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Graduation Project:

Machine learning system for selecting best suppliers of health care system

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Abstract

The main objectives of the project is to help Executives and managers to find the best suppliers of medical supplies which is used in healthcare system according to the aspects of high quality, less time, and low cost. Finding the best supplier will help the company to gain the customer trust and much profit. During crisis and pandemic it became so hard to get the required amount of medical supplies because of the unawareness of it and the lack of market research so the project aims to let the managers know what the required amount is, when they will need it, and who the best supplier is to get the required products.

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Chapter 1

Introduction

1.1. Introduction:

Strategic management decisions impact all areas of a firm. Once such decisions have been made, the criteria for making subsequent operational decisions must be re-examined. New strategic directions may require new criteria and/or a re-emphasis of existing criteria used in making the operational decisions necessary to implement them. An important area of operational decision making is that of purchasing. In the current scenario of global competition, it has become indispensable for the manufacturers to cut down their fixed costs and deliver the goods at the right place in the right time to sustain the competition and survive the market. It is found from the past analysis that the raw material and component costs themselves carry 70% of the total cost.[1]

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturing and supplier, but also transporters, warehouses, retailers and customers themselves. The goal of Supply Chain Management (SCM) is to reduce cost and generate gains for every participating supply partners. The basic unit of a supply chin activity is: Receive input from supplier add value deliver to customers Suppliers have been acknowledged as the best intangible assets of any business organization[2].

A supplier may be an external vendor or an upstream process within the firm. SCM requires the coordination of the flow of the products, services and information among SC entities such as supplier, manufacturers, distributors and customers[3].

Selection supplier is a strategic decision in the course of supply chain management. The selection of suppliers depends on the sourcing strategy of the buyer/manufacturer. It help in optimizing the supply chain and thus increasing the efficiency of the supply chain. An incorrect supplier selection can drive the entire supply chain into confusion[4].

[1] (Weber, Current, Benton, 1991)
[2] (Chris I. Bell-Hanyes, 2010)
[3] (Toloei, Kalantay, 2011).
[4] (Parthiban et al. 2010).

Lee et al. (2001) and Kumara et al. (2003) emphasize that selection of the best supplier is an essential strategic issue imperative for supply chain effectiveness and efficiency. Kumara et al. (2003) contend that strategic partnership with the right supplier must be integrated within the supply chain to contain costs, improve quality and flexibility to meet end-customers' value and reduce lead time at different stages of the supply chain[5] The main objective of supplier selection process is to reduce purchase risk, maximize overall value to the purchaser, and develop closeness and long-term relationships between buyers and suppliers, which is effective in helping the company to achieve "Just-In-Time" (JIT) production. Additionally, with the increase in use of Total Quality Management (TQM) and JIT concepts by a wide range of firms, the supplier selection question has become extremely important (Tahriri et al. 2008). Purchasing and supply management support the management of supplier network with respect to identification of supplier selection criteria, supplier selection decisions, and monitoring of supplier performanceAccording to Wang et al.(2008), supplier selection or evaluation is the process of finding the supplier who is able to provide the customer with the products or services that have the right quality, the right price, the right quantity and at the right time (Parthiban et al. 2010). Many approaches and algorithms are available that they have been used for supplier selection. Some of these algorithms are Analytical Hierarchy Process (AHP), Data Envelopment Analysis (DEA). Multi-Criteria Decision Making (MCDM) models have two major branches: Multi-Attribution Decision Making (MADM) and MultiObjective Decision Making (MODM) models. MADM models are good techniques for selecting a supplier, because many different factors play role in supplier selection problems. These factors usually have not

[5] (Chris I., Bell-Hanyes, 2010).

same dimensions, for example price, delivery time, delivery reliability, reliability, quality and so on (Toloei, Kalantary, 2011). MCDM techniques support the decision-makers (DMs) in evaluating a set of alternatives (Tahir et al. 2008). One of the most reputed techniques of MADM models is TOPSIS (Technique for Order-Preference by Similarity to Ideal Solution). TOPSIS is a technique combines quantitative attributions (such as price, time, distance, and so on) and qualitative attributions (such as quality of relationship, quality assurance, reliability) and compares all alternatives together based on these attributions. TOPSIS is a powerful technique although it has a big weakness that is the fact that it doesn't provide us with a good alternative. According to this technique, the nearest alternative to the ideal solution is a suitable one. Now, the question is, where it origins from. The ideal solution, origins from the information of the available alternatives. Is there any assurance that the available alternatives are in suitable condition or not? Therefore, TOPSIS only is used whenever we want to select one alternative among others, regardless of suitability of the desired alternative (Toloei, Kalantari, 2011). In the past decade, TOPSIS has been successfully applied to the areas of supplier evaluation and selection, inter-company comparison, expatriate host country selection, risk assessment, facility location selection, robot selection, operating system selection, software outsourcing problems, partner selection, customer evaluation, weapon selection, performance evaluation, etc

1.2. Problem statement:

It’s hard to choose trusted suppliers that can supply your medical business with the appropriate medical supplies with the right amount as well as keeping the right relationship with these suppliers. If you made the wrong choice your business might fail because of low quality with high price and longtime shipping and this will effect on the customer relationship and customer trust. In general, supplier selection problem falls under purchasing department. The critical objective of the purchasing department is to procure right product at the right cost in the right quantity with the right quality at the right time from the right source. This requires executing effective decisions concerning supplier selection and evaluation.

Chapter 2

Theoretical Background And Tools

Introduction:

in this chapter we are going to discuss some theoretical background that is related to our topic which are represented in the literature review and the tools that are used in the project since data gathering to the user interfaces.

Theoretical background and tools…..

1- Literature Review

METHODOLOGY: Using the keyword "supplier relationship management" and "supplier selection," journal articles were searched for journal articles in Mendeley Library, ProQuest, EBSCO and Google Scholar. The keyword was found either in the title or the abstracts of the paper. In Google Scholar, top hundred results were considered. The search on Google scholar was limited to the abstract and the title of the respective document. The articles found in searches was scrutinized by the list of articles in ABDC Journals and Schimago Journals. Over 30 articles were identified published between 2000 and 2018. The findings are presented below from the analysis of the papers reviewed. The authors combine several categories that were used to analyze the articles as given below.

Preliminary Analysis:-

Authorship: Most of the articles reviewed had multiple authors and the average lies between two and three. From the 30 papers reviewed, each paper has around 40 references. It adds up to more than 1200 references in total. About 50% of the articles reviewed are published in 2012 or later. Less than five articles are published before 2007.

Nature of Study: About 50% of the papers reviewed had a specific country context such as India, China, Switzerland, USA, Japan, United Kingdom, Netherlands, Finland, and Malaysia. Most of the papers were descriptive, a few were diagnostic or experimental, and others were case studies. The

majority of papers used literature reviews to generate hypothesis and the conducted surveys and interviews to verify them.

Theories Utilized: Few research studies mentioned the theories which they applied in the context of supplier relationship management to generate the hypothesis. Some of these are Social Exchange Theory (SET), Grey Theory, Evolutionary Game Theory (EGT), Intellectual Capital (IC) Theories, Resource Dependence Theory (RDT), Transaction cost analysis (TCA), and Game Theory.

Research Methodologies Used: Different studies were classified according to the dominant research method and data sources such as secondary data, survey, case study or a combination of these. About ten articles were conceptual or theory development papers based on literature reviews; about six papers were based on primary case studies; another five studies were based on experimentally collecting data through questionnaires and then analyzing the data

DOMINANT THEMES:

One of the critical objectives of a systematic review of literature is to assimilate the key findings of the different studies and identify common themes of research. The purpose of this study is to consolidate perspectives on supplier relationship management and supplier selection. In-depth and iterative analysis of the papers helped us evolve four dominant themes namely, buyer-supplier relationships, supplier selection strategies, supplier evaluation strategies and supplier development strategy. The chosen topics reflect both quantitative and qualitative emphasis of the papers reviewed rather than a complete mapping of all possible variables of interest. The items relate to issues and factors which are associated with SRM presented as higher-order constructs operationalized through lower-level elements. We introduce two of the themes i.e. buyer supplier relationships and supplier selection in this paper, categorize the research studies reviewed under each one and present brief summaries of the studies. Given the space constraints, the studies presented are reflective of the themes, although not purely representative.

- **Buyer-Supplier Relationship:**

1. In (Wieteska Grażyna, 2016) described how companies should develop relationships with suppliers while facing high market volatility. It focused on of flexibility and adaptability in the context of Supplier Relationship Management (SRM). Flexibility in supply chain results in effective response to the changes in supply, demand, and products. Adaptability is built up in the context of adjusting to significant environmental changes. Flexibility in relations can be achieved through Flexible Purchasing and Supplier Flexibility.

2. To identify the possible obstacles to the SRM integration is the central theme of (Oghazi et al., 2016), and he strives to provides solution suggestions to overcome these barriers. In this regard, the survey of the literature and subsequent analyses of the empirical findings represent that the SRM process integration can take place by the integration of its different sub-processes into strategic and operational characteristics. Strategic sub-processes describe the definition and the structure of the entire process whereas operational sub-processes refer to the executive phase of the process. In this context, the lack of goal congruence, commitment, and trust among the manufacturer and its supplier are the main potential barriers to the SRM integration.

3. According to (Soh et al., 2016), the seven dimensions that are commonly used in literature to denote buyer-supplier relationships (BSRs) are trust, involvement, business understanding, communication, commitment, information sharing and knowledge. Trust most is essential in BSR. Factors that affect trust: commitments, communication effectiveness, cooperation, and transparency. The findings reveal Supplier Quality (SQ) and Supplier Commitment (SC) have direct significant relationships with Supplier Performance (SP). It also reveals that no mediating effects of BSR upon the relationships between Supplier Engagement (SE) and Supplier Infrastructure (SI) to Supplier Performance (SP).

4. Ji et al., (2015) studied the changing of cooperation tendency among multi-stakeholders (buyers and suppliers). The Evolutionary Game Theory (EGT) is adopted to describe the phase of further evaluation by analyzing green costs and its benefits to players. Results implied that recycling capability is a crucial factor for the cooperation tendency among multi-stakeholders in the long-run. Green purchasing relationships among multi-stakeholders will influence the payoffs of the suppliers and manufacturers (buyers) in a two-tier supply chain.

5. In the following article, (Anni-Kaisa Kähkönen et al., 2015) empirically examine the relationships between value-creating activities and buyer's dependence, and to determine what kind of supplier relationship management activities might decrease or increase the dependence. The results of the study indicate that the value-creating activities of inter-firm learning and early supplier involvement in buyer-supplier relationships improve the buyer's dependence on its suppliers, whereas a supplier orientation does not. From this study, it could be implied that the firms should weigh the pros (value creation) and cons (dependence) and develop management practices and relationship strategies based on those.

6. Identification of four main categories of both buyer and supplier attractiveness plays an important role in the article of (Tanskanen and Aminoff, 2015). These are: 1) economic-based, 2) behavior-based, 3) resource-based, and 4) bridging-based attractiveness. They found economic- and behavior-based attractiveness present in all dyads, while resource- and bridging-based attractiveness are emphasized when the strategic intention has more explorative elements and when the aim is to leverage the dyadic relationship in developing businesses outside the dyad

7. Exploring the key supplier management (KSM) phenomenon (Ivens et al., 2013) discusses: how should it be organized, what are the (organizational) implications, and which benefits can be

realized? KSM deals with the question how to analyze, plan, manage, and control interactions with these key suppliers.

8. Rezaei and Ortt, (2013) designed a rule-based approach to segment the suppliers of a firm based on two overarching dimensions that capture these available segmentation criteria. Another methodological contribution of the paper is to develop and apply a general sensitivity analysis procedure for fuzzy rulebased systems. This analysis is used to identify the most crucial supplier capabilities and willingness criteria and to formulate better supplier development strategies. A fuzzy rule-based system is formed of four functional blocks: knowledge base, decision-making unit, fuzzification interface, and defuzzification interface

9. Main focus of (Jeong et al., 2013) in their article is on SCM in manufactured housing (MH) industry and an SRM Framework called MSROM is developed. Critical issues identified in SCM are Variable supplier Lead time and consistent safety stock level and a poor supplier evaluation process these issues are solved by MSROM framework and others specific Optimization model. Framework for MSROM has to main subsystems: Material Sourcing process and Material control process. Results showed that the proposed system was more effective in controlling supplier lead time.

10. Akamp and Müller, (2013) investigates which measures of supplier management could advance supplier performance and buyer satisfaction. They proposed a structural equation model which was analyzed using Partial Least Squares (PLS). The conceptual model takes supplier selection and evaluation, supplier monitoring, supplier development, and supplier integration as independent variables while supplier performance and buyer satisfaction being dependent variables. The results show that mainly cooperative activities such as supplier development and supplier integration are effective while,

supplier monitoring does not seem to have a positive influence on supplier performance.

