is sales performance that falls below the expected target or budget.

The most difficult stage in addressing this type of problem is its identification, since it cannot simply be detected through comparison with predefined standards. Solving such problems requires a thorough understanding of customer needs as well as identifying the underlying causes of unsatisfactory performance.

- **Efficiency Problems**

Efficiency problems primarily concern the interests of system owners and operators. They occur when operational processes generate higher costs than desired or create unsafe or undesirable working conditions. Cost efficiency is the most common concern associated with this category.

Employees play a key role in identifying efficiency problems because they are often the most familiar with wasteful practices and unsafe production procedures.

Solving these problems involves identifying unnecessary activities, eliminating waste, and finding more cost-effective ways of performing essential tasks. Finding the reasons for these gaps and fixing the system to its original performance level.

- **Product Design Problems**

Product design problems include the development of products or systems that effectively satisfy consumer needs. These problems are particularly common in competitive and technology-driven sectors.

Many enterprises have specific departments responsible for product development; modern product design usually needs teamwork with many stakeholders.

A principal step in product design is the identification of requirements, which is the process of understanding consumer needs and turning them into product specifications. One of the essential tools used for this purpose is Quality Function Deployment (QFD), which defines

the relationship between customer expectations to product characteristics and production processes.

The important problem in product design is the design process itself—imagining and creating a product that satisfies these needs. This process usually begins with the formulation of high-level design concepts, then the development of components and subcomponents, finally ending in a detailed specification of the finished product.

Effective product design goes beyond explicit consumer needs and considers the product's context of usage and its operational environment throughout its life cycle.

- **Process Design Problems**

A process can be defined as a structured plan of activities aimed at achieving a specific goal. Process design problems develop when current procedures are not capable of efficiently achieving their intended goals. As a result, if all the enterprise procedures were correctly planned, many operational problems might be avoided.

In the past, enterprises paid little attention to the design of internal processes, often identifying process deficiencies only after major performance problems occurred, But the quality movement has changed this strategy by emphasizing the importance of continuous process design and improvement for organizational performance.

Identifying process design problems can be difficult because it needs a full understanding of how present processes work, how comparable activities are done in other enterprises, and how technological advancements can provide new process possibilities.

Improvements in process design usually result from practical standards and experience-based heuristics related to workflow, task allocation, coordination, scheduling, input control, and the management of interruptions or delays. (Boulsnane, 2021)

2. Non-conformity

2.1. Definition of non-conformity

ISO 19011 (2018) defines non-conformity as: « non-satisfaction of a requirement »

Non-conformity is any deviation from requirements, standards, or procedures. It refers to any failure to comply with established norms or requirements (Efalia, 2025)

A non-conformity is any situation where a requirement fails to be satisfied, whether it comes from an ISO standard, a customer, a statutory or regulatory body, or an organizational procedure. (International Atomic Energy Agency, 2021)

2.2. Types of non-conformity

Three severity levels are typically used to classify non-conformities:

- Non-Conformity Critical: Needs immediate action; directly affects customer satisfaction, safety, or compliance.
- Non-Conformity Major: Major deviations that have an impact on the quality of the final product or process performance.
- Non-Conformity Minor: minor deviations that don't have an immediate effect but need to be checked to avoid getting worse. (Efalia, 2025)

2.3. Detecting non-conformity

Non-conformity can be identified by any stakeholder, including Customers, Suppliers, External auditors, Internal staff, and public administration staff.

This is done either during internal and external audits, quality control, customer complaints, or complaint analysis. In this context, non-conformity must be identified as quickly as possible.

During this initial phase of the process, the non-conformity must be clearly described and properly documented. The following information should be provided:

- The reference document or standard specifying what should have been done but was not respected
- Objective evidence demonstrating the non-conformity
- The date of detection and the identity of the person who identified it. (Picomto, 2024)

This concept is essential in quality management, by helping organizations identify deviations and implement appropriate corrective actions.

2.4. Audit

"Systematic, independent and documented process for obtaining objective evidence (3.8) and evaluating it objectively to determine the extent to which the audit criteria (3.7) are fulfilled.

***Note 1 to entry**: Internal audits, sometimes called first-party audits, are conducted by or on behalf of the organization itself.*

***Note 2 to entry**: External audits include those generally called second- and third-party audits. Second-party audits are conducted by parties having an interest in the organization, such as customers or other persons acting on their behalf. Third-party audits are conducted by independent auditing organizations, such as those granting registration or certification of conformity, or public bodies"*ISO19011 (2018)

2.4.1. types of audits

_ First-party audit: Internal audit

_ Second-party audit: Audit of external service providers, Audit of other interested parties external

_ Third-party audit: Audit for certification and/or an accreditation, Audit for legal, regulatory purposes and similar ISO 19011 (2018)

- **First Party Audit**
  It is the Internal Audit. The organization audits itself to ensure that internal systems and procedures are working as planned, and for self-improvement purposes.
- **Second Party Audit**
  An audit carried out by an organization on its suppliers or partners to evaluate their performance and ensure compliance with quality requirements.
- **Third Party Audit**
  An audit performed by an independent and impartial body to assess conformity with standards such as ISO 9001 (Stephens & Roszak, 2010)

2.4.2. Auditing principles

_ Integrity: The foundation of professionalism

_ Fair presentation: The obligation to report truthfully and accurately

_ Due professional care: The diligent and discerning attitude during the audit

_ Confidentiality: Security of information

_ Independence: The basis for the impartiality of the audit and objectivity of audit conclusions

_ Evidence-based approach: The rational method for reaching reliable and reproducible audit conclusions in a systematic audit process

_ Risk-based approach: Audit approach considering risks and opportunities ISO 19011 (2018)

3. Chemical Product Management

According to National Research Council (2011) Chemical management refers to the set of procedures used to ensure safe handling, storage, transportation, and disposal of chemical substances within an organization. Effective chemical management aims to reduce risks to human health and the environment by ensuring that chemicals are properly labeled, documented, and stored according to safety regulations.

3.1. Inadequate chemical product management

According to the World Health Organization, (2010) Inadequate chemical product management occurs when chemical substances are not properly controlled, labeled, documented, or stored according to established safety procedures. Such deficiencies may lead to safety risks, regulatory non-compliance, and potential hazards for workers and the environment.

3.1.1. Safety Data Sheet (SDS)

A Safety Data Sheet (SDS) is a document that provides detailed information about a chemical substance, including its risks, physical and chemical properties, safe handling techniques, storage conditions, and emergency measures. It is designed to ensure that workers and users have access to important safety information and handling dangerous chemicals. (Occupational Safety and Health Administration , 2012)

- **the importance of SDS**

Safety Data Sheets are essential tools for chemical safety management because they provide hazard information, proactive measures, and emergency procedures necessary for the safe use, storage, and handling of chemical substances. (Occupational Safety and Health Administration , 2012)

3.1.2. Chemical expiration date

The expiration date of a chemical product shows the period during which the substance maintains its stability, quality, and safety under specified storage conditions. Using chemicals beyond their expiration date can lead to reduced effectiveness or serious safety problems related to chemical degradation, (United Nations, 2019).

4. Problem solving

4.1. Definition of problem solving

Problem-solving can be defined as the process of overcoming barriers that prevent the achievement of specific objectives. It involves cognitive activity that requires interaction between a person's previous experience and the specific requirements of the task. The objective is to identify the root causes of a problem and select the most appropriate solution to ensure sustainable results ((Fogler & LeBlanc, 2008).

Problem solving is not limited to just identifying a quick solution to a problem. Instead, it is a structured and logical thinking process that aims to select the most appropriate strategy of action that results in visible and lasting changes. (liker & Meier, 2006)

4.2. Quality Problem Solving and Its Importance

The Significance of Effective Problem Solving

problem resolution is essential in Total Quality Management (TQM)

It helps to reduce the probability of problems and support continuous growth in businesses.

Problem solving is the process of evaluating a situation and creating appropriate solutions to fill the gap between the goal and actual conditions.

A problem is only considered completely solved in the context of total quality management when its recurrence becomes impossible or less likely.

Simply restoring the situation to its previous state is not sufficient, as the problem may reoccur.

To ensure long-term progress, enterprises using Total Quality Management concentrate on identifying and eliminating the root causes of problems.

Several benefits can be obtained when efficient problem-solving methods result in procedures, goods, or services:

- Improved product or service quality
- Reduced costs (the elimination of waste and warranty claims)
- customer satisfaction
- Enhanced competitiveness

The probability of success increases. (Boulsnane, 2021)

According to American Society for Quality. (2026) Problem Solving Identify the root cause of the problem and then select the appropriate solution to prevent it from recurring.

What matters is not “solving the problem quickly,” but solving it at its root.

Problems can be:

_ Minor (within a single department) Or major (across the entire organization)
_ Recurring or a single serious incident
_ Some are obvious (due to standards like ISO 9001) and some are hidden and difficult to detect

That is why we need different tools such as: Root Cause Analysis, Fishbone Diagram

4.3. The main stages of problem solving

The problem-solving process consists main five stages. with each stage presenting its purpose and the quality tools applied for its implementation.

- **Identifying the Problem:**

As is said, "A well-defined problem is half solved." (Shaughnessy, 2012)

This step aims to verify that all essential information is available to solve the problem. It includes data collection and initial exploration to clearly identify the problem and clarify the objective René et al. (2014).

To understand and clarify the problem, it is necessary to review information based on multiple factors, such as location, people, time, and processes, using the 5W2H tool. (Gillet-Goinard & Seno, 2022)

- **Researching and Validation of Causes**

After identifying the problem, it is important to analyze its causes using a structured methodology:

- Identifying potential reasons: Collect all potential causes and classify them using the Ishikawa (Fishbone) diagram. & Brainstorming.
- Identifying the main causes: Focus on the most possible causes and conduct tests to confirm their validity.
- Identifying root causes: determining the fundamental causes in order to eliminate them effectively.
- Analyzing the identification time of non-conformities: evaluate the performance of the present monitoring system (Gillet-Goinard & Seno, 2022)

- **Solution Research**

Once the root causes are identified, the team works to find solutions to completely fix the problem. These solutions are reviewed using a decision matrix and then given to management for approval (Gillet-Goinard & Seno, 2022)

- **Solution Implementation and Effectiveness Monitoring**

After selecting the appropriate solutions, a detailed action plan is developed. Including:

- Defining responsibilities, actions and timelines
- Implementing solutions according to the plan
- Monitoring effectiveness: Twice, immediately after setup and three to four months later to confirm that the problem does not repeat (Gillet-Goinard & Seno, 2022)

Action plan: The Action plan presents the responsible person, objectives, timeline, actions, indicators, and resources utilized (Stern & Schoettl, 2024)

- **Recording and capitalization**

Documentation and Knowledge Capitalization is the final stage involves closing the case and drawing lessons from the experience. This includes verifying document completeness and analyzing team performance. Preventive actions and improvement opportunities are also considered, such as training or updating documentation. All elements are recorded in a corrective and preventive action report *(Gillet-Goinard & Seno, 2022)*

Table 4 : Stages of problem solving and applied quality tools

Problem-Solving Steps	Tools Used
Identifying the Problem	5W2H
Researching and validation Causes	Brainstorming Ishikawa Diagram 5 whys
Solution Research	Proposed solution brainstorming
Solution Implementation and Effectiveness Monitoring	Action plan Immediate evaluation
Recording and capitalization	Follow-up after 3–4 months Checklist

Source: Elaborated by the author based on Ghali et al. (2025); (Gillet-Goinard & seno, 2023; Gillet-Goinard & Seno, 2022); (Stern & Schoettl, 2024)

According to American Society quality (n.d.) Problem-Solving has 4 Steps

Step 1: Define the problem

What do we do?

_ We involve everyone affected by the problem

_ We collect data (numbers + observations)

_ We go to the Gemba and understand how the process actually works

_ We answer basic questions using: 5W2H

Step 2: Identify the Root Cause

Root Cause = The true source of the problem

If we don't find the true cause: The solution will only be temporary, and the problem will return

How do we identify it?

_ The 5 Whys technique (Why? 5 times)

_ Eliminate other causes

_ Verify with evidence

Sometimes the cause lies: In the system, in training, in management and there may be more than one cause

Step 3: Identify and Implement the Solution

First: Propose Solutions

_ Common Mistake: Choosing the first idea that comes to mind

_ Correct Approach: Propose several solutions

Tips:

_ Think creatively

_ Combine solutions

_ Ask customers or suppliers

_ Second: Choose the best solution

We evaluate solutions based on: Is it effective? Is it feasible? Does it cause other problems? Will people accept it? Does it align with the organization's goals?

second: Implementation

_ A clear plan is essential: What will we do? Who is responsible? When?

_ Rely on good communication with the team

_ Involve people to minimize resistance

Step 4 – Sustain the results

After implementing a solution, its results must be monitored to ensure effectiveness. If the solution fails, the organization should review the implementation, improve the solution, or identify the correct root cause. If successful, the solution should be standardized, documented, and supported through training to sustain continuous improvement.

Consequently, as demonstrated above, problem-solving methodologies vary across scientific references and management schools. While some frameworks, such as the ASQ (2026) model, suggest a concise 4-step approach (Define, Generate, Evaluate, Implement), others like Gillet-Goinard & Séno (2022) propose a more detailed 5-step process that emphasizes 'Capitalization' as a final stage for sustainability. In this study, after reviewing both perspectives, we have opted to adopt the 5-step methodology for our practical application. This choice is justified by the necessity of not only solving the immediate issue but also standardizing the solution through preventive tools—specifically the Receipt Checklist—to ensure long-term quality control and prevent recurrence within the organization.

5. The basic quality tools

This section of the study attempts to link quality tools with the problem-solving process, since solving problems represents the foundation of this project.

Several tools are used to analyze problems or prevent their occurrence, including: 5w2h: a questioning tool used to better understand a problem by asking questions such as who, what, where, when, how, why, and how much.

Brainstorming: a group technique used to generate a large number of ideas and possible solutions.

5M (Ishikawa): a cause-and-effect diagram used to identify the causes of a problem. Action plan: defines the actions required to solve a problem, including the tasks to be carried out, the responsible persons, deadlines, and the necessary resources.

Maintaining a high level of work quality within the organization is essential for the success of a continuous improvement approach. Both internal customers (employees) and external customers (clients) can observe this improvement in quality.

Therefore, organizations use various methods and tools developed by quality specialists to improve the performance of all their activities. Some of these tools are simple and easy to use, yet they can produce significant long-term results, particularly in continuous improvement and problem-solving projects

5.1. The 5W2h

5.1.1. Definition

This method was initially developed by Sakichi Toyoda and later adopted by the Toyota Motor Corporation as part of the development of its manufacturing and management practices.

The 5W2H method (five “Wh” questions and two “How”) is a method used to clarify and understand a problem (an error or non-conformity). The objective of applying this method is to identify the root cause of a system failure or a problem. The set of five “Wh” questions helps clarify different aspects of the problem, making it easier to determine its origin and identify possible solutions. Over time, the 5W2H tool has expanded beyond Toyota and is now widely applied.

The purpose of applying the 5W2H method is not limited to just determining the cause of a failure or nonconformity. This is also to facilitate the implementation of effective corrective and preventative actions Nagyova et al. (2015)

5.1.2. Principles of the 5W2H Method

- responds to these questions: What? Why? Where? Who? When? And how?
- The depth of the analysis is limitless.
- There is no need for a specific questioning strategy (Nagyova et al. (2015)

Table 5: Principle of 5w2h methods

	5W2H	**Response**
5W	What is the problem? Describe it in a single sentence, so that others will be able to understand what you mean.	The problem is…
	Why is it a problem?	This problem has occurred because…
	Where do we encounter the problem?	We encounter the problem at (location) (Time) when (Specific circumstance) …
	Who is impacted?	This impacts: (Staff) by…, (Customers) by…, (Other providers) by … (others) by…
	When did we first encounter the problem?	We first encountered this problem…
2H	How did we know there was a problem?	The symptoms of this problem are…
	How often do we encounter this problem?	We encounter this problem (x) times and each encounter is (this big). The problem is getting (better/worse).

Source: Nagyova et al. (2015)

5.2. Brainstorming

5.2.1. definition

The invention of this method is attributed to Alex F. Osborn in 1942 introduced the concept of “thinking up”, and in 1953 he introduced the process of Brainstorming encouraging people to produce as many ideas as possible without criticism. (besant, 2016)

Brainstorming is a group technique designed to foster creative thinking and generate a maximum number of ideas in a very short period of time. Using a flipchart allows for all shared ideas to be noted and preserved.

There are two main modes:

- Very Open Brainstorming: Used for high creativity (e.g. advertising, searching for a brand name).
- Directed Brainstorming: Used for more restricted creativity, following precise criteria (e.g., technical solutions), (AFNOR, 2011)

5.2.2. The Purpose

It is a method that is both disciplined and relaxed, allowing team members to participate in searching for new ideas. This process challenges previous assumptions and paradigms. It is typically used during the "Measure" and "Innovate/Improve" phases, though it can be used whenever a need for new ideacadres arises, (AFNOR, 2011).

5.2.3. The Rules & Steps

The process follows a specific methodology:

- Preparation:
  Recall the current work stage and objective. Set the expected results and a time limit.
  Agree on a clear statement or question and write it at the top of the flipchart.

- The Rules of Conduct:

- Do not criticize the ideas presented.
- Do not comment on the ideas.
- Encourage "wild" ideas. Build on the ideas of others.
- Write down every single idea.

- The Session:

  Ensure all ideas are legible to everyone. Make sure every participant speaks freely and that the floor is not monopolized by a "talker." Use "rounds" to restart momentum; a participant can say "I pass" if they have no idea.

- The Facilitator's Role:

  The facilitator must stay standing and write ideas exactly as they are spoken, without shortening or interpreting them.

- Conclusion:

  After the session, clarify any points that aren't understood. Once finished, move to analytical techniques (such as Cause-and-Effect Analysis or Paired Comparisons). Recommendations Provide a flipchart with easily detachable sheets, felt-tip markers in good condition, and something to stick the sheets onto a wall. Would you like me to create a summary checklist based on these steps for your next meeting? (AFNOR, 2011).

5.2.4. Benefits and Limitations

The table below shows the main benefits and limitations of Brainstorming; each point includes its description.

Table 6: Benefits and limitations of Brainstorming

Benefits	**Description**
Encourage creative thinking.	Allows teams to think openly and creatively without limits.
Develop teamwork	Focusing on the quantity of ideas and focusing on others' efforts helps improve collaboration and team unity
Allow everyone to express themselves	Gives all participants, including shy people, the chance to share their thoughts and add to creative thinking and decision-making (David, 2021)
Limitations	**Description**
Groupthink issues	Individuals may avoid conflict and accept others' opinions even if they are weaker, while dominant individuals control the conversation
Censorship of critique and debate	Non-critical sessions allow everyone to share ideas, but some weak or unimportant ideas may be absent
Time pressure	Brainstorming sessions are usually time-limited, which might seriously limit creative thinking
Social loafing	Some individuals expend less effort in a group compared to working alone
Social stress	Participants may feel nervous about how others understand their ideas
stopping Production	In big meetings, only one member may propose an idea at a time, which reduces the total number of suggestions. (Elodie, 2020)

Source: Elaborated by the author based on ((David, 2021) (Elodie, 2020)

5.3. Ishikawa diagram

5.3.1. Definition

The Ishikawa diagram was developed by Dr. Kaoru Ishikawa in 1943. It is also known as the Cause-and-Effect Diagram or fishbone diagram, because it's like a fish skeleton. This diagram is used to detect and analyze problems by identifying all probable causes (Neyestani, 2017). It is a visual tool that facilitates the identification of root causes by organizing and classifying the factors, and it is constructed during Brainstorming sessions, where the problem is placed at the head of the fish and the main causes appear as principal branches across the spine, and the sub-branches showing more specific causes Realyvásquez (2018)

The diagram aims to show the relation between cause and effect and to avoid working immediately to solutions without first studying the root causes. The process begins by defining the problem, identifying possible causes, and classifying them into main categories and sub-categories.

usually, the reasons are identified using the 5M method: Manpower, Machine, Material, Method, and Mother Nature/Environment. (AFNOR, 2011).

