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Ecole Supérieure d 'Ingénieurs Privée de Gafsa

Etablissement d'Enseignement Supérieur Privé Agrée par l'Etat sous N° 05-2013

Ecole Supérieure d'Ingénieurs Privée de Gafsa
ESIP-Gafsa

Projet de Fin d'études

Présenté en vue de l'obtention de
DIPLOME D'INGENIEUR EN INFORMATIQUE
Spécialité: (Logiciel et Systèmes d'Information)

Par

Trabelsi Oussama

Création d'un système de gestion des maintenances assistée par ordinateur

Soutenu le 11/08/2020, devant le jury composé de :

Président : Dr. Awali Slim

Rapporteur : Dr. Othmeni Mohamed

Encadrant universitaire: Dr. Issaoui Brahim

Encadrant industriel : Mr.Ben Rejab Fahmi

Organisme : AZUR CONSULTING

Azur Consulting

Année Universitaire: 2019/2020

AZUR Consulting

ATTESTATION DE STAGE

Nous soussignés, la société AZUR CONSULTING, domiciliée au 12, Passage de l'information Cité El-Habib, EZZAHRA 2034 – Ben Arous, attestons par la présente que : MR.OUSSAMA TRABELSI, a effectué un stage de projet de fin d'étude au sein de notre société AZUR CONSULTING du 01/02/2020 au 30/07/2020 et a réalisé

« une application de gestion de maintenance assistée par ordinateur(GMAO) intégrée avec un ERP ».

Cette attestation est délivrée à l'intéressé(e) pour servir et valoir ce que de droit

Fait à Tunis le 03/08/2020

Le maître de stage

Mehdi Baccar

AZUR Consulting
12, Passage de l'Information
Cité El Habib - Ezzahra - 2034
MF: 1447765/C/A/M/000
Tél: 79 486 007 - GSM: 52 374 535

Dedication

To my father,

'' My shoulder, the understanding and attentive eye and the person most worthy of my respect.

No dedication can express my feelings, may God preserve you and give you health and long life. ''

To my mother,

'' You gave me the life, the tenderness and the courage to succeed.

Nothing in this world I can offer you, will be able to express the love and gratitude I have for you. ''

''Beloved parents, I offer you this modest work to thank you for your sacrifices and the affection you've always shown me. ''

To my syster Hana and brother Yahia,

'' No matter what I say, I can't express the love and tenderness that I have for you.

I would like to thank you, for your support and encouragement, for all the moments of joy and happiness that we were able to share together.

May GOD, the Almighty, preserve you from any harm and fill you with health and happiness. ''

To Dana, the person who shares the road with me ,

'' In remembrance of the wonderful times we have had and the strong ties that unite us. Many thanks for your support, encouragement and help during hard times.

I pray to God that our love and partnership will last forever. ''

To my friends, Prof. Bernd, Eduardo, Elina, Wided and Souha,

'' I am very grateful for your support and encouragement.

I pray to God that our friendship and brotherhood will last forever. ''

Trabelsi Oussama.

Acknowledgement

During the last months, i was able to acquire theoretical and practical experiences, thanks to the help and support of AZUR CONSULTING members, including professors and students from our and other universities, in order to keep moving forward until the accomplishments of this work.

First of all, I would like to thank

Mr. Brahim Issaoui

For his guidance and advices through brainstorming, especially on achieving this report, insuring the coherence of this work with means of transaction from one context to another

Mr. Fahmi Ben Rejab

For the trust he has placed in me by agreeing to supervise my work and his advices and attention. He has given to my final project at various stages of its development and recommending me to realize uncountable actions for many enterprises.

Monsieur Mehdi Baccar

AZUR consulting's chief technology officer

For accepting me as an intern into his company with all generosity.

I would also be pleased to extend my warmest thanks to the members of jury involved in judging this work for their time and energy.

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List of acronyms

UML : Unified Modeling Language

SQL: Structured Query Language

PL/SQL: Procedural Language/ Structured Query Language

CMMS : Computerized maintenance management system

ERP : Enterprise Resource Planning

BI : Business Intelligence

General introduction

Nowadays, data automation is an indispensable tool in the vast majority of companies. The challenge is no longer to collect the information but rather to make it available in the right form at the right time and to the right person in order to have a global vision and optimize the company's information assets.

Thanks to these computerized information systems, companies have succeeded in assembling fragmented and scattered sources of data, whether they are internal sources,(software packages, accounting systems, ERP, CMMS, etc)or external sources(orders, Bills, etc).

In this context, the data are collected from these different systems are voluminous and very complex to manage, there is a real need to clean, consolidate and analyze the data in order to extract knowledge and help the members of the company and the executives in their management. This need has led these companies to distribute their decision centers and to provide all managers and autonomous teams with the indispensable tools, namely reports and dashboards, to better know and understand the processes and results. In order to complete this challenge, several technological solutions have emerged under a generic term called Artificial Intelligence.

The solution proposed as part of this work consists of designing and building a Computer-assisted Maintenance Management Software (CMMS) and business indicators in real time, which allows the right information to be obtained at the right time.

Our project was carried out within AZUR CONSULTING, a company specialized in management and information systems. This host organization entrusted us with the mission of creating a CMMS, based on their integrated management software package "GXPRO" which is designed for medium and large companies and which allows managing all the company's processes through these different modules. Obviously "GXPRO" is the source of information on which our project is based.

Thus, this report is divided into three chapters that are organized according to the stages of the project based on the cascade method:

The first chapter is the representation of the project framework and detect the client needs. The second chapter is dedicated to the design, it is the creation of diagrams that clarify the operations of our application. Finally, the last chapter presents the realization of the project as well as some graphical interfaces of the application.

Chapter 1: Presentation of the project framework

Introduction

In this chapter we will put the work in its general context. It is devoted to the presentation of the project framework, the terms and concepts used, and the host organization that collected us and guided us during the realization of this project.

1.General presentation

In this section we will present the framework of the work as well as the presentation of the company AZUR consulting.

2. Framework of the work

At this level, a definition of our general "CMMS" framework seems essential to determine the context of the work and to clarify the terms that will be used thereafter.

2.1.CMMS

A CMMS (or Computer-assisted Maintenance Management Software) is a simple and efficient means of making maintenance management a breeze in industrial, tertiary and public sectors.

WHAT IS A CMMS ?

A maintenance department and its technicians, are always striving to keep equipment and machines running smoothly and efficiently to ensure higher uptime, lower downtime and overall system reliability. This is where a CMMS comes in. This user-friendly software ensures complete management of equipment fleets, curative analysis, preventative and regulatory interventions, purchasing and stock, on demand reports and statistics, and all of this, with a strong focus on the everyday ground realities.

A Maintenance Software is a scalable software, just like a business or institution.

2.2.The most common features of a CMMS

A CMMS can have many uses, we've listed some of the most common ways it can help systems run smoothly :

- **Equipment fleet management:** inventory, leasing, information management for types, etc..,
- **Maintenance management:** corrective (with WO: work order), preventive (systematic, conditional, provisional), curative, etc...
- **Work Requests managing (WR)**
- **Inventory management:** spare parts storerooms, replenishment, inventory valuation, etc.
- **Purchase management:** price inquiry, purchase requests, orders, service and supply purchases, billing vendors, etc.
- **Personnel management and planning:** activities, tasks, teams, rosters, forecast planning, work load, etc.
- **Cost and budget management:** labor tasks, inventories, purchases, equipment rentals, budget preparation, periodic reports, discrepancy reports, etc.
- **Key performance indicators:** dashboards (database queries for statistics, alerts, MTTR, MTBF, Pareto, etc.).

3.Presentation of the host company

3.1.Company description

AZUR consulting is a medium-sized company specialized in management and information systems founded in 2015. It offers high level market forecasting and consulting services to independent companies. AZUR consulting has experience in leading teams, identifying and implementing ideas for continuous improvement. In fact, they have the ability to convert customer needs into products and solutions while continuously improving operations while ensuring safety and quality.

Thanks to their extensive experience in strategic consulting. They have analytical power with service flexibility, offering a comprehensive support structure and a solid foundation on which to build investment strategies and monitor market risk exposure and compliance requirements under various scenarios.

Figure 1.AZUR consulting logo

3.2.The main features of the company

AZUR consulting is a management and information system consulting firm. This organization offers to industrial companies, through its Tunisian and foreign consultants, advice and assistance in the following fields:

- Strategic diagnosis, prior to the "Upgrading".
- Implementation of the "Upgrading Plan".
- Assistance in setting up your future Information System
- The implementation of an ISO-9000 quality systems

3.3.AZUR consulting's clientele

AZUR consulting has supported and developed integrated relationships with a diversified client based on financial institutions, investor brokers, insurance companies, equipment and services by offering a variety of specialized consulting services for manufacturers and distributors to ensure the right information, technology and processes to engage the work force and positionate the company as leader in the market by growth and success.

4.The existing system

The existing system, on which AZUR consulting relies, is based on an integrated management software package called GXPRO. It is a complete ERP (Enterprise Resources Planning) designed for small and medium sized companies. It is considered the simplest and most user-friendly software package, which has allowed it to be the most installed in the French Oracle market as well as in Tunisia. In fact, GXPRO brings together business functional modules and cross-functional modules that can be parameterized and customized according to customer needs.

In what follows, a presentation of the various interfaces of the GXPRO software package:

4.1.Home Page

After logging on to the GXPRO software package, the user sees the welcome interface, which is set up according to the user's profile.

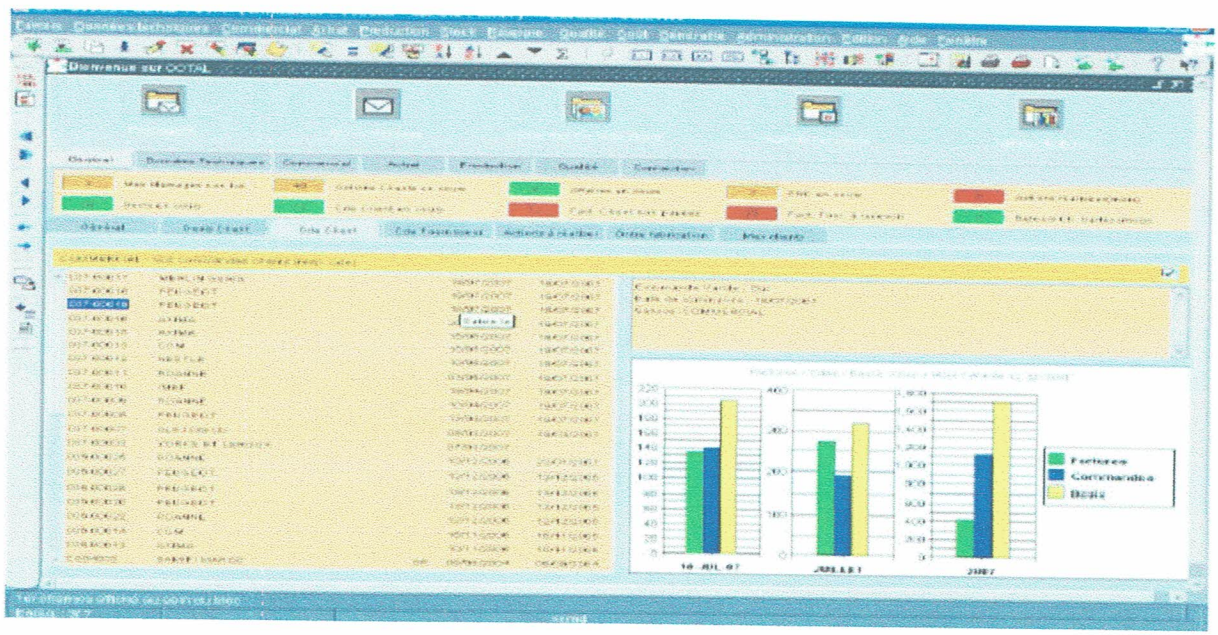


Figure 2.GXPRO Home page

4.2.Stock

The stock module allows you to view stock by center and storage bin, general and rotating inventory, multi-center movements and ABC analysis. These are classic functions that are available in GXPRO.

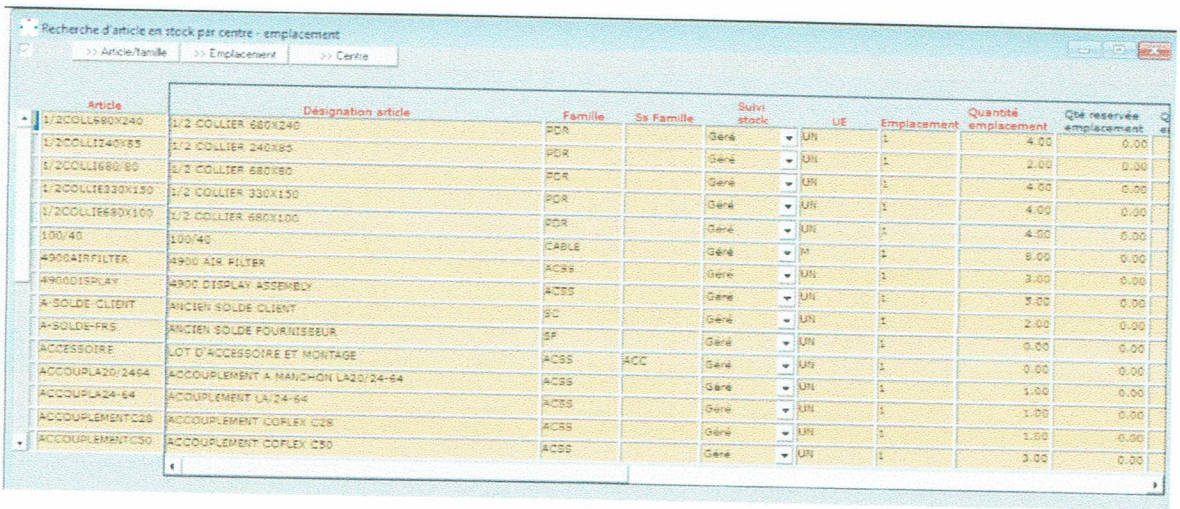


Figure 3.Interface Search article by center

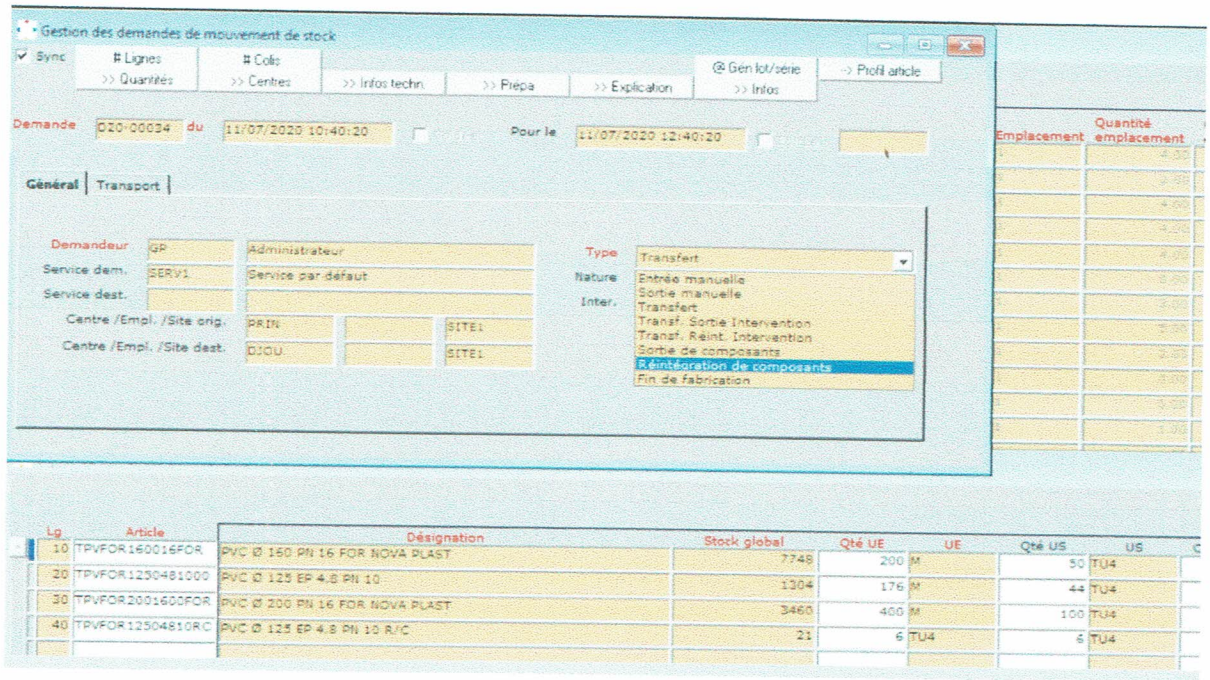


Figure 4.Interfaces manage stock mouvement

4.3.Intervention

The intervention module allows user to view interventions details, the operations made during the intervention and link accessing to operations Interface in order to manage related operation for a specific intervention.