11. Bemelmans et al., (2012) shed light on obstacles to, and opportunities for, increasing the effectiveness of construction firms in managing buyer-supplier relationships. More specifically, the focus was on assessing the maturity level of buyer-supplier relationship management by construction firms. Aspects important in determining the effectiveness of buyer-supplier relationship management for a buying company includes optimizing supply base in terms of both the number and the quality of its suppliers, attention towards managing a buying company's portfolio of suppliers, deciding to what extent suppliers have to be integrated into their own processes, and attention to developing suppliers, on the basis of an ongoing monitoring of their performance. The impeding factors can be summarized as the lack of formalization, documentation, and communication (both internally and with suppliers) linked to the various policies, plans, processes and measurement systems that form part of the management of buyer-supplier relationships.

12. In the following paper, (Liu et al., 2010) developed a 2X2 relationship quality (RQ) matrix based on levels of mutual trust and commitment between both buyers and suppliers and explore the use of control mechanism. The research also tests the matrix and hypothesis proposed using the cluster, ANCOVA and SEM analysis. Based on the matrix different levels of trust and commitment can be developed namely the buddy, relier, arm's-length and initiative.

13. Svante Anderson and Per Servais, (2010) reviewed international industrial purchasing and marketing literature on portfolio models, to develop portfolio models for buyers' and sellers' international strategies, and to consolidate the models so that both the buyer and seller perspectives are dealt with simultaneously. He stated five product-related basic dimensions for buying situations: (importance, complexity, familiarity,

innovativeness, and frequency) and three buyer-seller interaction-related dimensions (familiarity, dependence, and depth of interaction). These dimensions are used to develop a portfolio model of supplier relationship management and a marketing management model for supplier strategies. This study also examines how the different marketing management strategies fit with different supply strategies and buying situations. The author concluded that to find a fit between buyers' and sellers' international strategies, the parties have to negotiate.

14. In this article, (Griffith and Lusch, 2008) determined how the individual elements of procedural justice influence the long-term orientation of a channel partner. Procedural justice refers to the perceived equity in the policies and procedures used within the relationship for resolving disputes and allocating outcomes. From the analysis it is implied that more open communication (bilateral communication, explanation) may not increase long-term orientation if the channel relationship doesn't become more reliable (i.e., improved consistency and credibility) and/or unless treatment of channel partners (interactional norms) is enhanced, and/ or develop policies that integrate the interests of their channel partner (voice)

15. Ounnar et al., (2007) contributed to the improvement of customer-supplier relationship is a decentralized self-organized control model based on the concept of Holon. Holon is the decision-making center linked with the production system of the entity such as 'product', 'resource', 'order' and 'staff' (PROSA). In this model, the decision system controls a group of actors' operations who are in a partnership. In this paper, in particular, Analytic Hierarchy Process (AHP) for the evaluation of the suppliers' network is discussed. It allows a supplier to become an intelligent production unit able to operate in self-organization with other companies

16. Aim of (Moeller et al., 2006) is at the development of a Framework for Supplier Relationship Management. For this purpose, they adapted and applied insights from Customer Relationship Management (CRM) as well as existing findings in supplier management literature. According to them, SRM can be subdivided into the following three main and sequential phases: Out-Supplier Management, In-Supplier Management, and In-Supplier Dissolution Management.

17. In their contribution, (Hwan-Yann Su et al., 2013) explores how partnerships can be enhanced through making transparent Intellectual Capital (IC) information to partners in the supply chain setting. IC refers to the sum of all intangible knowledge resources – the sum of all individual and organizational knowledge and capabilities – a firm can utilize for competitive advantage. Providing information comprising two components of IC transparency – the transparency of essential business characteristics and the transparency of relationship atmosphere produces higher supply chain partner trust, satisfaction, and commitment than not providing that information.

18. Jiang et al., (2011) seeks to present empirical evidence about the effects of trust and dependence in business relationships in the construction industry. They test the extent to which trust and dependence act as antecedents to four dimensions identified from the literature as being important determinants of relationship quality: commitment, communication, satisfaction, and long-term orientation. Main conclusion that one gets from this research is that Trust has more significant impact on relationship consequences (commitment, communication, satisfaction and long-term orientation) than dependence.

19. Identification of criteria for achieving efficient contractor-supplier relations for long-term relationships with suppliers and continuous cost-reductions play a crucial role in the article of (Mikael Frödell, 2011). These criterions can be divided into four groups: attributes of the relationship, communication behavior,

conflict resolution, and commodity/supplier selection process formalization. This study found that the most eminent enablers are total cost focus, aligned core values as well as the willingness and capability for collaboration and development.

20. Petersen et al., (2008) used resource dependency theory (RDT) to examine the circumstance in which a supplier has increasing levels of power above the buyer, such that the supplier may have little motivation to yield control or withhold the exercise of this potential power. Managerial strategies are also explored that a buyer may implement to mitigate the influence of supplier power on the creation of relational capital within the relationship. The results of the study imply that dependency, socialization processes, supplier integration, and relational capital have a more complicated set of interrelationships that form a vibrant and dynamic context for the study of buyer-supplier relationships.

- **Supplier Selection Strategies**

1. In the following article, (Thakur and Anbanandam, 2015) proposed a Multi-Attribute Decision Making (MADM) model based on the grey theory for optimal supplier selection in the context of Indian banking industry. This optimal selection helps a lot to provide the best supplier for "optimizing digital banking" services under uncertainty. Grey theory includes five significant parts: grey prediction; grey relational analysis; grey decision; grey programming; and grey.

2. In their paper, (Abdullah et al., 2015) described a theoretical framework for supplier selection based on the two groups of "lean" and "agile" suppliers is presented and a guideline for supplier relationship management (SRM) for these suppliers has been proposed. To determine the precise interdependencies between the suggested criteria, fuzzy decision making trial and evaluation laboratory (DEMATEL) is applied to the problem. Moreover, Analytical network process (ANP) application finds the weight of each sub-criterion, and finally, Data envelopment

analysis (DEA) approach is utilized to rank the suppliers regards to their score in each criterion.

3. Yeniyurt et al., (2018) found in their study that if a sourcing organization strives to achieve exceptional supplier working relations, it should be integrated across its geographic regions with knowledgeable global and local procurement personnel which effectively communicate with the company's suppliers, while working collectively in a coordinated manner to achieve a globally responsive supply chain.

4. Wu and Shen, (2006) developed a strategy-based planning process to guide user requirements determination. It focuses on problem structuring issues; i.e., the unstructured problems of the SRM domain. An analysis of buyer-supplier behavior in developing a relationship with suppliers. The planning process includes three steps: define purchasing strategies, identify supplier selection criteria, and determine system requirements. Olsen and Ellram model which includes four situations (namely Bottleneck, Strategic, Noncritical and Leverage) has more power in interpreting research findings. So it was chosen for the survey. This new approach fundamentally overcomes the impact of problem unstructured issues associated with SRM domain toward user requirements determination of e- SRM.

5. According to (Choy et al., 2003, 2004), there is an urgent need for developing an enterprise application integration (EAI) system for outsourced type manufacturers so that selection of appropriate suppliers can be made through a common Web-based platform. By doing so, customers" need can be directly related to suppliers" capability. This paper focuses on the integration of the Customer Relationship Management (CRM) and Supplier Relationship Management (SRM). By developing an Intelligent Supplier Relationship Management System (ISRMS) using Case-Based Reasoning, the author is making a system for potential supplier selection, and it is tested in Honeywell Consumer Products Limited. Case-Based Reasoning (CBR) is a

method for solving Problems using previous similar situations from the case Database. Its Process uses 4 "Re's": Reuse, Retrieve, Revise and Retain. Its applications can be classified into two types- Classification Tasks and Synthesis Tasks. CBR can be applied in Planning, Design, Diagnosis of Diseases and customer service section. In ISRMS two CBR modules are present, Supplier selection and Help Desks.

Tools that is used in the project:

1- Python

- It is an open source programing language that is working efficiently with statistical and mathematical equations that can handle the data to perform data analytics to extract some useful information. It's the best choice to build a machine learning model because of its libraries.

2- SAS

- It is a programing language which is made for preparing, manipulating, and transforming dirty datasets to clean data that can be used in a machine learning model that can transform these data into useful information that can be used to make a decision.

3- Odoo

- It is an open source web-based enterprise resources planning software that can handle the business' data. it is simple to use and fast and extremely efficient

4- PostgreSQL(Structured Query Language)

- It is an interactive database that can store data and perform queries to extract data into reports as need.

Summary:

We've discussed in this chapter the literature review and we reviewed 25 of articles that's related to our topics from google scholarship. Also we viewed the tools that is used to build the project including programming languages and tools.

Chapter 3

Project analysis and implementation

Introduction:

in this chapter we are going to discuss about the implementation phase which divided in two phases they are ordered as

1- Analysis phase: this phase is divided into two sub phases and they are listed as:

   1.1- structured analysis: it is represented in UML use case diagram and UML sequence diagram which shows the cases happened in the system and the scenario of work during the system working journey.

   1.2- requirements engineering: we defined functional requirements engineering as user requirement definition and System requirement specification then we mentioned the non-functional requirements.

2- Coding and implementation phase: in this phase we are going to view the Algorithm that we used in ML model and the result we got to compare between the models and select the highest results.

3- User Interfaces implementation: in this phase we will show some screens from the project to show the functionality and how it reflects the required purpose.

Project analysis and implementation

3.1 Analysis phase:

- **Structure analysis:**
  i. **Use case diagram:** it describes the list of actions than happens on the system since login till making the decision

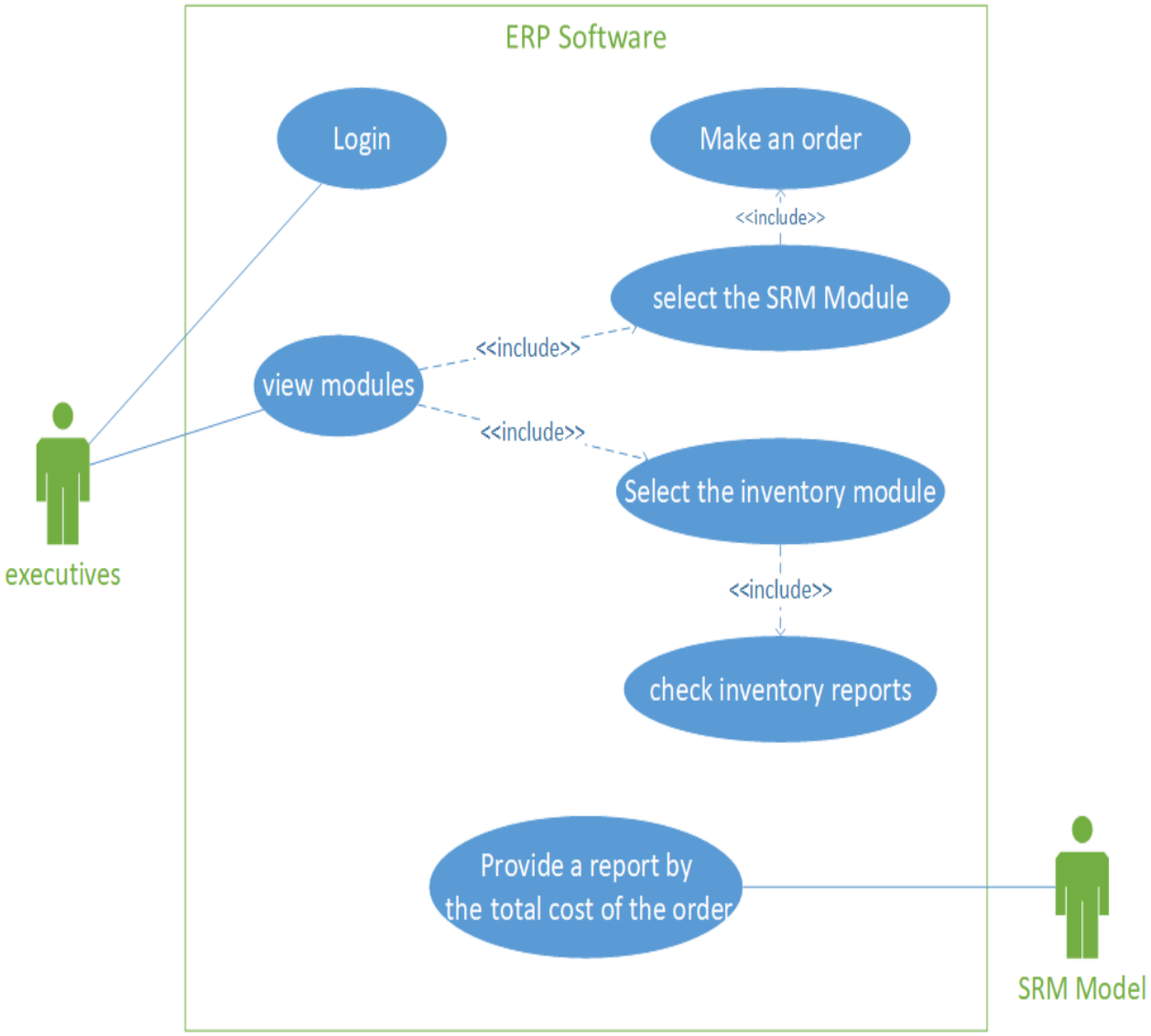


Fig1: UML use case analysis.