Depending on the level of analysis required, this classification can be increased to 6M, 7M, or even 8M, by adding more categories such as Measurement (to determine performance accuracy), Management (to analyze organizational decisions and planning), and Money (to manage for financial resources, budgeting, costs, and investments) (Forcam, 2025)

5.3.2. Relationship between the Ishikawa and problem solving

The Ishikawa analysis is used after the formulation of the problem using the 5w2h method, and before thinking about possible solutions. The usual sequence is therefore:

- Define the problem.
- Analyze the problem using 5w2h
- Identify the possible causes using the Ishikawa diagram.
- Propose and implement appropriate solutions. (Gillet-Goinard & Seno, 2016)

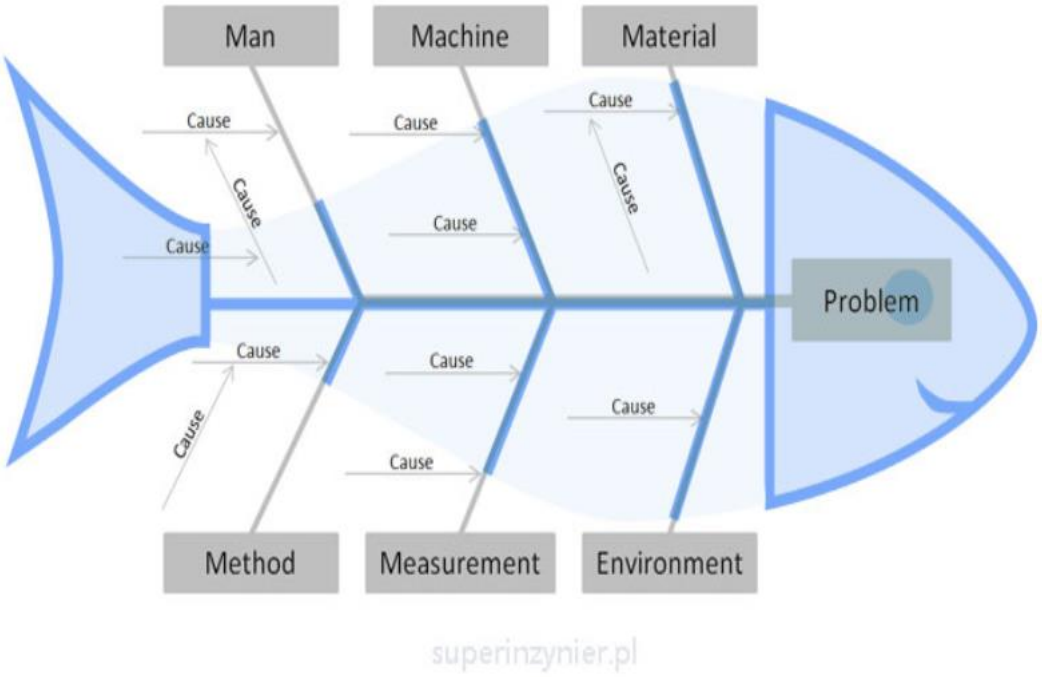
5.3.3. Principles of Ishikawa

The Ishikawa is based on two main principles:

- The causes of a problem can be divided into main causes and secondary causes.
- Solving a problem first requires distinguishing between the main cause and the secondary causes to identify the most influential factors. (Gillet-Goinard & seno, 2023)

Figure 1 below shows the appearance of an Ishikawa diagram resembles a fishbone:

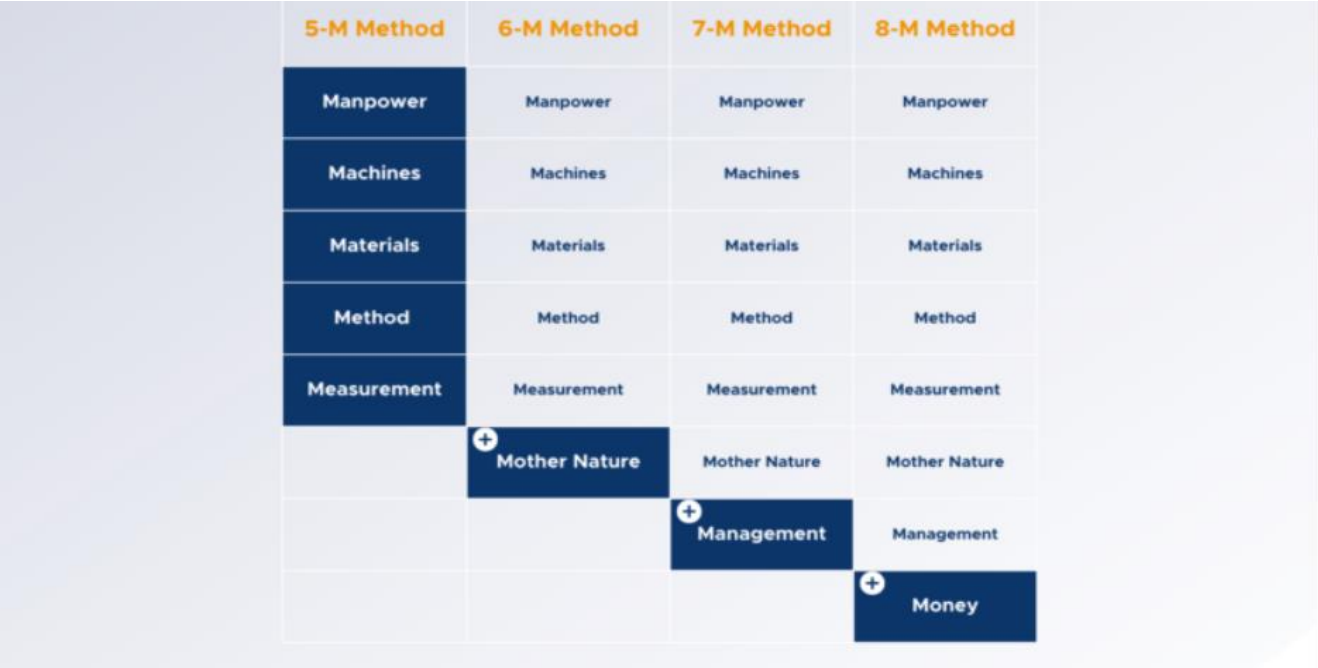
Figure 1: Fishbone diagram (Ishikawa)



Source: (Zbigniew, 2023)

The figure 2 below shows the “M” methods, including 5M, 6M, 7M, and 8M

Figure 2: The M method



Source: (Forcam, 2025)

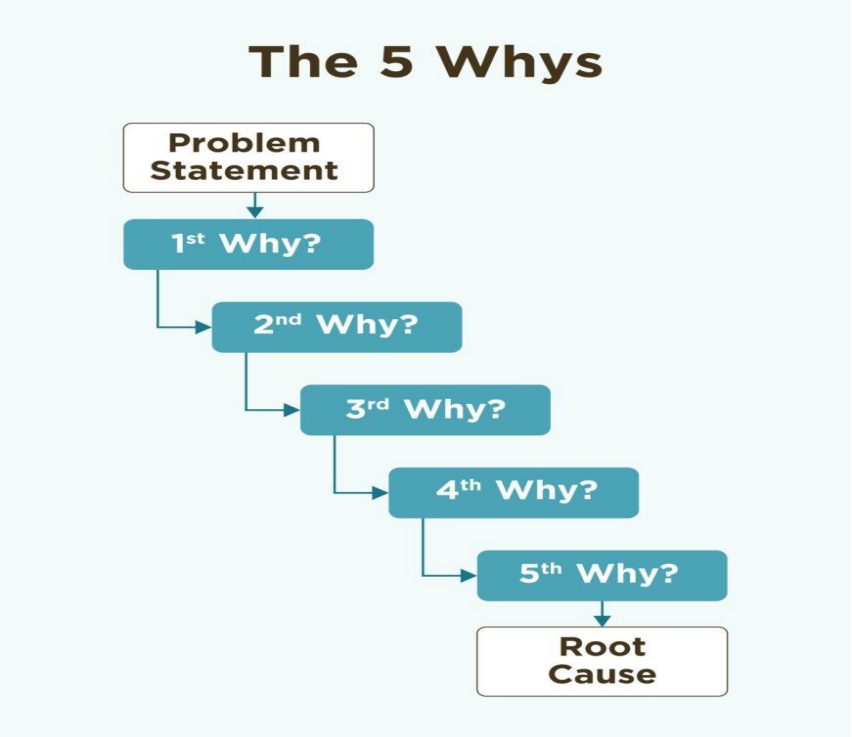
5.4. The 5 Whys

The 5 Whys tool is a root cause analysis used in quality management. It is repeatedly asking “Why?” 5 times, can lead to the root cause of a problem.

The 5 Whys uses "counter-measures," rather than solutions. A counter-measure is an action or set of actions that seeks to prevent the problem arising again, the 5 Whys can help in: identify the root cause of a problem. it is a simple tool easy to complete without statistical analysis.

“If you don’t ask the right questions, you don’t get the right answers. A question asked in the right way often points to its own answer. Asking questions is the ABC of diagnosis. Only the inquiring mind solves problems.”*– Edward Hodnett* (Ahmedani, 2020).

Figure 3: The 5 whys tool



Source : https://udyamee.com/2026/02/17/five-whys-analysis-the-proven-secret/

5.5. Action plan

5.5.1. Definition

According to (Gillet-Goinard & Seno, 2016)The Action plan allows an organization to formalize its annual quality objectives, as well as the actions and responsibilities associated with these objectives.

It can also include action lines with monitoring of status, resources, tasks, and activities. In this way, the Action plan serves as a planning tool for the key actions that must be initiated within a company to achieve its objectives.

according to Ghali et al (2025), the Action plan includes 5 components:

- Action: A description of the correct action or step to be taken.
- Objective: Determines the desired end result of this action.
- Responsibility: Identify the person or section responsible for implementation and supervision to ensure accountability.
- Duration: Identify the time frame needed for completion (start and end dates).

_ Final result: This is the indicator that proves the action has successfully and definitively solved the problem.

5.5.2. Advantages

The text highlights several advantages of the Action plan according Goinard & Seno (Gillet-Goinard & Seno, 2016):

- It formalizes the actions and specifies their implementation deadlines.
- It allows the monitoring of action implementation within the company.
- It ensures a formal commitment from the responsible persons assigned to carry out these actions.

5.5.3. Immediate Action

according to (Ernoul, 2010) This is the urgent and direct intervention carried out immediately upon discovering a non-conformity or defect in a product or service. This action is primarily aimed at "containing" the error and minimizing its immediate negative effects on the customer or on the production process. It includes processes such as:

- Repair: Restoring the defective product to a usable condition.

-Replacement: Replacing the damaged part with a functional one to ensure operational continuity.
- Segregation: Removing non-conforming products from the production line to prevent them from reaching the customer.

This procedure is considered a necessary "first aid" measure, but it is insufficient because it does not guarantee that the problem will not recur in the future.

Immediate Action =A "quick fix" for the current problem (repair or replacement).

5.5.4. Corrective Action

Improvement Plan, which is more than just an immediate fix, is characterized by the following:

- Logic of Progress: It does not merely repair the part but aims to improve the entire work process.

-Long-term: It is a measure aimed at permanently preventing the problem from recurring in the future.

-Feedback loop: It relies on informing the party responsible for the error (the supplier or department) of the results to ensure they do not make the same mistake again.

Corrective Action= A comprehensive "improvement plan" for the future (preventing recurrence).

5.6. Checklist

A checklist is a simple and structured tool consisting of a list of items or steps that must be completed or verified to ensure that no important step or requirement is overlooked during the execution of a task or process. It is used to reduce errors, improve accuracy, and standardize work procedures. It is also widely used in quality management to ensure compliance with established standards and to facilitate monitoring and control activities. (Stern & schoettl, 2024)

In the context of this research, these quality tools will be applied to analyze a non-conformity related to chemical product management within SONATRACH. The objective is to identify the root causes of problems such as expired chemicals and missing SDS and to propose corrective actions using a structured problem-solving approach.

Conclusion of Chapter 1

This chapter 1 presented the theoretical framework of the study.in section 1 It first presents an overview of previous studies related to the application of quality tools, and in section 2 reviewed the main concepts related to problems, quality problems, and non-conformities, highlighting their importance in quality management systems. The chapter also examined the principles of chemical product management and the risks associated with improper handling of chemical substances. In addition, different problem-solving approaches and basic quality tools such as Brainstorming, the Ishikawa diagram ,5 whys, Pareto analysis…and others These concepts and tools provide the theoretical basis for analyzing the non-conformities related to chemical product management in the case study. The next chapter presents the research methodology and the organizational context in which the study is conducted.

CHAPTER II

METHODOLOGICAL FRAMEWORK AND ORGANIZATIONAL CONTEXT

CHAPTER II: METHODOLOGICAL FRAMEWORK AND ORGANIZATIONAL CONTEXT

After presenting the theoretical background, this section describes the methodological approach adopted in this study and presents the case study organization, SONATRACH – DML Laghouat. The objective is to provide a clear framework for applying basic quality tools to improve chemical product management.

The chapter is divided into two sections. The first section explains the research methodology, including the research approach and data collection methods. The second section presents the host enterprise where the research was performed and gives an overview of its operations and organizational structure, The choice of SONATRACH DML as a case study is justified by its strategic importance in the Algerian energy sector.

Section 01: Research Methodology

In this section, we will undertake an exploration of the essential foundations that have influenced our study. We will start by setting out the methodology of research that we have deployed to collect and analyze the data in detail.

1. Project Framing

This study aims to analyze the problem of inadequate management of chemical products, particularly problems related to expired chemicals and the missing SDS.it focuses on identifying the root causes of these problems and proposing corrective actions using quality tools such as the Ishikawa diagram, Brainstorming, the 5W2H, Action plan, and the 5 whys.

The study was conducted within the context of a case study in an Industrial organization called SONATRACH DML where chemical products are used and stored as part of operational activities.

1.1. The epistemological posture

According to THIÉTART et al (2014)Epistemology is defined as "the study of the constitution of valid knowledge." It is an activity that explores how scientific knowledge is produced and justified. This reflection considers four essential dimensions:

the ontological dimension (nature of reality), the epistemic dimension (nature of produced knowledge), the methodological dimension (how knowledge is generated), and the axiological dimension (the values involved in the knowledge) (THIÉTART, 2014)

It provides the theoretical foundation to choose a research paradigm, which guides the approach to understanding reality.

Paradigms are "primary starting points" that a group of scientists or people agree on and use as a map to understand the world and solve its problems. Without this "paradigm," thinking would become distracted and we would not be able to reach clear scientific results. Translated from Arabic (Zadeh, (2019). The main epistemological paradigms include:

Table 7: Epistemological positioning

Positivist	**Interpretivist**	**Constructivist**
• Explain / predict the world (Behavior). • Discover the laws (the reality) • Test the hypotheses theoretical. **Reasoning:** hypothetico-deductive **Approach:** Quantitative	• Understanding the world (social behavior) • Interpret/decode the perceived reality of the actors • Generate new responses **Reasoning:** Inductive **Approach:** Qualitative	• Acting on the world (Behavior social) • Participate in build the perceived reality of the actors • Generate some hypotheses theoretical **Reasoning:** Inductive or/and deductive. **Approach:** Qualitative or/and quantitative **Plurality** of logics and Approaches. **(positivist + interpretivist).**

Source (Bedaida, 2023)(translated from French by the author)

The table above illustrates the fundamental differences between the epistemological positions: The Positivist, Interpretivist and Constructivist.

- **Interpretive Posture:**

The study adopts an interpretive approach because it is dictated by the nature of the problem, our study depends on understanding field reality. Instead of studying the chemical problem as just numbers, we follow a (Bedaida, 2023) method of collecting information from the people involved. This approach justifies our use of tools such as (Brainstorming) and (Ishikawa diagram), because these tools require information from the field to arrive at a technical solution to the problem.

2. Research methodology

this section presents the methodological approach adopted in this study. and describe the tools, the techniques used for collecting data to ensure the consistency and validity of our research approach.

Methodology is the set of principles and procedures used to produce and justify scientific knowledge, including the selection of methods, data collection techniques, and criteria for validating results. Methodology = how research is conducted (Thietart et al. 2014).

2.1. Qualitative methodology

This study adopts a qualitative research design based on a case study. This choice is suitable because the objective of the research is to understand and analyze a real problem inside an organization.

The case study is conducted in SONATRACH – DML Laghouat, which allows for a detailed analysis of the real situation in the company.

The qualitative approach allows understanding the problem of poor management of chemical products, specifically missing expiration dates and SDS.

It focuses on analyzing and identifying weaknesses instead of using numerical data.

In addition, this study is based on a problem-solving approach using basic quality tools such as 5W2H, Brainstorming, Ishikawa diagram, 5 whys, Action plan. These tools help to identify the causes of the problem and propose appropriate solutions.

- This approach is also supported by our literature review; we noticed that the research methods used in the cited articles were of a qualitative nature.
- The use of several methods such as observation, analysis of documentaries, and interviews, which are qualitative methods of collecting data. These methods will allow us to collect detailed data on current practices, to design effective interventions for improving the use of quality tools as part of the resolution of problems.

A qualitative methodology is an approach that understands social phenomena by interpreting meanings, experiences, and interactions, rather than measuring them quantitatively. Focuses on understanding rather than measuring. (Thietart et al., 2014). This approach is particularly suitable for studying real-life situations within their natural context ((Creswell, 2014)

This study provides a thorough analysis of how chemical products are managed and why certain non-conformities occur.

The research is both descriptive and analytical.

Descriptive: to present the current situation

Analytical: to identify root causes and propose solutions

2.2. Data collection tools

To achieve the research objectives several qualitative data collection tools were used, including:

- Semi-structured interviews with the storekeepers and HSE officers and the auditor.
- observation during field visits to the chemical storage areas.
- Analysis of internal documents.

2.2.1. Semi-Structured Interviews

The primary method of data collection was semi-structured interviews. Qualitative research recognizes this technique for its flexibility and depth.

(Bryman, 2012)stated that semi-structured interviews allow the researcher to direct the discussion while giving participants the liberty to express their experiences and perceptions. This study involved conducting interviews with key stakeholders involved in chemical management.

The purpose of these interviews was to: Understand current practices Identify existing problems Collect suggestions for improvement

2.2.2. The Interview Guide

We designed our interview guide based on the Bryman, (2012) and (Creswell, 2013)methodology. according to Bryman (2012) The guide is semi-structured, meaning it has main topics, but the questions are open-ended so participants can share their experiences freely, he also emphasizes having clear thematic axes while keeping flexibility for exploring new ideas during the interview. From these references, the interview guide for this study was developed.

Creswell (2013) proves that the questions should be related to the study topics to ensure all essential aspects are discussed without being overly limiting. This strategy helped us obtain a useful information from each participant.

the structure of the interview guide was guided by the doctorate thesis of Bedaida (2023). I especially focused on his strategy of organize the guide into different thematic axes and his way of writing open-ended questions, which ensures obtaining detailed data that matches with the study objectives.

Application: The axes of the guide were specifically developed to bridge the gap between theory and practice. They cover diagnosis of non-conformities (using the 5w2h logic), root cause analysis (aligned with the Ishikawa model), and improvement suggestions (based This structure ensures the collection of detailed qualitative data regarding chemical product management at DML. (SEE ANNEX A).

The choice of participants was guided by the organizational structure of DMLI selected five key roles to cover both office-based rules and field-based reality: Quality/QHSE Lead, The HSE Manager, the Warehouse Manager, the Storekeeper, the Procurement Officer, and the Maintenance Foreman. This way, I can compare the official procedures with the actual daily practices.

- **Axis Justification Interview Guide**

Axe 1: Profile of participants

This axis was included to collect general information about the participants (position, experience, and role in chemical management). According to qualitative research methodology, understanding the profile of respondents is essential to interpret their answers and ensure the reliability of the collected data. It also allows linking the responses to the level of responsibility and expertise in chemical product management.

Axe 2: Current Chemical Management Practices

This axis is based on the National Research Council's (2011) definition of chemical product management, which emphasizes the importance of properly handling, storing, and documenting chemical substances.

This axis also assesses the operational control requirements of ISO 14001:2015 (Environmental Management) and ISO 45001:2018 (Occupational Health and Safety) regarding daily handling and storage activities.

Axe 3: Problems and non-conformities

This axis was chosen based on the concept of non-conformity, as defined in ISO 9000 (2015), ISO 14001 (2015)and ISO 45001 ((2018)), which describes a failure to meet a requirement. It also builds on research like that of Ochieng et al.

(2025), which highlighted the prevalence of expired chemicals and poor storage conditions.

This dimension facilitates the identification of pre-existing issues, including the absence of expiration dates and SDS, both of which pose significant safety hazards.

This axis is supported by ISO 9001:2015 Clause 7.1.5, focusing on the "fitness for purpose" of monitoring and measuring resources (such as labels and SDS clarity). It also investigates non-conformities as defined in the IMS framework of DML.

Axis 4: Causal Analysis

The significance of root cause analysis in effective problem resolution, as highlighted by Gillet-Goinard (2023), underpins this axis. Prior to the formulation of potential solutions, a thorough identification of the underlying causes of the problem is essential.

This axis prepares the application of quality tools such as Brainstorming and the Ishikawa diagram, which are widely used to identify and structure causes.

Axe 5: Use of quality tools

This axis is based on several studies (Soković et al., 2009; El Allaoui et al., 2024) that demonstrated the effectiveness of quality tools in problem-solving and process improvement.

It aims to evaluate whether tools such as 5W2H, Ishikawa, are used in practice and how they contribute to solving problems.

Axe 6: Corrective actions and improvement

This axis is directly linked to the solve the problem which is a fundamental for improvement.

According to the literature, effective problem-solving requires not only identifying causes but also implementing corrective and preventive actions and evaluating their effectiveness.

This axis helps assess how the organization manages improvement actions and prevents recurrence of problems when ordering and receiving them. (Information provided by DML 2026).

2.2.3. Observation

Observation enables the researcher to observe actual behaviors rather than relying solely on reported data (Yin, 2018).

For our research case, we used the non-participant observation to examine real practices within the organization, particularly those related to the storage, handling, and management of chemical products.

By observing, it is possible to identify several issues, like:

Absence of expiration dates.

The absence of Safety Data Sheets (SDS).

2.2.4. Observation Guide

We designed our observation guide following the methodology of Bryman (2012) and Flick (2014)

Bryman (2012) addresses observation guides in general, explaining how to define criteria and behaviors to be observed in order to reduce bias

Flick (2014) offers practical recommendations for designing observation grids, including selecting criteria, organizing elements, using checklists, and categorizing observations (e.g., Always / Sometimes / Never) to facilitate systematic and analyzable data collection.

Application: The grid was structured around the 5M factors (Material, Methods, Milieu/Environment, etc.). This allowed for transforming field observations in warehouses into technical data that feeds directly into the quality tools, such as the Ishikawa diagram and others. (see ANNEX B)

- **Justify Observation Grid Axis**

– Storage Conditions

This axis is based on studies highlighting the risks associated with improper storage of chemical products, particularly expired chemicals.

For example, the Queensland Government (2018) case showed that poor storage conditions can lead to serious hazards such as chemical instability and explosion risks.

– Labelling and Identification

Proper labeling is essential in chemical safety management.

According to international safety guidelines, chemical products must include labels, hazard symbols, and expiration dates to ensure safe handling and risk communication.

– Safety Measures

This axis is derived from the principles of occupational safety, which require the availability of personal protective equipment (PPE), emergency tools, and safety instructions.

It helps evaluate whether safety measures are effectively implemented in practice.

- Documentation (SDS)

This axis is strongly justified by the importance of SDS, as highlighted in the literature.

Studies such as Lee et al. (2024) showed that missing or inaccurate SDS can lead to incorrect risk assessment and unsafe practices.

Therefore, checking the availability and validity of SDS is essential.

The presence and accessibility of SDS are cross-referenced with ISO 9001 8.5.1 and ISO 45001 requirements for emergency preparedness and operational information.

- Handling Practices

This axis is linked to the concept of compliance with procedures.

Even if procedures exist, problems may occur due to improper application.

Thus, observing real practices allows identifying gaps between theory and practice.

- Staff Awareness and Training

Human factors are critical in quality management.

Several studies emphasize that lack of training and awareness is a major cause of non-conformities.

This axis evaluates employees' knowledge of risks and safety procedures.

- Compliance with standards

This axis is based on the requirement of compliance with internal rules and safety standards.

According to quality management principles, non-compliance is a key indicator of process failure.

The observation grid includes technical checkpoints from ISO 9001:2015 Clause 7.1.5 to verify the calibration status of measuring equipment (like scales) and the legibility of identification markings.

- Risk situations

This axis allows direct observation of hazardous situations such as leaks or unsafe practices.

It provides objective evidence of existing risks in the organization.

These axes are justified by ISO 45001:2018 Clause 8.1.2 (Hierarchy of Controls), where we observe the actual use of PPE and the effectiveness of emergency response tools (eye washes, extinguishers) as required by safety standards.

2.2.5. Document Analysis

To ensure consistency between formal procedures and actual practices, document analysis was performed to complement the collected data.

The documents that have been analyzed are:

- QHSE Policy.
- ISO Certifications (ISO 9001, ISO 14001, ISO 45001).
- Organizational Structure of the DML.
- Corrective Action Control Sheets (FMAC).

- Safety Data Sheets (SDS).
- Chemical Management Procedures.
- Chemical Storage Procedures.
- Chemical Inventory Records / Register.
- Expired Products List.
- Warehouse Monitoring Checklists.
- Internal Audit Reports.
- Non-Conformity Reports.
- Waste Disposal Records.

These documents provide the empirical evidence needed to populate the Ishikawa diagram and the 5W2H matrix in the subsequent analysis.

Also, we analyzed the content of the interviews.

Contextual and historical insights can be gained through document analysis, which is considered a reliable source of qualitative data (Bowen, 2009).