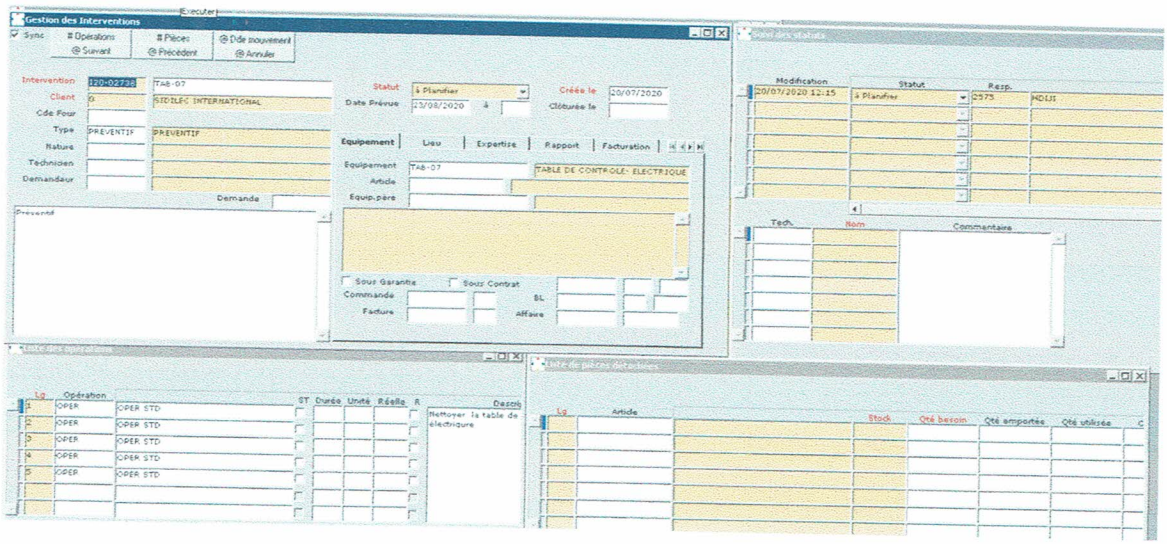


Figure 5.Interface manage intervention

4.4.Sales

The Sales module allows you to view the customer order details, the customer information who made the buying action.

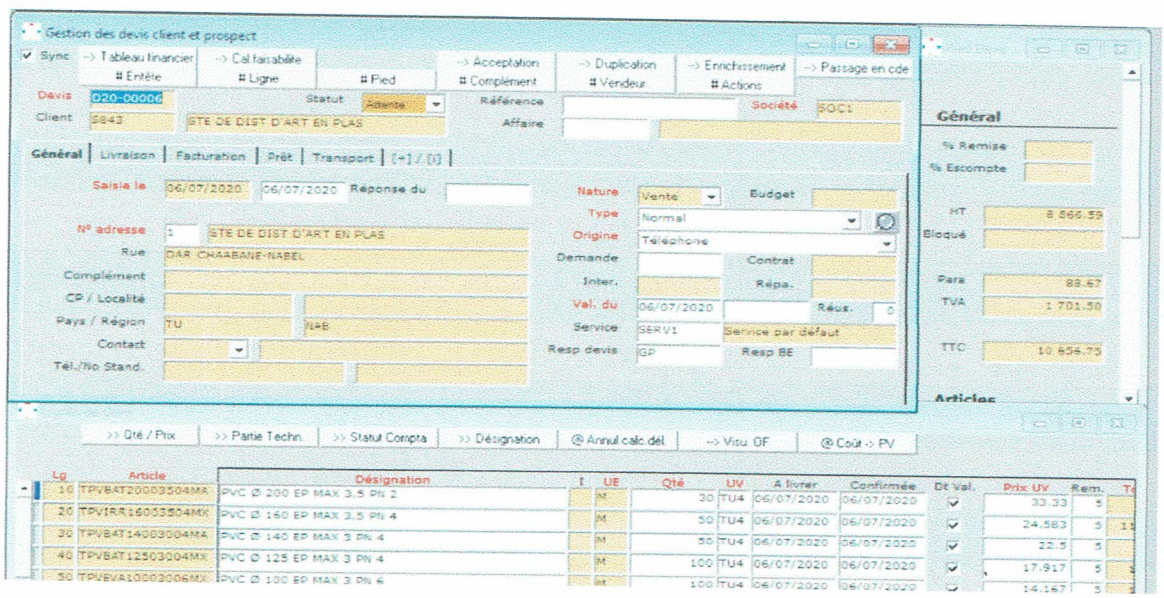


Figure 6.Interface manage sales

5.Overview of the existing system

The analysis of the system with which AZUR consulting manipulates the data, allowed us to identify functional as well as aesthetic failures.

This system is characterized by the difficulty of manipulation by user. Indeed, there is a great complexity at the level of the connection and loading of the database, at each connection the database has to be loaded again, it is a weak point in their system that we are invited to put it in the list of priorities in our application.

We also noticed that the presentation of the interfaces is very classical, the colors are very dark and the dashboards are poorly represented with difficult access in the form of a folder hierarchy.

Moreover, the results of the dashboards are not in real time, when there is an update at the database level, the dashboards are not updated until the next database loading. In result, we have awarded the use of a large amount of unnecessary memory and ambiguity of information in the system.

All these short comings and problems have led us to determine our role in improving this system.

6.The proposed Solution

Our project consists in designing and implementing a decision-making platform based on an ERP(GXPRO). This platform includes dashboards and key performance indicators (KPIs) grouped by module. According to their ERP and their needs in the company.

Our objective is to avoid the inconveniences of the software package and consequently avoid the difficulties that oppose the user and produce a platform that helps and facilitates user tasks.

7.Client needs analysis

7.1.The Functional needs

Functional needs are those that concern the actions performed by our application. In fact, they express the user's expectations towards the system and specify the functions that will serve the different tasks of the user. Indeed, our application must meet the following requirements:

- An authentication page to guarantee data security.
- A home page.
- The consultation of dashboards by indicator for the modules: technical data, Indicators, sale, Intervention and stock.

7.2.Non functional needs

Non-functional requirements characterize the performance of the application, they represent the implicit requirements that the project must meet. Our application, therefore, must respect the following characteristics:

- Availability / reliability: The application must be available 24/7 except during unscheduled maintenance periods.
- Speed: Indicators must be provided with a minimum response time. The users demand an immediate response to their needs.
- Ergonomics: Interfaces must be clear, concise and easy to use.
- Clear / easy to access : Access to the indicators must be through an ergonomics that allows intuitive and simple navigation for all concerned.
- Secure: Access to the member area must be carried out in a secure manner to ensure user confidentiality.

Conclusion

In this chapter, we have presented the general framework, CMMS or GMAO, which is much more than software, but rather describes a set of processes and technologies for simplifying and improving the use of key information within an enterprise. Also we presented AZUR consulting. In the following chapter we will present the stage of analysis and specification of needs. And finally we described the necessary needs to be provided by our project.

Chapter 2 : Application design

Introduction

In this chapter we discuss the design part of the project, in which we detail the different design diagrams, namely use case diagrams, sequence diagrams and class diagrams.

1.UML Definition

It is a pictograph-based graphical modeling language designed to provide a standardized method for visualizing the design of a system. It is commonly used in software development and object-oriented design.

This language can be used to implement over nine different diagrams. One or the other of the diagrams is chosen according to the concepts to be represented at a given stage of development.

Figure 7.Logo UML

2.Why using UML ?

We will use UML because of its main criteria :

- It is more expressive, cleaner and more uniform.
- It could be applied to any science based on the description of a system.
- It allows projects to model things that could not have been modeled before.
- It removes all unnecessary differences in notation and terminology that obscure the basic similarities between these different approaches.

3.Use case diagram

This is the most critical diagram in the design phase. It is classified as a behavioral diagram because it allows the customer's needs to be expressed and the functional requirements of the system to be captured. By determining the system's limits and specifying what the application will have to provide as functionality, this diagram will allow us to best predict the aspect of our future platform.

4.Identification of actors

4.1.An actor

It is a role played by an external entity interacting with the system under study.
This application has several users such as the CEO, stock agent, supervisor, technician, etc. These users has a minimum knowledge of computer science. their goals is to consult necessary information that helps them to make the right decisions at the right time. For this, we have represented these actor by the general term "USER".
The following figure shows our actors:

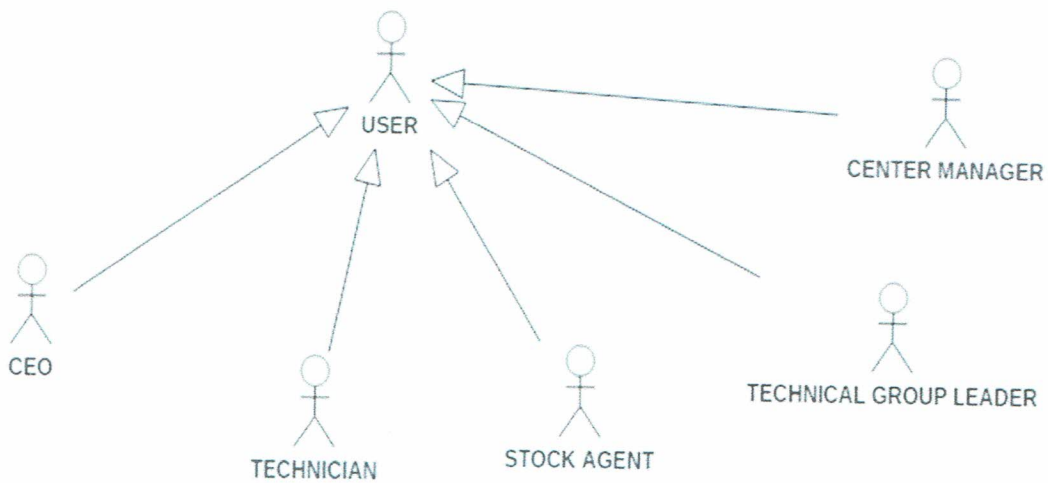


Figure 8.The System Actors

5.Global use case diagram

The purpose of this diagram is to give a general vision of the functionalities of our future platform.

This diagram shows all the possible the possible prospects we are working on during our project.

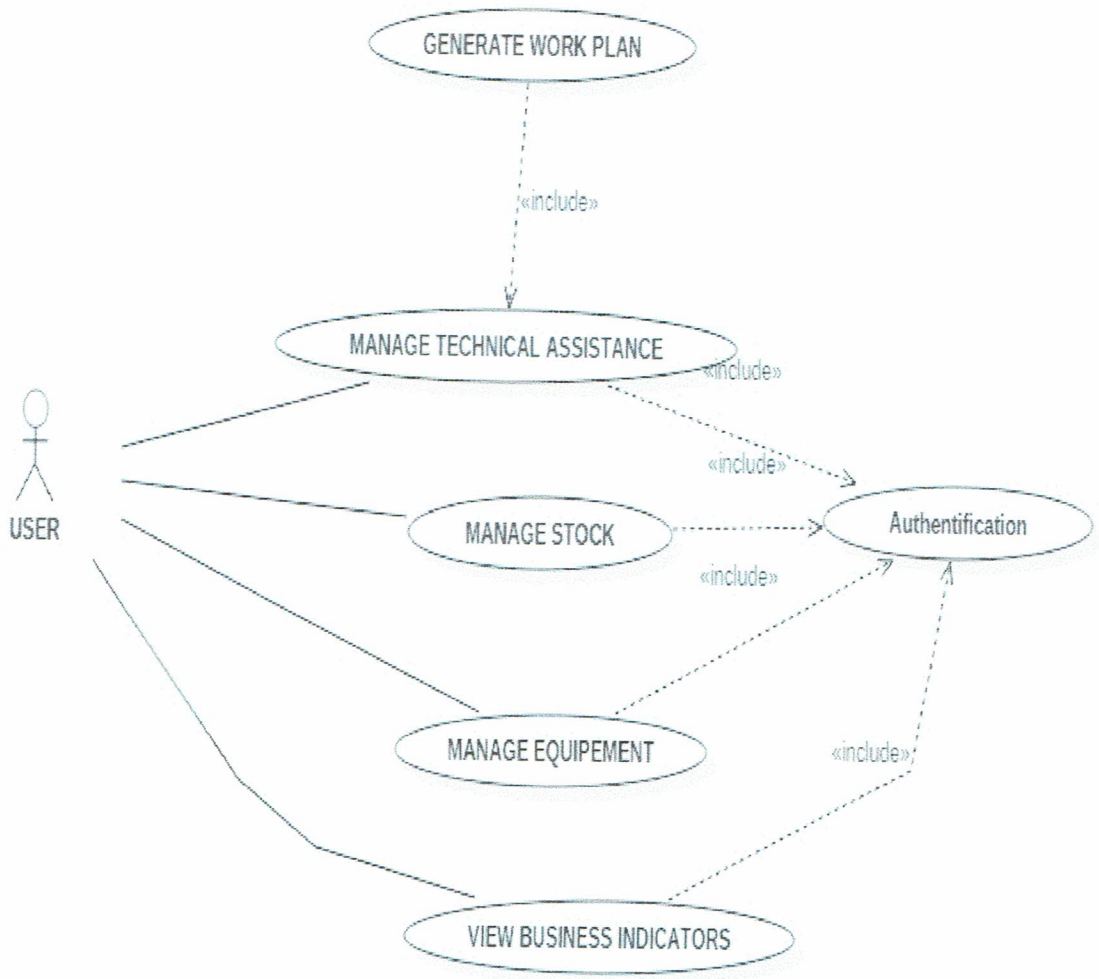


Figure 9.Global use case diagram

This diagram represents the actors interacting with the system as previously noted. These are the members of society who have the privileges to consult the application. The system gives these actors the hand to consult the various headings (the technical data, sales, purchase, production, or stock modules) after having authenticated themselves. They also have the possibility to change application setting as they needs to.