ii. **Sequence diagram:** It shows object interactions arranged in time sequence. It depicts the objects involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario

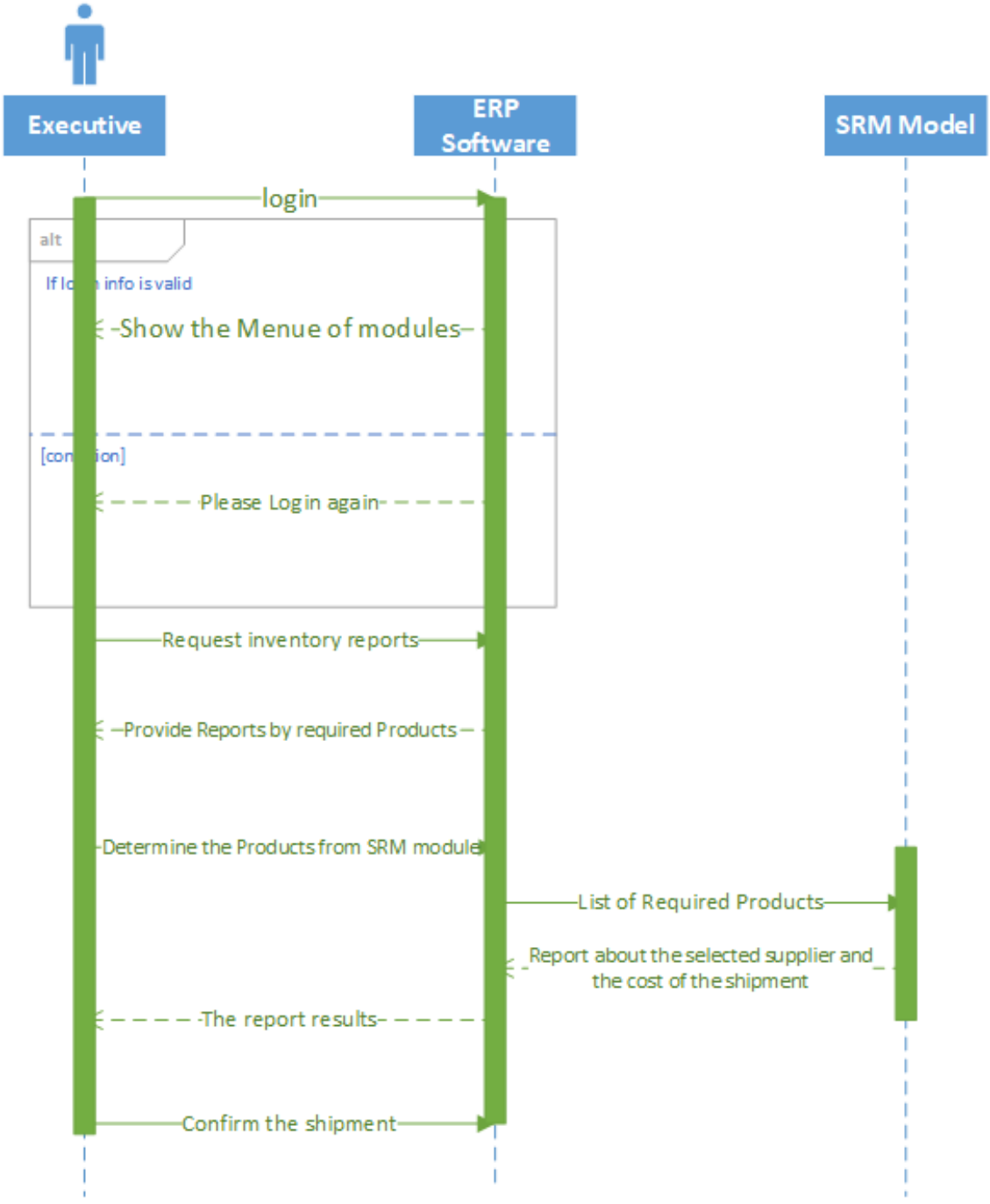


Fig2: UML sequence diagram

➢ Requirements Engineering:

i. User requirement definition:

1. The system shall have a list of modules to choose between them
2. The system shall provide a report by the required amount of medical supplies from inventory module.
3. The system shall have a list of shipping companies and pricing of shipping for each one
4. The system shall analyze and calculate the cost of determined products which is required from the inventory.
5. The system shall allow the executive to verify and confirm the choice.

ii. System requirement specification:

1.1. The system shall present the modules to the users according to their access rights.

1.2. The system shall redirect the user to the selected module.

2.1. The inventory module shall provide a report weekly by the required products.

2.2. The inventory module shall have a list of receipts and delivered products to specify the products that should be ordered.

3.1. The system shall have a detailed report about shipping companies and pricing policy for each company.

3.2. The system shall have day to day updates about shipping to track the shipment.

4.1. The system shall provide a detailed report by the required amount of products and the shipping details.

4.2. The system shall provide a calculated report by the final price

5.1. The system shall provide easy access to the analyzed results for managers and executives to modify and refine the decisions.

5.2. The system shall provide the executives a detailed report about the analytics process and the learning results

iii. Non-Functional requirements:

1. **Usability Requirement:** The system shall allow the users to access the system from Web browsers. Browsers are used as an interface to run the project .Since all users are aware and familiar with the general usage of web browsers, no special is required The system is user friendly and online help makes using the system easily.
2. **Availability Requirement:** The system is available 100% for the user and is used 24/7 and 365 days a year. The system shall be operational at all times.
3. **Security:** The system shall prevent all unauthorized users from viewing the data and reports.
4. **Integration ability:** the Module and model shall be integrated easily to fit in as a part of larger system.
5. **Configurability:** the system shall allow the end user to change the aspects of the software easily (such as views, colors….etc.).
6. **Auditability:** Ability of the system to show what has happened to it, who did it and when.

3.2 implementation Phase:

- **Machine learning model:**

1. **data steps:**

   a. **data gathering:** data is gathered manually from different E-commerce sites such as: Amazon, Souq Egypt, Alibaba, tienliglobal, noon Egypt, and etc… data collected as [device name, device price, shipping price, shipping time, total cost, quality quantity, supplier name, supplier country, supplier city, supplier feedback]

   b. **Data exploration:** in this task data is imported in python code with pandas library to read the data attributes and instances to enable us to make the essential preprocessing tasks and the code that is used to implement that step is :

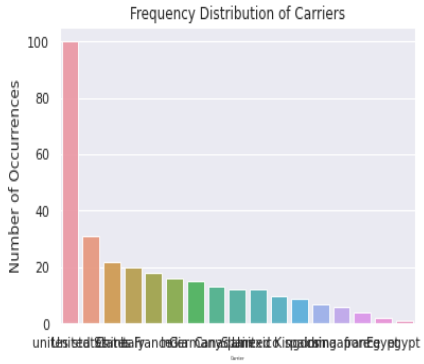
```
#importing data
import pandas as pd
df=pd.read_excel("/content/data.xlsx")
```

Fig3: Importing data to work with it.

then it comes to discover what we have in our dataset to know what we should do with it and the manipulation that is needed and it's done as follows:

```
%matplotlib inline
import seaborn as sns
import matplotlib.pyplot as plt
carrier_count = df['supplier_country'].value_counts()
sns.set(style="darkgrid")
sns.barplot(carrier_count.index, carrier_count.values, alpha=0.9)
plt.title('Frequency Distribution of Carriers')
plt.ylabel('Number of Occurrences', fontsize=12)
plt.xlabel('Carrier', fontsize=4)
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following va
  FutureWarning
```




```
labels = df['supplier_country'].astype('category').cat.categories.tolist()
counts = df['supplier_country'].value_counts()
sizes = [counts[var_cat] for var_cat in labels]
fig1, ax1 = plt.subplots()
ax1.pie(sizes, labels=labels, autopct='%1.1f%%', shadow=True) #autopct is show the % on plot
ax1.axis('equal')
plt.show()
```

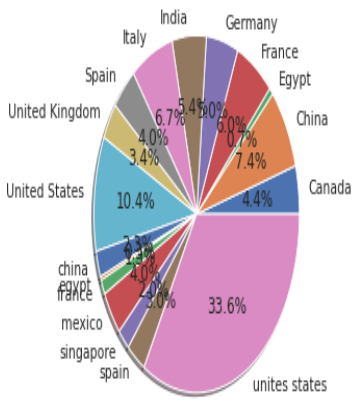


Fig4: some data exploration statistics and graphs

c. **Replacing strings into a categorical values:** since machines can't work well with strings and textual data so it was a must to replace the values in the variables that contain the textual data into numeric values that seems to be categorical values so we replaced the supplier country into a categorical variable by giving each country a specific number and it is done as follows:

```
[ ] replace_map = {'supplier_country': {'unites states': 1,'United States': 1, 'China': 2, 'Italy': 3, 'France': 4,
                                        'India': 5, 'Germany': 6, 'Canada': 7 , 'mexico': 8 , 'Spain': 9,'United Kingdom': 10,'Span': 11
                                      , 'china': 12, 'singapore': 13 , 'france': 14 , 'Egypt': 15,'egypt': 16,'Span': 17


                                      }}
```

Fig5: replacing strings into categorical

d. **Exporting cleaned data into a csv file:** after doing these main steps of cleaning data to make it valid and ready for processing we should have a cleaned copy and that step is done by code as follows:

```
[ ] df.to_csv("mydata.csv")
```

```
pd.read_csv("/content/mydata.csv")
```

	Unnamed: 0	price	shipping_cost	total_price	shipping_time	availability	quality	supplier_country	supplier_feedback
0	0	100	3	103	3	100	1	17	4.5
1	1	19	3	22	2	33	1	17	5.0
2	2	30	0	30	1	124	1	17	5.0
3	3	20	0	20	2	26	1	17	4.0
4	4	20	5	25	2	196	3	17	3.5
...	...	...	...	...	...	...	...	...	...
293	293	1200	100	1300	1	100	3	12	2.0
294	294	650	200	850	1	50	1	12	4.3
295	295	400	100	500	3	50	1	12	4.7
296	296	150	50	200	2	100	1	12	4.0
297	297	100	100	200	4	100	1	12	4.5

298 rows × 9 columns

Fig6: copying cleaned data.

e. Splitting (dividing) the dataset and specifying the target: What should be done for honest assessment of model performance in predictive modeling? How do you tune your model to improve its generalization? You might be tempted to simply avoid the standard strategy of data splitting in which a portion is used for fitting the model and the remaining data is separated for empirical validation. The process of division is done as follows:

```
[ ] Y=df["quality"]

[ ] del df['quality']

[ ] X=df
```

```
X
```

	price	shipping_cost	total_price	shipping_time	availability	supplier_country	supplier_feedback
0	100	3	103	3	100	17	4.5
1	19	3	22	2	33	17	5.0
2	30	0	30	1	124	17	5.0
3	20	0	20	2	26	17	4.0
4	20	5	25	2	196	17	3.5
...	...	...	...	...	...	...	...
293	1200	100	1300	1	100	12	2.0
294	650	200	850	1	50	12	4.3
295	400	100	500	3	50	12	4.7
296	150	50	200	2	100	12	4.0
297	100	100	200	4	100	12	4.5

298 rows × 7 columns

```
[ ] #-----------------------------------------------
    #Import Libraries
    from sklearn.model_selection import train_test_split
    #-----------------------------------------------
    #Splitting data

    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.20, random_state=44, shuffle =True)

    #Splitted Data
    #print('X_train shape is ' , X_train.shape)
    #print('X_test shape is ' , X_test.shape)
    #print('y_train shape is ' , y_train.shape)
    #print('y_test shape is ' , y_test.shape)
```

Fig7: data division into train and test.

f. Model testing: to make a prediction and decision data should be integrated into a model to get the prediction results. In our case we used two of the common ML models and they are implemented as follows:

1- SVM Model:

```
#-------------------------------------------------------
#Import Libraries
from sklearn.svm import SVC
#-------------------------------------------------------
#Applying SVC Model

'''
sklearn.svm.SVC(C=1.0, kernel='rbf', degree=3, gamma='auto_deprecated', coef0=0.0, shrinking=True,
                probability=False, tol=0.001, cache_size=200, class_weight=None,verbose=False,
                max_iter=-1, decision_function_shape='ovr', random_state=None)
'''

SVCModel = SVC(kernel= 'rbf',# it can be also linear,poly,sigmoid,precomputed
               max_iter=100,C=0.9,gamma='auto')
SVCModel.fit(X_train, y_train)

#Calculating Details
print('SVCModel Train Score is : ' , SVCModel.score(X_train, y_train))
print('SVCModel Test Score is : ' , SVCModel.score(X_test, y_test))
#print('----------------------------------------------------')

#Calculating Prediction
y_pred = SVCModel.predict(X_test)
print('Predicted Value for SVCModel is : ' , y_pred[:10])
```

```
SVCModel Train Score is :  0.9957983193277311
SVCModel Test Score is :  0.55
Predicted Value for SVCModel is :  ['1' '1' '2' '1' '1' '1' '1' '1' '1' '1']
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/svm/_base.py:231: ConvergenceWarning: Solver terminated early (max_iter=100).  C
onsider pre-processing your data with StandardScaler or MinMaxScaler.
  % self.max_iter, ConvergenceWarning)
```

```
pred_y = SVCModel.predict(X_test)
pred_y
```

```
array(['1', '1', '2', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1',
       '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1',
       '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1',
       '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1', '1',
       '1', '1', '1', '1', '1', '1', '1', '1', '1'], dtype=object)
```

```


pred_y = SVCModel.predict(X_test)

accuracy = accuracy_score(y_test, pred_y)
#recall=precision_recall_fscore_support(train_y, pred_y)
average_precision = average_precision_score(y_test, pred_y)
average_recall= recall_score(y_test, pred_y, average='macro')

print('Average precision-recall score: {0:0.2f}'.format(average_precision),1)
print( 'Accuracy', accuracy,'precision',average_precision,'recall',average_recall)

```

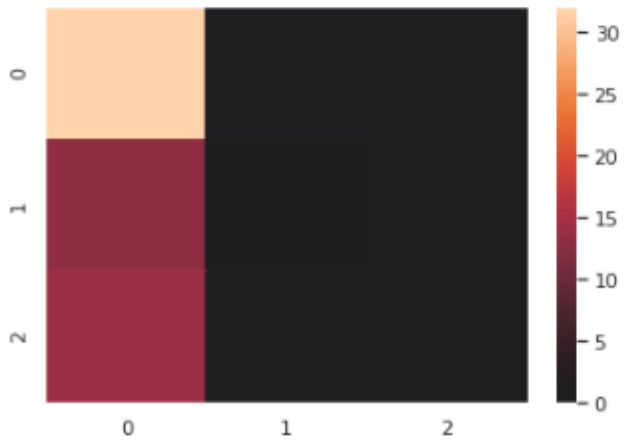
```
# Import Libraries
from sklearn.metrics import f1_score
#Import Libraries
from sklearn.metrics import confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score
from sklearn.metrics import f1_score
from sklearn.metrics import recall_score
from sklearn.metrics import precision_score
from sklearn.metrics import precision_recall_fscore_support
#-------------------------------------------------------
pred_y = SVCModel.predict(X_test)

#-------------------------------------------------------
#Calculating F1 Score  : 2 * (precision * recall) / (precision + recall)
# f1_score(y_true, y_pred, labels=None, pos_label=1, average='binary', sample_weight=None)

F1Score = f1_score(y_test, pred_y, average='micro') #it can be : binary,macro,weighted,samples
print('F1 Score is : ', F1Score)
```

```
F1 Score is :  0.55
```

Fig8: implementing SVM model.

```python
#-----------------------------------------------------
y_pred = SVCModel.predict(X_test)

#-----------------------------------------------------
#Calculating Confusion Matrix
CM = confusion_matrix(y_test, y_pred)
print('Confusion Matrix is : \n', CM)

# drawing confusion matrix
sns.heatmap(CM, center = True)
plt.show()

#-----------------------------------------------------
#Calculating Accuracy Score  : ((TP + TN) / float(TP + TN + FP + FN))
AccScore = accuracy_score(y_test, y_pred, normalize=False)
print('Accuracy Score is : ', AccScore)

#-----------------------------------------------------
#Calculating F1 Score  : 2 * (precision * recall) / (precision + recall)
# f1_score(y_true, y_pred, labels=None, pos_label=1, average='binary', sample_weight=None)

F1Score = f1_score(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,samples
print('F1 Score is : ', F1Score)

#-----------------------------------------------------
#Calculating Recall Score : (Sensitivity) (TP / float(TP + FN))   1 / 1+2
# recall_score(y_true, y_pred, labels=None, pos_label=1, average='binary', sample_weight=None)

RecallScore = recall_score(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,samples
print('Recall Score is : ', RecallScore)

#-----------------------------------------------------
#Calculating Precision Score : (Specificity) #(TP / float(TP + FP))
# precision_score(y_true, y_pred, labels=None, pos_label=1, average='binary',sample_weight=None)

PrecisionScore = precision_score(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,samples
print('Precision Score is : ', PrecisionScore)

#-----------------------------------------------------
#Calculating Precision recall Score :
#metrics.precision_recall_fscore_support(y_true, y_pred, beta=1.0, labels=None, pos_label=1, average=
#                                        None, warn_for = ('precision','recall', 'f-score'), sample_weight=None)

PrecisionRecallScore = precision_recall_fscore_support(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,s
print('Precision Recall Score is : ', PrecisionRecallScore)
```

```
Confusion Matrix is :
 [[32  0  0]
 [13  1  0]
 [14  0  0]]
```




```
Accuracy Score is :  33
F1 Score is :  0.55
Recall Score is :  0.55
Precision Score is :  0.55
Precision Recall Score is :  (0.55, 0.55, 0.55, None)
```

Fig9: SVM model results.

Support vector machine (SVM) model explanation: It is a supervised machine learning algorithm which can be used for both classification and regression challenges. However, it is mostly used in classification problems. In the SVM algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane that differentiates the two classes very well**.**

How does it work?

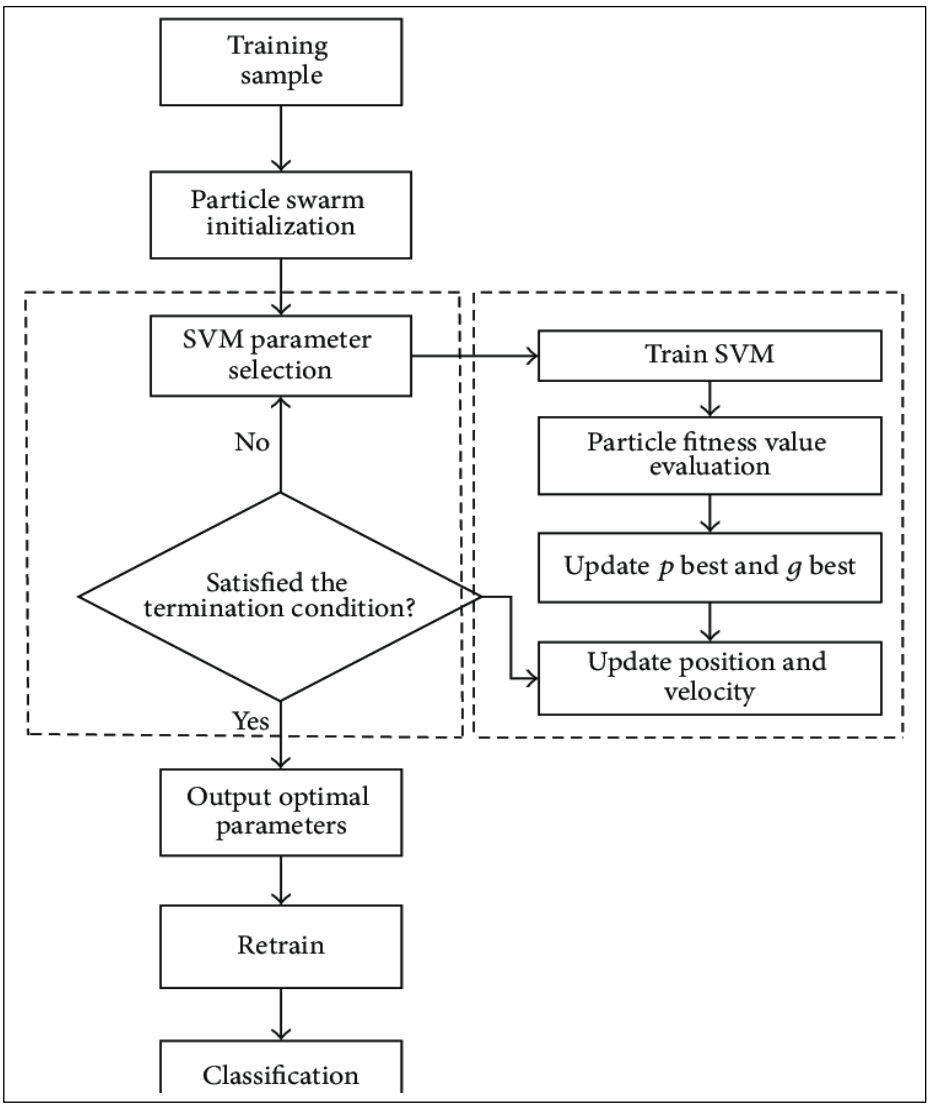


Fig10: Support vector machine flowchart.

2- Decision tree model:

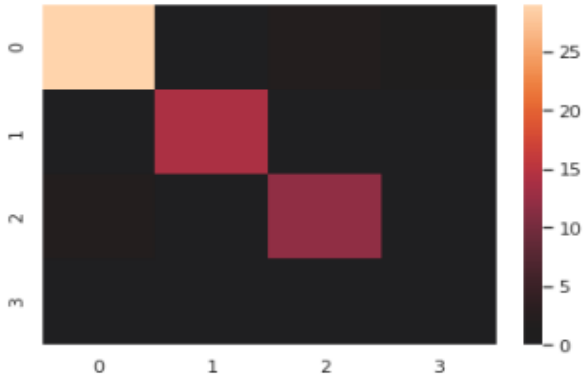
```
#-------------------------------------------------
#Import Libraries
from sklearn.tree import DecisionTreeClassifier
#-------------------------------------------------
#Applying DecisionTreeClassifier Model

'''
sklearn.tree.DecisionTreeClassifier(criterion='gini', splitter='best', max_depth=None,min_samples_split=2,
                                    min_samples_leaf=1,min_weight_fraction_leaf=0.0,max_features=None,
                                    random_state=None, max_leaf_nodes=None,min_impurity_decrease=0.0,
                                    min_impurity_split=None, class_weight=None,presort=False)
'''

DecisionTreeClassifierModel = DecisionTreeClassifier(criterion='gini',max_depth=7,random_state=33) #criterion can be entropy
DecisionTreeClassifierModel.fit(X_train, y_train)

#Calculating Details
print('DecisionTreeClassifierModel Train Score is : ' , DecisionTreeClassifierModel.score(X_train, y_train))
print('DecisionTreeClassifierModel Test Score is : ' , DecisionTreeClassifierModel.score(X_test, y_test))
print('DecisionTreeClassifierModel Classes are : ' , DecisionTreeClassifierModel.classes_)
print('DecisionTreeClassifierModel feature importances are : ' , DecisionTreeClassifierModel.feature_importances_)
#print('----------------------------------------------------')

#Calculating Prediction
y_pred = DecisionTreeClassifierModel.predict(X_test)
y_pred_prob = DecisionTreeClassifierModel.predict_proba(X_test)
#print('Predicted Value for DecisionTreeClassifierModel is : ' , y_pred[:10])
#print('Prediction Probabilities Value for DecisionTreeClassifierModel is : ' , y_pred_prob[:10])
```

```
DecisionTreeClassifierModel Train Score is :  0.9831932773109243
DecisionTreeClassifierModel Test Score is :  0.9166666666666666
DecisionTreeClassifierModel Classes are :  ['1' '2' '3' 'goog']
DecisionTreeClassifierModel feature importances are :  [0.08761719 0.06113662 0.         0.03763688 0.00138276 0.05622362
 0.08715564 0.66884729]
```