The collected data were analyzed using basic quality tools. The information obtained from interviews, observations, and document analysis was organized and used to identify problems, analyze their causes, and propose corrective actions. Tools such as 5W2H and Ishikawa diagram and others were used to structure and analyze the data.

2.2.6. Use of quality tools:

Quality tools were used to adopt a structured problem-solving methodology in order to analyze the collected data and address the identified problem.

The collected data from interviews, observation, and documents were analyzed using quality tools such as 5W2H, Brainstorming, Ishikawa, 5 whys, and Action plan.

1. Problem Definition using 5W2H

The problem was defined and structured using the 5W2H method by answering the following questions.
What? Why? Where? When? Who? How? How much?

This tool was selected because it ensures that a complete understanding of the problem is gained before proceeding to deeper analysis.

According to the literature, such as Junior & Gonçalves, (2019) it is an essential tool in the problem identification phase and helps structure the analysis before moving to deeper.

2. Brainstorming

Brainstorming was chosen as a tool for generating a large number of possible causes.

according to AFNOR (2011) It encourages team participation and creativity, allowing the identification of potential factors contributing to the problem.

3. Ishikawa Diagram

The Ishikawa diagram it was used in this study to identify and classify the essential causes of non-conformities related to chemical product management.

According to AFNOR (2011) It allows organizing and classifying causes into categories (5M, 6M, etc.), making it easier to identify the main causes of non-conformities.

4. 5 whys

5 whys were chosen to identify the root cause of the problem according to Ahmedani (2020). And Ghali Et al. (2025**)**

5. Action plan

According to Gillet-Goinard & Seno (2016) It allows defining actions, responsibilities, deadlines, and resources required to solve the problem.

It also ensures follow-up and effectiveness of corrective actions.

All quality tools were applied using the 5-step problem-solving method of the (Gillet-Goinard & Seno, 2022)

I chose the 5-step method (rather than the 4 or 7-step methods) for the following reasons:

Because the problem is clear and not a complex manufacturing issue requiring 7 steps, the 5steps get us straight to the goal.

For speed and practicality: Chemical hazards (such as missing safety data sheets) require rapid intervention (we identify the problem and implement the solution). Lengthy methodologies waste time.

Because it suits our tools: Our tools are simple and rely on observation and discussion (Ishikawa, 5 Whys), and the 5-step methodology aligns perfectly with them, requiring no complex calculations or statistics that we don't need in our studies.

Although there are many well-known methodologies for solving problems in quality management (such as the DMAIC methodology of Six Sigma, or the 8D methodology, etc.), we chose to rely on the specific 5-step methodology in our study.

This is because the nature of the problem under study—chemical material management at DML—is primarily an "organizational and procedural" issue, not a "statistical or manufacturing" one. The DMAIC methodology and others require access to large quantitative data sets to measure statistical variances, while the 8D methodology is often used to address complaints from external customers in complex production lines.

In our case, the 5-step approach provided us with a flexible, direct, and practical framework that fit perfectly in the context of qualitative research, allowing us to move easily and directly from identifying the management problem to proposing an Action plan.

We have not used other quality tools because this selected list of tools and steps was complete and sufficient, it helped us to diagnose and identify the problem, and to find and implement a solution, so we did not need to add any other tools.

6. Reliability and Validity of the Study

Data triangulation was employed to enhance the reliability of the research by combining:

- Interviews
- Observations
- Document analysis

By using this approach, the findings can be more credible and potential bias can be minimized.

7. Conclusion of Methodology

The development of effective and sustainable solutions in a continuous improvement perspective is supported by this methodological framework, which combines qualitative research methods with structured quality tools to provide a comprehensive analysis of the problem. After defining the methodological framework, the following section provides a detailed overview of the host organization.

Section 2: Organizational context

1. Presentation of SONATRACH Company

According to the Official (SONATRCH, n.d.) is (The National Society for research, processing, transportation and marketing of hydrocarbons), (in French Société Nationale pour la Recherche, la Production, le Transport, la Transformation et la Commercialization des Hydrocarbures) is a public company in Algeria specialized in the hydrocarbons sector.

It was established on December 31, 1963, after the nation gained independence. With the objective to manage and develop Algeria's oil and gas resources and in the 1970s: Complete nationalization of hydrocarbons (strengthening the role of the state in the energy sector). SONATRACH is now the largest energy company in Africa. make a substantial contribution to Algeria's GDP and state income and plays a crucial role in the country's economy. This company is active in every stage of the hydrocarbon value chain, including marketing, production, transportation, refining, and exploration. It employs close to 200,000 people and has more than 150 subsidiaries.

- SONATRACH Mission is:
  - Meet the domestic needs of hydrocarbons
  - Maximize national revenues over the short, medium, and long term
  - Support Algeria’s economic growth
- Ambition
  - Reinforce our role as the driving engine of the national economy.
  - Sustain our market presence and international competitiveness.
  - Complete transition into an integrated energy company successfully.

SONATRACH is an integrated company, which means that it intervenes in all stages of the oil and gas chain:

- Exploration
- Production
- Transport
- Refining
- Transformation
- Marketing

- SONATRACH Activities

- Explore: Searching for oil and gas fields.
- digging: Create wells to access resources.
- Production: Oil and natural gas extraction.
- Transfer (Routing via): Pipelines Gas pipeline networks, Oil tankers
- Refining (Processing crude oil into finished products): Jawhar, Diesel, Private pilot license, Petrochemicals
- Marketing: Export to global markets.

2. Presentation Maintenance Directorate of Laghouat (DML) – SONATRACH

The Maintenance Directorate of Laghouat (DML) is one of the important technical units of the national company SONATRACH.

It is responsible for the maintenance of the hydrocarbon transport network in Algeria. This network includes:

- Approximately 30 pipelines
- Around 15,800 km of pipelines
- 77 pumping and compression stations across the country

The DML has highly qualified technical staff, which enables them to carry out maintenance operations efficiently and safely.

- The DML Creation and Evolution
  - 1963: Creation of a simple maintenance base.
  - 1981: Development into a maintenance department under the Western Regional Directorate (Oran).
  - 1989: Became an independent Maintenance Directorate (DML).
  - The organization was structured into departments and services to improve efficiency.

Located in the urban area of Sidi El-Sadikia, Laghouat.

- 2002: DML was created

Total Workforce: 363 agents (Information provided by DML 2026)

Recently, the name DML was changed to MNL to avoid confusion with another SONATRACH branch that has the same name (DML). This information was communicated to me by the head of the IMS department. However, the designation DML has been retained in this report as it is the most commonly used and widely recognized.

2.1. Certifications in Quality, Health, Safety, and Environment (QHSE):

SONATRACH - DML Laghouat demonstrates its commitment to international standards through its Integrated Management System.

ISO 9001:2015: Quality Management System (QMS), it ensures the effectiveness of maintenance services and operations.

ISO 14001:2015: Environmental Management System (EMS), focusing sustainable operations and reducing environmental impact.

ISO 45001:2018, The Occupational Health and Safety Management System (OHSMS), attempts to avoid work-related accidents and provide a safe workplace.

These certifications include safety valve calibration, specific pipeline operations, rotating equipment maintenance.

- Activities of DML

The DML performs several important activities:

- Preventive maintenance of large petroleum equipment
- Corrective maintenance (repair after breakdowns)
- Maintenance of pumps, rotors, and major mechanical systems
- Implementation of maintenance plans
- Developmental maintenance (technological updates)
- Risk and failure analysis
- Technical studies and interventions on pipelines

These activities ensure the safety and continuity of the hydrocarbon transport system.

The company has a quality policy that focuses on safety and compliance (Information provided by DML 2026)

2.2. the QHSE policy

Vision

The company aims to maintain its leading position in pipeline transport maintenance, while ensuring its sustainability in a changing economic, technological, and regulatory environment.

Mission

DML is committed to:

-Enhancing customer satisfaction as a top priority

-Complying with legal and regulatory requirements

-Providing services such as:

-Maintenance of rotating machinery

-Special pipeline operations

-Safety valve testing and calibration

-Instrument calibration

Values

The company is based on:

-Credibility: respecting professional ethics

-Objectivity: ensuring independence and impartiality

-Responsiveness and responsibility: quickly meeting customer needs while:

-Protecting data confidentiality

-Ensuring health and safety

-Preserving the environment

Objectives

The company seeks to:

-Develop employees' skills and competencies

-Ensure continuous improvement of the QHSE management system

-Comply with international standards:

-ISO 9001 (Quality)

-ISO 14001 (Environment)

-ISO 45001 (Health & Safety)

-Strengthen customer relationship

-Improve workplace safety and reduce risks

-Minimize environmental impact

-Maintain laboratory accreditation (ISO 17025)

-Obtain inspection accreditation (ISO 17020)

Commitment

-Top management is committed to:

-Ensuring impartiality

-Meeting customer and regulatory requirements

-Continuously improving the QHSE system

-Reducing risks and protecting workers

-Involving employees in system improvement

-Providing safe and healthy working conditions

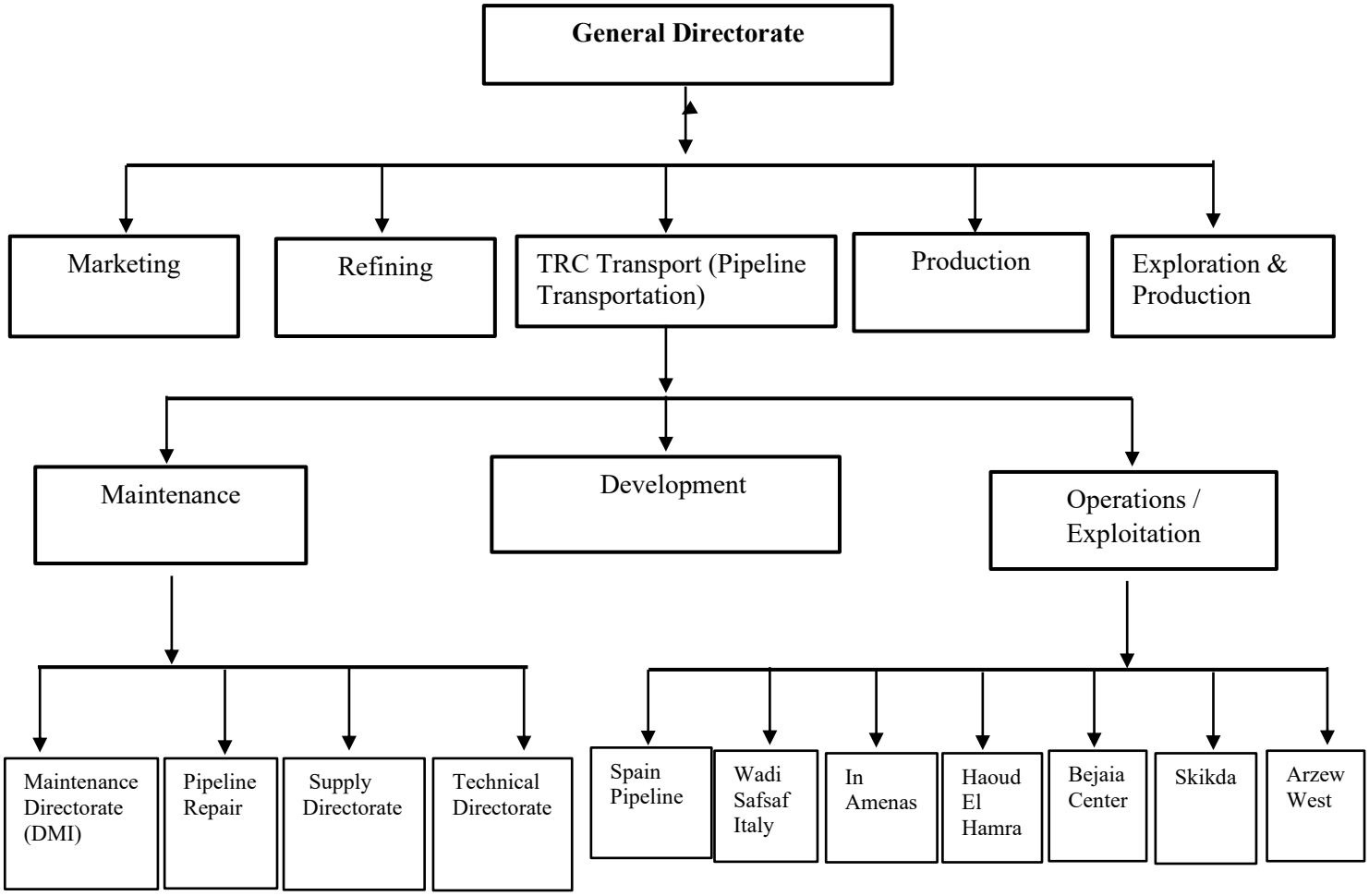
-Protecting the environment

-A representative is appointed to ensure the implementation and effectiveness of the QHSE system. (see ANNEX C)

The QHSE policy refers to the entity as DML (see ANNEX C), which is consistent with the internal designation used by the company.

3. The position of the DML in SONATRACH's organizational Structure

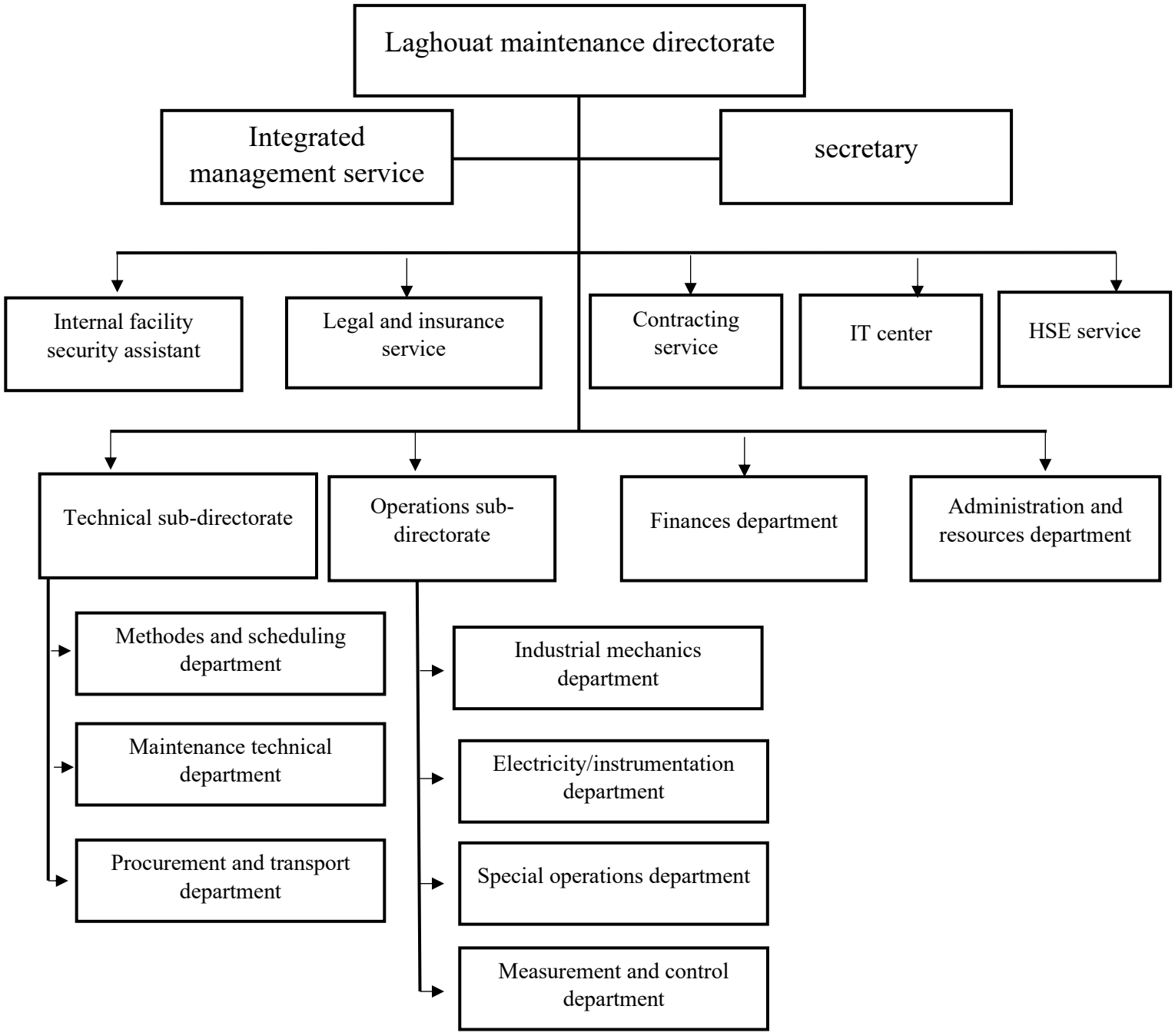
Figure 4: The position of the DML in SONATRACH organisational structure



Source: Khalifa, M. (2018) translated from Arabic

4. Organizational Structure of the DML

Figure 5: Organizational structure of the DML



Source: Company Documentation (English Translation of the Original Document)

Integrated Management Service (IMS): This service is responsible for ensuring that all departments comply with the company's quality standards and certifications (ISO 9001, ISO

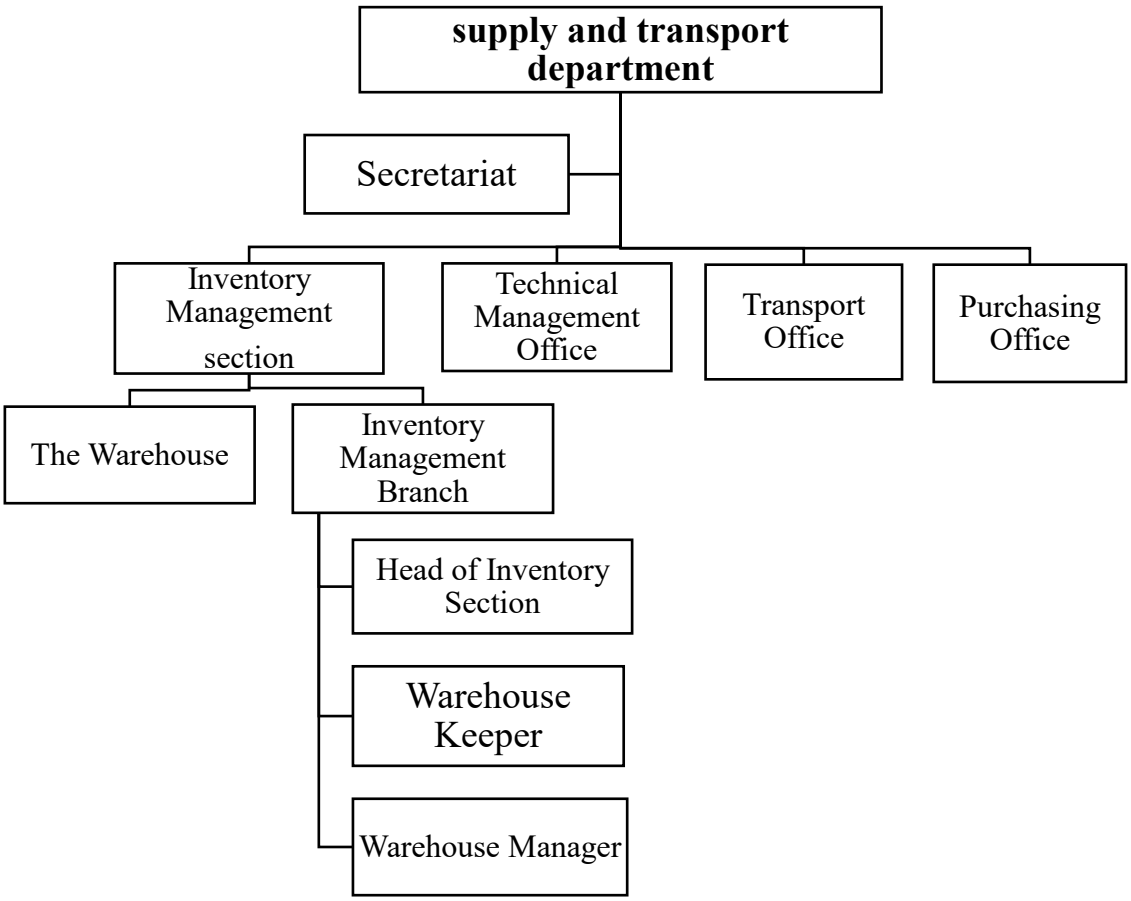
14001, and ISO 45001). It provides the regulatory framework for the management of chemical products and safety documentation.

And to show how different interests work together to reach these goals, below is the Directorate's process map. (SEE ANNEX D).

5. Inventory Management Office

5.1. Organizational Structure of the Supply and Transport Department.

Figure 6: Organizational structure of the supply and transport department



Source: Source: Prepared by student based on Information provided by DML

5.2. Inventory Management section:

It consists of two branches:

- **The Warehouse**

is where the Maintenance Directorate places its stocks such as machinery, spare parts... etc.).

- **Inventory Management Branch**

This branch is concerned with maintaining, managing, monitoring inventory, and recording everything in it.

Distribution of responsibilities:

In the inventory department, it consists of three main employees: the head of the inventory department, the storekeeper, and the store manager

- **Head of Inventory Section**

He is responsible for organizing and managing warehouse operations in the directorate

How to develop the necessary plans and strategies

-The warehouse keeper

is responsible for receiving, recording and storing materials and equipment in the warehouse, examining incoming materials to ensure their quality and health, arranging and organizing them in the designated places in the warehouse, facilitating access to them when needed, and bringing in and taking out stocks.

-Warehouse Manager:

He is responsible for preparing and distributing orders according to the requests received from the maintenance departments. He prepares the goods for delivery and monitors the registration of all items according to the inventory card within the automated system, including monitoring their classification and locations within the warehouse, following up and arranging according to their validity, following up on the movement of inventory from inputs and outputs, designing records and lists of items according to the family to which they belong, and coding them to facilitate dealing. (Information provided by DML 2026).

CHAPTER III

RESULTS AND DISCUSSION

CHAPTER III: RESULTS AND DISCUSSION

This chapter presents an analysis of the findings from the field study, based on direct observation, document analysis and interviews. quality tools are applied to analyze the non-conformity identified and propose practical solutions to address them. The chapter is divided into two sections:

-the first section Presentation of Results

-the second section is Discussion of Results.

Section 01: Presentation of Results

1. Description of Inventory Management Practices

the DML uses a structured system to manage its inventory, designed to ensure that the materials needed for maintenance work are available.