A use case is a sequence of actions performed by the system that provides an observable result with added value for a particular actor.

For our application, we will distinguish the following use cases :

5.1. Refining use case « Authentication »

Figure 10.Use case diagram « Authentication »

Table 1.Refining use diagram « Authentication »

Use case :	Authentication
Actor :	Any user who has a login and a password
Pre-condition :	- Being a staff member of the client company -User has an account
Post condition :	Validated username and password
Main scenario description :	- The user enters a login and a password. -Click on the login button. -The system checks the login and password. - If they are correct the system will display the home page.
Exception :	-If the user name or password is incorrect, the system will display an error message. -The system will redirect it to the beginning of the main scenario..

5.2.Refining use case « Manage Stock »

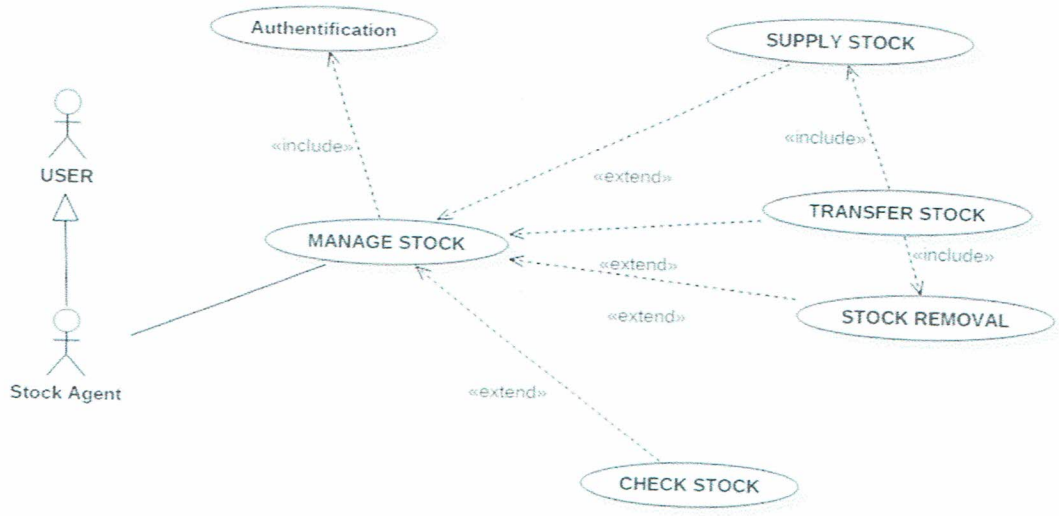


Figure 11.Use case diagram « Manage Stock »

Table 2. Refining use case « Manage stock »

Use case :	Manage stock.
Actor :	Every stock agent who have an account.
Pre-condition :	User click on stock menu.
Post condition :	Show menu option and possible action on stock module.
Main scenario description :	- The user enters a login and a password. -Click on the login button. -The system checks the login and password. - If they are correct the system will display the home page. - user click on the stock menu -user click on any submenu of stock menu.
Exception:	-incorrect username or password then the system will redirect user to login page again. -connected user is not a stock agent.

5.3.Refining use case diagram « Manage Equipment »

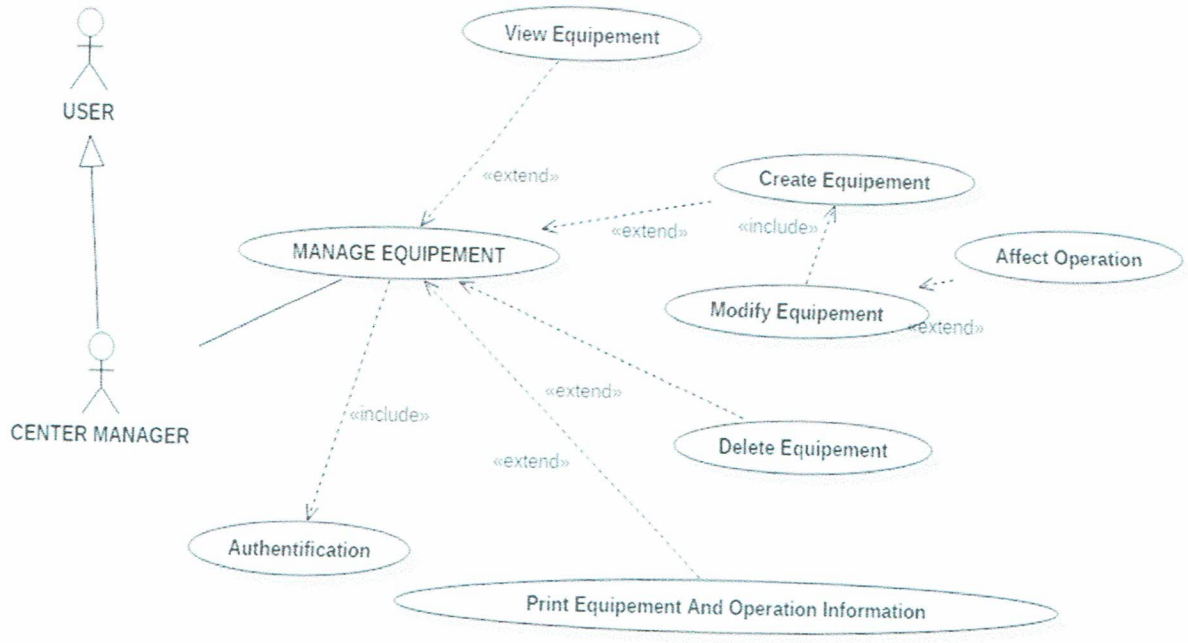


Figure 12.Use case diagram « Manage Equipment »

Table 3. Refining use case « Manage Equipement »

Use case :	Manage equipment.
Actor :	Every center manager who have an account and administrator.
Pré condition :	-User Must Authenticate. User must be a center manager account holder.
Post condition :	Show management tools interface for equipments.
Description de scenario principal :	-User authenticate correctly. -User choose Manage Equipment menu. -User select the requested sub-menu. -The system shows the related interface chosen by the user.
Exception	-User is not a center manager neither an administrator

5.4.Refining use case « Manage technical assistance »

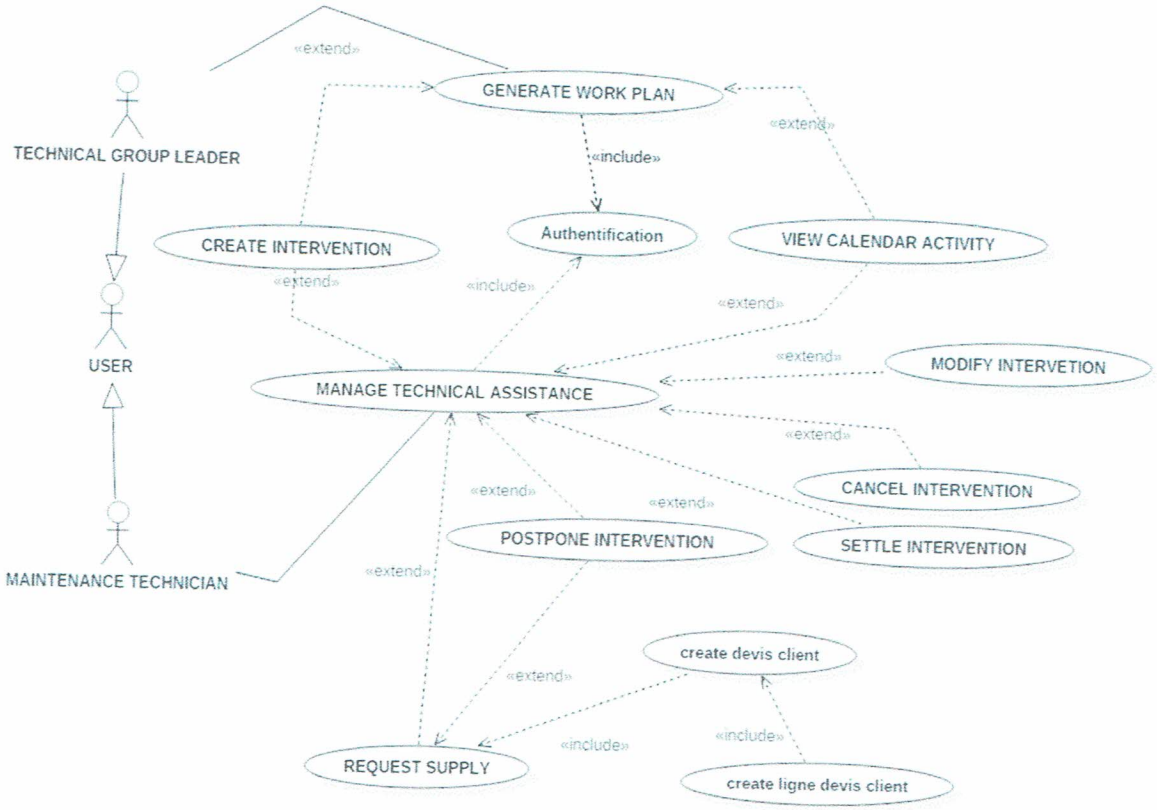


Figure 13.Use case diagram « Manage technical assistance»

Table 4. Refining use case diagram « Manage technical assistance »

Use case :	Manage technical assistance.
Actor :	Every technical group leader or maintenance technician who is holder of an account in the system.
Pre-condition :	-User authenticated. -User is a technical group leader or maintenance technician.
Post condition :	Show of Intervention List.
Main scenario description :	-User authenticate. -User click on Intervention menu or Maintenance calendar menu based on the authentication entry. -The system shows the related interface.
Exception	-User is not a technical group leader or maintenance technician.

5.5.Refining use case « View business indicators »

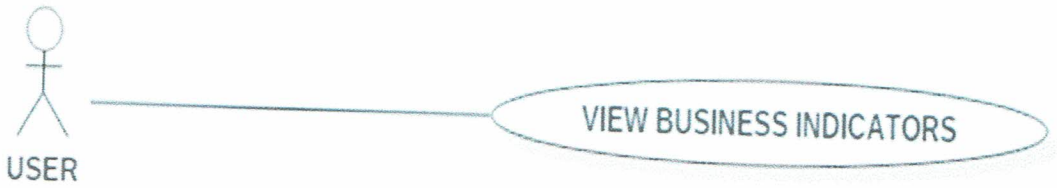


Figure 14.Use case diagram « View business indicators»

Table 5. Refining use case diagram « View business indicators»

Use case :	View business indicators.
Actor :	CEO.
Pre-condition :	-User authenticated. -User Must have administrator rights.
Main scenario description :	-User authenticate. -User click on DASHBORD menu . -The system calculate the current results from data base and show the indicators. The system refresh the results every 5 seconds
Exception	-User is not a holder of an administration rights account.

6.Sequence diagrams

Sequence diagrams are a detailed explanation of a use case. The main information contained in a sequence diagram are the messages exchanged between the lifelines, presented in chronological order. A sequence diagram is an interaction diagram.

In this part we will be taking in consideration every possible scenario that might happens during the execution of certain use case, the next diagrams will be detailed in a way that makes every designer or developer understand the constraint to be taking care of during the implementation of our Project. this diagram is the connection channel between designers and developpers.

6.1.Sequence diagram « Authentication »

In order to access our application the user will first have to authenticate by entering the username and password, the system will check the data entered. When they are not correct, it will display an error message, otherwise it will open the home page.

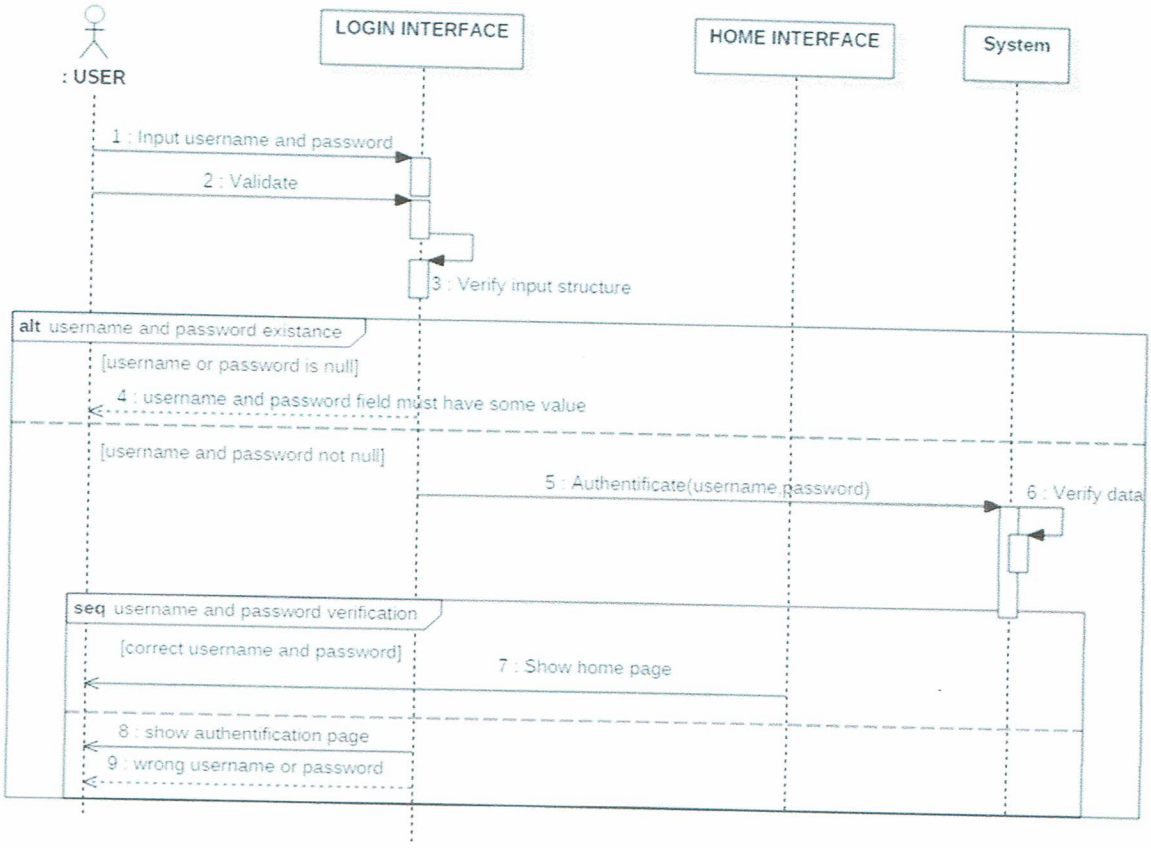


Figure 15. Sequence diagram «AUTHENTIFICATION»

6.3.Sequence diagram « Transfer Stock »

This diagram describes how to transfer supplies or stock from center to another one . This operation, Begins with choosing the sender and receiver center and emplacement after having authenticated. Afterwards, the choice of the article and the quantity to be transferred between these sender. this action was designed and implemented as 2 sub-actions which are supply stock and removal stock.