Fig 11: Decision tree implementing

```
#-------------------------------------------------------
y_pred = DecisionTreeClassifierModel.predict(X_test)

#-------------------------------------------------------
#Calculating Confusion Matrix
CM = confusion_matrix(y_test, y_pred)
print('Confusion Matrix is : \n', CM)

# drawing confusion matrix
sns.heatmap(CM, center = True)
plt.show()

#-------------------------------------------------------
#Calculating Accuracy Score  : ((TP + TN) / float(TP + TN + FP + FN))
AccScore = accuracy_score(y_test, y_pred, normalize=False)
print('Accuracy Score is : ', AccScore)

#-------------------------------------------------------
#Calculating F1 Score  : 2 * (precision * recall) / (precision + recall)
# f1_score(y_true, y_pred, labels=None, pos_label=1, average='binary', sample_weight=None)

F1Score = f1_score(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,samples
print('F1 Score is : ', F1Score)

#-------------------------------------------------------
#Calculating Recall Score : (Sensitivity) (TP / float(TP + FN))   1 / 1+2
# recall_score(y_true, y_pred, labels=None, pos_label=1, average='binary', sample_weight=None)

RecallScore = recall_score(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,samples
print('Recall Score is : ', RecallScore)

#-------------------------------------------------------
#Calculating Precision Score : (Specificity) #(TP / float(TP + FP))
# precision_score(y_true, y_pred, labels=None, pos_label=1, average='binary',sample_weight=None)

PrecisionScore = precision_score(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,samples
print('Precision Score is : ', PrecisionScore)

#-------------------------------------------------------
#Calculating Precision recall Score :
#metrics.precision_recall_fscore_support(y_true, y_pred, beta=1.0, labels=None, pos_label=1, average=
#                                        None, warn_for = ('precision','recall', 'f-score'), sample_weight=None)

PrecisionRecallScore = precision_recall_fscore_support(y_test, y_pred, average='micro') #it can be : binary,macro,weighted,s
print('Precision Recall Score is : ', PrecisionRecallScore)
```

```
Confusion Matrix is :
 [[29  0  2  1]
 [ 0 14  0  0]
 [ 2  0 12  0]
 [ 0  0  0  0]]
```



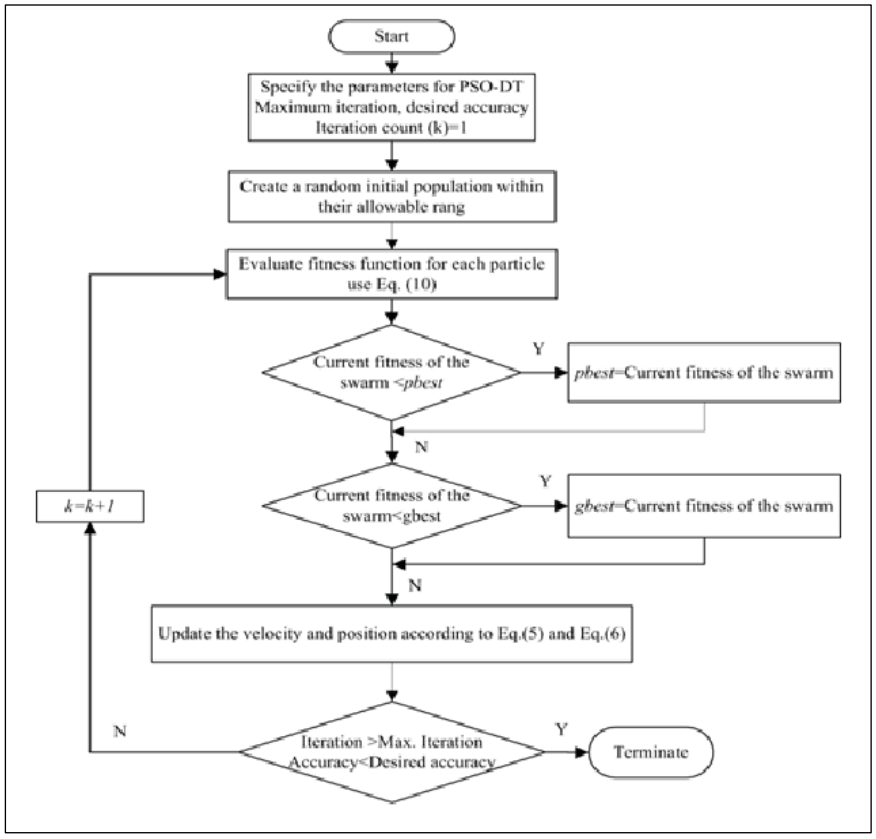

```
Accuracy Score is :  55
F1 Score is :  0.9166666666666666
Recall Score is :  0.9166666666666666
Precision Score is :  0.9166666666666666
Precision Recall Score is :  (0.9166666666666666, 0.9166666666666666, 0.9166666666666666, Non
```

Fig 12: testing decision tree predicting model and results

Decision tree explanation: It is the most powerful and popular tool for classification and prediction. A Decision tree is a flowchart like tree structure, where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node (terminal node) holds a class label.

Construction of decision tree: A tree can be "learned" by splitting the source set into subsets based on an attribute value test. This process is repeated on each derived subset in a recursive manner called recursive partitioning. The recursion is completed when the subset at a node all has the same value of the target variable, or when splitting no longer adds value to the predictions. The construction of decision tree classifier does not require any domain knowledge or parameter setting, and therefore is appropriate for exploratory knowledge discovery. Decision trees can handle high dimensional data. In general decision tree classifier has good accuracy. Decision tree induction is a typical inductive approach to learn knowledge on classification.

How does it work?



g. Models comparison:

	SVM	Decision Tree
Training accuracy	99%	98%
Test accuracy	55%	91%
Accuracy score	33	55
F1 score	0.55	0.91
Precision Score	0.55	0.91
Precision Recall Score for classes (0,1,2,3)	(0.55, 0.55, 0.55, None)	(0.9166666666666666, 0.9166666666666666, 0.9166666666666666, None)

h. Chosen model: after this comparison table the accepted model is decision tree which has highest accuracy score, f1 score, precision score, and precision recall score.

- **User interface implementation:**
  1. **Login screen:** It is the first screen that appears to the users that enables the users to access the system:

Fig13: Login Screen

  2. **The list of apps to choose between them:** this screen allows the user to choose which module to work with:

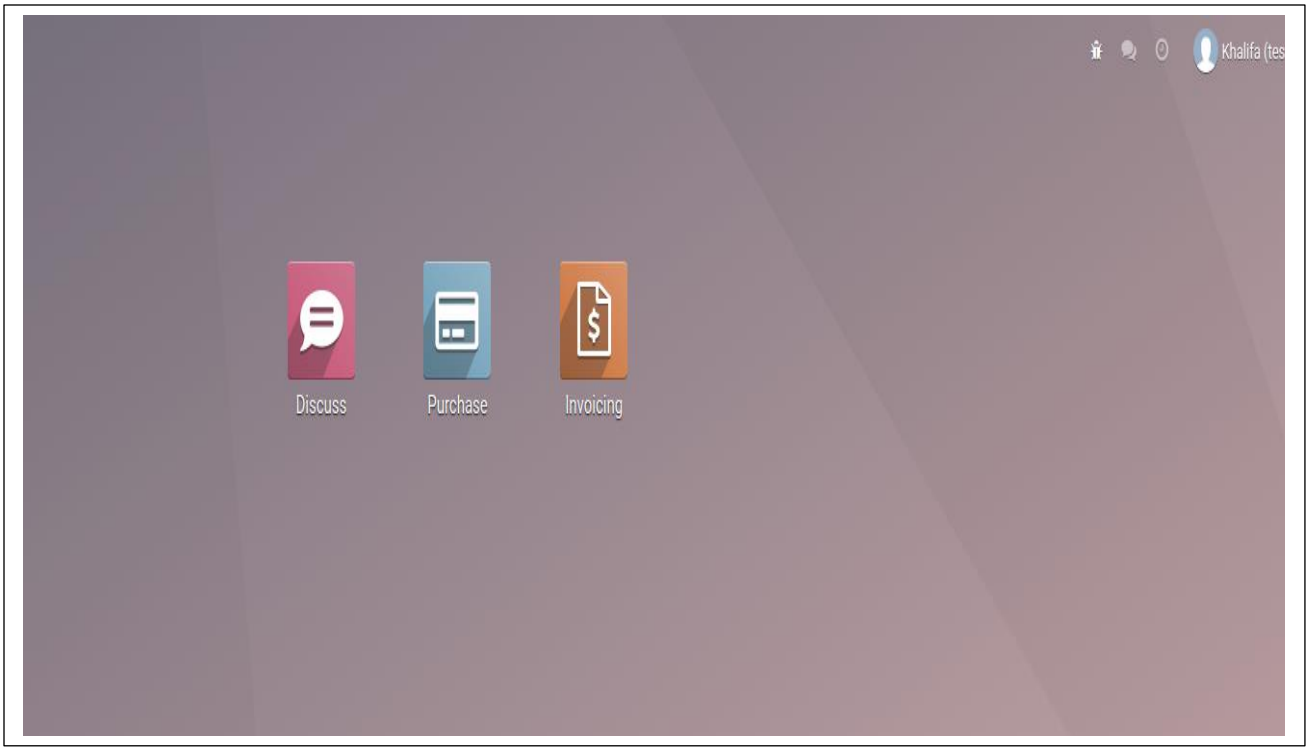


Fig14: List of modules

3. **Purchasing module:** this module is responsible for supply chain management which is the main object of our project and it has multiple functions which will be shown as following order:

   1- It views summary report of purchased orders and postponed purchasing orders with a control dashboard like purchase late invoices and another controlling actions:

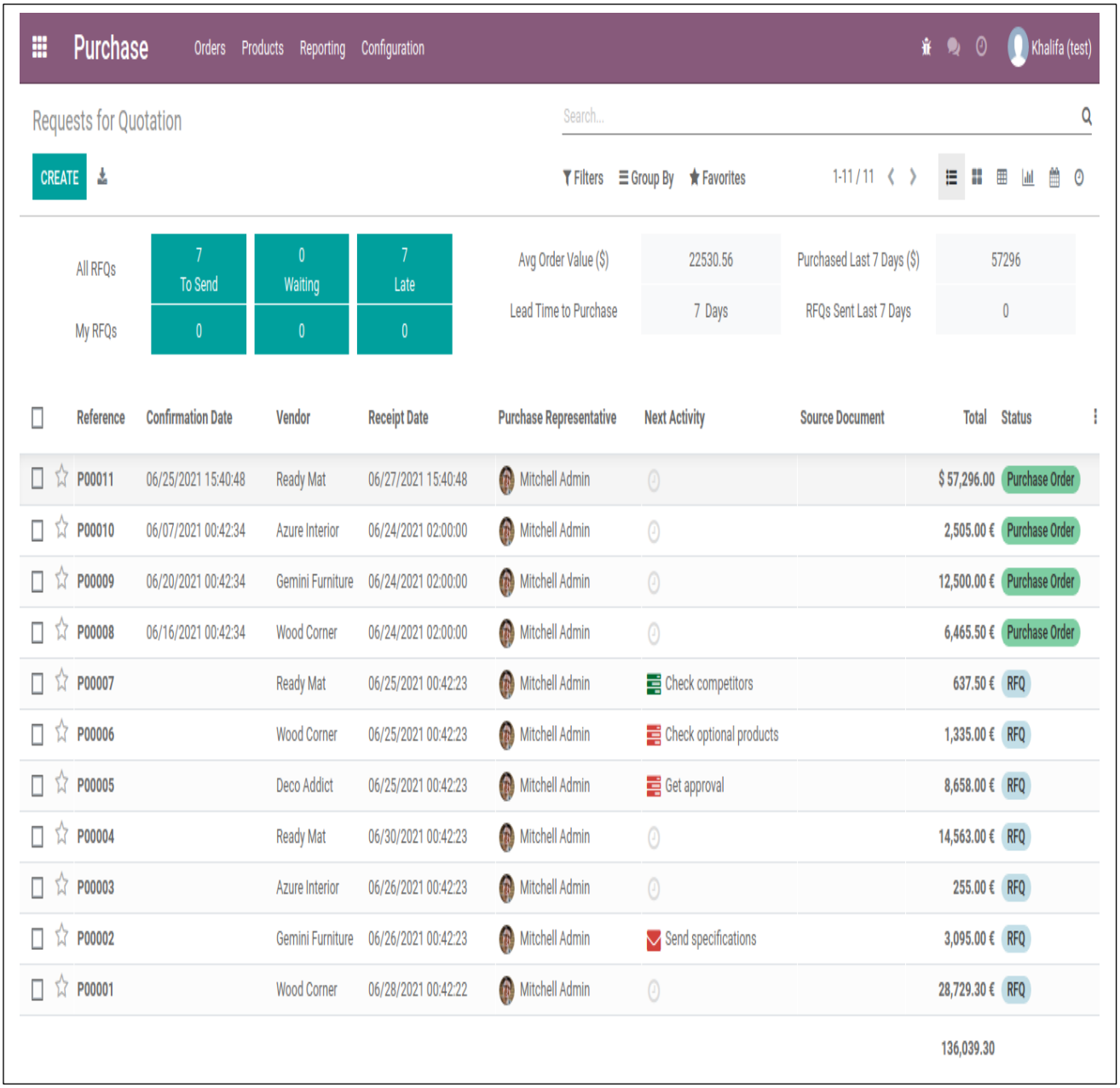


Fig15: inside Purchasing module.