1.1. Digital Management and Documentation System:

DML uses the SAP system to organize and manage all aspects of inventory in an efficient and systematic manner. SAP helps you:

- Track stock quantities in the warehouse
- Record the receipt and issuance of goods
- Know the location of each product within the warehouse

Data Elements in the SAP system: track the movement of materials. The process begins with "determining requirements" and ends with "issuing materials" (ANNEX E)

1.2. Flowchart:

To clarify these procedures the following flowchart illustrates the material's path within the DML:

- **Process definition:**

Process name: Inventory management

Objective: ensure material availability and technical conformity

Scope: from purchase requisition to final material delivery

Process owner: inventory and reception department

Figure 7: Flowchart of the inventory management procedure in DML

Input	Who?	Process activity?	How?	Output
Resource Need	-	Start	-	Request Initiated
Need for material	Requesting dept	Material request	Internal request form	Validated Request
Validated request	Inventory and purchase Department	Send order to supplier	SAP / Purchase Order	External Supplier
Shipped Goods	Reception Dept	Receive Product / Return to supplier	Delivery Note (facture)	Technical Inspection
Delivered Items	Storekeeper	Quantity correct?	-Stock checking (quantity)	Decision (Yes/No)
Rejection (No)	Storekeeper		-non conformity note	Supplier Notified
Accepting (yes)	Storekeeper	Yes	-Conformity notes (Quantitative)	Quantity conforms
Verified quantity	Requesting dept	Technically Compliant / No	Technical checking Quality	Decision (Yes/No)
Quality Approval (Yes)	Storekeeper	Register in SAP	SAP Software Conformity notes	SAP Registration (Data registed)
Registered Items	Storekeeper	storage	Storage Procedures (stock in note)	Stock avaibility
Approved Document	Storekeeper	material exit	SAP / Approval (stock out note)	Requesting Dept
Consumed Material	Requesting dept	Is there a surplus? / No	Visual Check	Decision (Yes/No)
Surplus Items	Storekeeper	Yes / Issue return note	Return Note	SAP (Back to Stock)
-	-	End	-	-

Source: elaborated by the author based on company information

The flowchart shown above explains the inventory management process at DML.

The process begins with the requesting department with purchase requisition (ANNEX F), identifying material requirements, followed by the purchase and Inventory depts verifying the request. Once the request is approved, it is sent to the supplier , when the DML receive the materials from the supplier with receive note (ANNEX G), the requesting dept check them if it the product that they request or not and quantity(by the inventory dept).if the material not conform, they are returned to the supplier with non-conformity note (ANNEX H) If the materials pass the inspection, they are recorded in the SAP system with (conformity note, ANNEX I) and the facture (ANNEX J) and stored accordingly with the stock in note (ANNEX K). Finally, the materials are delivered to the requesting department with stock out note (ANNEX L), if the material has a surplus, they returned it to the stock with returned note (ANNEX M).

While the administrative side of the process is clear, our field study found a serious problem in Step 4 (Technical Inspection). We noticed that chemical products, like WD-40, are often received without their SDS. This is a non-conformity that we will present next

2. Presentation of the non-conformity

During the training period, with the purpose of applying quality tools to a real-life problem within the organization, a case was proposed relating to a non-conformity recorded previously by the Quality Department. This non-conformity was identified during an internal audit in February 2026, where a non-conformity relating to poor management of chemical substances was recorded.

Figure 8:Non conformity rapport {WD-40)

Non-conformités	**N° 2 de 6**	**Majeure** ☐	**Mineure** ☒
Processus /Structure	Processus ATR	Standard réf :	ISO 9001, ISO 45001 et ISO 14001
Preuve	WD-40 Nettoyant Contrat avec fournisseur « ABM3 Services »	Chapitre du standard	8.5.1 et 6.1.2
Détails de la Non-conformité	Gestion des produits chimiques insuffisante Certains produits sont stockés sans date de péremption et sans Fiche de sécurité (FDS).		

Source: company document

According to the (FMAC), this non-conformity related to the storage of a chemical product without an expiry date and the lack of an SDS. This non-conformity relates to the requirements of the Integrated Management System (QHSE), the non-conformity was in the 8.5.1 and 6.2.1 in ISO 9001 (2015) ,45001(2018) and 14001(2015)

8.5.1 Control of production and service provision (ISO 9001)2015

“The organization must carry out production and service provision under controlled conditions.

Controlled conditions must include, where applicable:

a) the availability of documented information defining:

1) the characteristics of the products to be manufactured, the services to be provided or the activities to be carried out.”

Our case:

- WD-40 with no expiry date.
- Absence of SDSs

ISO 9001 - 6.2.1

Quality objectives: Establish measurable objectives to ensure product conformity.

No system in place to flag missing technical information upon receipt.

-Current objectives do not prevent the entry of materials with missing data, meaning that ‘planning’ has not achieved product conformity.

ISO 45001 - 6.2.1

Safety objectives: Protect workers through risk assessment and the provision of information.

Our case: Absence of Safety Data Sheets (SDS) for certain chemicals.

The risk posed by the material to the worker cannot be assessed without the SDS, which is a direct breach of employee health and safety.

ISO 14001 - 6.2.1

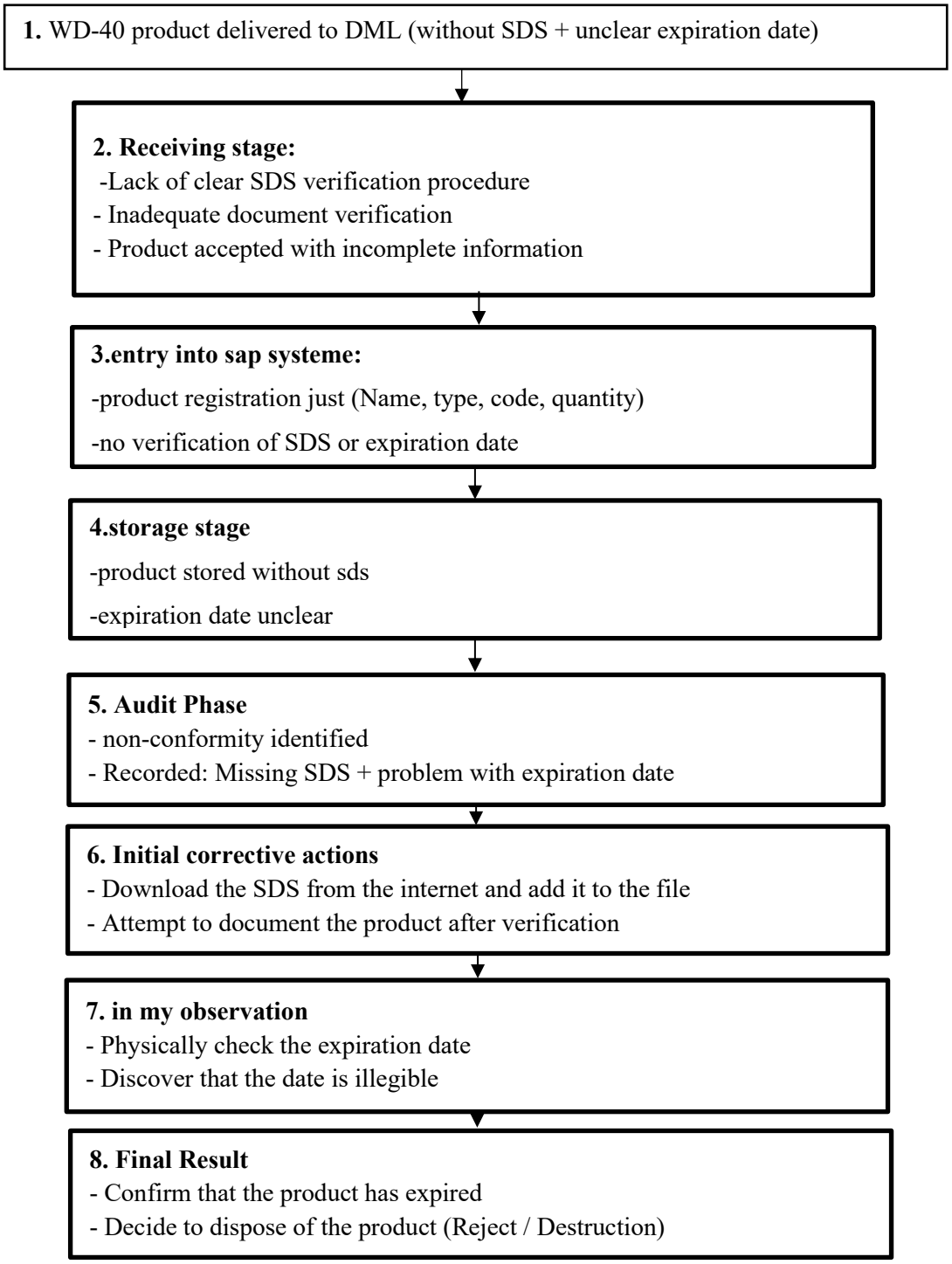
Environment: Compliance with environmental legislation and prevention of pollution.

Our case: Storage of materials that may be damaged (due to an unknown expiry date).

The evidence provided in the FMAC form also shows the one product (e.g. WD-40) did not comply with the requirements in force at the time of the audit. To support this information, the FMAC have been included in the appendices (see ANNEX N).

To get a better understanding of the whole nonconformity process, a flowchart was created to clarify how the problem developed from its start to its discovery.

Figure 9: Problem evolution diagram (WD-40)



Source: elaborated by author

The figure above shows the different stages of the problem, starting from the receipt of the product until the discovery of the nonconformity during the internal audit.

3. Data collection results

3.1. Observation

The observation was conducted in April 2026 in the chemical storage area in DML to verify the non-conformity identified during the internal audit. A structured observation guide was used (see ANNEX B). The observation lasted one day. Several photographs were taken to document the observed conditions (see Figures 10 to 15).

With regard to storage conditions, it was found that the chemicals were generally stored under suitable conditions, being placed securely on shelves and pallets. The storage area benefits from both natural light and good airflow. However, a thin layer of dust was found on some containers despite regular cleaning., this is due to the area's desert climate. To illustrate the storage conditions, the following figure is presented:

Figure 10: Organization of chemical products in the warehouse

Source: author 2026

The figure shows that the products are stored in an organized manner on shelves and pallets.

As for labelling and identification, it was found that most products bear clear commercial identification labels. Expiry dates are indeed present on some containers, but they are written in a complex coding format. An example of this issue is shown in the figure below:

Figure 11: Expiry date in a complex coding format

Source: author 2026

As shown above, the expiry date exists but is difficult to interpret.

The studied product is illustrated below:

Figure 12: The studied product (WD-40)

Source: author 2026

Furthermore, hazard symbols are limited, given that these products are cleaning materials that are not highly hazardous. the following figure shows the hazard labeling on the products:

Figure 13: Hazard symbols on chemical products

Source: author 2026

safety procedures; personal protective equipment such as gloves and workwear is available and used by workers. Fire extinguishers are also suitably located within the warehouse. it was noted that safety instructions for handling chemicals are not always clearly displayed in the workplace. An example of the available safety equipment is shown below:

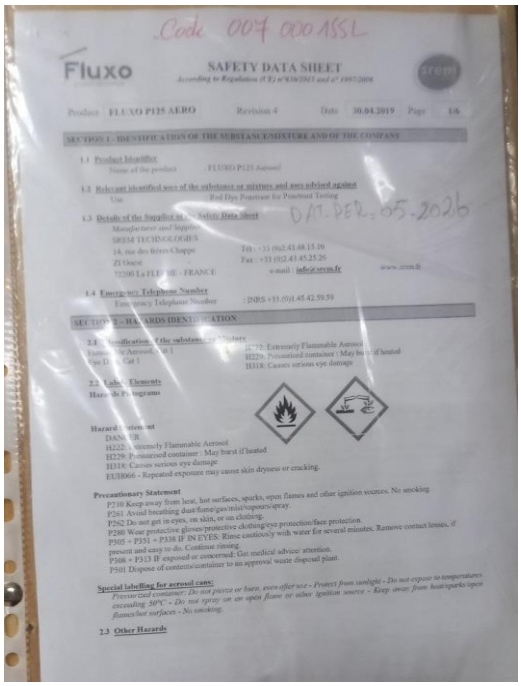
Figure 14:Fire extinguisher in the warehouse

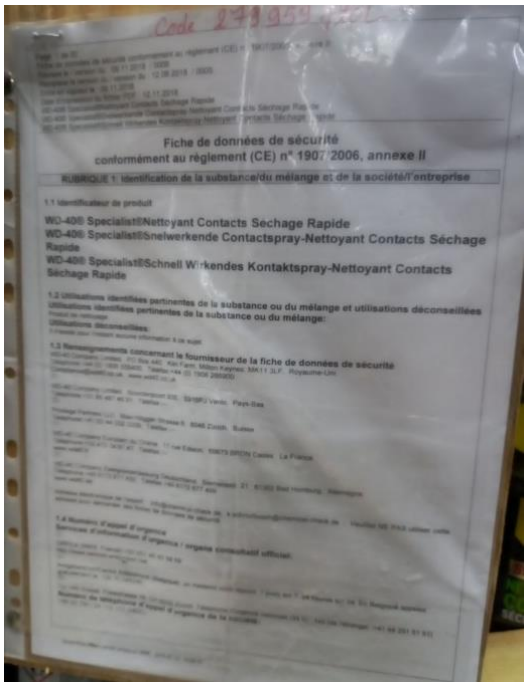
Source: author 2026

Regarding documentation: SDS were located and prominently displayed in the warehouse, close to the products.

The availability of Safety Data Sheets is illustrated in the figure below:

Figure 15: Safety data sheet displayed near the products





Source: author 2026

Written work procedures also exist, though they are not always directly accessible to workers whilst they are carrying out their tasks. Most documents, such as delivery notes and product labels, are up to date.

With regard to handling practices; it was found that workers generally handle chemicals safely. Workers use experience and verbal instructions during daily activities rather than referring to written procedures.

As for workers' awareness, it was found that they are aware of general risks, but they struggle to understand technical details, particularly those relating to product codes and expiry date formats. Although regular awareness-raising sessions are organized, specialist training in interpreting technical information remains inadequate.

Finally, in terms of compliance, the organization's general rules are observed, but there are some shortcomings in compliance with international standards, particularly regarding the clarity and accessibility of information.

3.2. Interviews

The interviews were conducted in April 2026 using a semi-structured interview guide (see ANNEX A). Each interview lasted between 20 and 30 minutes**.** all the interviews are in (ANNEX A)

The interviews aimed to understanding the reality of chemical management in the DML identifying the problems, analyzing their causes, and proposing ways to improve it. These interviews were held with a group of stakeholders involved in chemical management to obtain a comprehensive overview that covered the different stages of the process (receipt, storage, monitoring and safety).

3.2.1. Interview participants

The interviews included several parties selected for their direct role in chemical management, as follows:

Table 8 : Profile of interviewees

Position	**Department**	**Years of Experience**	**Key Role in Process**
Head of Quality	IMS	30 Years	Supervision of ISO Standards
Warehouse Manager	Stock	8 Years	Physical Management & Verification
Head of Technical Dept.	Reception Technical Dept	16 Years in the company and two months in the reception dept	Quantitative & Initial Check
Head of HSE	HSE	30 years	Safety & SDS Compliance
Management Engineer	IMS	13 Years in achat dept and 2 years in IMS	Auditing & Non-conformity Records

Source: elaborated by the author according to the interviews data

3.2.2. Results of the interviews

Following the interviews, a series of observations were drawn up describing the actual situation regarding the handling of chemicals, these findings can be summarized as follows:

- The interviews indicate that responsibilities are distributed between departments. The receiving department performs quantitative control, while the requesting department verifies conformity with specifications.

- Those interviewed, particularly in the receiving and warehousing departments, unanimously reported difficulties in handling suppliers' reference data. Expiry dates and batch codes are encoded in ways that are not understood locally. In the absence of clear guidelines for decoding these codes upon receipt of goods, products are stored based solely on visual inspection. In some cases, product remained in storage without verification of expiry date (such as with WD-40).

- The Head of the Health, Safety and Environment (HSE) Department explained that the department is making continuous efforts to provide Safety Data Sheets (SDS) at key locations (at the occupational health clinic and within the HSE Department), in addition to organizing regular awareness campaigns. However, the challenge remains when new materials arrive; the team is sometimes forced to search for material data online and print it out after the material has actually been received, indicating that the availability of the document is not a "prerequisite" guaranteed by the procurement or receiving process.
- An IMS engineer noted that the department's role becomes clearly evident when non-conformities are identified during audits. The case of the product (WD-40), which was found to be out of date or without an SDS, was the result of 'failure to honor contracts' on the part of suppliers; this is a gap that is only detected after the material has passed through all stages of receipt and storage, necessitating belated immediate action.

- The Head of the Quality Department (with 30 years' experience) emphasized that the biggest obstacle lies not in the absence of procedures, but in the failure to report missing documentation in a timely manner. The departments concerned (Reception and Order Processing) do not feel it is their responsibility to 'halt' receipt in the absence of technical documentation, which means that the Quality Department only discovers these gaps at a late stage of the operational process.

3.3. Documentary analysis

We reviewed the administrative forms used in the DML and recorded the results below:

_ Analysis of administrative forms (receipt, entry slip, purchase order) (from ANNEX F to M).

these documents are generic forms used for all types of materials (spare parts, consumables, etc.).

These forms completely lack a field dedicated to 'expiry date' or SDS.

_ Analysis of the SAP system:

By reviewing the system interface (ANNEX E), it appears that it focuses on physical and accounting flows (quantity received, location in the warehouse), without any software restrictions preventing the receipt of chemical materials in the absence of safety and technical data.

_ Examination of the Corrective Action Control Document (FMAC No. 02/ATR/2026) IN 11/02/2026 (ANNEX N):

The FMAC records a non-conformity concerning WD-40, stemming from its storage without an assigned expiry date and the absence of SDS.

_ Status of the SDS (ANNEX O):

We noted a significant discrepancy on site; whilst the sheet was missing at the time of the audit (as indicated in the FMAC), it was subsequently provided and placed in its correct position next to the substance after the issue was highlighted.

When the document was requested, it was found to be downloaded from the ‘internet’ as and when necessary, which means that there is no proactive technical archiving system to ensure that the sheet accompanies the substance from the moment of purchase.

4. Problem solving using quality tools

Based on the results obtained from observation and document analysis and interviews, now we will focus on the identified non-conformities and proposes practical solutions for them. The steps are strictly based on the stages of the problem-solving approach described in the theoretical framework, using the specific quality tools selected for this study.

Table 9: Problem solving stages

Stage	Objective	Tools Used	Application to the Case
1. Identifying the Problem	Define the non-conformity and collect data.	– 5W2H	Describing the lack of SDS and expiry date issues for WD-40.
2. Researching and validation Causes	Analyze the factors leading to the problem and identify the true cause	– Brainstorming – Ishikawa – 5 Why	Identify causes through interviews, observation, and document analysis, then classify and analyze them to determine the root.
3. Solution Research	Finding and implementing appropriate solutions	_ Brainstorming	Proposing solutions (implementing SDS, improving receiving, modifying the system...)
4. Solution Implementation and Effectiveness Monitoring	Execute immediate actions and propose corrective action plans	– immediate Action plan – Propose Corrective Action plan	Immediate application for WD-40 and submission of corrective proposals for the process.
5.Recording and capitalization	standardize the solution and ensure permanent prevention of the problem.	– Proposed Chemical Receipt Checklist (Annex P)	Formalizing the receipt process to prevent future missing SDS or unclear expiry dates.

Source: elaborated by the author

This table shows the stages of the problem-solving process that was followed, starting with identifying the problem, analyzing the causes, then proposing and implementing solutions, and finally monitoring the results to ensure the problem does not return.

Stage 1: Identifying the Problem using 5W2H

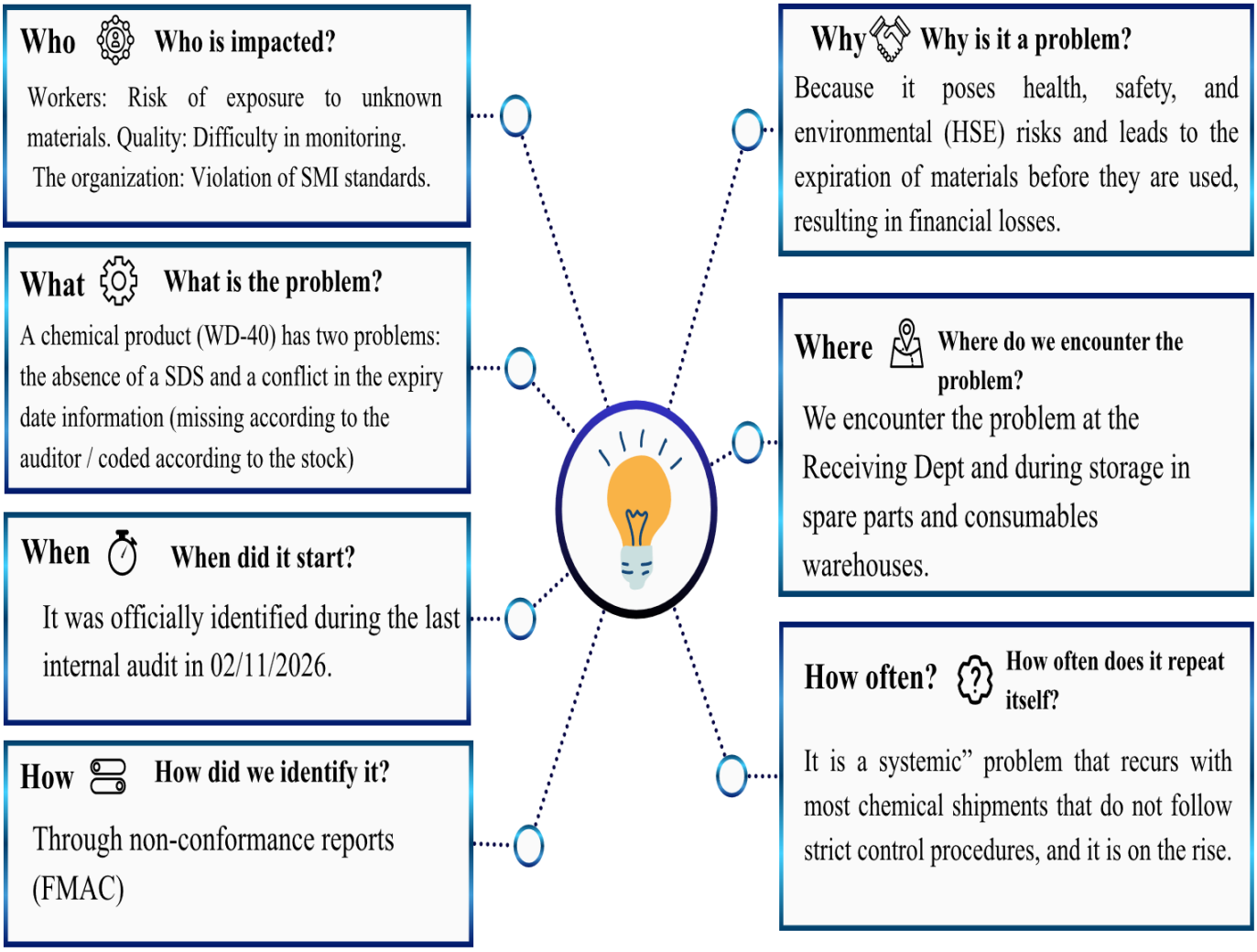
to better understand the problem described in the FMAC report (No. 02/ATR/2026), we applied the 5W2H tool:

Table 10: The 5w2h tool

Questions	Answers
What? What is the problem?	A chemical product (WD-40) has two problems: the absence of a SDS and a conflict in the expiry date information (missing according to the auditor / coded according to the stock)
Why? Why is it a problem?	Because it poses health, safety, and environmental (HSE) risks and leads to the expiration of materials before they are used, resulting in financial losses.
Where? Where do we encounter the problem?	We encounter the problem at the Receiving Dept and during storage in spare parts and consumables warehouses.
Who? Who is impacted?	- Workers: Risk of exposure to unknown materials. Quality: Difficulty in monitoring. The organization: Violation of IMS standards.
When? When did it start?	It was officially identified during the last internal audit in 02/11/2026.
How? How did we identify it?	Through non-conformance reports (FMAC)
How often? How often does it repeat itself?	It is a systemic" problem that recurs with most chemical shipments that do not follow strict control procedures, and it is on the rise.