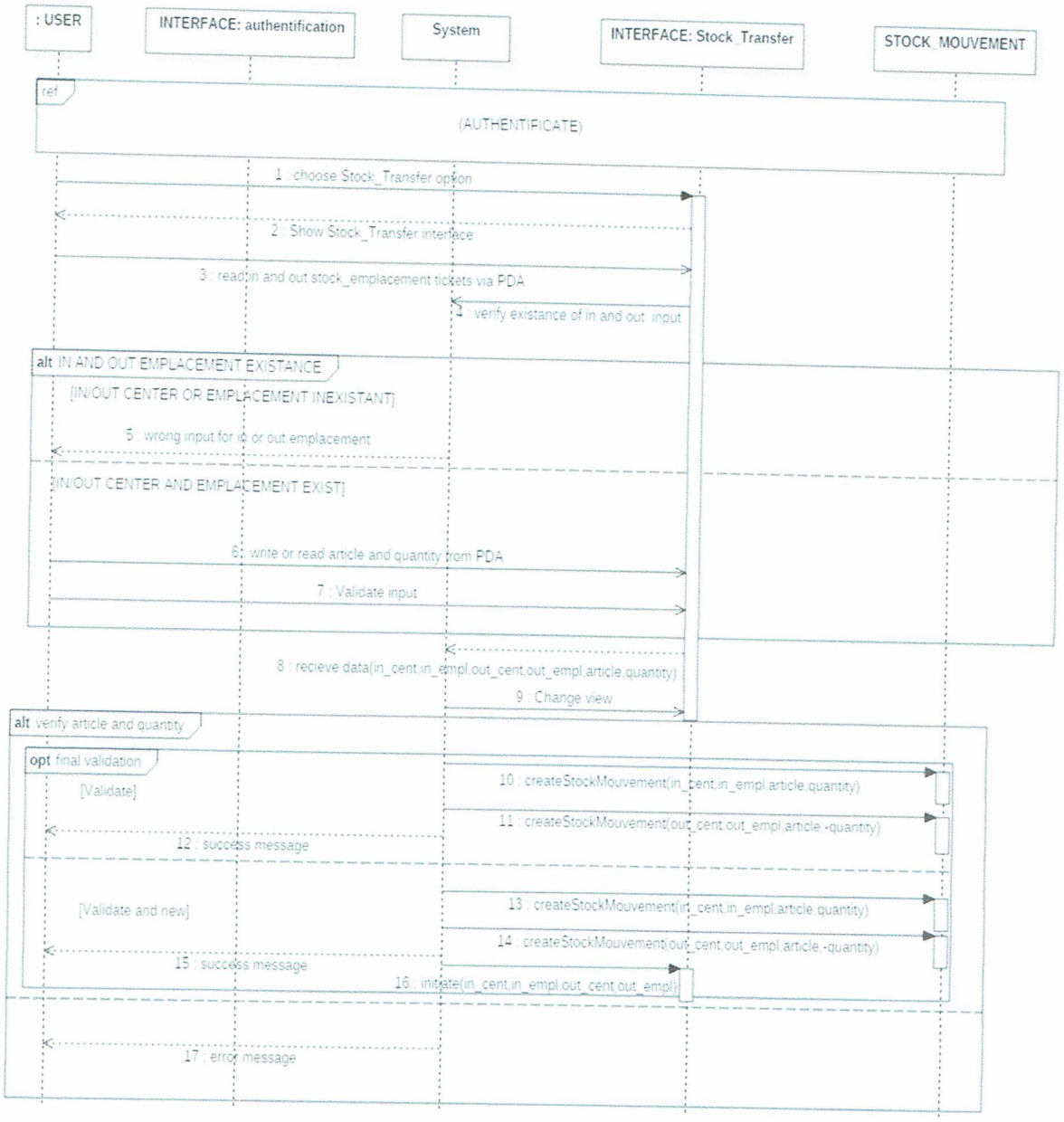


Figure 17.Sequence diagram « Transfer stock »

Table 8.Refining sequence diagram « Transfer stock »

Order	Type	Description
1 and 2	Normal Message	The user will choose the "Stock_Transfer" Menu or sub-Menu and the system will show as a result the stock transfer interface.
3	Normal Message	The user will tape manually or read via PDA the IN and OUT center and places of supply packages.
4	Syncrone Message	The system will verify the existence of the inputted information.
5	Reply Message	The system will inform the user about wrong Data inputted in the IN or Out center and places input field.
6	Normal Message	The user will tape the article and quantity manually or read it via PDA.
7	Normal Message	The user will validate the inputted information.
8 and 9	Reply Message	The system will memorize the inputted data in session values and will redirect to confirmation interface.
10 and 11	Data Base Request	The system will send 2 request contain IN and a positive quantity in the first one and OUT and negative quantity in the second one.
12	Reply Message	The system will inform the user that the quantity was transferred successfully then clear session values and finally redirect user to first

		view.
13 and 14	Data Base Request	The system will send 2 request contain IN and a positive quantity in the first one and OUT and negative quantity in the second one
15	Reply Message	The system will inform the user that the quantity was transferred successfully
16	Syncrone message	The system will clear the article and quantity field only.
17	Reply	Any other scenario will cause an error message and the transfer transaction wouldn't be taken in consideration.

During the implementation of this part of work, we noticed that the supply_return_to_zero indicator was not working correctly, and finally we decided to update all of Azur Consulting client's Data base to make it working again by adding a column in "Stock_mouvement" table called "STMO_NMST_CODE" to reference the type of the transaction.

6.4.Sequence diagram « Create devis client »

The create devis client scenario might be an execution of one or more times of the create ligne devis client. It regroups all the replacement equipment and article needed in order to finish an intervention.

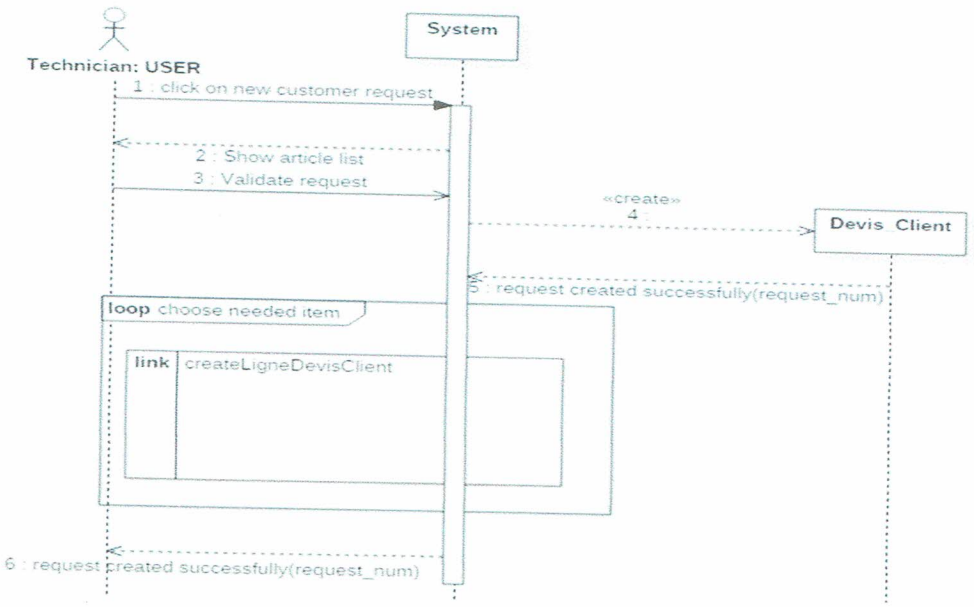


Figure 18. Sequence diagram « Create devis client»

Table 9.Refining sequence diagram « Create devis client »

Order	Type	Description
1	Normal Message	The user will ask for supplies via choosing "commande_Client" Menu or Sub-Menu
2	Reply Message	The system will show the article list in an E-commerce view.
3	Normal Message	The user will confirm items in chart.
4	Create Message	The System will create a new "Devis_Client" based on integrated sequence
5 and 6	Reply Message	The system and user will be informed of the success creation.

6.5.Sequence diagram « View business indicator »

This view gives the CEO of the company a deeper look of the current year work and helps him making important decisions with his executive committee specially related to supplies and sells field and compare them to older times results in order to understand the developpement of the company.

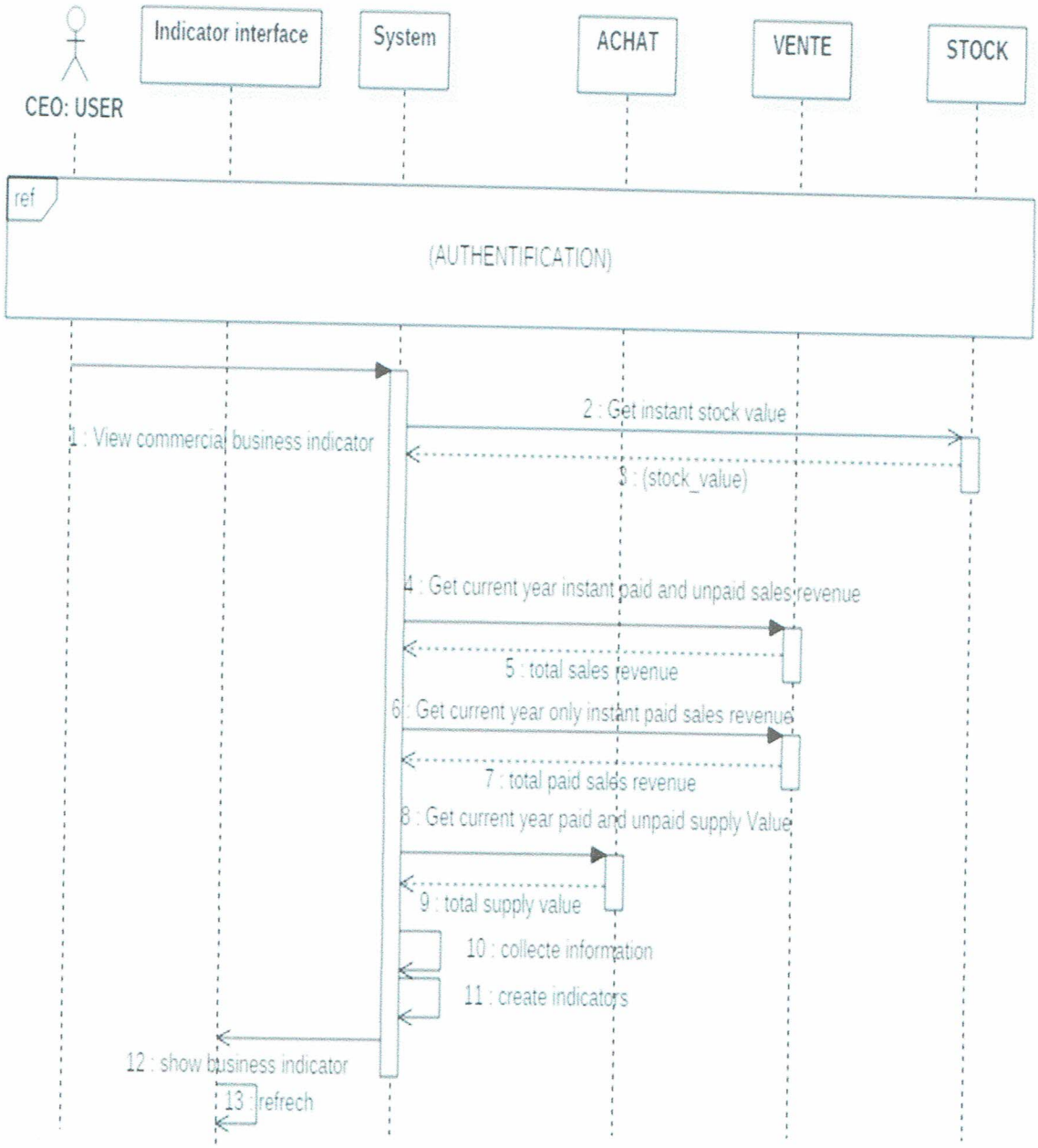


Figure 19. Sequence diagram « View business indicators »

7.Class Diagram

The class diagram is a static description of the system focused on the concept of class and association. A class represents a set of objects that have similar properties and common behavior described in terms of attributes and operations.

The database provided by the company as a test basis is large and contains more than 1400 tables. We have chosen from the database tables only those that are used to model our indicators. As a result, the number of tables directly manipulated by us were reduced.

In addition, we have created some packages and triggers in order to generate automatically some other table on inserting, deleting and updating from the manipulated tables.

We tried to follow the indexes of each table to establish the relationships between the tables. We divided the tables into Modules to make it easier to represent the model. Here are the results.

7.1.Technical Data Module

The Octal Data Base is designed in order to grant to every Department to integrate workers who are associated with login information to connect to the system and a specific level who grant the level and the rights on the DB tables.

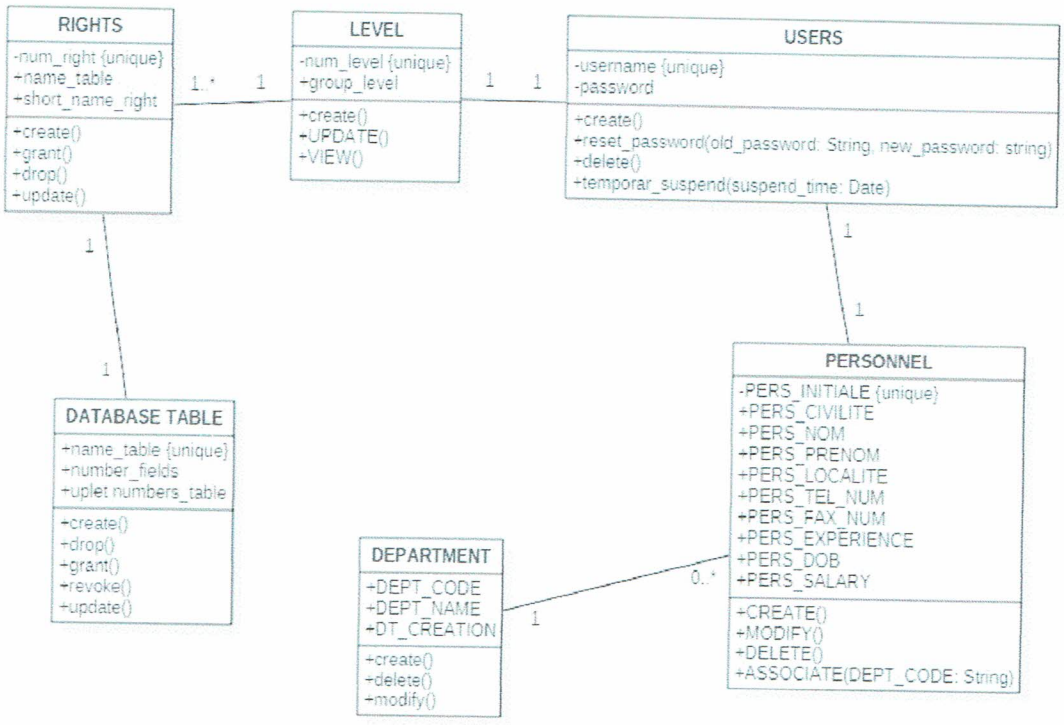


Figure 20.Class diagram« Module Technical Data»