2- Viewing vendors and purchasing orders and request quotations for new shipment: each button in the following list has internal function which will be explained in details in advanced stage.

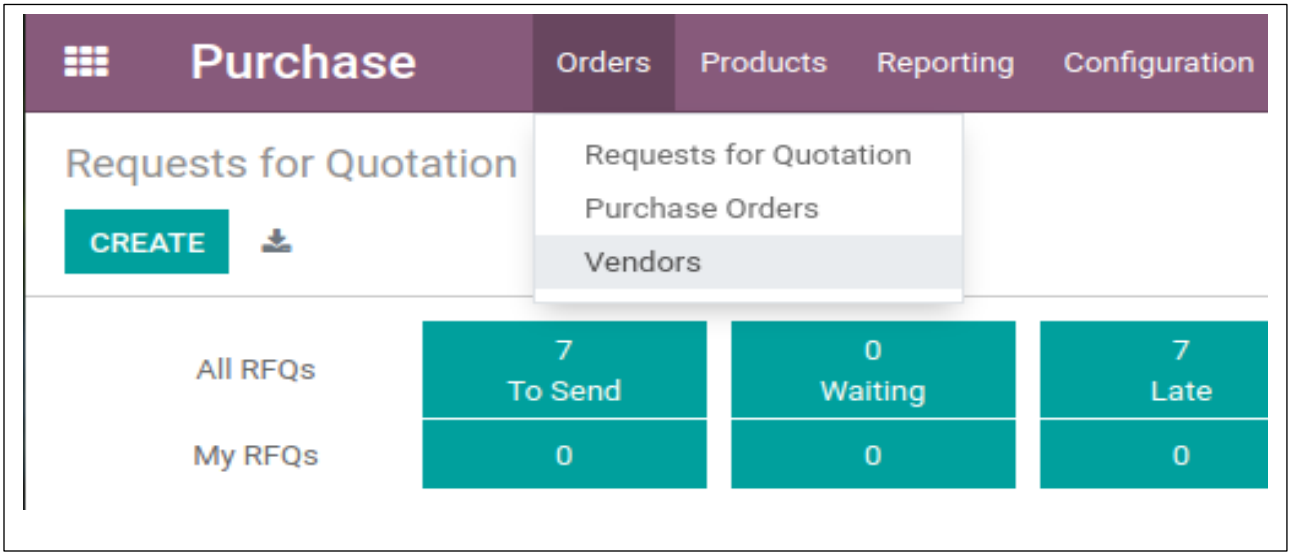
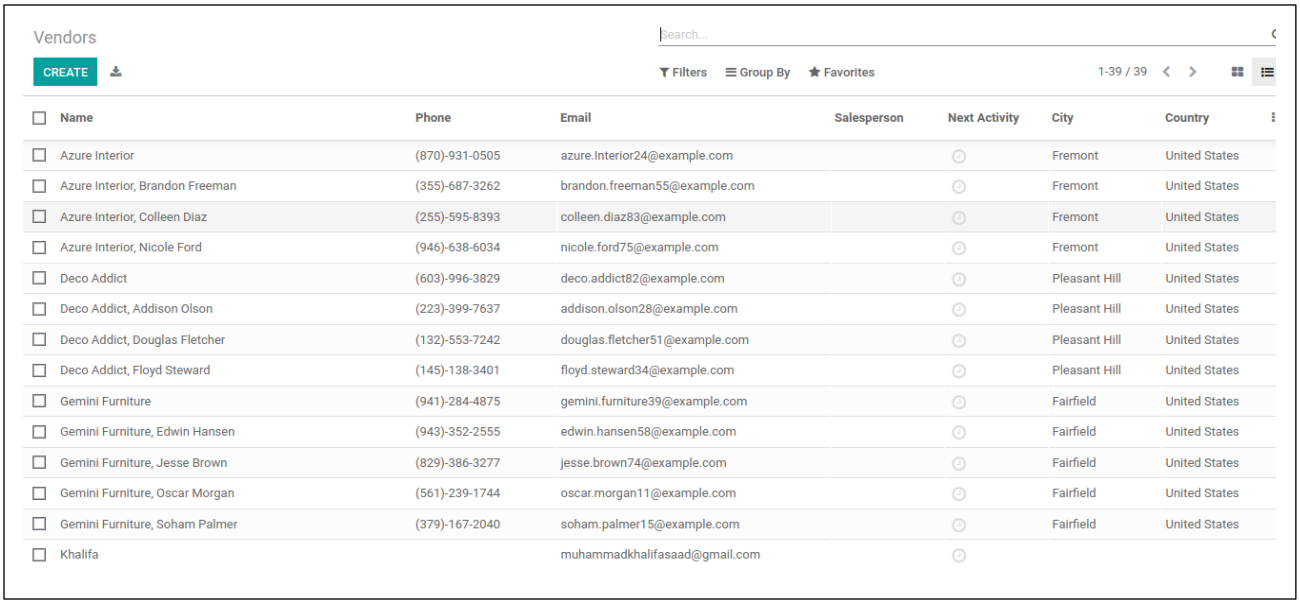


Fig16: orders dropdown menu.

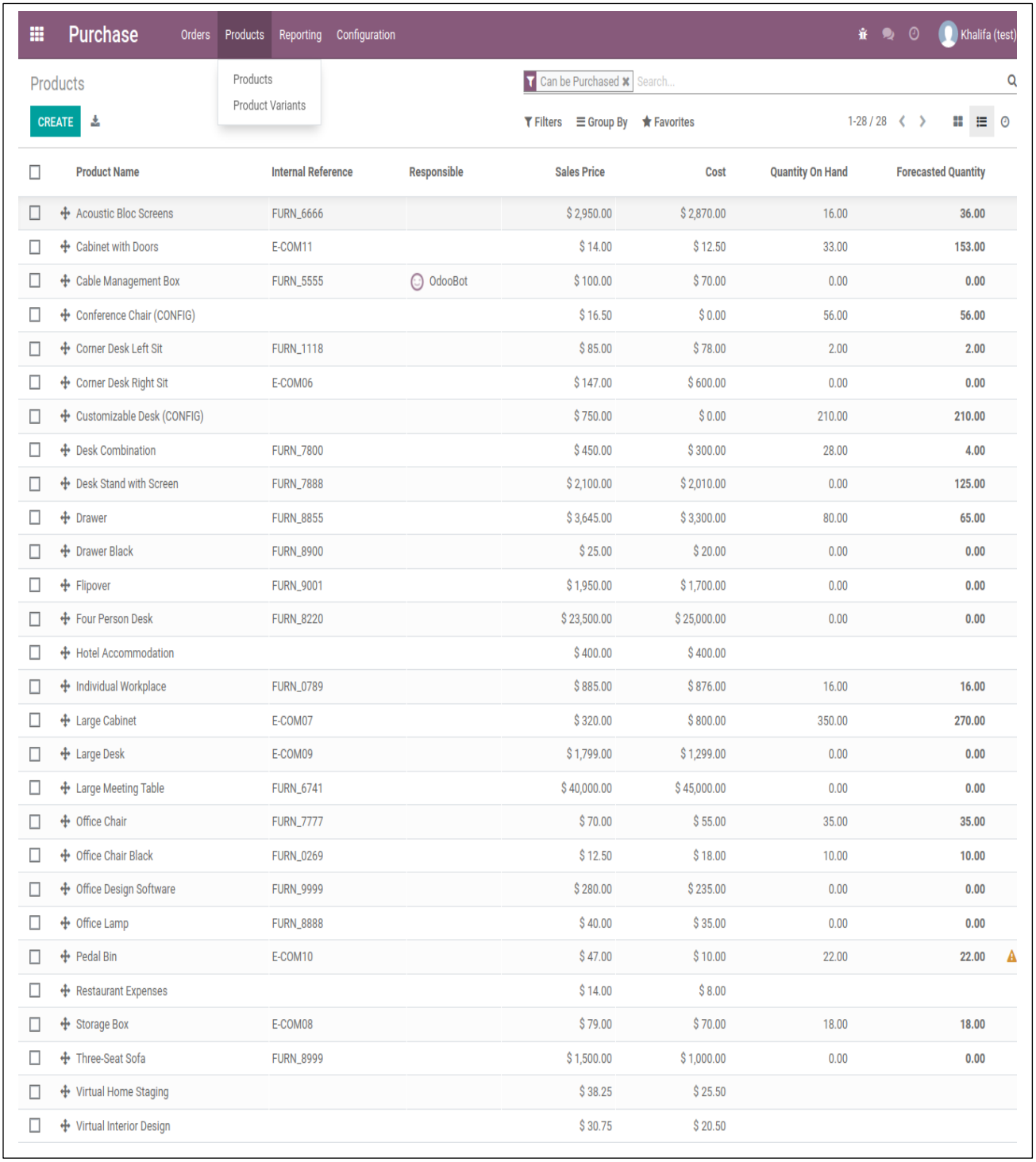
3- vendors button: this button view the list of vendors and suppliers which we can order products from them that meets our selection criteria and it has a control board that enables the user create, delete, make an order, send email, change cost of shipping and taxes, and etc…..



Name	Phone	Email	Salesperson	Next Activity	City	Country
Azure Interior	(870)-931-0505	azure.Interior24@example.com			Fremont	United States
Azure Interior, Brandon Freeman	(355)-687-3262	brandon.freeman55@example.com			Fremont	United States
Azure Interior, Colleen Diaz	(255)-595-8393	colleen.diaz83@example.com			Fremont	United States
Azure Interior, Nicole Ford	(946)-638-6034	nicole.ford75@example.com			Fremont	United States
Deco Addict	(603)-996-3829	deco.addict82@example.com			Pleasant Hill	United States
Deco Addict, Addison Olson	(223)-399-7637	addison.olson28@example.com			Pleasant Hill	United States
Deco Addict, Douglas Fletcher	(132)-553-7242	douglas.fletcher51@example.com			Pleasant Hill	United States
Deco Addict, Floyd Steward	(145)-138-3401	floyd.steward34@example.com			Pleasant Hill	United States
Gemini Furniture	(941)-284-4875	gemini.furniture39@example.com			Fairfield	United States
Gemini Furniture, Edwin Hansen	(943)-352-2555	edwin.hansen58@example.com			Fairfield	United States
Gemini Furniture, Jesse Brown	(829)-386-3277	jesse.brown74@example.com			Fairfield	United States
Gemini Furniture, Oscar Morgan	(561)-239-1744	oscar.morgan11@example.com			Fairfield	United States
Gemini Furniture, Soham Palmer	(379)-167-2040	soham.palmer15@example.com			Fairfield	United States
Khalifa		muhammadkhalifasaad@gmail.com				

Fig17: List of the vendors.