Source: elaborated by the author

Figure 16 : 5w2h tool



Source: elaborated by the author using Canva

This analysis helps clarify the problem and makes it easier to identify the causes.

Stage 2: Researching and validation Causes

After identifying the problem in the first stage, this next step classifying the Causes and Identify the Root Cause to understand the causes of the non-conformity related to the WD-40 product (the absence of a SDS and the date of expiry).

Several sources of information were used to ensure a comprehensive and objective analysis, including: interviews, observation, document analysis and Brainstorming.

1. classify the Causes

1.1. Brainstorming

A Brainstorming session was set up to identify the possible causes for the non-conformity of the WD-40 product.

The session was attended by 7 individuals from different departments,3 from Receiving, 2 from the Warehouse, and 2 from the IMS, in addition to the researcher.

The session lasted an estimated ten (10) minutes.

During this session, opinions and experiences were exchanged, drawing on the participants' field experience, as well as data obtained from observation and document analysis.

- **Session Results (Proposed Causes)**

_ At the receiving stage: Weak control and lack of verification of the availability of the SDS and the clarity of the expiration date when receiving the product.

_ failure to report difficulties related to reading information or missing documentation.

_ At the warehouse stage: lack of knowledge regarding how to read the expiration date.

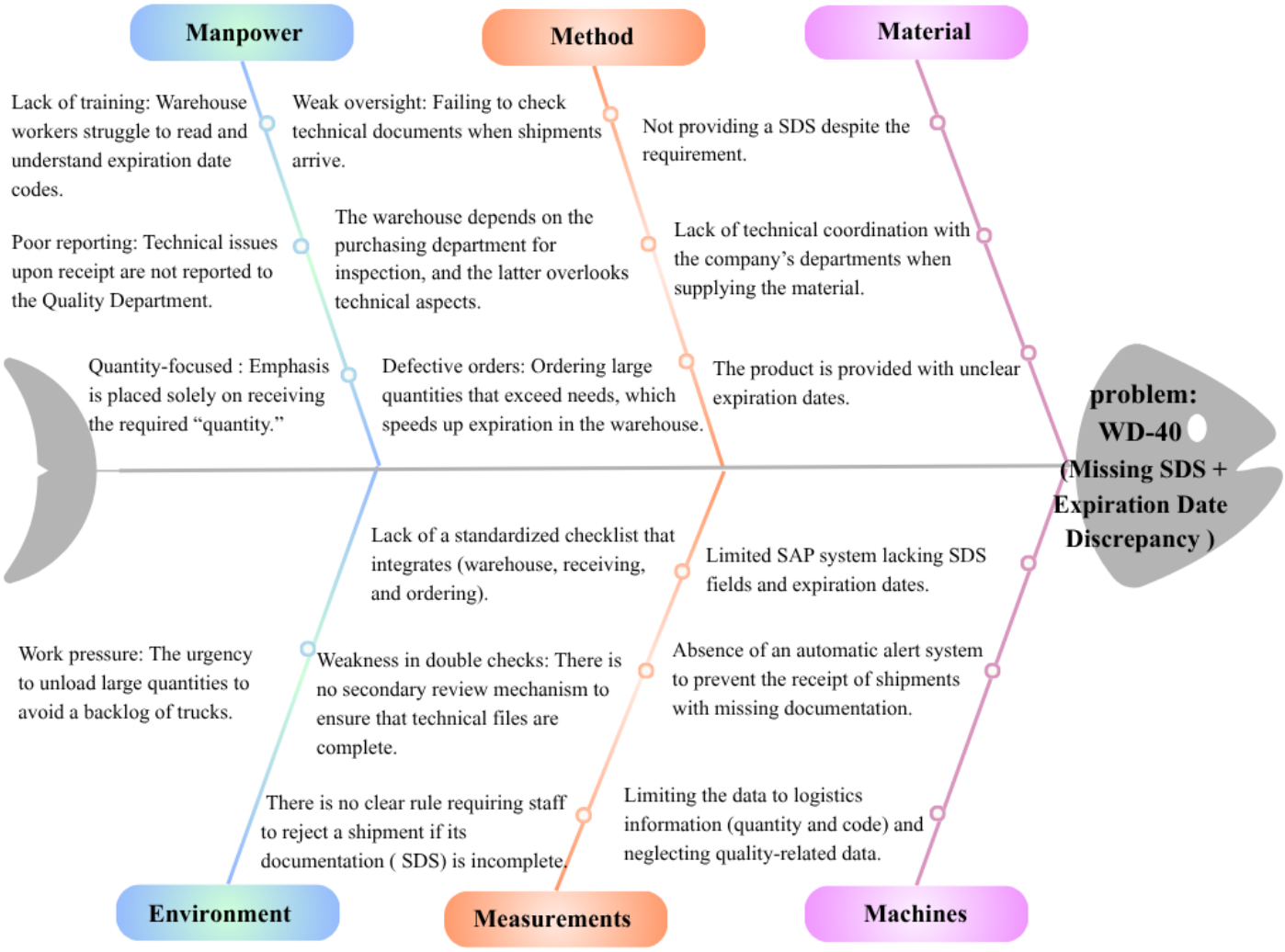
_ At the purchase stage: ordering quantities that exceeded actual needs, resulting in the product sitting in storage until it expired.

_ At the supply stage: No clear product information provided (safety data sheet and expiration date).

These causes were used as the basis for classification and analysis using the Ishikawa diagram and the 5 Whys tool to identify the root cause of the problem.

2. Ishikawa

Figure 17: Ishikawa diagram



Source: elaborated by the author using Canva

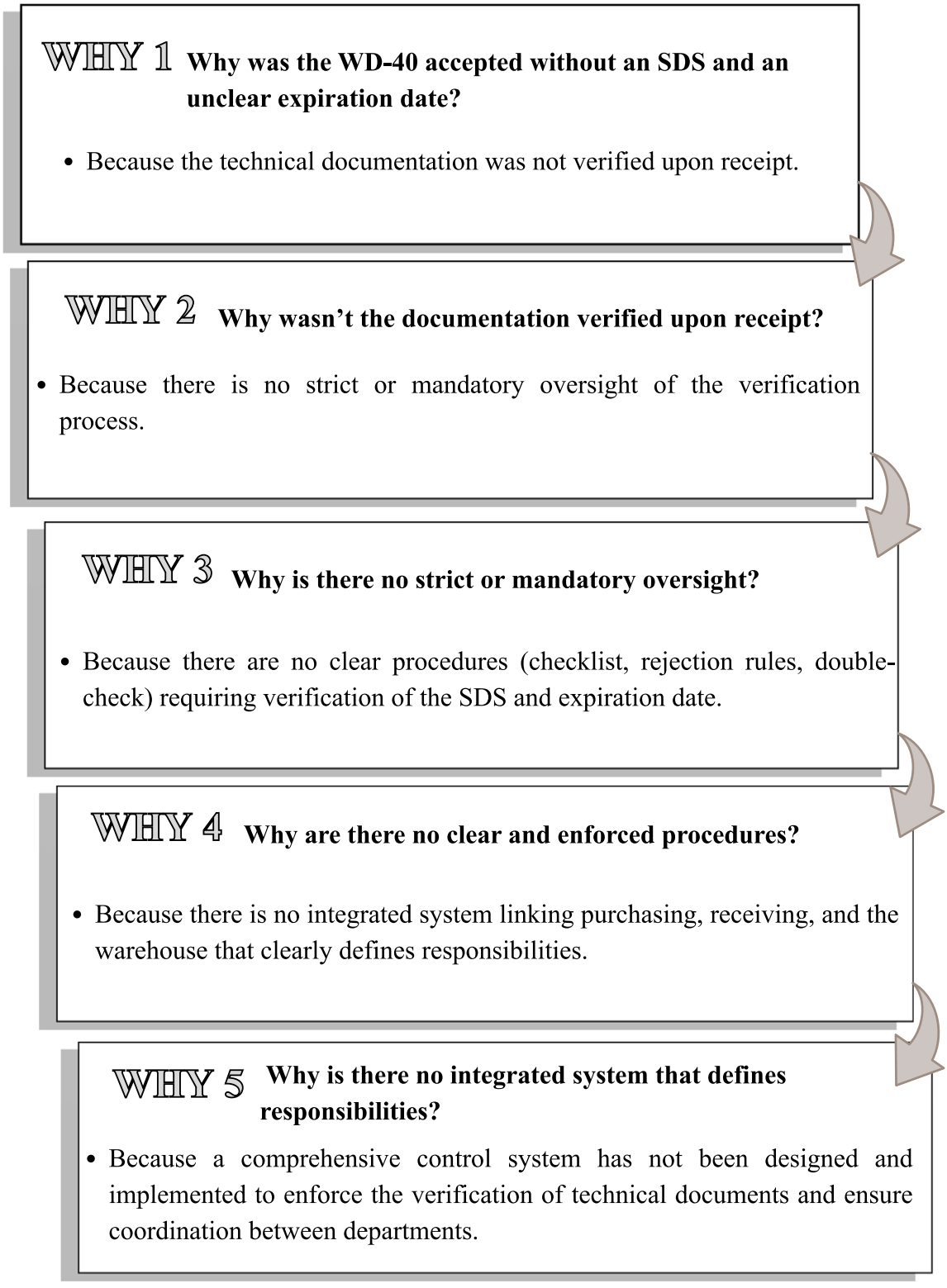
The Ishikawa diagram helped identify different possible causes of the problem, showing that it was not caused by a single cause, but was linked to several factors related to workers, procedures, the supplier, and the information system. For Methods, the audit was not clear because it didn't involve the workers. For People, the staff could not read the supplier's codes. This proves that the problem is not just about missing papers, but about how people communicate and understand information.

We will use the 5 Whys tool to find out the root cause of this problem.

3. Identify the Root Cause

3.1. 5 whys

Figure 18: 5 Whys tool



Source: elaborated by the author using Canva

_ **The Root Cause**

A weak control system that ensures mandatory verification of SDS and expiration dates and guarantees coordination between the purchasing, receiving, and warehouse departments.

Stage 3: Solution Research

after classifying the Causes and Identifying the Root Cause in the second stage, now we will Proposing solutions with Brainstorming.

Brainstorming

In the second part of the Brainstorming session previously described in Stage 2, the conversation moved from identifying causes to proposing solutions. The same participants presented their ideas about the solutions of the problem

The session lasted an estimated 15minutes.

Session Results (Proposed Solutions)

The session resulted in the following solutions according to the participating departments:

_ Receiving Department: Add conditions specific to chemicals in the conformity note and apply strict controls at entry points.

_ Warehouse: Control order quantities to match actual usage (to avoid expiration), and require the presence of a representative from HSE and the requesting department during receiving.

_ IMS Department: Establish additional requirements regarding the SDS, and immediately report any gaps in technical information.

_ Technical Solutions (SAP): Activate the date alert system and make the SDS a mandatory field in the system.

_ Supplier Management: Impose penalties on non-compliant suppliers and place repeat offenders on a blacklist.

Stage 4: Solution Implementation and Effectiveness Monitoring

To effectively implement these solutions, we adopted the method proposed by Ghali et al ((2025) This Action plan has 5 elements: action, objective, responsible duration, and result.

Based on the results of Brainstorming the proposed actions have been classified into 2 categories: immediate Action plan, which aims to rectify the current situation, and corrective Action plan, which aim to address the root cause and prevent the problem from recurring.

1. Immediate Actions

When the non-conformity was identified, warehouse workers took immediate actions These actions were organized into the following immediate Action plan:

1.1. immediate actions plan

Table 11: The immediate actions plan

Action	Objective	responsible	Duration	result
Decoding the expiration date from the internet (Researching the supplier's official codes online).	To decisively determine the true expiration status of the WD-40 product.	Warehouse Workers	Immediate	Confirmed that the product was indeed expired.
Quarantining the expired product (Removing the WD-40 from the warehouse).	To prevent the distribution and use of an expired and potentially unsafe product.	Warehouse Workers	Immediate	Elimination of immediate risk and securing the inventory.
Extracting and printing SDS from the internet (Downloading the official SDS and placing it physically next to the product).	To provide essential safety and handling information immediately.	Warehouse Workers	Immediate	Temporary compliance with basic safety awareness requirements.
Generalizing the SDS extraction (Applying the same internet search for other chemicals lacking SDS in the warehouse).	To secure the storage environment for all existing chemical products.	Warehouse Workers	Immediate	A temporarily safe and compliant storage environment.

Source: elaborated by the author

These actions were reactive, taken to control the situation immediately, without treating the root cause of the problem.

While immediate actions are effective in controlling the problem and protecting the warehouse, they are short-term solutions that do not solve the root cause; so, long-term actions are needed.

2. corrective actions

To solve the root cause and avoid the problem from happening again, a set of corrective actions has been developed to improve current procedures and improve the control system within the warehouse.

2.1. Corrective Actions plan

The actions aim to solve the root cause of the problem and include:

Table 12: Corrective Action plan

Action	**Objective**	**responsible**	**Duration**	**result**
Implement mandatory verification of SDS and expiration date at receiving	Ensure no product is accepted without required documents	Receiving Team	Immediate and Continuous	Verified products at receiving
Develop a formal procedure for chemical receiving	Standardize and enforce the control process	Quality Department	1 Week	Approved and applied procedure
Update purchase orders with clear supplier requirements (SDS + clear expiration date)	Ensure suppliers provide complete and clear information	Purchasing Department	1 Week	Compliant purchase orders
Reject any non-conformity product at receiving	Prevent entry of unsafe or incomplete products	Receiving Team	Immediate and Continuous	Zero acceptance of non-compliant products
Improve SAP system by adding mandatory fields (SDS & expiration date)	Ensure complete data before product registration	IT Department / Warehouse	2 Weeks	Complete and reliable SAP records

Implement alert system for expiration dates in SAP	Monitor product validity and avoid expiration	IT Department	2 Weeks	Active alert system
Develop a receiving checklist (SDS, expiration date, labeling)	Ensure systematic verification	Quality Receiving	1 week	Standardized control
Implement double-check verification at receiving	Reduce human error	Receiving / Warehouse	Immediate and Continuous	Reliable inspection
Conduct training for workers on SDS and date reading	Improve staff awareness and competence	Quality / HSE	2 weeks	Trained personnel
Involve HSE and requester during chemical receiving	Strengthen control and responsibility sharing	HSE Receiving Requester	Immediate and Continuous	Improved coordination
Apply penalties to non-compliant suppliers	Enforce supplier commitment	Purchasing Department	Continuous	Reduced supplier non-compliance
Establish coordination between departments (meetings / communication)	Ensure information flow and shared responsibility	Management / Quality	Monthly	Better coordination
Control and rationalize order quantities to match actual usage	To prevent chemicals from sitting in storage until they expire	Purchasing / Warehouse	Continuous	Optimized inventory with zero expired chemicals.

Source: elaborated by the author

Putting the proposed solutions into practice is a critical step, but verifying their success is just as important. For this reason, the next stage is focused on monitoring results and establishing solid procedures to ensure long-term compliance.

Stage 5: Recording and capitalization

This final stage evaluates the actual results of the immediate actions we have taken in the terrain and identifies the benefits expected from the corrective actions we have proposed to prevent the problem from recurring.

As part of the proposed Action plan, I personally designed a “Chemical Receiving Checklist” (see ANNEX P) This checklist was specifically designed to fill the gaps identified in my observations at the DML storage facility., to ensure a standardized and documented inspection process. It makes the storekeeper and the supervisor check the product together. This 'Double-Check' ensures that dates are not just there, but also easy for everyone to read and understand

1. Evaluation of the Immediate Actions Taken

The warehouse workers applied the immediate Action plan successfully. The follow-up on-site showed that these actions yielded the following tangible benefits:

_ Decoding Dates and Product Isolation: By searching for supplier codes online, we confirmed that the WD-40 had expired and immediately isolating it. This completely eliminated the immediate risk of distributing or using an unsafe, expired product and secured the inventory.

_ Downloading and printing the SDS from the internet: We downloaded the official SDS for WD-40 and placed it next to the product. This procedure provides workers with the clear and necessary guidelines for the safe handling of the substance and avoiding its risks.

_ SDS extraction generalization: We applied the same online search to find and print the SDS for all other chemicals in the warehouse. This secured the entire storage environment and improved workers’ awareness of chemical hazards.

2. Expected Benefits of Proposed Corrective Actions

While the immediate actions solved the current issue, we proposed a corrective Action plan to fix the system. If management implements these proposals, the expected benefits.

_ SAP System Improvements: By adding mandatory SDS fields and expiration date alerts to SAP, the system will automatically block any product with incomplete data. Benefit: this will completely eliminate the human error and prevents unsafe products from being recorded.

_ Strict Receiving Procedures and HSE Participation: By updating in the “conformity note” and making HSE presence during receiving mandatory. Expected benefit: This will ensure that every chemical delivery is subject to a careful technical check by experts before entering the warehouse.

_ Updating Purchase Orders and Sanctioning Suppliers: By clarifying requirements in purchase orders and enforcing penalties. Expected Benefit: This will force suppliers to respect technical standards and provide valid expiration dates and SDSs before shipment.

To ensure these proposed solutions remain effective and the problem never recurs, we recommend the following simple follow-up plan:

_ Document review: The IMS must conduct random checks on newly received chemicals to ensure the receiving team strictly uses the updated “matching slip.”

_ System Checks: Regularly review the SAP system to ensure that the new mandatory fields (SDS and dates) are being filled out correctly by workers without circumventing the rules.

_ The success of the solutions will be evaluated after 3 months through re-audit and observation of a decrease in the number of non-conformities

With the completion of this final stage, the problem-solving process is successfully completed, moving from immediate solutions to long-term solutions.

this section presented the collected data and explaining the problem-solving stages, the section 2 will focus on the Discussion of Results.

Section 02 Discussion of Results

1. Discussion of Data Collection Results

This section discusses the main findings obtained from observation, interviews, and document analysis conducted at the DML. The results revealed that the problem under study is more complex than what was initially identified in the internal audit. While the audit mentioned the missing SDS and expiry dates, the case study showed that this information sometimes became available but still difficult to read or utilize by workers. This shows that the problem is not only related to missing information, but also to its clarity and accessibility.

This result is consistent with Lee et al. (2024) who showed that even when SDS are available or unclear information can reduce their usefulness and make it difficult to understand chemical problems.

Also, there was a difference between the audit and my observation. The audit said the dates were missing, but I found them. They were just very hard to read. This means the auditor did not talk to the workers to double-check the information. The problem was identified by the auditor as missing information's but the study shows it was actually a problem of legibility and communication.

The interviews also showed that workers do not ignore safety labels on purpose. The main problem is that they do not understand technical codes, especially expiration dates. This means that the problem is related to lack of training and complex information.

2. Interpretation of the Problem

The analysis showed that the problem is not caused by one mistake, but affects several stages such as receiving and storage and information management. This, result is similar to what Knop (2023) mentioned, saying that many problems in organizations stem from weak control systems.

The observation showed that the expiration date is not missing but difficult to read because of complex codes. This does not respect the requirements of ISO 9001:2015 (8.5.1) which require clear and understandable information. The problem is that the information is not clear. Because the codes are hard to read, the auditor thought the dates were not there. This shows that the control system is weak because it does not help workers or auditors find the right information easily. According to ISO 19011, the auditor should work together with the workers. If the auditor and the storekeeper checked the products together, they would have found the expiry dates easily, and there would be no mistake in the report.

This also agrees with the Queensland Government, (2018), which showed that poor management of chemical information can create safety risks.

3. Root Cause Analysis

The use of quality tools such as the Ishikawa and the 5 Whys helped to understand the problem better.

The Ishikawa showed that the problem was caused by several factors (people, methods, system, and suppliers), not just a one cause This is in line with the results of Oancea et al. (2024) who showed that this tool is effective in analyzing problems.

Neyestani (2017) also explained that quality tools help companies identify and analyze problems in a structured way.

the lack of control to verify SDS and expiration date, at the time of receipt and poor coordination between departments.

In the 5 Whys we see that the root cause of the problem is a weak control system.

So why the auditor thinks the dates were missing?

Because the information was hard to read This shows we need better training and a simple way to make sure everyone sees the expiry dates clearly.

- **System Evaluation and SAP Limitations**

The study showed the limit in the SAP system It focuses on quantity and stock movement but does not include SDS and expiration dates.

This leads to incomplete data and recurring problems. This finding is similar to that of Fernandes et al. (2013), who found that poor integration of quality requirements and systems leads to inefficiency. Also downloading SDS after receiving products shows that the system is reactive, not preventive.

4. Evaluating Proposed Solutions

Immediate actions help to quickly reduce the risk. (setting an expiration date, isolating the product, and providing an SDS). These actions, provide only a short-term solution and do not solve the root cause This aligns with what Gillette (2021) that problem solving must focus on root causes. The corrective actions are long-term solutions, such as improving procedures, strengthening controls at the time of receipt, improving the SAP system, and improving coordination. Compared to other studies that use PDCA or DMAIC, this study focused on the 5w2h, Brainstorming, Ishikawa and 5 Why and Action plan. This is in line with the results of Hamza and Rebib (2021), El Allaoui et al (2024) and Ghali et al (2025), showed that these tools are effective in problem solving.

- **General Discussion**

In general, the results show that the problem is systemic, not individual. It is mainly caused by weak control, lack of coordination, and system limitations.

This is consistent with Chiromo and Moagi (2014), who showed that most quality problems come from organizational issues, not workers.

The study also shows the importance of using a complete approach that includes quality tools, system improvement, and worker training. and shows that we need better communication. Using quality tools and clear labels will help everyone see the information correctly and avoid mistakes in the future."

Conclusion of Chapter III

This chapter presented and discussed the results obtained from the case study at DML, using observation, interviews, and document analysis. Also used problem-solving steps and quality tools to better understand and solve the non-conformity. The practical part of this study began with direct observation of the chemical product management process in order to understand the identified non-conformity and its context. This first step made it possible to detect several weaknesses related to the availability of SDS, expiry-date information, and control practices. Based on the observations made in the field, semi-structured interviews were conducted with the different stakeholders involved in the process. These interviews provided additional explanations and helped understand the practices, responsibilities, and difficulties encountered by each department. To further validate and enrich the collected information, a document analysis was carried out. The examination of procedures, records, and internal documents enabled a better understanding of the existing system and the requirements related to chemical product management. The information obtained through observation, interviews, and document analysis was then used as input for the quality tools. The application of 5W2H, Brainstorming, Ishikawa Diagram, and 5 Whys facilitated the identification of the root causes of the non-conformity and the development of corrective actions aimed at improving the process and preventing the recurrence of similar problems.