7.2.Stock Module

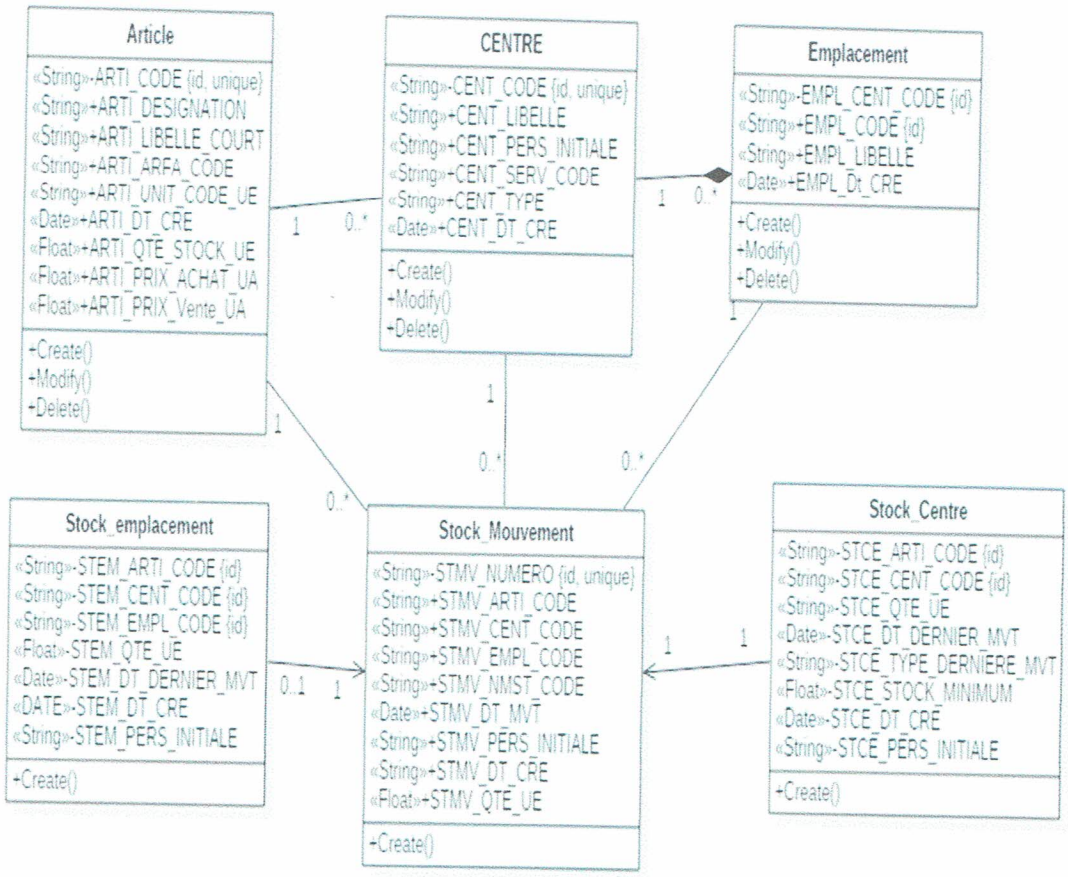


Figure 21.Class Diagram« Stock Module »

Every Stock_Mouvement object is referenced by a unique id which will keep the related information of certain article transaction related to a specific center and place and will automatically trigger the creation of "stock_emplacement" and "stock_center" instances creation after adding a new "stock_mouvement" instance. This action is controlled by a bunch of triggers designed and realized by us and co-workers of Azur Consulting to be launched before and after the "Stock_Mouvement" creation.

7.3.CMMS Module

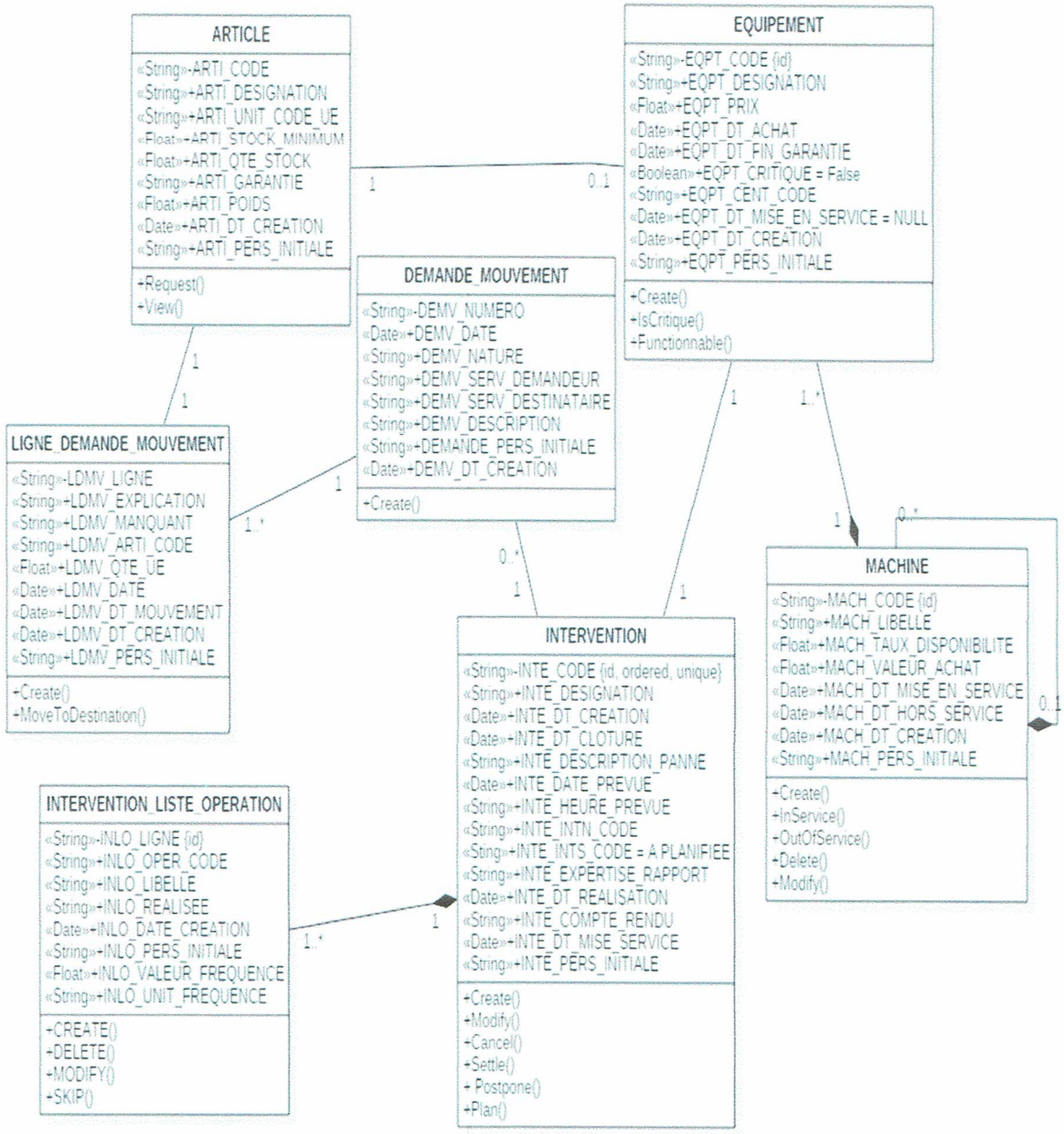


Figure 22.Class diagram « CMMS Module»

This Module is specific for intervention process and was created and updated by us to insert the Postpone status and wait for confirmation of receiving supplies to complete and settle down an intervention.

7.4.SELL Module

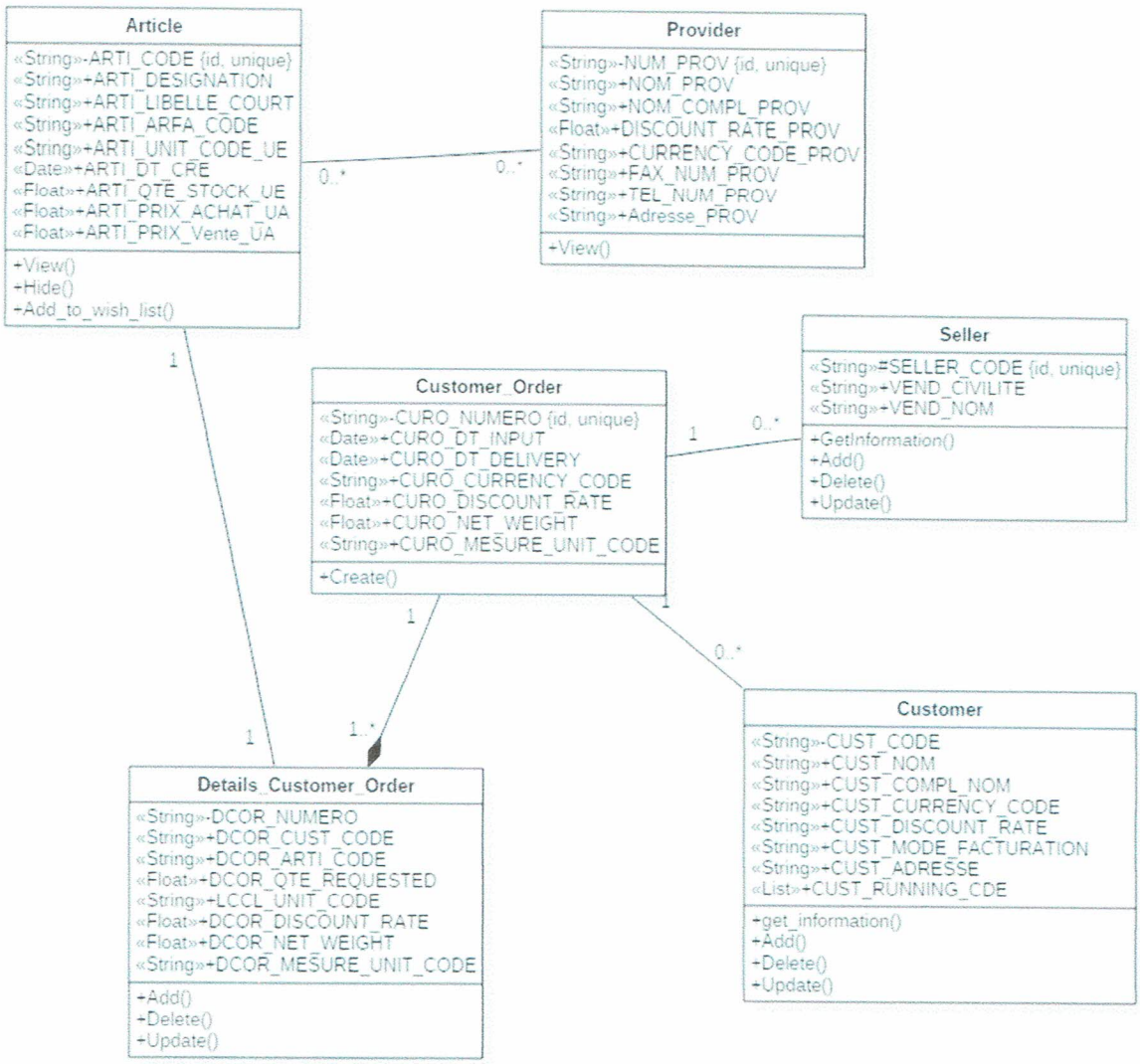


Figure 23.Class Diagram« Sell Module»

Conclusion

In this chapter, we have developed a detailed conceptual study of our application using the UML forma. The implementation of our application will be in the next chapter.

Chapter 3 : Implementation and realization

Introduction

In this last chapter we will move on to the implementation and realization of our project. This chapter will represent the result of the work done during this project. But first in this part we will determine the hardware and software used during the implementation.

1.Development Environment

1.1.Hardware environment

This application will be developed via a laptop with the following characteristics:

- Brand: LENOVO.
- CPU: Intel(R)Core(TM) i3-4005u CPU @ 2.70GHz 2.70 GHz.
- Hard Disk : 500 Go.
- RAM : 6Go.
- Operating System : Windows 10 Professional 64bits.

But also, this application was developed using remote desktop connection feature on windows 10 in order to access to clients server and develop a standard version for all of them on different software version such as apex and OCTAL[1] DB.

1.2. Software environment

During the development of this application, we will use the following software:

- Oracle database 11 g(OCTAL v19).
- Apex 18.2 and Upgrade apps to 19.1 ,19.2 and 20.1 for certain clients

1.2.1.Oracle database 11g

Is a relational database management system (RDBMS), which since the introduction of object model support in version 8 can also be called a relational object-database management system (RODMS).

[1] This is the most known ERP database system known in Tunisia and France.

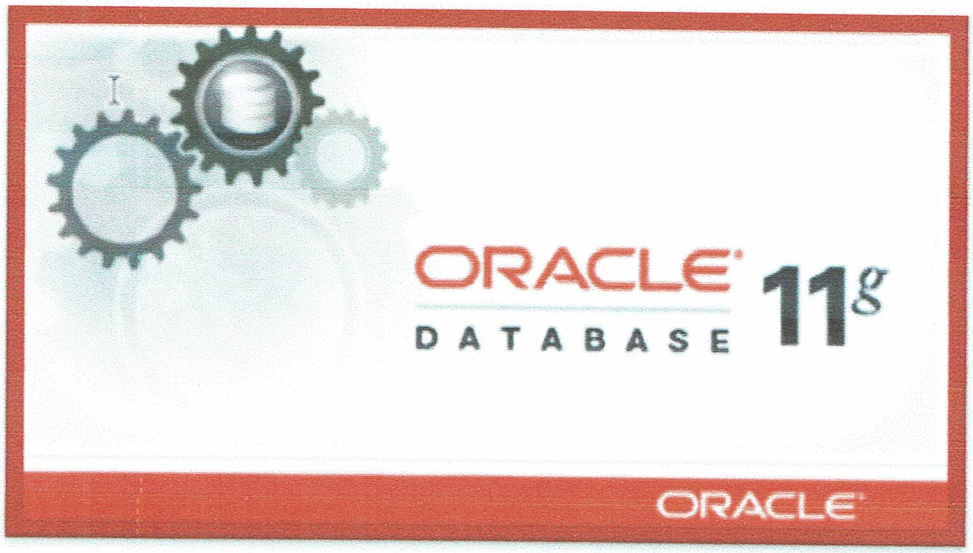


Figure 24.Oracle database

1.2.2.Apex

- **Apex:** Oracle Application Express (formerly Oracle HTML DB), more commonly known as Oracle Apex, is an Integrated Development Environment for creating rapidly developing web-based applications that use Oracle databases. It is at version 20.1 in production since May 2020. All versions of Oracle 11 and 12, including Oracle XE 11.2 [Express Edition], have a version of Apex pre-installed.