3- Products button: this button views the products which is available in the inventory, can be purchased, and wanted products and some other important features of products. Here is what product button shows:

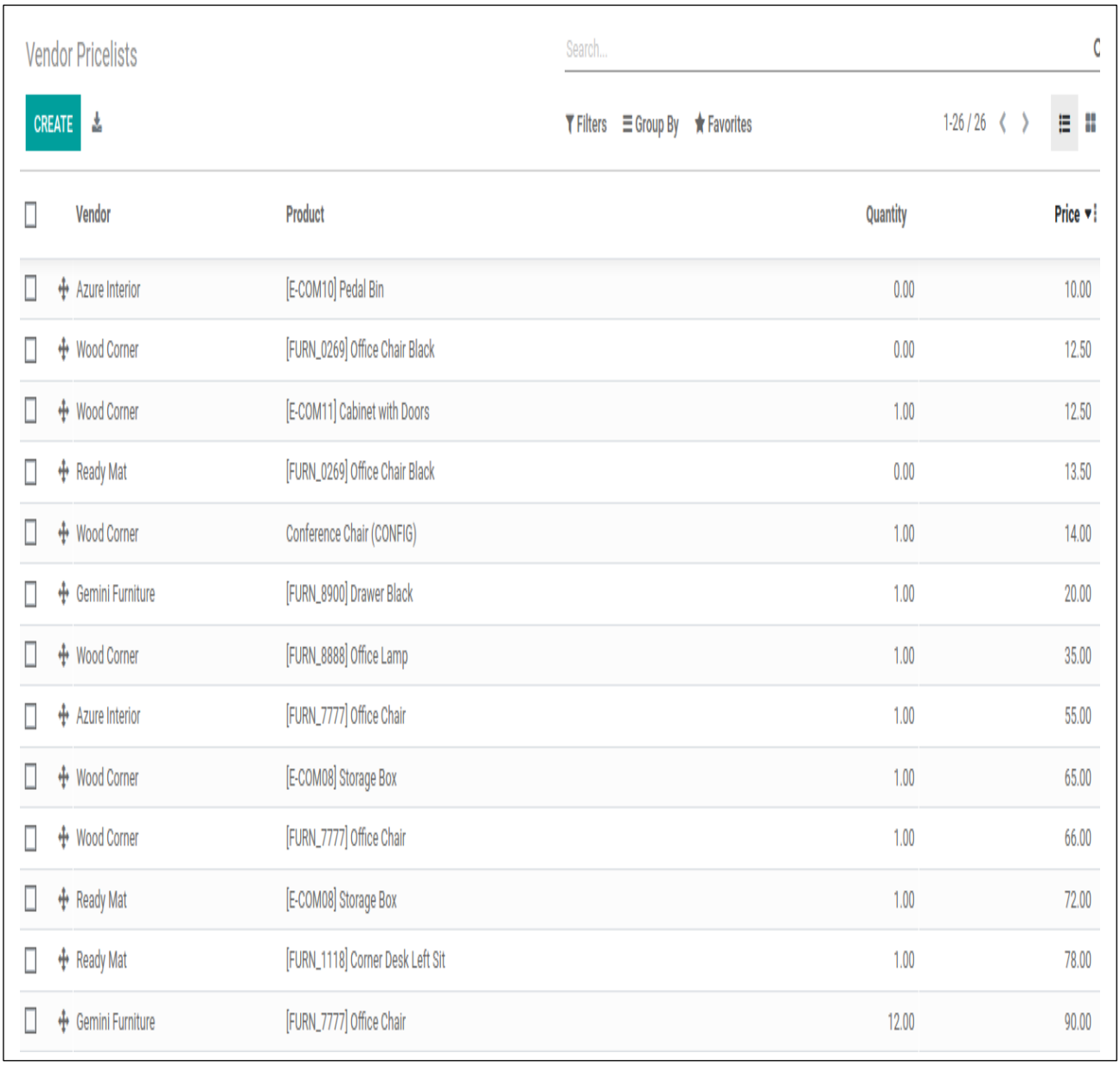


Product Name	Internal Reference	Responsible	Sales Price	Cost	Quantity On Hand	Forecasted Quantity
Acoustic Bloc Screens	FURN_6666		$ 2,950.00	$ 2,870.00	16.00	36.00
Cabinet with Doors	E-COM11		$ 14.00	$ 12.50	33.00	153.00
Cable Management Box	FURN_5555	OdooBot	$ 100.00	$ 70.00	0.00	0.00
Conference Chair (CONFIG)			$ 16.50	$ 0.00	56.00	56.00
Corner Desk Left Sit	FURN_1118		$ 85.00	$ 78.00	2.00	2.00
Corner Desk Right Sit	E-COM06		$ 147.00	$ 600.00	0.00	0.00
Customizable Desk (CONFIG)			$ 750.00	$ 0.00	210.00	210.00
Desk Combination	FURN_7800		$ 450.00	$ 300.00	28.00	4.00
Desk Stand with Screen	FURN_7888		$ 2,100.00	$ 2,010.00	0.00	125.00
Drawer	FURN_8855		$ 3,645.00	$ 3,300.00	80.00	65.00
Drawer Black	FURN_8900		$ 25.00	$ 20.00	0.00	0.00
Flipover	FURN_9001		$ 1,950.00	$ 1,700.00	0.00	0.00
Four Person Desk	FURN_8220		$ 23,500.00	$ 25,000.00	0.00	0.00
Hotel Accommodation			$ 400.00	$ 400.00		
Individual Workplace	FURN_0789		$ 885.00	$ 876.00	16.00	16.00
Large Cabinet	E-COM07		$ 320.00	$ 800.00	350.00	270.00
Large Desk	E-COM09		$ 1,799.00	$ 1,299.00	0.00	0.00
Large Meeting Table	FURN_6741		$ 40,000.00	$ 45,000.00	0.00	0.00
Office Chair	FURN_7777		$ 70.00	$ 55.00	35.00	35.00
Office Chair Black	FURN_0269		$ 12.50	$ 18.00	10.00	10.00
Office Design Software	FURN_9999		$ 280.00	$ 235.00	0.00	0.00
Office Lamp	FURN_8888		$ 40.00	$ 35.00	0.00	0.00
Pedal Bin	E-COM10		$ 47.00	$ 10.00	22.00	22.00
Restaurant Expenses			$ 14.00	$ 8.00		
Storage Box	E-COM08		$ 79.00	$ 70.00	18.00	18.00
Three-Seat Sofa	FURN_8999		$ 1,500.00	$ 1,000.00	0.00	0.00
Virtual Home Staging			$ 38.25	$ 25.50		
Virtual Interior Design			$ 30.75	$ 20.50		

Fig18: list of products.

In the previous picture the quick view of products with list view and we have control buttons to create and other functions that can be done in the products branch from purchasing module.

4- Vendor Pricelist: in this screen prices will be shown in a list ordered by vendors and quantity that can be ordered or stored in inventory.



Vendor	Product	Quantity	Price
Azure Interior	[E-COM10] Pedal Bin	0.00	10.00
Wood Corner	[FURN_0269] Office Chair Black	0.00	12.50
Wood Corner	[E-COM11] Cabinet with Doors	1.00	12.50
Ready Mat	[FURN_0269] Office Chair Black	0.00	13.50
Wood Corner	Conference Chair (CONFIG)	1.00	14.00
Gemini Furniture	[FURN_8900] Drawer Black	1.00	20.00
Wood Corner	[FURN_8888] Office Lamp	1.00	35.00
Azure Interior	[FURN_7777] Office Chair	1.00	55.00
Wood Corner	[E-COM08] Storage Box	1.00	65.00
Wood Corner	[FURN_7777] Office Chair	1.00	66.00
Ready Mat	[E-COM08] Storage Box	1.00	72.00
Ready Mat	[FURN_1118] Corner Desk Left Sit	1.00	78.00
Gemini Furniture	[FURN_7777] Office Chair	12.00	90.00

Fig19: vendors' pricelist.

5- Product categories: in this screen product are compressed into categories to make it easier to search for a product.

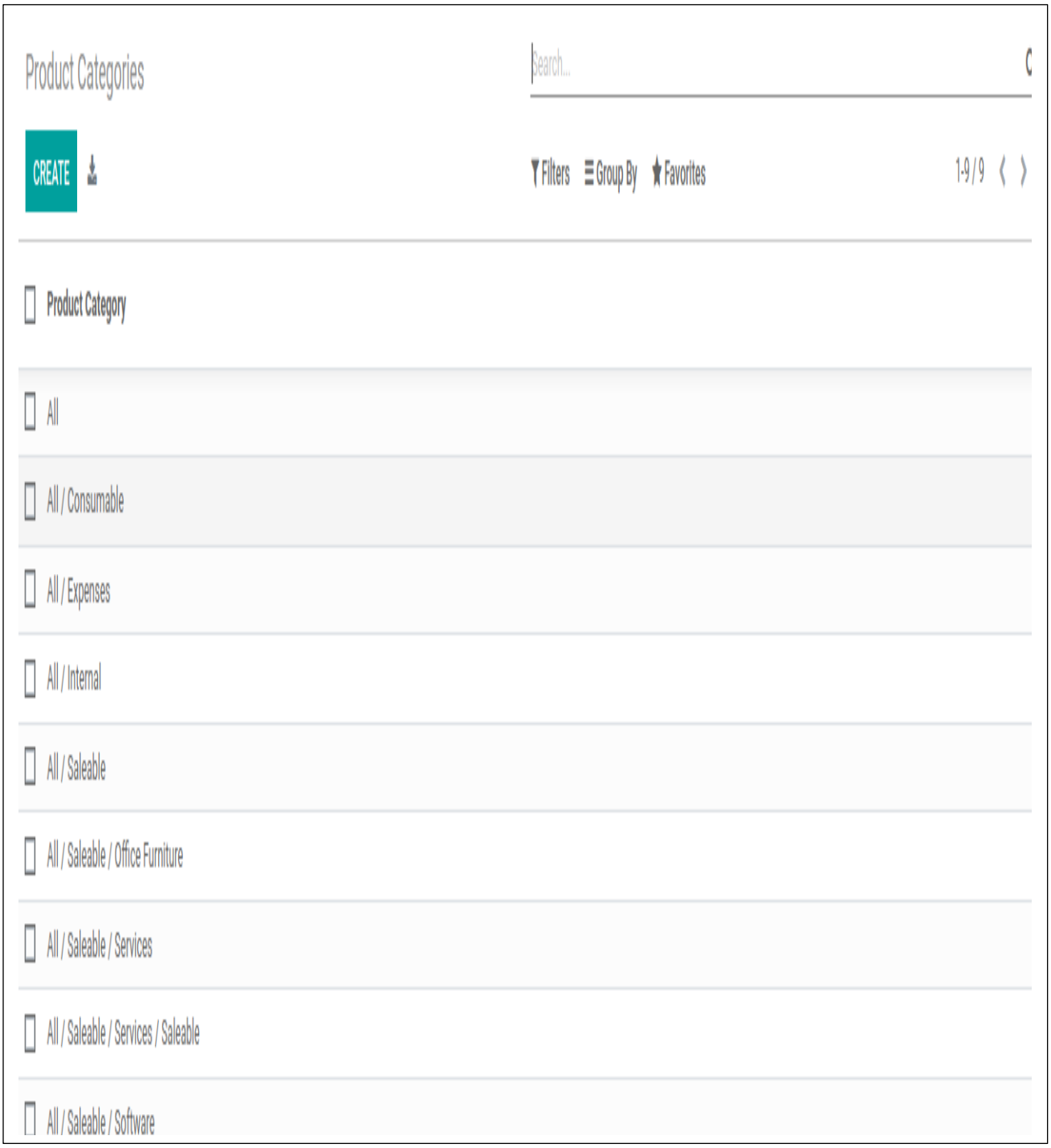
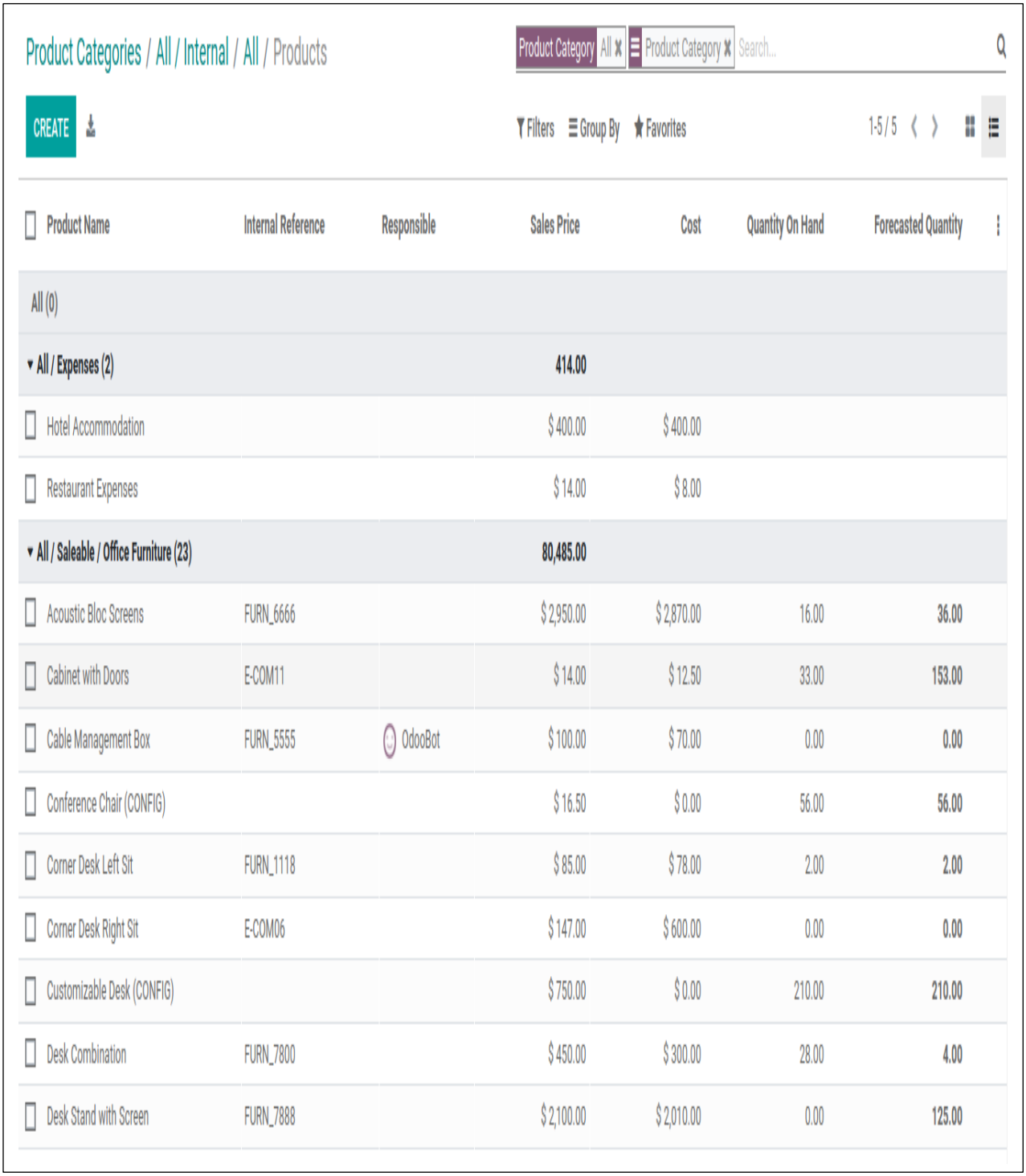


Fig20: Product categories.