The results showed that even though there is a structured stock management system, there are several weaknesses in practical application, specifically in the management of technical information such as SDS and expiration dates. The study showed that the problem is not only about missing information, but also about its lack of clarity, poor accessibility, and lack

of proper control. The root cause of the problem was found to be the lack of an integrated control system to verify technical data at the receiving stage, together with a poor coordination between departments, through the application of quality tools.

CONCLUSION

CONCLUSION

1. Summary of Findings

The main objective of this study was to know the role of quality tools in resolving non-conformity in the DML. The study was based on the question:

How can quality tools be used to resolve non-conformity within the DML?

To answer this question, a simple methodology was followed, relying on field observations, interviews with some workers, and analysis of documents available within the organization. A set of quality tools including 5W2H, Brainstorming, Ishikawa diagrams, and others was also used to study the problem in a systematic manner.

At first, the problem was identified then, the real causes leading to the problem were identified, and it became clear that the problem was not related to a single factor, but to several factors. Tools such as Ishikawa and 5Why helped to identify the root causes, allowing us to avoid surface solutions and focus on effective ones. A set of solutions was proposed in the ACTION PLAN that can be applied in DML to prevent the same problem from occurring again.

The results showed that using quality tools in a correct and systematic way helps understanding problems and making better decisions, and also helps improve the performance of the company and reduce errors.

2. Study Recommendations

Based on the results obtained, a set of recommendations can be made to help improve the management of non-conformities in the organization:

_ The need to improve the organization of information and make it clear and easy to understand
_ Work to continuously monitor processes to avoid repeating mistakes
_ Relying on quality tools on an ongoing basis
_ Providing training for employees on how to use quality tools and their importance
_ Improving communication between different departments to avoid misunderstandings or information gaps

An Action plan has been proposed that includes the necessary steps, responsible parties, and specific deadlines, in order to implement the solutions in an organized and effective manner.

3. Challenges and Obstacles

During the course of this study, several challenges were encountered, the most significant of which were:

_ Limited time allocated for the internship and completion of the study
_ Difficulty obtaining certain information within the organization
_ Limited access to certain document

4. Future Directions

This study opens the door to several avenues for future work, including:

Applying quality tools to other problems, conducting similar studies in different organizations for comparison and using other quality tools for different problems

Finally, it can be said that quality tools represent an important means for any organization seeking to improve its performance and reduce errors; they also help achieve better organization and make decisions based on logical analysis.

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ANNEXES

ANNEXES

ANNEX A: INTERVIEWS GUIDE AND THE INTERVIEWS

Type of interview: Semi-structured individual interviews

Duration: Approximately […… minutes]

Target participants: Personnel involved in chemical product management such as:

• Quality Manager

• HSE Manager

• Warehouse Manager

• Production Supervisor

• Others: ……

Introduction

Hello, I introduce myself my name is LEKOUINI Doaa

I am a Master's student in Quality Management, conducting a research study the use of quality tools to solve problems specifically the problems in managing chemical products.

The purpose of this interview is to better understand current practices, identify existing problems, analyse their causes, and explore possible improvement actions.

All information collected will be used strictly for academic purposes.

Part 1: Profile of the Interviewee

1.Current position: ……

2.Department: ……

3.Years of experience: ……

4.Role in chemical product management: ……

Part 2: Current Practices/

5.How are chemical products managed in your department?

6.Are there clear procedures for storage?

7.Are SDS available and accessible?

8.How do you ensure compliance with safety and quality standards?

Part 3: Problems and non-conformities

9.What problems do you encounter in/ managing chemical products?

10.Have you observed any non-conformities?

11.Where do these problems usually occur?

12.When do these problems happen most frequently?

13.Who is involved or/ affected by these problems?

Part 4: Causes Analysis

14.In your opinion, what are the main causes of these problems?

1.What are the possible, sources of these problems?

15.Are these problems related to:

Lack of training?

Poor procedures?

Storage conditions?

Communication issues?

Other causes: ……

Part 5: Use of Quality Tools

16.Are quality tools used to analyse and solve problems?

17.Which tools are used (5W2H, Ishikawa, etc.)?

18.How are these tools applied in practice?

19.How do you ensure that problems are properly analysed?

Part 6: Corrective Actions and Improvement

20.What actions are taken when a problem is identified?

21.How do you ensure that these actions are effective?

22.How do you prevent the recurrence of problems?

23.What improvements do you suggest for better management of chemical products?

24.Do you follow any continuous improvement such as PDCA?

Conclusion

Do you have any additional comments or suggestions?

Thank you for your time and valuable contribution.

1. **Interview with Inventory Manager**

Introduction:

Hello, my name is LEKOUINI Doaa I am a Master's student in Quality Management. I am doing a case study on the use of quality tools to solve the problem of chemical management. The purpose of this interview is to understand the situation and to use your experience to propose practical solutions that will help develop the work. All information will remain confidential and is for academic purposes only.

Part 1; General Information

Mr. Marzouq Bilal

1. Current Position: Inventory Manager

2. Department; Inventory

3. Years of Experience: 8 years

4.Role in Chemical Management; VEREFING

Part Two: Current Practices,

5. How are chemicals managed in your department?

•We now use the SAP computer system, which was implemented in September 2025. We request products via a purchase/ order written by the department that needs the product, which is then sent to the warehouse. The warehouse forwards it to their supplier. Upon arrival, the product goes to the receiving department, where a warehouse employee verifies the quantity, other conditions are monitored by who monitor the process (the department that requested the product verifies that it is the correct item). The product is then placed /in its designated location in the warehouse and recorded in the SAP system.

6. How is inventory information documented and stored?

A receipt is issued upon entry, and when it is later retrieved, it is issued according to the request of the department that needs it, in the required quantity, and a withdrawal receipt is issued.

7.Do you have written procedures that you follow when transporting, storing, or using chemicals? How is this done?

•No, we do not have any.

8. Are Safety Data Sheets (SDS) available, and are they easily accessible?

• Yes, they are available and easily accessible; they are placed next to the product.

9. How is the completeness of technical data (such as expiration dates) verified at the time of receipt?

•Bellie has it signed by the quality manager, HSE, and the product recipient, and then we only monitor the quantity; the rest of the conditions are monitored by the relevant specialist

10. How do you handle materials that you discover lack a Safety Data Sheet (SDS) or an expiration date?

•If we find that an item lacks an SDS, we handle it ourselves by searching for the product online and retrieving the information.

Part 3: Problems and Non-Compliance Issues

11. What problems do you encounter in the handling of chemicals?

•Lack of knowledge regarding storage methods

12. Regarding the environment

Do storage conditions (such as desert dust) affect the legibility of labels and SDSs?

- Yes, desert dust has a significant impact on worker health and also affects labels and SDSs; therefore, we place the SDSs in a protective sleeve

13. Regarding cases like WD-40 or products arriving without an expiration date or an SDS, how are they handled to ensure operations continue?

- Regarding the SDS, I don't know if one was present or not. Perhaps it was there but fell off and the auditor didn't notice it, or perhaps it wasn't there at all. After the auditor informed us, we marked it as non -conformity, we removed it. As for the product without an expiration date, it actually had a date on it; we just didn't know how to read it at the time. After the auditor issued a finding that it had no expiration date, we couldn't do anything about the product unless we received instructions to remove it (because it had no date and wasn't expired). After we figured out how to read it, we found it was expired and removed it immediately.

Part Four: Analysis of Causes

14. In your opinion, what are the main causes of these issues?

- The supplier did not. provide an SDS
- Lack of proper oversight at receiving

15. Are the issues related to:

- Lack of training
- Weak procedures
- Storage conditions
- Communication issues

16. Regarding the system (Machine), do you think adding mandatory fields in SAP could prevent data gaps in the future??

• Yes

17. Regarding suppliers (Material): How can suppliers be encouraged to ensure that documents are included with the first shipment?

• Include conditions in the purchase order regarding the availability of SDS/FDS and other requirements

• Receiving the product in batches means that if we need

20. What minor obstacles if resolved would make operations run smoothly?

• Ensuring that employees are properly trained

Conclusion

Do you have any additional suggestions or comments?

Thank you for your time and contribution.

2. Interview with the audit

Introduction:

Hello, my name is LEKOUINI Doaa, I am a Master's student in Quality Management. I am doing a case study on the use of quality tools to solve the problem of chemical management. The purpose of this interview is to understand the situation and to use your experience to propose practical solutions that will help develop the work. All information will remain confidential and is for academic purposes only.

Part one General Information

Current Position: Management Engineer.

Department: IMS

Experience: 13 years total (11 years in the Procurement Department + 2 years in the IMS)

Role in Chemical Management: Conducting audits and inspections, responsible for recording “non-conformities” for WD-40 products.

Part Two Current Practices

1- How do you ensure compliance with quality and safety standards in your daily work? (Quality Manager/Auditor)

Answer: We rely on periodic on-site inspection rounds, in addition to organizing awareness and education campaigns for employees in coordination with the HSE Department.

2- Based on the requirements 8.5.1 (Control of Production and Service Provision), what gaps have you observed in the management of chemical materials?

Answer: We have observed “contract non-compliance” Sometimes the contract specifies certain specifications or documents, but upon receipt, there is insufficient oversight to ensure the supplier meets these conditions, so the materials are accepted into the warehouse in violation of the contract.

3- How many chemical substances did you find without a Safety Data Sheet (SDS) during the audits?

Answer: We found about two or three cases of chemicals lacking an SDS.

Part Three: Problem Diagnosis

4- Based on the requirements of Clause 6.2 (Quality Objectives and Planning), what are the risks associated with the detected “non-conformities”?

Answer: The risks relate to worker and process safety; not knowing the properties or history of a substance may lead to operational risks requiring immediate corrective action.

5- Do you believe that the problem related to:

Lack of training: Yes.

Weak procedures: Yes.

Communication issues: Yes.

6- Are quality tools (such as Ishikawa, 5W2H) currently being used to analyze and solve these problems?

Answer: No not yet.

Part Four: Suggestions and Solutions/

7- What are your suggestions for improving chemical management??

Answer: I suggest organize the storage, and good control, and verifying when materials arrive.

8. What are the minor obstacles that, if resolved, make the management process ideal?

Answer: Improving communication channels between departments and intensifying specialized training.

Conclusion:

Thank you so much for your time and your valuable contribution to this research.

3. Interview with the Head of Technical Operations

Hello, my name is LEKOUINI Doaa, 'I am a Master's student in Quality Management. I am doing a case study on the use of quality tools to solve the problem of chemical management. The purpose of this interview is to understand the situation and to use your experience to propose practical solutions that will help to develop the work. All information will remain confidential and is for academic purposes only.

Part One: General Information; Fashkar Taher

1. Current Position: Head of Technical Operations ((Reception))
2. Department: Receiving / Technical Operations Department,
3. Years of Experience: 16 years with the company (2 months in current position)

4. Role in Chemical Management: Overseeing; the entry of all materials into the company, quantitative verification,

Part Two: Current Practices

1. How are chemicals managed in your department??

Answer: We receive the materials as soon as they arrive from suppliers, and we begin the process of counting and verifying quantities (Quantitative Check) and matching them against the delivery note.

2. Are there any written procedures or steps you follow upon receipt??

Answer: Yes, there is internal regulations and specific work procedures that we. adhere to in order to ensure a systematic reception process.

3. How are chemicals /specifically handled upon arrival?

Answer: We count the quantity, and the goods are not accepted individually; instead, the Health, Safety and Environment (HSE) officer and the person (or department) who technically requested the material are called in to inspect it and verify its quality and conformity.

4. Do environmental conditions affect your work in the receiving area?

Answer: Yes, the environment has a direct impact, and the company provides us with a ‘hazard allowance’ to compensate for the nature of the work in these conditions.

Part Three: Problem Diagnosis

5. What obstacles do you face that prevent the process from reaching its ideal state??

Answer: The biggest problem is that some parties don't fully follow the rules, and procedures. need to be applied more strictly...

6. Have you had any problems with product data, like expiration dates?

Answer: Yes, there is a problem with the clarity of the dates they are sometimes unclear or formatted in a way that makes them difficult to read quickly.

Part Four: Solutions and Proposals

7. What are your suggestions for improving chemical management from your perspective?

Expiry dates must be clear. and understandable to everyone.

Implement an automated alert system in SAP system to know when expiry dates are approaching.

Order small quantities that meet current demand only to avoid stockpiling and the expiry of materials in storage

8. What is your closing remark regarding work improvement??

the strict enforcement of internal regulations is the key to better and safer operations.

4. Interview with Head of the HSE

Hello, my name is LEKOUINI Doaa, I am a Master's student in Quality Management. I am doing a case study on the use of quality tools to solve the problem of chemical management. The purpose of this interview is to understand the situation and to use your experience to propose practical solutions that will help develop the work. All the information's will remain confidential and is for academic purposes only.

Part one: General Information

Full Name: Boujlajel kouider

Current Position: Head of the Health, Safety, and Environment HSE

Department: HSE Department

experience:30 years

Role in Chemical Management: Providing necessary protection for employees and the facility, and ensuring compliance with occupational safety standards.

Part Two: Current Practices

1. Are Safety Data Sheets (SDS) available for chemicals?

Answer: Yes, they are available at several locations it is with the DML Docter, at the HSE Department, and in the warehouse.

2.. How do you ensure that employees adhere to quality and safety standards in their daily work?

Answer: We make continuous efforts that include employee awareness campaigns, conducting periodic inspections, and evaluating employee performance and compliance.,

3.. How do you handle situations where materials are found without an SDS?

Answer: We immediately search for their data online, then print it out and attach it to the material to ensure safety information is available.

Part Three: Problem Diagnosis

4. Does the department face major issues regarding chemicals?

Answer: We have not faced major problems before; the materials used are primarily simple substances such as detergents and the like, not highly hazardous materials.

5. What are the underlying causes of the minor problems that may arise?

Answer: This is primarily due to a “lack of knowledge” regarding the properties of the materials or the procedures.

6. In your opinion, are these problems related to a lack of training or weak procedures?

Answer: Yes, the problems are related to a lack of training, weaknesses in some procedures, and communication issues.

Part four Solutions & Proposals

7. Do you believe that employees have sufficient knowledge to handle these materials?

Answer: We at the HSE Department play our part by providing awareness sessions and ongoing reminders to employees to raise their level of awareness

8. What are your proposals for improving the management of chemical products?

Answer: There should be a focus on training to make sure everyone knows the correct and safe handling procedures.

5. Interview with the Head of the IMS Department

Introduction:

Hello, my name is LEKOUINI Doaa, ‘I am a Master's student in Quality Management. I am doing a case study on the use of quality tools to to solve the problem of chemical management. The purpose of this interview is to understand the situation and to use your experience to propose practical solutions that will help develop the work. All the information’s will remain confidential and is for academic purposes only.

Basic Information:

Interviewee: Mr Blidi Rabie

Current Position: Head of the Quality Department.

Department: IMS

Years of Experience: 30 years

Role in Chemical Materials Management: Overseeing the existence and application of quality standards.

Parts Two and Three:

Current Practices and Issues

1- Level of worker awareness:

He believes that workers'

experience and knowledge exist but are lacking and incomplete when it comes to handling chemicals.

2- Standards adopted in inventory management

The Integrated Management System (IMS) is relied upon, which includes: ISO 9001, ISO 45001, and ISO 14001.

3- Availability of technical documentation (Clause 8.5.1)

It was noted that technical documentation (such as instructions for use) is not always available before storage operations commence.

4- Defined objectives (Clause 6.2.1)

Objectives are in place and have been communicated; they are as follows:

Availability of materials on demand.

Achieving the safety objective.

The objective of raising staff awareness.

5- Issues identified:

Constant staff turnover, leading to a lack of awareness.

Problems with communication at 'interfaces' between different departments

Failure to report missing documentation (such as the SDS/FDS) or inability to read it.

Part Four: Analysis of Causes

6- Main Causes

Identified as (lack of communication, lack of training, weak procedures).

7- System (Machine/SAP): Strongly supports the addition of

mandatory fields in the SAP system relating to expiry dates and the presence of an SDS to prevent data gaps.

8- Suppliers (Material): It is proposed that, to ensure

their compliance

9- Strict conditions should be set out in the Purchase Order.

10- Implement strict checks upon receipt, using a 'Supplier Rating'

system which deducts points if documentation is missing.

11- Environment: (No further details were mentioned in this interview regarding dust, but the focus was on communication).

Part Five: Use of Quality Tools

12- Tools actually used: PDCA (Deming Cycle), audit reports and the 5w2h tool are used, whilst “Brainstorming” is rarely used.

13- Method of Application: An Audit File Conductor is applied to monitor operations before and during implementation to ensure compliance with standards.

Ensuring the Validity of the Analysis: This is achieved by involving the stakeholder (the line manager) in the analysis process, as they are most familiar with the reality on the ground, and to ensure their buy-in to the proposed solutions.

Part Six: Corrective Actions and Improvement

14- Preventing recurrence of issues: This is achieved by re-evaluating the solutions; the QHSE Manager ensures the effectiveness of the measures taken before closing the issue file.

15- Digitization: It is considered that the most appropriate department to oversee the digitization of the SDS is the warehouse, in collaboration with the HSE department.

16- Suggestions for improvement:

-Prepare a comprehensive inventory list of all chemicals, including (date of receipt + expiry date) with a monitoring tool.

-Implement a storage and usage mechanism based on the FIFO principle first in first out,

-Minor obstacles to achieving optimal management: (communication, discipline, and immediate reporting of problem)

ANNEX B: OBSERVATION GUIDE

Category	Elements to be Observed	Always	Sometimes	Never	Remarks
Storage Conditions	Proper and appropriate storage of chemicals.	X	☐	☐	Cleaning products are stored safely on shelves and pallets.
	Separation of chemically incompatible materials.	X	☐	☐	Since these are general cleaning agents, there are no significant chemical compatibility risks.
	Cleanliness of the storage area.	☐	X	☐	A light layer of dust was observed on some chemical containers. This is mainly due to the geographic nature of the region (arid/desert environment). However, they do clean the place regularly
	Are the lights and ventilation adequate for storing chemicals?	X	☐	☐	Lighting and natural ventilation appear adequate for the warehouse size and structure.
Labeling and Identification	Presence of identification labels on containers.	X	☐	☐	Most products have clear original commercial labels.
	Presence of production/expiry dates.	☐	X	☐	Although expiry dates are physically present on the containers, they are marked as 'Sometimes' because they are often 'non-functional'. the coding format used is complex and difficult to interpret by the workers
	Presence of hazard symbols.	☐	X	☐	General hazard signs are displayed on warehouse walls. However, the products only carry simple precautionary symbols (e.g., "Avoid eye contact") because they are non-hazardous cleaning agents
Safety Procedures	Availability of Personal Protective Equipment (gloves, masks...).	X	☐	☐	Standard PPE (gloves/uniforms) is available for staff performing cleaning tasks.
	Availability of emergency equipment (fire extinguisher...).	X	☐	☐	Fire extinguishers are distributed and maintained across the warehouse.

	Safety instructions displayed in visible locations	☐	X	☐	General warehouse safety signs are present, but specific handling procedures are not displayed.
Documentation	Availability of SDS	X	☐	☐	SDS sheets are available and displayed near the products in the warehouse.
	Ease of access to work procedures	☐	☐	X	There are no standard operating procedures in place or on display; each employee works according to their own experience and instructions.
	Validity of documents (updated and not outdated)	X	☐	☐	Documented delivery notes and product labels are current and updated.
Handling Practices	Proper handling of chemical materials.	X	☐	☐	Workers use appropriate manual handling techniques for small cleaning containers.
	Adherence to written work procedures.	☐	X	☐	Workers rely. on experience and verbal orders rather than reading the written
Employee Awareness	Employees' knowledge of material-related hazards.	☐	X	☐	Workers know general risk but struggle with technical details and batch codes
	Level of training on handling materials.	☐	X	☐	Periodic, safety briefings are held, but specific training on labeling is needed
	Awareness of emergency procedures.	X	☐	☐	Staff are, aware of fire safety and emergency assembly points
Compliance	Respect for the company's internal rules and regulations.	X	☐	☐	General company regulations regarding discipline and attendance are strictly followed
	Compliance with international standards.	☐	X	☐	The facility meets physical storage standards, but accessibility to technical data and labeling clarity need better alignment with ISO 9001. (8.5.1)
Hazardous Situations	Presence of leaks or material spills.	☐	☐	X	The storage area is dry and clean with no signs of leaks or spills.
	Observation of unsafe practices, during work	☐	☐	X	No unsafe behaviors were observed workers adhere to basic safety protocols

ANNEX C: POLITIQUE QHSE

سوناطراك sonatrach	SONATRACH-TRC Division Maintenance Direction Maintenance Laghouat	Code : EN-06-03 Version : 09 Date : 03.11.2025
	Déclaration Politique QHSE	Page : 1/1

NOTRE VISION

Dans un environnement spécifique marqué des enjeux économiques, technologiques, réglementaires et professionnels et afin d'assurer la pérennité de notre entreprise, la MNL qui appartient au Groupe SONATRACH s'est inscrite dans une stratégie aspirant au maintien de sa position de leader de maintenance dans l'activité transport par canalisation.

NOTRE MISSION

Afin d'accroitre la satisfaction de nos clients, constituant notre principale préoccupation, et dans le respect des exigences légales, réglementaires et des textes applicables, des normes de management adoptées et des exigences des organismes fournissant la reconnaissance, MNL s'engage à répondre aux attentes de ses parties intéressées en réalisant ses activités de Maintenance des machines tournantes, Opérations spéciales sur canalisations, Essais de tarage des soupapes de sécurité et Etalonnage des instruments de mesure.

DIFFUSION CONTROLÉE

NOS VALEURS

- **Crédibilité** : en respectant constamment les règles de déontologie ;
- **Objectivité** : en garantissant l'indépendance et l'impartialité de notre personnel ;
- **Réactivité et responsabilité** : en répondant avec célérité aux attentes de nos Clients, tout en assurant la confidentialité des données, la préservation de la santé et la sécurité de notre personnel et nos partenaires ainsi que la préservation de l'environnement.