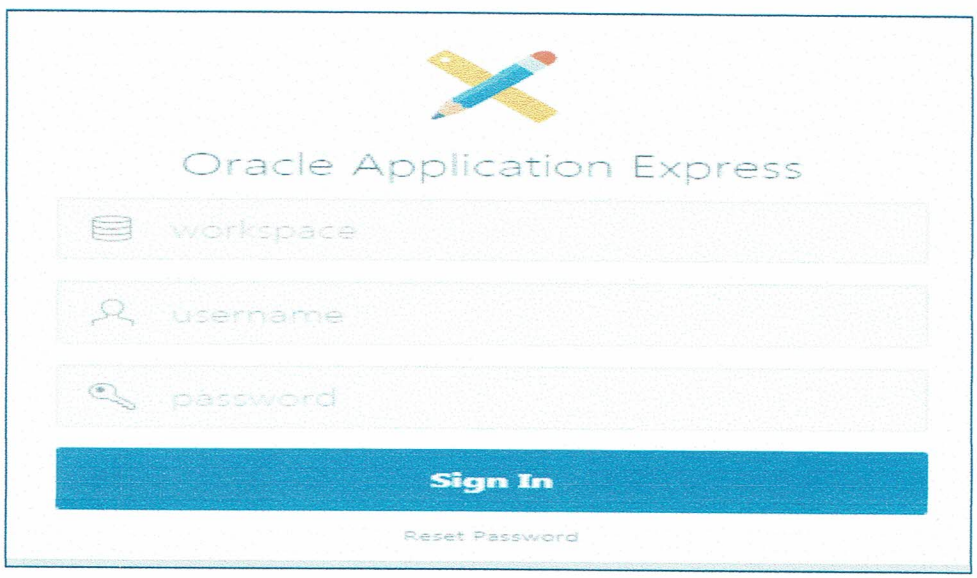


Figure 25.APEX home page interface

2.Development language

2.1.*PL/SQL*

Is a language, based on procedural and structured programming paradigms. It is proprietary, created by Oracle and used in relational databases. Its general syntax resembles that of the Pascal and Ada languages.

Figure 26.PL/SQL logo

2.2.JAVASCRIPT

Is a programming language commonly used in web development. It was originally developed by Netscape as a means to add dynamic and interactive elements to websites. ... Like server-side scripting languages, such as PHP and ASP, JavaScript code can be inserted anywhere within the HTML of a webpage.

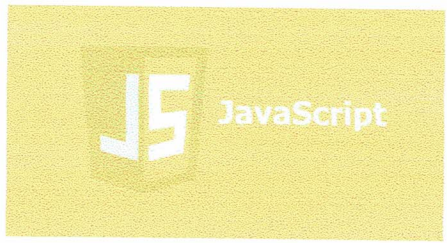


Figure 27.JavaScript logo

2.3.HTML

Hypertext Markup Language, a standardized system for tagging text files to achieve font, color, graphic, and hyperlink effects on World Wide Web pages.

Figure 28.HTML5 logo

3.Hardware architecture

In this section, we will see how Apex's architecture works, because Apex offers two different ones:

- A 3-tier architecture that has been present since the launch of Apex.
- A 2-tier architecture which was available with the 10.2.0.3.0 version of the Release 2 of the Oracle10g databases but which was officially integrated with the 11g databases for Apex.

3.1. Three tiers architecture

This architecture is composed of three elements :

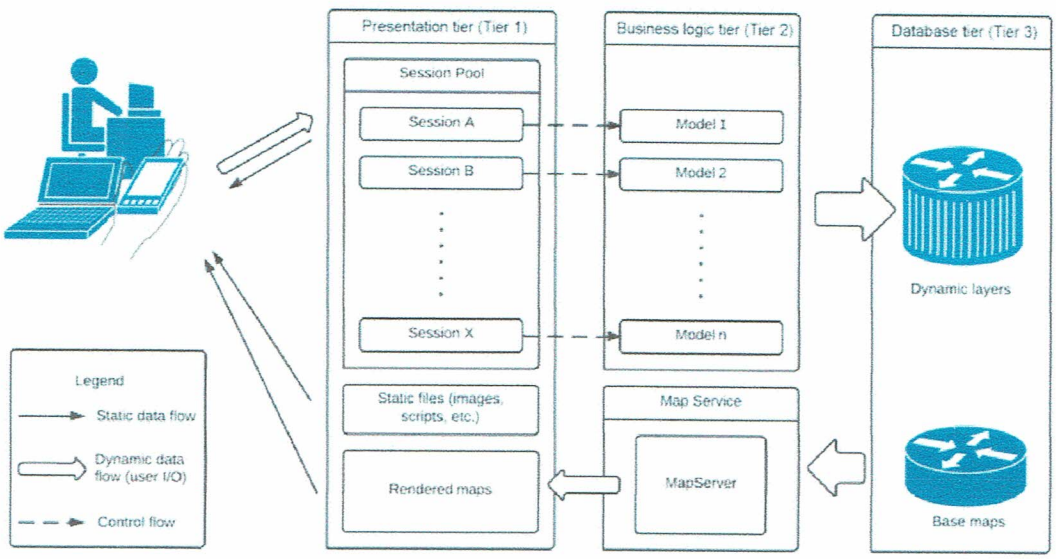


Figure 29. Three-tier architecture

- Web browser.
- An Apache HTTP server with a plug-in called "mod_plsql".
- An oracle database containing Apex into it.

In this architecture, the mod_plsql plug-in will act as an information relay between browser requests and APEX metadata objects. To be more specific,this is how APEX works:

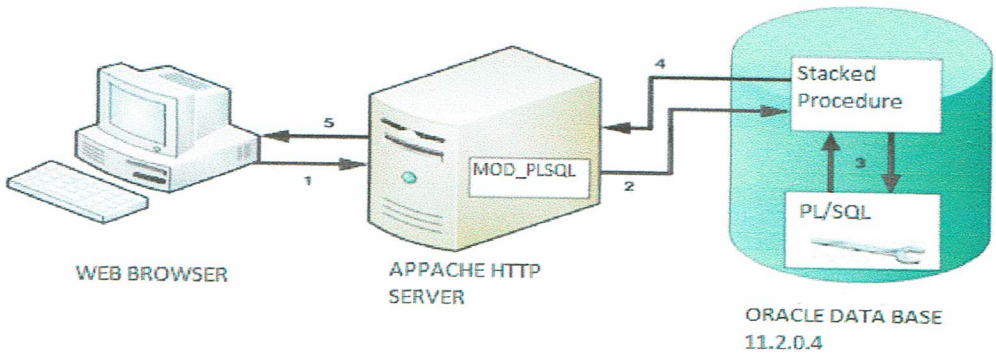


Figure 30.APEX Three-tier architecture

First ,the client via his browser, will perform an action, for example press a button or trigger a search in a table.

1. This triggers an HTTP request which is sent to the Apache server.
2. The HTTP server will relay this request, via an SQL.Net connection, to the stacked or stored procedures of the APEX engine thanks to the plug in mod_plsql.
3. These stored procedures will call the PL/SQL Web Toolkit functions to process the browser request. The PL/SQL Web Toolkit is in fact an API realized in PL/SQL language that allows to analyze the HTTP request and to interact with the database to retrieve, add, delete, update data via simple SQL queries. It will then generate a page composed of HTML code that will correspond to the result of the user's request. This page will then be returned to the Apex stored procedures.
4. Next, the reverse scenario will be executed, where APEX will send the generated HTML page to the Apache server via the SQL.Net connection of the mod_plsql plug-in.
5. The HTTP server then relays the information to the Internet browser so that it displays the generated page.

3.2. Two tiers architecture

this architecture is basically composed of 2 elements:

- Internet Browser,
- A server who contains :
  - ✓ Data Base.
  - ✓ Oracle XDB listener.

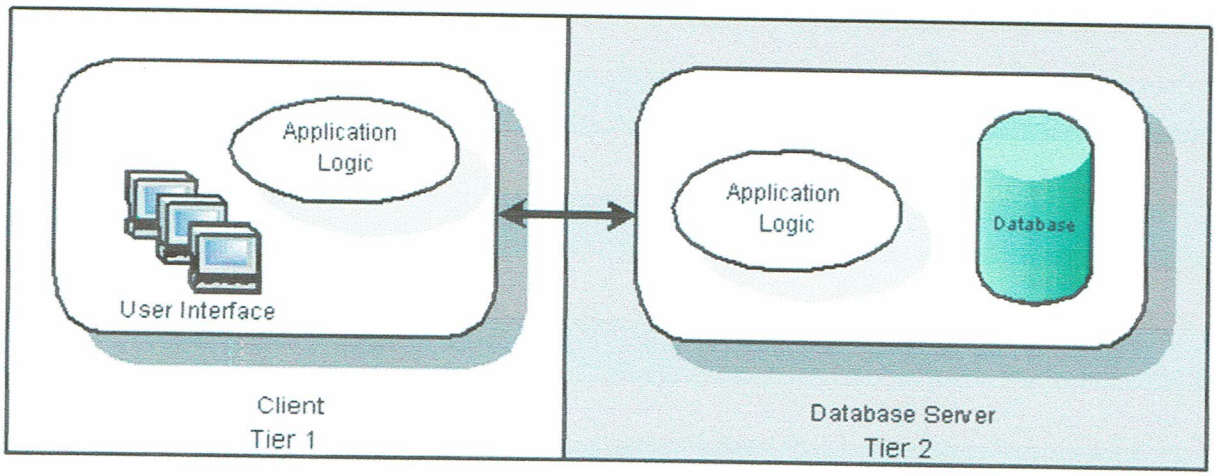


Figure 31. Two-tiers architecture

The difference from the previous architecture is that the XML DB HTTP Listener provides about the same functionality as the mod_plsql plug-in but does not require an HTTP server and is directly integrated into the database that hosts APEX.

Specifically, how does APEX work with this architecture:

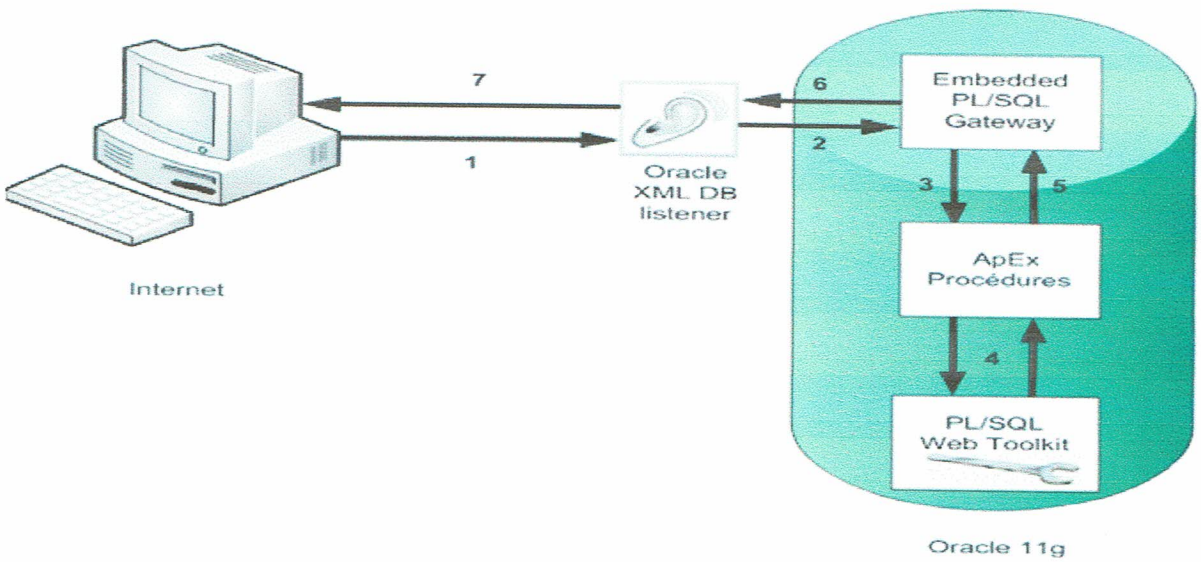


Figure 32.APEX two tiers architecture

1. The XDB Listener receive a request from the client's browser.
2. It redirect this request to the integrated PL/SQL (PL/SQL Gateway).
3. This gateway will analyze the information contained in the HTTP request and call the corresponding stored procedures of the Apex engine.
4. As before, the APEX engine will use the PL/SQL Web Toolkit API to access the information in the database (and to consult, add, update or delete data) and generate the HTML page for the customer.
5. This page is retrieved by the Apex engine and sent to the integrated gateway.
6. Then the gateway sends the page to the XML DB Listener, which itself provides the page to the client's browser(7).

3.3. The chosen architecture

The 3-tier architecture is used for security reasons. It can be coupled with a firewall. However, it is complex and difficult to install and configure.

For this reason, in the development of our application we use the 2-tier architecture. This architecture is shared between 2 layers, and has the following advantages:

- Since we don't have to worry about an HTTP server, the use of this architecture greatly simplifies the installation, configuration, administration and maintainability of Apex.
- The XML DB Listener can be used for other PL/SQL Web applications. This means that if we want to recode our own ApEx engine, we can use the XDB listener.

A two-tier architecture is a database architecture where :

- Presentation layer runs on a client (PC, Mobile, Tablet, etc)
- Data is stored on a Server.

An application interface which is called ODBC (Open Database Connectivity) is an API which allows the client-side program to call the DBMS. Today most of the DBMS offers ODBC drivers for their DBMS. 2 tier architecture provides added security to the DBMS as it is not exposed to the end user directly.

4. Main graphical user interfaces

In this part, we will present the final product of our project and actions during this internship.

4.1.Sign in interface

This interface represents the Sign In form, to access the application. Every user is able to see this page.

Figure 33.Sign in interface

4.2.Home page

Once the user is connected successfully, he will be redirected automatically to this page.

Figure 34.Home page

4.3.Business Indicators

This interface and the related menu is shown only to specific users of the application such as system administrators and CEO. it provides 4 different indicators view:

4.3.1.Stock Value

this chart is a SMG(Status Meter Gauge) who indicate the current stock value in real time and give the CEO (Chief Enterprise Office) visual and logical decision either to get or sell supplies.

4.3.2.Total supply buying value

this chart is a SMG who indicate the current year's supply who were bought in real time .

4.3.3.Total paid and unpaid sales revenue:

this chart is also a SMG who indicate the current year's sales revenues in real time including paid and unpaid bills by clients.

4.3.4.Total paid sales revenue

this chart is a SMG who indicate the current year's sales revenues in real time and exclude client's unpaid bills.

The difference between the C and D indicators determine all client's debts toward the enterprise.

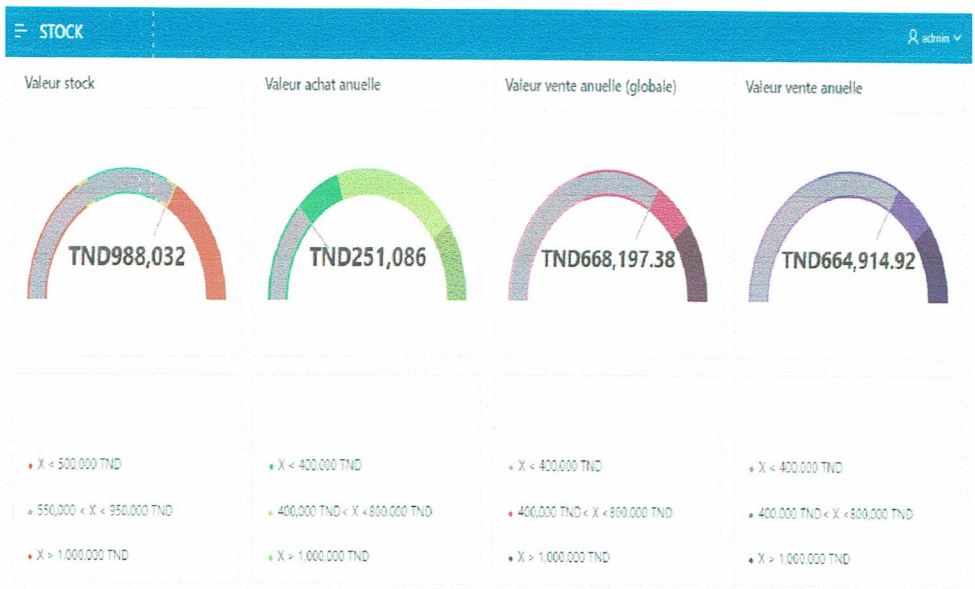


Figure 35.Business indicator interface

4.4.Daily And Monthly turnover indicators

This indicator shows the monthly turnover of the top clients and provides a comparison between them. It also give an overview who concerns discount decision for specific client.

Figure 36.Monthly turnover indicator

This interface shows the daily revenues or turnovers of top 2 clients during the last week.

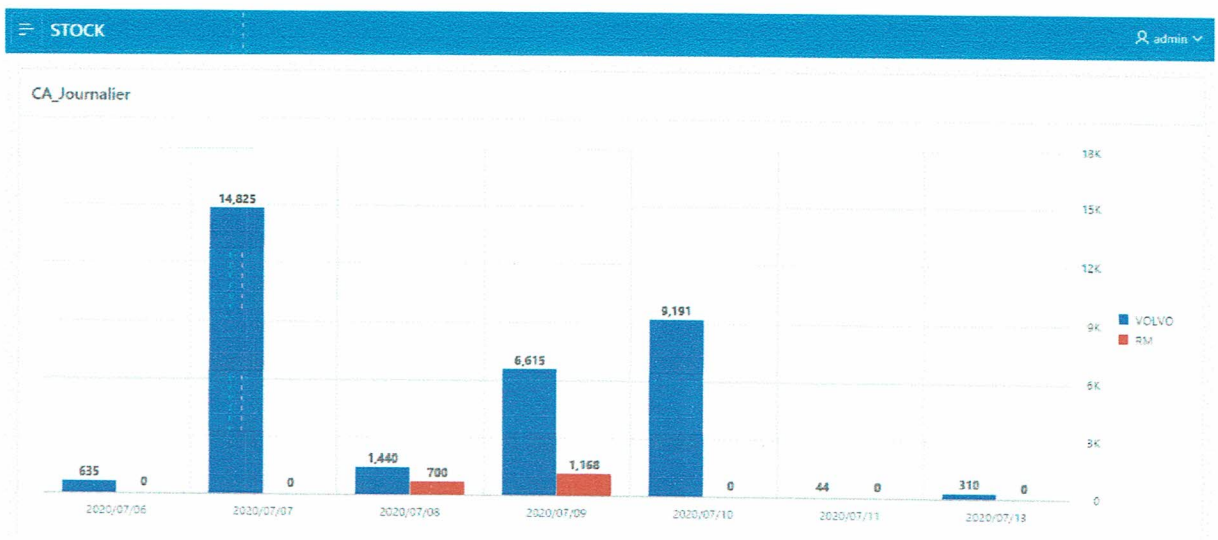


Figure 37.Daily revenues of top 2 clients

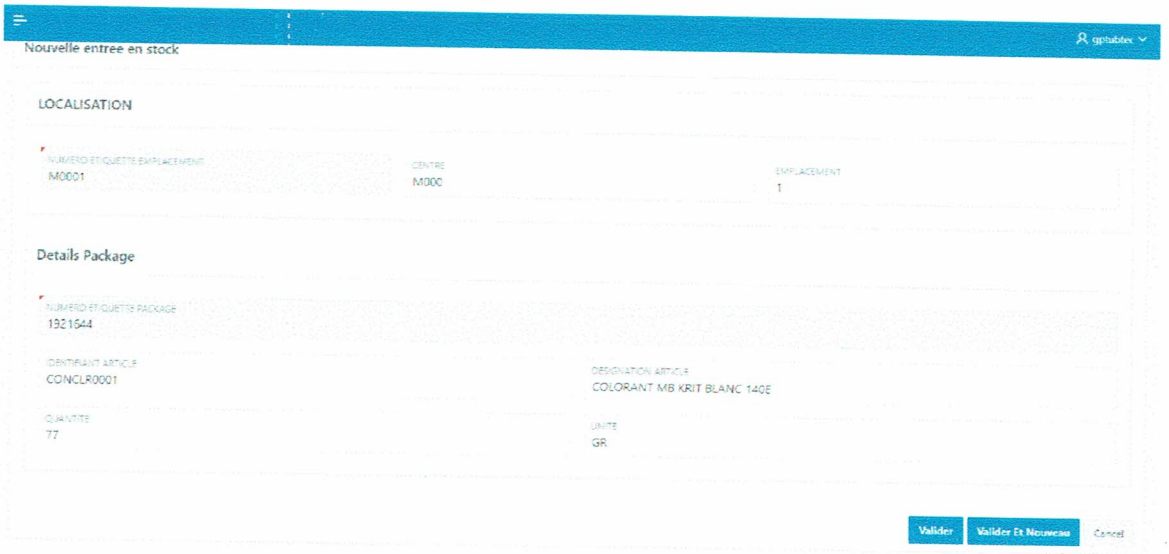


Figure 39.add storage interface via BC code reader

4.5.2.Stock removal

The stock removal use the figures 38 and 39 in order to operate with a simple difference in the process where the quantity value will be multiplied by (-1).

4.5.3.Stock transfer

The stock transfer process is done also in two different methods:

4.5.3.1.Automatic transfer

This process is subdivided between 2 interfaces where the user will choose the origin source and the destination target spots and will confirm the inputs. Finally he will have to read the package number to get all necessary information to finalize the transfer action. This Process needs a BC code reader in order to execute.

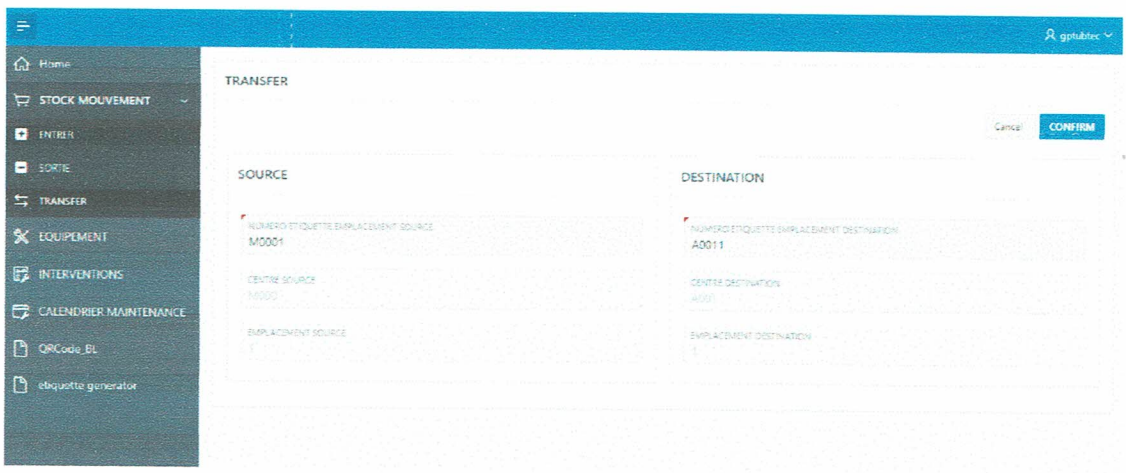


Figure 40.Auto Transfer storage interface via BC code reader(STEP1)

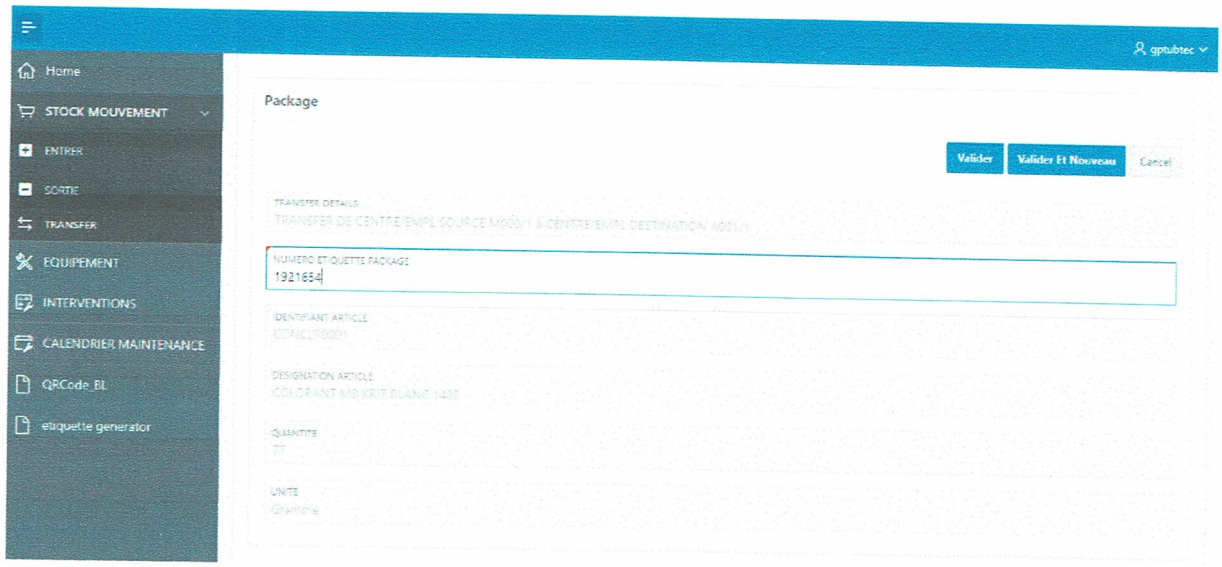


Figure 41.Auto Transfer storage interface via BC code reader(STEP2)

4.5.3.2.Manuel transfer

the manual transfer process is necessary for our system as much as the automatic for many reason as (package's ticket destroyer or package is opened,etc). all the information will be inputed manually in order to operate this process.

Figure 42.Manuel Transfer storage interface via BC code reader.

4.6.Supplier reception

The following figure shows the supplier reception interface which allow the user to receive totally or partially a provider order.

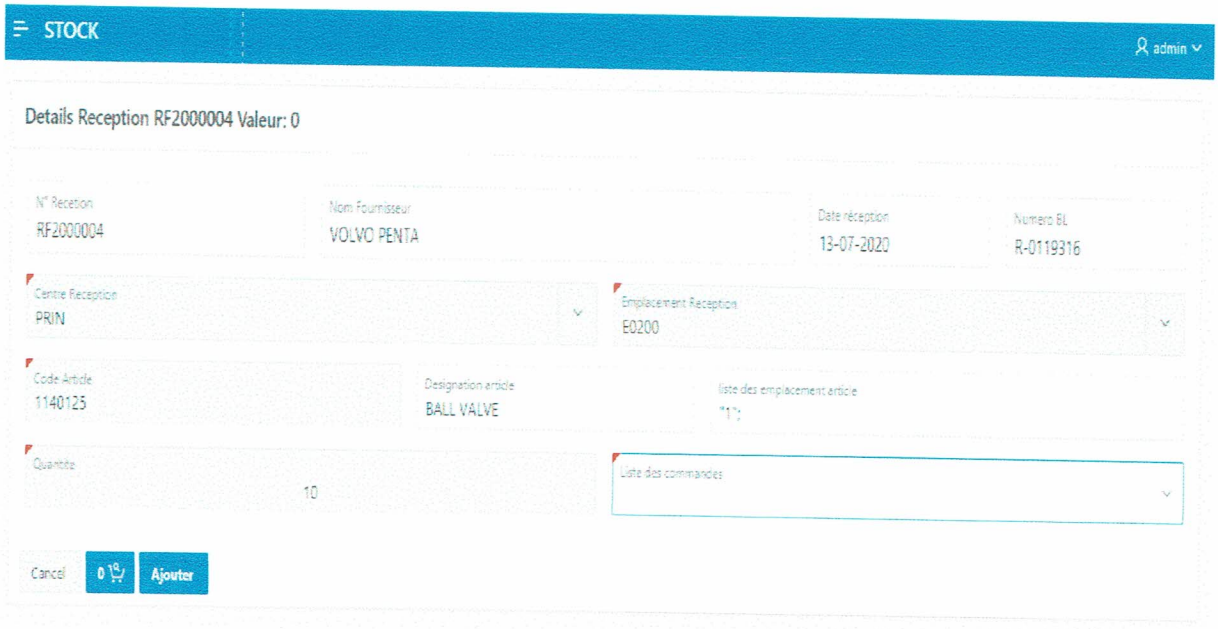


Figure 43.Supplier reception

4.7.CMMS Module's interfaces

4.7.1.Intervention Calendar by technical agent

This interface represent the calendar of interventions related to a specific technical agent in the system. The calendar interfaces in oracle apex provide multiple ways of display(Monthly ,Weekly, Daily by 24 hours format).

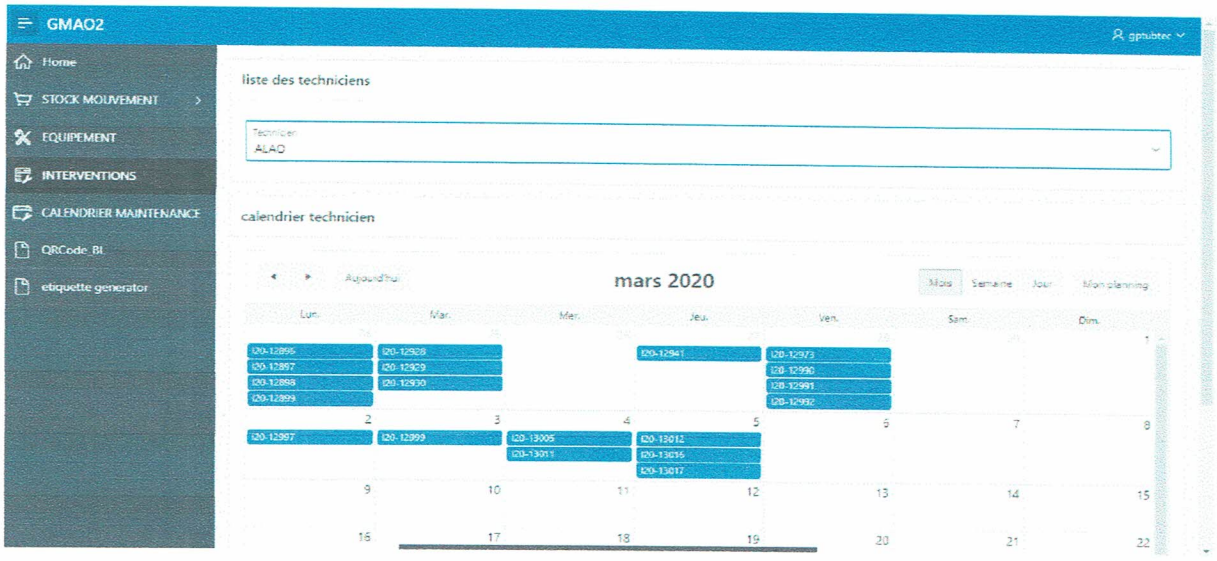


Figure 44.Interface intervention Calendar by technical agent

4.7.2.Intervention Calendar (view Technical chief)

This interface represent the calendar of interventions related to all the technical agents.

Figure 45.Interface Intervention Calendar (view Technical chief)

4.7.3.interface Manage Intervention

This interface shows all the necessary information related to a specific intervention and allow to user to modify, cancel, postpone or settle intervention. It might also show related operations management list based on the level of connected user's right.