NOS OBJECTIFS

Afin de concrétiser cette Déclaration de Politique QHSE, MNL a fixé comme objectifs :

- Acquérir, préserver et développer les compétences, les connaissances et les ressources nécessaires aux nouveaux besoins de nos Clients et parties intéressées ;
- Maintenir et veiller à l'amélioration continue de la performance du Système de Management Intégré (SMI QHSE) conformément aux référentiels ISO 9001 : 2015, ISO 14001 : 2015 et ISO 45001 : 2018, en promouvant l'efficacité dans les interfaces des processus de réalisation ;
- Développer et préserver les capacités technologiques, visant à répondre aux attentes des Clients, dans le respect des exigences applicables en matière de qualité, d'environnement, de santé et de sécurité ;
- Consolider et renforcer les relations mutuellement bénéfiques avec nos Clients ;
- Garantir les meilleures conditions de sécurité et de santé pour ses travailleurs ;
- Réduire l'impact de ses activités sur l'environnement ;
- Garantir l'impartialité et la cohérence dans la réalisation des activités du Laboratoire d'Essais de Tarage des Soupapes de Sécurité TSS et du Laboratoire d'Etalonnage des Objets Soumis à Etalonnage EVOSET ;
- Maintenir la preuve de conformité et l'accréditation des activités des Laboratoires d'essais de tarage des soupapes de sécurité et d'étalonnage et de vérification des Objets soumis à étalonnage, conformément aux exigences de la norme ISO 17025 V 2017 ;
- Obtenir la précualification des activités d'inspection auprès de l'ARH et l'accréditation des activités d'analyse vibratoire selon la norme ISO 17020.

NOTRE ENGAGEMENT

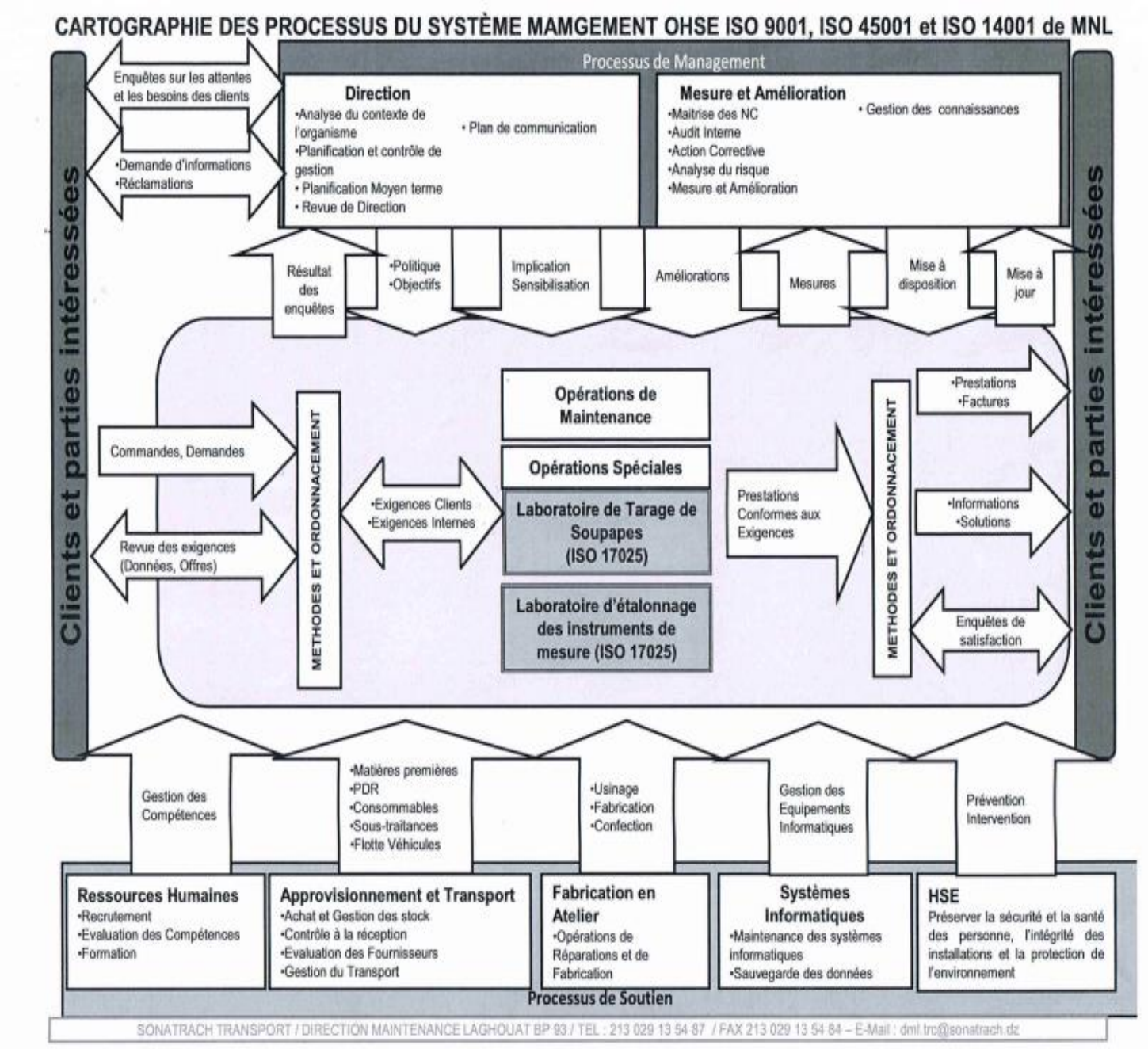
A cet effet, Le Directeur de MNL désigne Mme. Fatima CHEKNANE son représentant à qui il délègue l'autorité et la responsabilité nécessaire pour l'animation de la politique Qualité. Elle est tenue à s assurer que la sensibilisation aux exigences des clients est encouragée et que le Système de Management Intégré est établi, mis en œuvre et entretenu. Elle rend compte à la Direction du fonctionnement du Système de Management Intégré et de tout besoin d'amélioration lors de la revue de Direction, en assurant le suivi de l'efficacité des activités.

Le Directeur de MNL s'engage à :

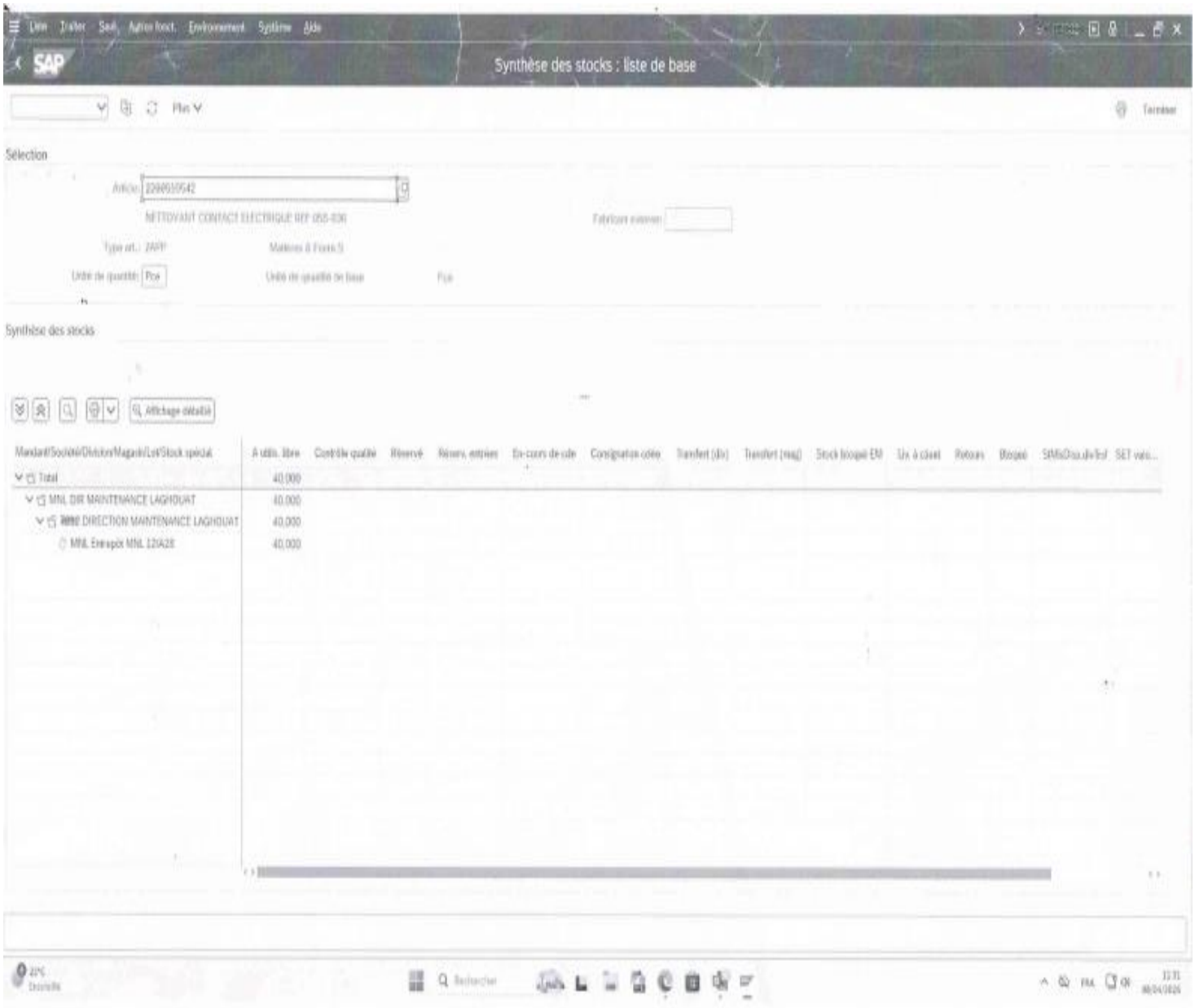
- Respecter et faire respecter le principe d'impartialité ;
- Satisfaire les exigences des clients de MNL, et les exigences réglementaires et légales applicables en matière de SST et Environnement ;
- Renforcer le dispositif d'écoute clients et améliorer la prise en charge et la satisfaction de leurs attentes ;
- L'amélioration continue du Système de Management Intégré ;
- Renforcer les ressources et les dispositions, visant la conformité aux exigences de sécurité ;
- Eliminer les dangers et réduire les risques pour la Santé et la Sécurité au Travail ;
- Consulter et Faire participer les travailleurs pour l'amélioration du Système de Management Intégré ;
- Procurer des conditions de travail sûres et saines pour la prévention des traumatismes et pathologies liés au travail ;
- Assurer la protection et la préservation de l'Environnement ;

Cette déclaration politique QHSE ne peut être mise en œuvre sans l'implication de toute le personnel de la Direction.

ANNEX D: FLLOW MAP (CATOGRAPHIE)



ANNEX E: SAP system



ANNEX F: purchase requisition

Activité Transport par Canalisation
Direction Maintenance Laghouat
Direction Maintenance Laghouat
Unité 7012

Commande 4500134106

Du : 29/03/2026

NIF : [redacted]
AI : [redacted]
RC : [redacted]
Tel. : 029-13-54 87/88/90
Fax : 029 13 54 84
Email : dml.tro@sonatrach.dz
Adresse : Cité Essadikia - Laghouat 03000 Laghouat

NAFTAL SPA LAGHOUAT
ROUTE DES DUNES CHERRAGA ALGER
03000 Algérie
Tel : 00000000
Fax : 00000000
Email : [redacted]@email.com

N°	Désignation	Qte	Unité	Prix Unit	Montant
1	LIQUIDE DE REFROIDISSEMENT- ANTIGEL REFERENCE	60,000	Pce	1 508,40	90 504,00

TOTAL HT : 90 504,00 DZ
TOTAL TTC : 90 504,00 DZ

Montant en lettres : QUATRE-VINGT-DIX MILLE CINQ CENT QUATRE Dinar algérien

Mode de paiement : Virement Bancaire Domestique
Délai de paiement : dans les 30 jours sans déduction

Lubrifiants Pneumatiques ★ Centre Lubrifiants ★ LAGHOUAT

Signature

Le Directeur Maintenance

[redacted]

01

Facturation à : Veuillez indiquer le numéro de la commande sur votre facture à communiquer à l'adresse ci-dessus ou à transmettre

Date d'impression : 29/03/2026

Page : 1

ANNEX G: receive note

سوناطراك
sonatrach

Activité Transport par Canalisation

Direction Maintenance Laghouat

Direction Maintenance Laghouat

Unité [redacted]

Bon de Réception

N° 5000278588

Date de réception 28.02.2026 Page 1/1

Division [redacted] Code fournisseur [redacted] N° Commande [redacted]

Code Mvt 101 Nom du fournisseur [redacted] Grpe Acheteur A01

Bon de livraison

Observation

Poste	Poste cde	N° Article	Ancien N° Article	Désignation	Qté	Unité	Magasin	Emplacement	PU	Montant
1	10	[redacted]	[redacted]	FEUILLE JOINT KLINGERIT 0.4M/M	15,000	Pce	MNL	79/C[redacted]	[redacted]000,00	[redacted] 000,00
Montant Total										[redacted] 000,00

Agent de Réception / Utilisateur

Utilisateur (Ctrle Qualité)

Magasinier

INTERNATIONAL TRANSIT TRANSPORT

FILTRANS

AGENCE D'ALGER

SIEGE : 2, Rue Jawaharlal NEHRU (ex-Béziers)
ALGER
Tél. : 021 74 76 72 - Fax : 021 71 80 70

BORDEREAU DE LIVRAISON

N° [redacted]

ALGER, le 16/03/26

M. [redacted]

Transit N° [redacted] Transporteur

Livré à AAR

Marques et N°	Nombre de Colis	Désignation	Poids
065446.06 7446	01	SPARE PARTS	74K

N° Camion

Matin	Après-Midi

Observations : Matériel Reçu à MNL

02 AVR. 2026

Réception & Expédition
SH - MNL - Laghouat

Réceptionnaire :

[redacted]

ORISÉ PAR :

DÉCLARATION		DATE EMISSIO
N	DATE	
5301	22/02/2026	05/03/2026

NS

REMENT

446

SIGNATION DES MARCHANDISES

PARTS

ANNEX H: NON-CONFORMITY NOTE

سوناطراك
sonatrach

Activité Transport par Canalisation
Division Maintenance
Direction Maintenance Laghouat
Département ATR
Service Gestion Technique

BON DE NON CONFORMITE

N°/ATR-GT - REC/2022	
TYPE DE LA N.C.	QUANTITE

DOSSIER RECEPTION	[redacted]
CONTRAT	
DESIGNATION	
FOURNISSEUR	
COMMANDE	
FACTURE	
DATE LIVRAISON	

ITEM	ARTICLE	DESIGNATION	RÉFÉRENCE	Qté FACT.	Qté LIV.	MANQUE EN Qté	U.E	OBS
4	[redacted]	TAPE	A606E[redacted]	6	4	2		

CONTRÔLE QUANTITE		OBSERVATIONS
NOM		
DATE	13-avr.-26	
VISA		
CHEF DE SERVICE GT		OBSERVATIONS
NOM		
DATE	13-avr.-26	
VISA		
CACHET		

ANNEX I: CONFORMITY NOTE

سوناطراك
sonatrach

Activité Transport par Canalisation
Division Maintenance
Direction Maintenance Laghouat
Département APT
Service Gestion Technique

BON DE CONFORMITE N°	030/ATR-GT - REC/2026

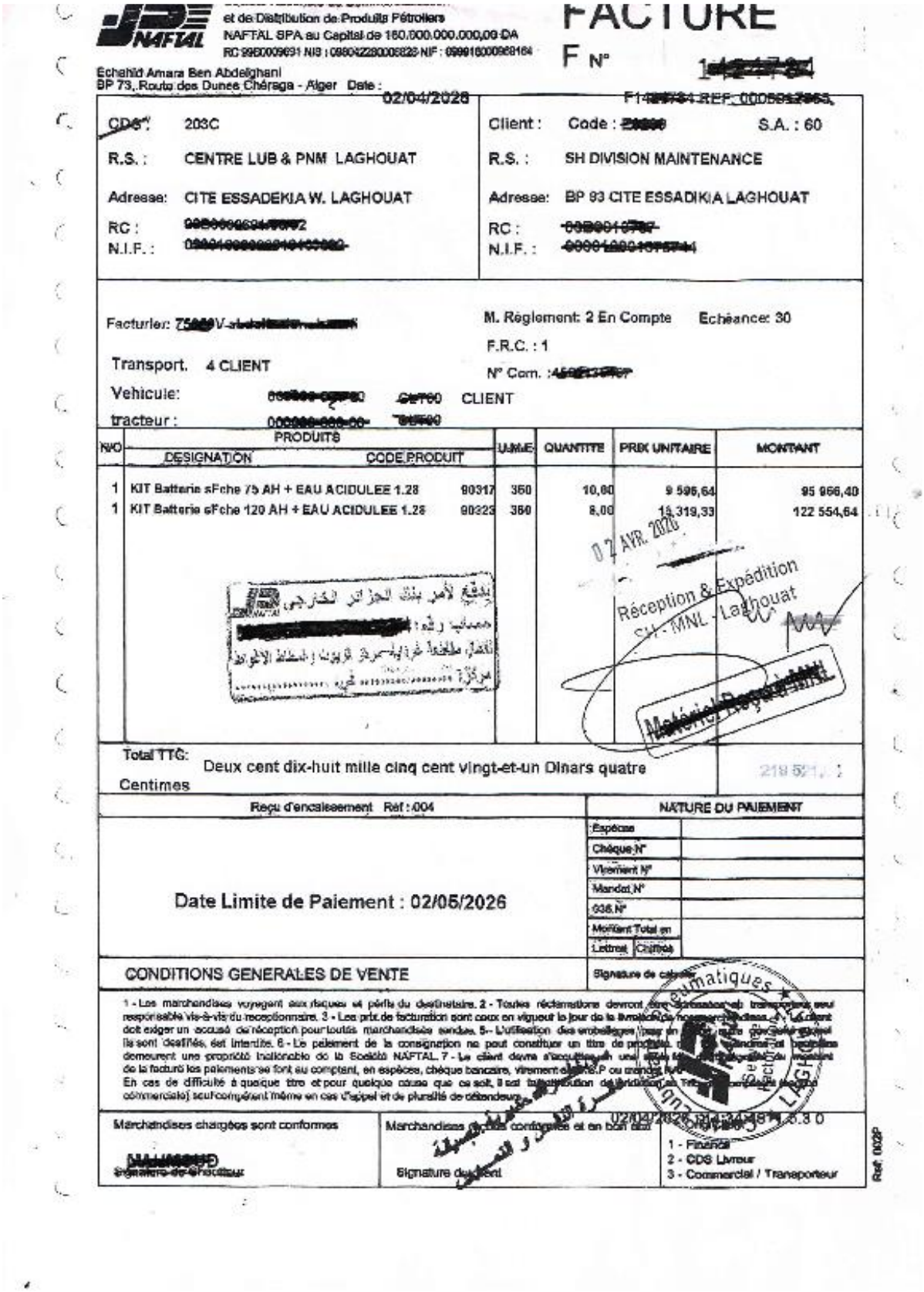
DESTINATAIRE	MNL

ITEM	ARTICLE	DESIGNATION	RÉFÉRENCE	QTE LIV.	U.E	OBSERVATIONS

BON DE CONFORMITE N°	030/ATR-GT - REC/2026

CONTRÔLE QUANTITATIF		OBSERVATIONS
NOM		
DATE		
VISA		
CHEF DE SERVICE GT		OBSERVATIONS
NOM		
DATE		
VISA		
CONTRÔLE QUALITATIF		Le visa de la structure technique sur ce document n' engage sa responsabilité que sur le contrôle qualitatif apparent. Cette Structure n'est pas responsable des éventuels vices cachés.
TECHNICIEN 1		OBSERVATIONS
NOM		
DATE		
VISA		
CHEF DE SERVICE TECH.1		OBSERVATIONS
NOM		
DATE		
VISA		

ANNEX J: the facture



et de Distribution de Produits Pétroliers
NAFTAL SPA au Capital de 150.000.000.000,00 DA
RC 95B0009691 NIS : 099042280008823 NIF : 099916000968164

Echahid Amara Ben Abdelghani
BP 73, Route des Dunes Chéraga - Alger Date : 02/04/2026

FACTURE
F N° [redacted]

F1 [redacted] REF: 0005852963

CDS : 203C	Client : Code : [redacted] S.A. : 60
R.S. : CENTRE LUB & PNM LAGHOUAT	R.S. : SH DIVISION MAINTENANCE
Adresse: CITE ESSADEKIA W. LAGHOUAT	Adresse: BP 93 CITE ESSADIKIA LAGHOUAT
RC : [redacted]	RC : [redacted]
N.I.F. : [redacted]	N.I.F. : [redacted]

Facturier: [redacted] M. Règlement: 2 En Compte Echéance: 30

F.R.C. : 1

Transport. 4 CLIENT

N° Com. : [redacted]

Vehicule: [redacted] CLIENT

tracteur : [redacted]

N/O	PRODUITS DESIGNATION	CODE PRODUIT	U.M.E.	QUANTITE	PRIX UNITAIRE	MONTANT
1	KIT Batterie sFche 75 AH + EAU ACIDULEE 1.28	90317	360	10,00	9 596,64	95 966,40
1	KIT Batterie sFche 120 AH + EAU ACIDULEE 1.28	90323	360	8,00	15 319,33	122 554,64

02 AVR. 2026
Réception & Expédition
SH - MNL - Laghouat

Total TTC: Deux cent dix-huit mille cinq cent vingt-et-un Dinars quatre Centimes 218 521,04

Reçu d'encaissement Réf : 004

NATURE DU PAIEMENT

Espèces	
Chèque N°	
Virement N°	
Mandat N°	
OS N°	
Montant Total en Lettres / Chiffres	

Date Limite de Paiement : 02/05/2026

CONDITIONS GENERALES DE VENTE

Signature de cachet

1 - Les marchandises voyagent aux risques et périls du destinataire. 2 - Toutes réclamations devront être formulées au transporteur seul responsable vis-à-vis du réceptionnaire. 3 - Les prix de facturation sont ceux en vigueur le jour de la livraison. 4 - Le client doit exiger un accusé de réception pour toutes marchandises vendues. 5- L'utilisation des emballages (sauf en [redacted] sont destinés, est interdite. 6 - Le paiement de la consignation ne peut constituer un titre de propriété. [redacted] demeurent une propriété inaliénable de la Société NAFTAL. 7 - Le client devra s'acquitter [redacted] de la facturé les paiements se font au comptant, en espèces, chèque bancaire, virement [redacted] En cas de difficulté à quelque titre et pour quelque cause que ce soit, il est [redacted] commerciale) seul compétent même en cas d'appel et de pluralité de défendeurs.