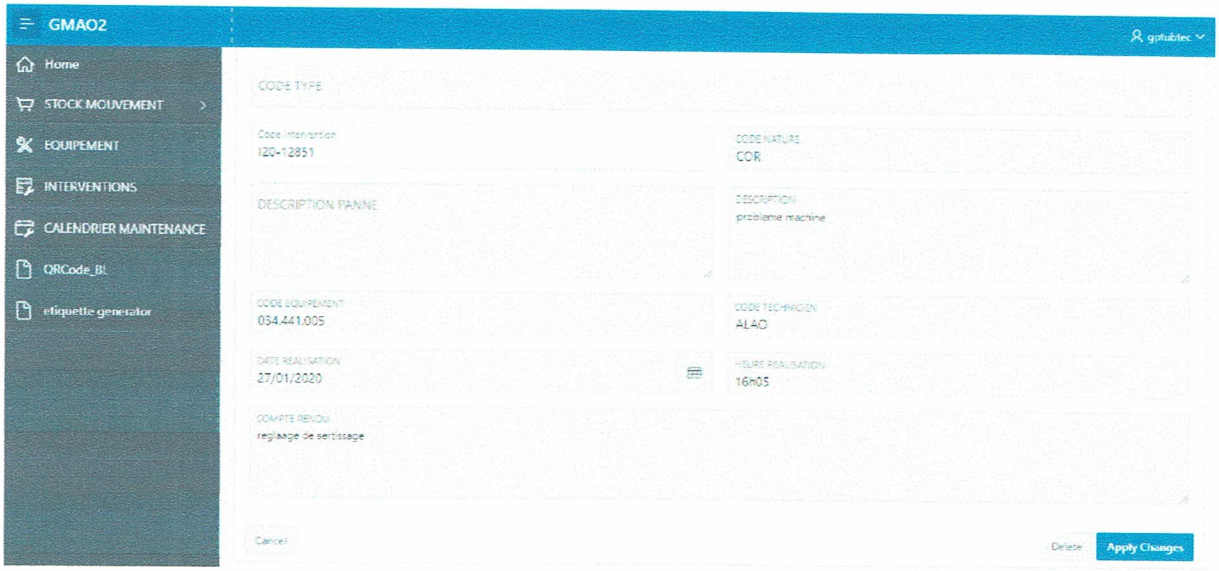


Figure 46.Interface manage intervention

4.7.4.Interface Manage Operation and request supplies

this interface is displayed as a sub region in manage Intervention interface, it allow the user to add an operation who wasn't involved in the intervention at the time of creation. This operation will be validated after settling the concerned intervention by a supervisor who is mainly the chief of technical group.

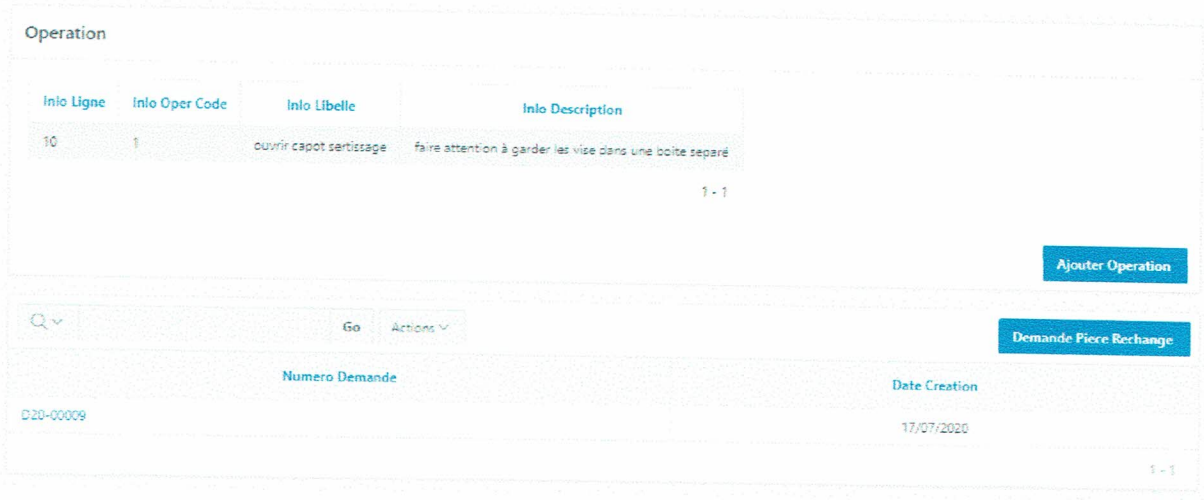


Figure 47.Interface Manage Operation and request supplies

4.8.Client Order Interfaces

4.8.1.E-commerce or E-Shop interface

This interface show the list of the article existing in the Database for sell. Every client has his own account or accompanied by a seller to create the client order.

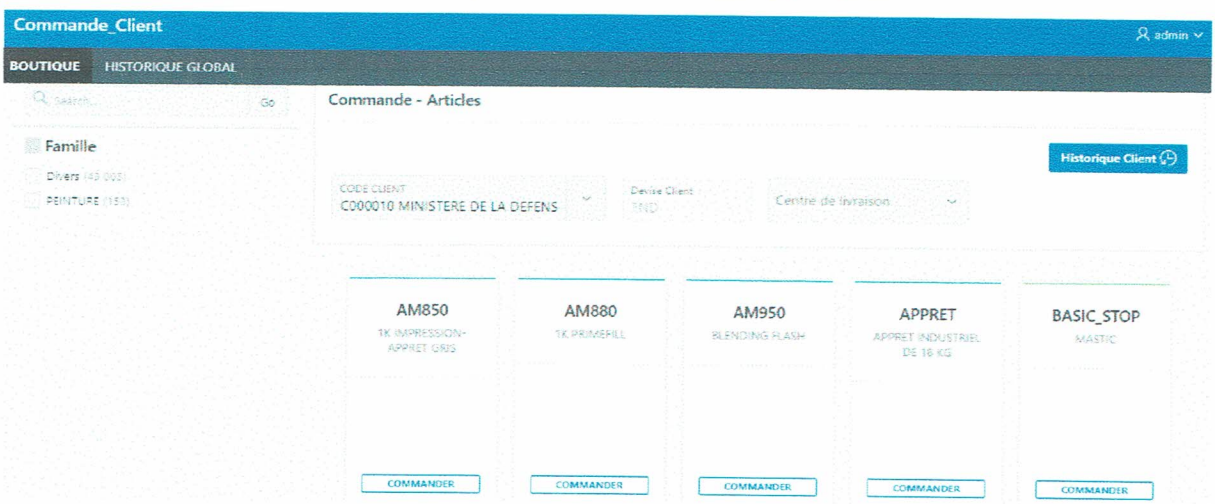


Figure 48.Client order interface

4.8.2.Add to cart

This interface contains all the necessary information to be added into cart and also appliy discounts, once the user validate the cart, all items in the cart will be added to DEVIS_CLIENT and LIGNE_DEVIS_CLIENT tables from the Sell Module.

Figure 49.Add to cart

4.8.3.Interface Client Deliver

This interface is created to be used by delivery agent who is also conceived as a seller in this ERP. It give the necessary access for him to validate the items partially or completely out of a client order.

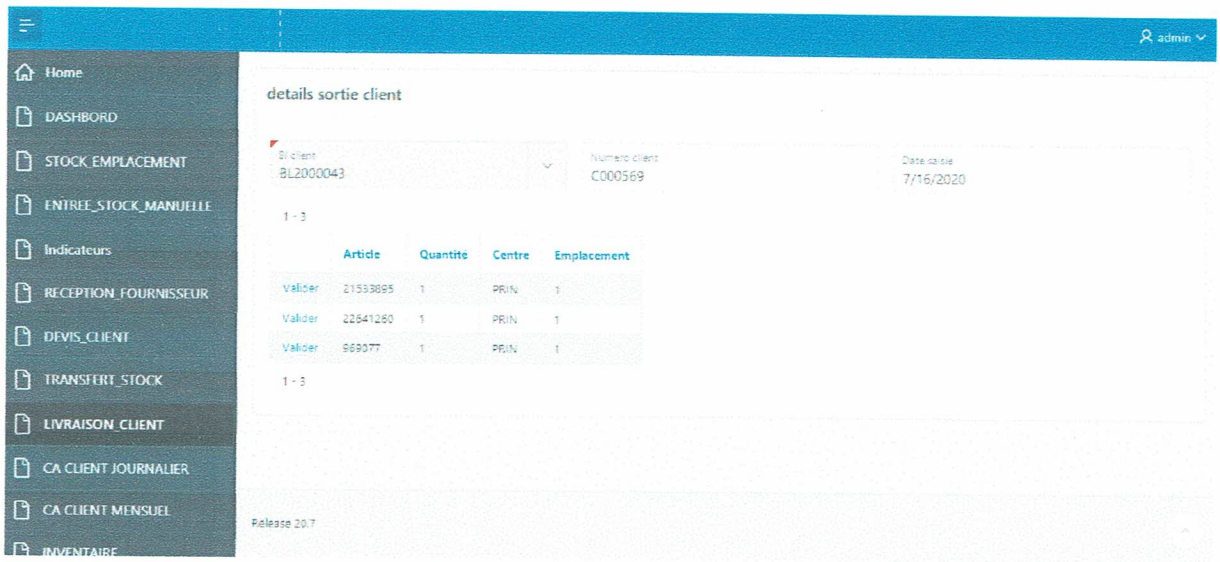


Figure 50.Interface Client Deliver

Conclusion

During this last chapter we presented the development environment (hardware and software), the different application's process and business indicators interfaces.

General conclusion

Within the framework of the final internship project for the diploma in Software and Information Systems Engineering at ESIP, we designed and implemented a different system process (SALES, STOCK, CMMS and BI) based on an ERP in cooperation between AZUR consulting and her clientele. It is an experience that left us with excellent memories and gave us the opportunity to realize our application which is part of the artificial intelligence framework and also Information System Management. Our solution can be easily adapted to solve problems related to decision making in any establishment who use Octal ERP made by oracle.

In fact, this internship was an unique opportunity to carry out a three years studies from a side, and to acquire the knowledge and best practices of the industry on the other side. It was very beneficial from a technical point of view since we were able to master and familiarize with a decision making and system information management's tool of great value in the open source tools market, knowing that this field requires a sense of analysis, design, organization and a practical application of all the knowledge acquired in computer science. Moreover, this project has not only allowed us to implement the knowledge acquired during our university course, but also to deepen our knowledge in the field of artificial intelligence and to integrate it into our professional life.

The development of this subject allowed us to approach fundamental concepts following a real and concrete approach. We went through a detailed analysis and a preliminary study concerning the framework, we then approached the design phase by using StarUML .

At the development phase, we chose the oracle application express tool which allowed us to create the platform according to the expectations of different establishment to satisfy AZUR CONSULTING's client needs.

Finally, we would like to express our satisfaction to have been able to work in good conditions and such a pleasant environment; we are completely satisfied on our choice that we judge it as the best. We hope that our work is up to your wishes.

Bibliography

[1] https://fr.wikipedia.org/wiki/Informatique_d%C3%A9cisionnelle

Last visit: 20/MAR/2020

[2] https ://en.wikipedia.org/wiki/Oracle_Database

Last visit: 16/FEB/2020

[3] https://en.wikipedia.org/wiki/Oracle_Application_Express

Last visit: 16/FEB/2020

[4] https://fr.wikipedia.org/wiki/UML_(informatique)

Last visit: 03/MAR/2020

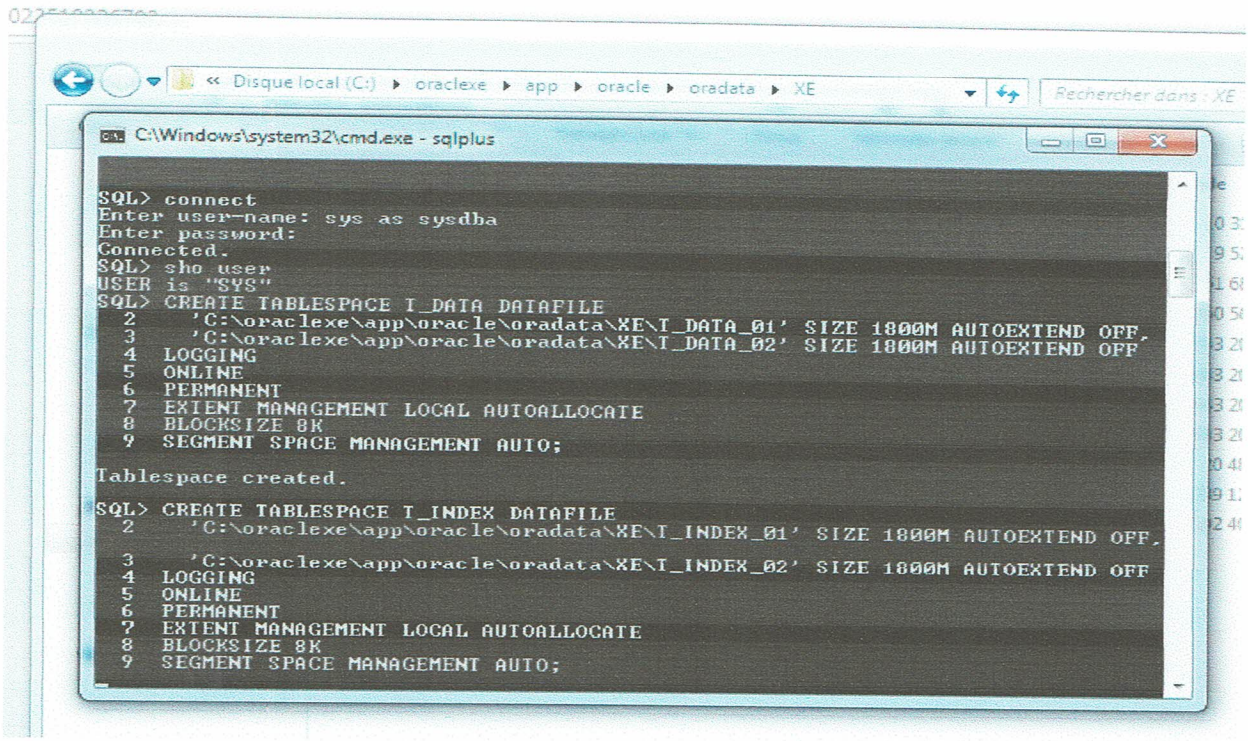
[5] https://en.wikipedia.org/wiki/Computerized_maintenance_management_system

Last visit: 09/FEB/2020

Annexes

After Installing oracle data base 11g and oracle apex 19.1 . here are the necessary actions to import a client database and allocate table spaces.

- ***Creation of table space :***



- **User Creation GPTUBTEC**

```
CREATE USER ANONYMOUS1
 IDENTIFIED BY  Syst@.*Azur@.*2020
 DEFAULT TABLESPACE T_DATA
 TEMPORARY TABLESPACE TEMP
 PROFILE DEFAULT
 ACCOUNT UNLOCK;
 GRANT RESOURCE TO ANONYMOUS1;
 GRANT CONNECT TO ANONYMOUS1;
 ALTER USER ANONYMOUS1 DEFAULT ROLE ALL;
 GRANT CREATE VIEW TO ANONYMOUS1;
 GRANT UNLIMITED TABLESPACE TO ANONYMOUS1;
```