Marchandises chargées sont conformes Signature du Chauffeur	Marchandises reçues conformes et en bon état Signature du client	02/04/2026 [redacted] 3.8 0 1 - Finance 2 - CDS Livreur 3 - Commercial / Transporteur

Réf: 002P

ANNEX K: STOCK IN NOTE

Bon de Réception Comptable

SONATRACH - TRC
DIVISION MAINTENANCE
DIRECTION MAINTENANCE LAGHOUAT
BP 93 ESSADIKIA

Date de Réception : 05-OCT-22
Commande : 20220152
Fournisseur : SARL RINZA TRAVAUX GENERAL
CONTRAT:

Bon de livraison :
Devise : DZD

Ligne Réception	Type	Article	Magasin	Gestion	Imputation	Qté	Prix	Montant
41 41	Materiel	[redacted] LAMPES 24V	DMNBLG01	602605		100	258.700	[redacted].700.000
42 42	Materiel	6[redacted] RELAIS DE CONTROLE TENSION DE RESEAU	DMNBLG01	602605		3	17 940.000	[redacted].000
43 43	Materiel	[redacted] REGULATEUR/POWER FACTOR CONTROL RELAY	DMNBLG01	602605		1	176 800.000	1 3.000
44 44	Materiel	6[redacted] FUSIBLE HPC/HRC FUSE GL T100*10dA	DMNBLG01	602603		3	5 200.000	1 100
45 45	Materiel	[redacted] FUSIBLE HPC/HRC FUSE GL T100*125A	DMNBLG01	602603		3	5 200.000	00

Total devise

Le Preneur
P / Le Chef de Service
Gestion des Stocks
Le Responsable Intérimaire

Origine: G.M.A.O

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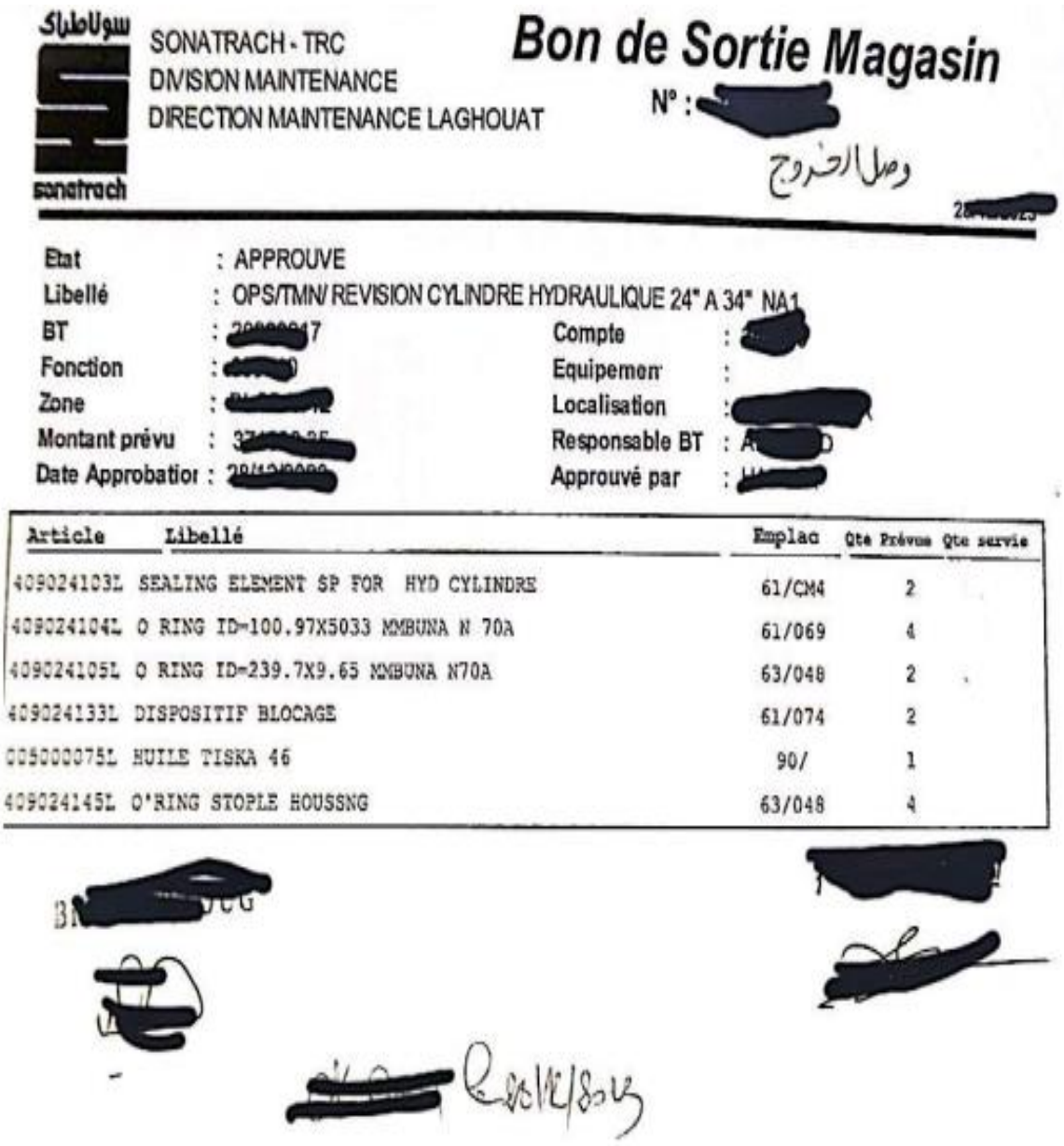
ANNEX L: STOCK OUT NOTE



SONATRACH - TRC
DIVISION MAINTENANCE
DIRECTION MAINTENANCE LAGHOUAT

Bon de Sortie Magasin

N° : [redacted]

وصل الخروج

Etat : APPROUVE
Libellé : OPS/TMN/ REVISION CYLINDRE HYDRAULIQUE 24" A 34" NA1
BT : [redacted] Compte : [redacted]
Fonction : [redacted] Equipement :
Zone : [redacted] Localisation : [redacted]
Montant prévu : [redacted] Responsable BT : [redacted]
Date Approbation : [redacted] Approuvé par : [redacted]

Article	Libellé	Emplac	Qte Prévue	Qte servie
4090241031	SEALING ELEMENT SP FOR HYD CYLINDRE	61/CM4	2	
4090241041	O RING ID=100.97X5033 MMBUNA N 70A	61/069	4	
4090241051	O RING ID=239.7X9.65 MMBUNA N70A	63/048	2	
4090241331	DISPOSITIF BLOCAGE	61/074	2	
0050000751	HUILE TISKA 46	90/	1	
4090241451	O'RING STOPLE HOUSSNG	63/048	4	

[redacted]

ANNEX M: RETURNE NOTE

SONATRACH - TRC
DIVISION MAINTENANCE
DIRECTION MAINTENANCE LAGHOUAT

Bon de réintégration

N° : [redacted]

وصل الإرجاع

Date de réintégration [redacted]

Date d'édition : [redacted]

Magasin : MAGASIN TECHNIQUE DE LA BASE DE LAGHOUAT
Libellé : INST / INTERVENTION SUR LE COMPRESSEUR D'AIR ATLAS-COPCO.
BT : [redacted]
Fonction : [redacted]
Zone :
Montant prévu : [redacted]
Date Approbation : [redacted]
Compte : [redacted]
Equipement :
Localisation :
Responsable BT : [redacted]
Approuvé par : [redacted]

Article	Libellé	Qte.reçue
687011460L	PRESSURE TRANSDUCTEUR (C.ATLAS COPCO) OZ2 34"	2.00

Total BRM : [redacted]

Magasinier
Nom:

Contrôle qualité
Nom:

Fichiste
Nom :

[redacted]

ANNEX N: THE FMAC

sonatrach	**SONATRACH-TRC** **Division Maintenance** **Direction Maintenance Laghouat**	**Code : EN-03-01** **Version : 02**
	Fiche de Maîtrise des Actions Correctives SMI-QHSE **N° 02 / ATR / 2026**	**Date : Juin 2024** **Page : 1 / 1**

	Non-conformité	
Source de l'Écart *(Mettre une croix dans la case correspondante)*	**Oui**	**Non**
Travaux non conformes (Atelier ou Site)		
Résultats d'audit	X	
Réclamation		
Actions correctives jugées inefficaces		

IDENTIFICATION DE L'ÉCART

Désignation :
Gestion des produits chimiques insuffisante
Certains produits sont stockés sans date de péremption et sans Fiche de sécurité (FDS).
Chap. 8.5.1 et 6.1.2
Preuves : WD-40 Nettoyant et Contrat avec fournisseur « ABM3 Services »

Nom : R. BLIDI Fonction : RA Date : 11/02/2026 Visa :

ACTIONS IMMEDIATES *(Si Applicables)*

Désignation :

Nom : Fonction : Date : Visa :

RECHERCHE DES CAUSES *(Si Applicables)*

Désignation :

Nom : Fonction : Date : Visa :

TRAITEMENT *(Plan d'Actions décidé)*

Action Corrective	Responsable	Délai

Nom : Fonction : Date : Visa :

SUIVI Responsable Qualité

Action Corrective	Date d'évaluation	Mesure d'efficacité		N° de la nouvelle FMAC
		Oui	Non	

Nom : Fonction : Date : Visa :

ANNEX O: THE SDS OF WD-40

Safety Data Sheet
California CARB Compliant

1 - Identification

Product Name: WD-40 Multi-Use Product Aerosol **Product Use: Lubricant, Penetrant, Drives Out Moisture and Protects Surfaces from Corrosion** **Restrictions on Use: None identified** **SDS Date of Preparation: November 13, 2024**	**Manufacturer: WD-40 Company** **Address: 9715 Businesspark Avenue San Diego, California, USA 92131** **Telephone:** **Emergency: 1-888-324-7596** **Information: 1-888-324-7596** **Chemical Spills: 1-800-424-9300 (Chemtrec)** **1-703-527-3887 (International Calls)**

2 – Hazards Identification

HCS 2024/GHS Classification:
Aerosol Category 1
Aspiration Toxicity Category 1
Specific Target Organ Toxicity Single Exposure Category 3 (nervous system effects)

Note: This product is a consumer product and is labeled in accordance with the US Consumer Product Safety Commission regulations which take precedence over OSHA Hazard Communication labeling. The actual container label will not include the label elements below. The labeling below applies to industrial/professional products.

Label Elements:

DANGER!
Extremely Flammable Aerosol.
Pressurized container: may burst if heated.
May be fatal if swallowed and enters airways.
May cause drowsiness or dizziness.

Prevention
Keep away from heat, hot surfaces, sparks, open flames, and other ignition sources. – No smoking.
Do not spray on an open flame or other ignition source.
Do not pierce or burn, even after use.
Avoid breathing vapors or mists.
Use only outdoors or in a well-ventilated area.

Response
IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or physician if you feel unwell.

Storage
Store locked up.
Protect from sunlight. Do not expose to temperatures exceeding 122°F (50°C). Store in a well-ventilated place.

Disposal
Dispose of contents and container in accordance with local and national regulations.

3 - Composition/Information on Ingredients

Ingredient	CAS #	Weight Percent	US HSC 2024 / GHS Classification
LVP Aliphatic Hydrocarbon	64742-47-8	45-50%	Aspiration Toxicity Category 1
Petroleum Base Oil	64742-56-9 64742-65-0 64742-53-6 64742-54-7 64742-71-8	<35%	Not Hazardous
Aliphatic Hydrocarbon	64742-47-8	10 - <25%	Flammable Liquid Category 3 Aspiration Toxicity Category 1 Specific Target Organ Toxicity Single Exposure Category 3 (nervous system effects)
Carbon Dioxide	124-38-9	2-3%	Simple Asphyxiant Gas Under Pressure, Compressed Gas

Note: The specific chemical identity and exact percentages are a trade secret.

4 – First Aid Measures

Ingestion (Swallowed): Aspiration Hazard. DO NOT induce vomiting. Call physician, poison control center or the WD-40 Safety Hotline at 1-888-324-7596 immediately.
Eye Contact: Flush thoroughly with water. Remove contact lenses if present after the first 5 minutes and continue flushing for several more minutes. Get medical attention if irritation persists.
Skin Contact: Wash with soap and water. If irritation develops and persists, get medical attention.
Inhalation (Breathing): If irritation is experienced, move to fresh air. Get medical attention if irritation or other symptoms develop and persist.
Signs and Symptoms of Exposure: Harmful or fatal if swallowed. Aspiration of liquid into the lungs during swallowing or vomiting may cause lung damage. May cause eye and respiratory irritation. Inhalation of mists or vapors may cause drowsiness, dizziness, and other nervous system effects. Skin contact may cause drying of the skin.
Indication of Immediate Medical Attention/Special Treatment Needed: Immediate medical attention is needed for ingestion.

5 – Fire Fighting Measures

Suitable (and unsuitable) Extinguishing Media: Use water fog, dry chemical, carbon dioxide or foam. Do not use water jet or flooding amounts of water. Burning product will float on the surface and spread fire.
Specific Hazards Arising from the Chemical: Extremely flammable aerosol. Contents under pressure. Keep away from ignition sources and open flames. Exposure of containers to extreme heat and flames can cause them to rupture often with violent force. Vapors are heavier than air and may travel along surfaces to remote ignition sources and flash back. Combustion will produce oxides of carbon and hydrocarbons.
Special Protective Equipment and Precautions for Fire-Fighters: Firefighters should always wear positive pressure self-contained breathing apparatus and full protective clothing. Cool fire-exposed containers with water. Use shielding to protect against bursting containers.

6 – Accidental Release Measures

Personal Precautions, Protective Equipment and Emergency Procedures: Wear appropriate protective clothing (see Section 8). Eliminate all sources of ignition and ventilate the area.
Methods and Materials for Containment/Cleanup: Leaking cans should be placed in a plastic bag or open pail until the pressure has dissipated. Contain and collect liquid with an inert absorbent and place in a container for disposal. Clean spill area thoroughly. Report spills to authorities as required.

7 – Handling and Storage

Precautions for Safe Handling: Avoid contact with eyes. Avoid prolonged contact with skin. Avoid breathing vapors or aerosols. Use only with adequate ventilation. Keep away from heat, sparks, pilot lights, hot surfaces, and open flames. Unplug electrical tools, motors, and appliances before spraying or bringing the can near any source of electricity. Electricity can burn a hole in the can and cause contents to burst into flames. To avoid serious burn injury, do not let the can touch battery terminals, electrical connections on motors or appliances or any other source of electricity. Wash thoroughly with soap and water after handling. Keep containers closed when not in use. Keep out of the reach of children. Do not puncture, crush or incinerate containers, even when empty.
Conditions for Safe Storage: Store in a cool, well-ventilated area, away from incompatible materials. Do not store above 120°F or in direct sunlight. U.F.C (NFPA 30B) Level 3 Aerosol. Store away from oxidizers.

8 – Exposure Controls/Personal Protection

Chemical	Occupational Exposure Limits
LVP Aliphatic Hydrocarbon	1200 mg/m3 TWA (manufacturer recommended)
Petroleum Base Oil	5 mg/m3 TWA (Inhalable) ACGIH TLV (as Mineral oil) 5 mg/m3 TWA OSHA PEL (as Oil mist, mineral)
Aliphatic Hydrocarbon	1200 mg/m3 TWA (manufacturer recommended)
Carbon Dioxide	5000 ppm TWA, 30,000 ppm STEL ACGIH TLV 5000 ppm TWA OSHA PEL

The Following Controls are Recommended for Normal Consumer Use of this Product
Appropriate Engineering Controls: Use in a well-ventilated area.
Personal Protection:
Eye Protection: Avoid eye contact. Always spray away from your face.
Skin Protection: Avoid prolonged skin contact. Chemical resistant gloves recommended for operations where skin contact is likely.
Respiratory Protection: None needed for normal use with adequate ventilation.

For Bulk Processing or Workplace Use the Following Controls are Recommended
Appropriate Engineering Controls: Use adequate general and local exhaust ventilation to maintain exposure levels below the occupational exposure limits.
Personal Protection:
Eye Protection: Safety goggles recommended where eye contact is possible.
Skin Protection: Wear chemical resistant gloves.
Respiratory Protection: None required if ventilation is adequate. If the occupational exposure limits are exceeded, wear a NIOSH approved respirator. Respirator selection and use should be based on contaminant type, form and concentration. Follow OSHA 1910.134, ANSI Z88.2 and good Industrial Hygiene practice.
Work/Hygiene Practices: Wash with soap and water after handling.

9 – Physical and Chemical Properties

Physical State:	Liquid packaged as aerosol	Color:	Light green to amber
Odor:	Mild petroleum odor	Flammable Limits: (Solvent Portion)	LEL: 0.6% UEL: 8%
Relative Vapor Density:	0.8 – 0.82 @ 60°F	Vapor Pressure:	95-115 PSI @ 70°F
pH:	Not Applicable	Relative Density:	
Melting/Freezing Point:	Not established	Solubilities:	Insoluble in water
Boiling Point/Range:	361 - 369°F (183 - 187°C)	Partition Coefficient; n-octanol/water:	Not established
Flash Point:	138°F (59°C) Tag Closed Cup (liquid)	Autoignition Temperature:	Not established
Particle Characteristics:	Not applicable	Decomposition Temperature:	Not established
Flammability:	Flammable Aerosol	Kinematic Viscosity:	2.79-2.96 cSt @ 100°F

VOC:	24.1% MIR=0.43gO3/gVOC	Pour Point:	-63°C (-81.4°F) ASTM D-97

10 – Stability and Reactivity

Reactivity: Not reactive under normal conditions
Chemical Stability: Stable
Possibility of Hazardous Reactions: May react with strong oxidizers generating heat.
Conditions to Avoid: Avoid heat, sparks, flames, and other sources of ignition. Do not puncture or incinerate containers.
Incompatible Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide and carbon dioxide.

11 – Toxicological Information

Symptoms of Overexposure:
Inhalation: High concentrations may cause nasal and respiratory irritation and central nervous system effects such as headache, dizziness, and nausea. Intentional abuse may be harmful or fatal.
Skin Contact: Prolonged and/or repeated contact may produce mild irritation and defatting with possible dermatitis.
Eye Contact: Contact may be irritating to eyes. May cause redness and tearing.
Ingestion: This product has low oral toxicity. Swallowing may cause gastrointestinal irritation, nausea, vomiting and diarrhea. This product is an aspiration hazard. If swallowed, can enter the lungs and may cause chemical pneumonitis, severe lung damage and death.
Chronic Effects: None expected.
Carcinogen Status: None of the components are listed as a carcinogen or suspect carcinogen by IARC, NTP, ACGIH or OSHA.
Reproductive Toxicity: None of the components is considered a reproductive hazard.

Numerical Measures of Toxicity:
Acute Toxicity Estimates: Oral > 5,000 mg/kg; Dermal >2,000 mg/kg based on an assessment of the ingredients. This product is not classified as toxic by established criteria. It is an aspiration hazard.

12 – Ecological Information

Ecotoxicity: No specific aquatic toxicity data is currently available; however components of this product are not expected to be harmful to aquatic organisms
Persistence and Degradability: Components are readily biodegradable.
Bioaccumulative Potential: Bioaccumulation is not expected based on an assessment of the ingredients.
Mobility in Soil: No data available
Other Adverse Effects: None known.

13 - Disposal Considerations

If this product becomes a waste, it would be expected to meet the criteria of a RCRA ignitable hazardous waste (D001). However, it is the responsibility of the generator to determine at the time of disposal the proper classification and method of disposal. Do not puncture or incinerate containers, even empty. Dispose in accordance with federal, state, and local regulations.

14 – Transportation Information

DOT Surface Shipping Description: UN1950, Aerosols, 2.1 Ltd. Qty
(Note: Shipping Papers are not required for Limited Quantities unless transported by air or vessel – each package must be marked with the Limited Quantity Mark)
IMDG Shipping Description: UN1950, Aerosols, 2.1, LTD QTY
ICAO Shipping Description: UN1950, Aerosols, flammable, 2.1

NOTE: WD-40 Company does not test aerosol cans to assure that they meet the pressure and other requirements for transport by air. We do not recommend that our aerosol products be transported by air.

15 – Regulatory Information

U.S. Federal Regulations:
CERCLA 103 Reportable Quantity: This product is not subject to CERCLA reporting requirements, however, oil spills are reportable to the National Response Center under the Clean Water Act and many states have more stringent release reporting requirements. Report spills required under federal, state, and local regulations.
SARA TITLE III:
Hazard Category for Section 311/312: Refer to Section 2 for the OSHA Hazard Classification.
Section 313 Toxic Chemicals: This product contains the following chemicals subject to SARA Title III Section 313 Reporting requirements: None
Section 302 Extremely Hazardous Substances (TPQ): None
EPA Toxic Substances Control Act (TSCA) Status: All the components of this product are listed on the TSCA inventory.
California Safe Drinking Water and Toxic Enforcement Act (Proposition 65): This product does not require a California Proposition 65 warning.
VOC Regulations: This product complies with the consumer product VOC limits of CARB, the US EPA and states adopting the OTC VOC rules.
Canadian Environmental Protection Act: All the ingredients are listed on the Canadian Domestic Substances List or exempt from notification.

16 – Other Information

HMIS Hazard Rating:
Health – 1 (slight hazard), Fire Hazard – 4 (severe hazard), Physical Hazard – 0 (minimal hazard)

Revision Date: November 13, 2024 Supersedes: May 16, 2024

Revision Summary: Updates to conform to HCS 2024 – changes to sections 2, 3 and 9.

Prepared by: IHSC, LLC. Milford, CT, USA

Reviewed by: I. Kowalski Regulatory Affairs Dept.

4012200/No.0084708

ANNEX P: PROPOSED Chemical Receipt Checklist

سوناطراك sonatrach	**SONATRACH** **Direction Maintenance Laghouat QHSE departement**	**Code :** **Version : 01**
	Chemical receipt checklist	**Date: April 2026** **Page :1 /1**

1. **General Information**
   - **Product Name :** .....
   - **Supplier :** .....
   - **Purchase Order No :** .....
2. **Quality and Safety Inspection**

No.	Verification Criteria	Yes	No	Remarks
1	**Safety Data Sheet (SDS):** Is the FDS/SDS provided?	☐	☐	**Mandatory**
2	**Expiry Date:** Is the date legible and understood by the workers?	☐	☐	
3	**Batch Number:** Does it match the documentation?	☐	☐	
4	**Warning Labels:** Are GHS (Globally Harmonized System) pictograms present?	☐	☐	
5	**Packaging Integrity:** Any leaks or damages?	☐	☐	

3. **Double-Check Control**

Role	Name	Date	Visa (Signature)
Verification 1 (Storekeeper)	.....	…/…/2026	
Verification 2 (QHSE Supervisor)	.....	…/…/2026	

ANNEX Q: Qualitative analyse of the interviews

Axis	Main Results
Current Practices	The interviews revealed that chemical products are managed through existing operational practices and the SAP system. However, the management of chemical-specific information, particularly SDS and expiration dates, is not systematically integrated into daily operations.
Problems and Non-Conformities	Participants reported difficulties related to missing SDS, unidentified expiration dates, and weaknesses in the management of chemical information. The non-conformity highlighted deficiencies in the reception and monitoring process of chemical products.
Causes Analysis	The interviews identified several potential causes, including insufficient control procedures, communication gaps between departments, limited verification of technical information during reception, and inadequate consideration of chemical-specific requirements.
Use of Quality Tools	Participants confirmed the importance of quality tools in understanding and solving operational problems. The tools were considered useful for identifying root causes, structuring analysis, and supporting decision-making.
Corrective Actions and Improvement	The interviewees proposed strengthening reception controls, improving documentation management, enhancing coordination between departments, increasing employee awareness, and implementing preventive measures to avoid recurrence of similar non-conformities.