6- Expanding product categories: when we expand each category a list of the



Product Name	Internal Reference	Responsible	Sales Price	Cost	Quantity On Hand	Forecasted Quantity
All (0)						
▾ All / Expenses (2)			414.00			
Hotel Accommodation			$ 400.00	$ 400.00		
Restaurant Expenses			$ 14.00	$ 8.00		
▾ All / Saleable / Office Furniture (23)			80,485.00			
Acoustic Bloc Screens	FURN_6666		$ 2,950.00	$ 2,870.00	16.00	36.00
Cabinet with Doors	E-COM11		$ 14.00	$ 12.50	33.00	153.00
Cable Management Box	FURN_5555	OdooBot	$ 100.00	$ 70.00	0.00	0.00
Conference Chair (CONFIG)			$ 16.50	$ 0.00	56.00	56.00
Corner Desk Left Sit	FURN_1118		$ 85.00	$ 78.00	2.00	2.00
Corner Desk Right Sit	E-COM06		$ 147.00	$ 600.00	0.00	0.00
Customizable Desk (CONFIG)			$ 750.00	$ 0.00	210.00	210.00
Desk Combination	FURN_7800		$ 450.00	$ 300.00	28.00	4.00
Desk Stand with Screen	FURN_7888		$ 2,100.00	$ 2,010.00	0.00	125.00

7- purchasing analysis: in this screen there is a summary analysis of purchased products and the ordered products. The summary is viewed by a different charts and graphs like bar chart, line chart, and pie chart. And here are the views:

a. the line chart:

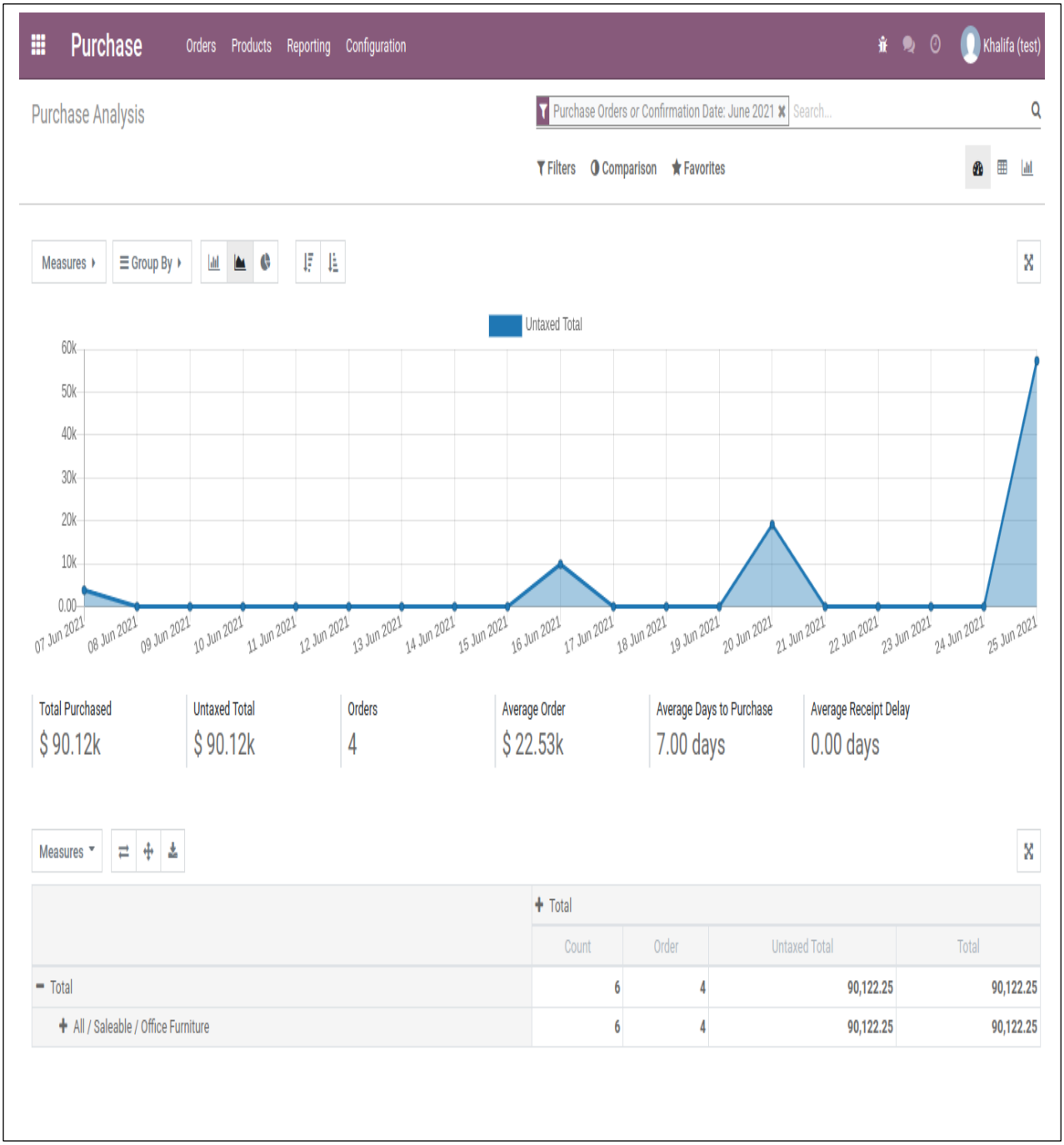


Fig21: line chart for purchase analysis.

b. the bar chart:

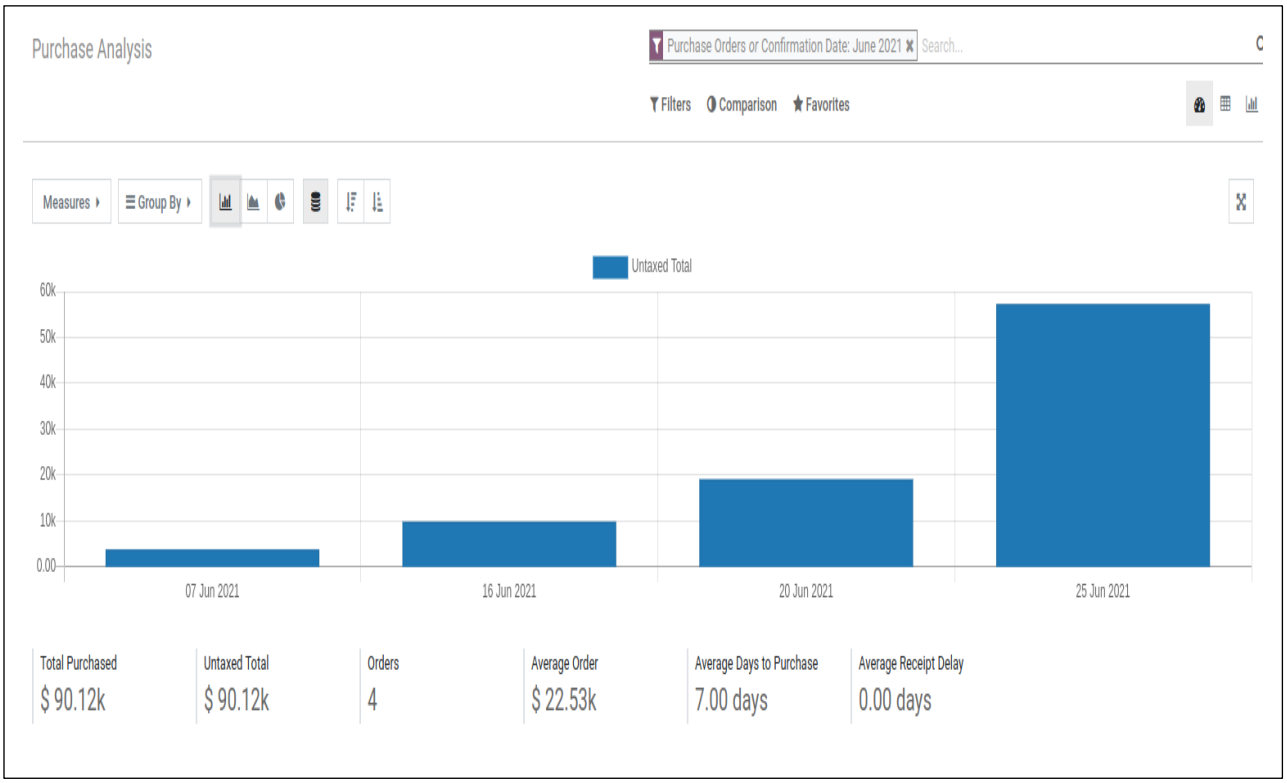


Fig22: bar chart for purchase analysis

c. the pie chart:

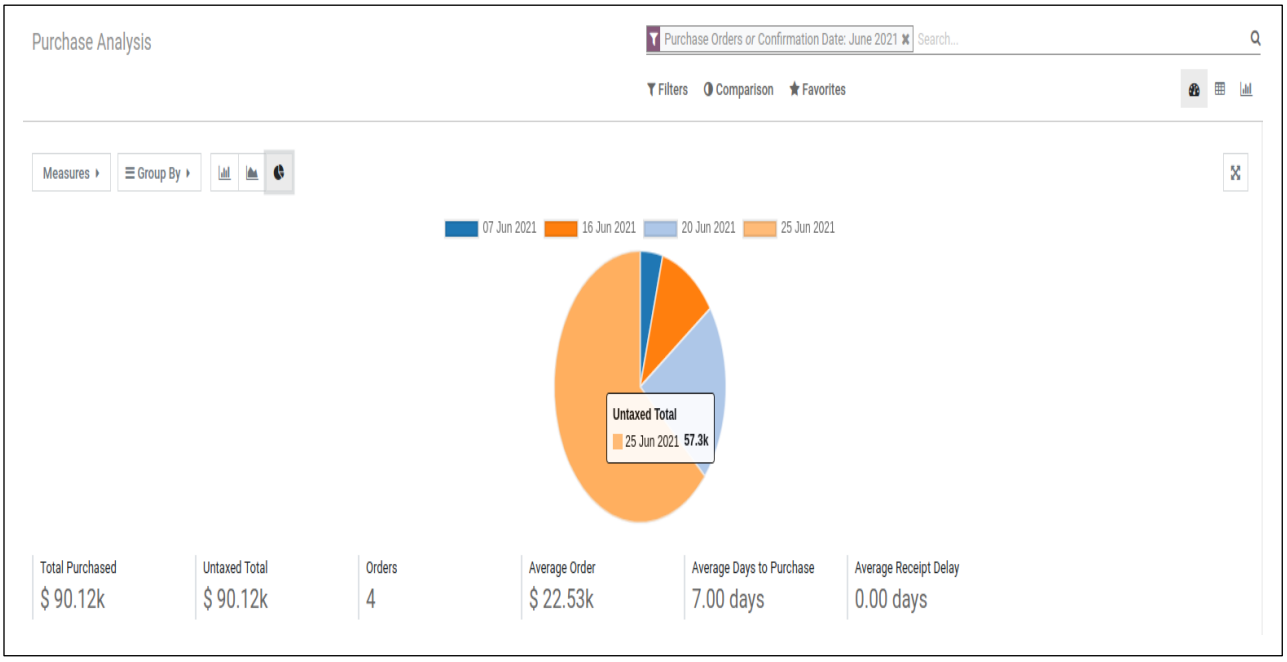


Fig23: pie chart for purchase analysis.

4. **The inventory module:** Odoo Inventory Management is intended to scale from a few thousands of operations to many various transactions. It helps businesses manage their products or assets inventory without any hurdles. Odoo inventory management is the best double entry integrated inventory & tracking system for warehouse management. With Odoo inventory management module you can manage your warehouse, vendors, purchase flows etc.
   this an internal view of the module:

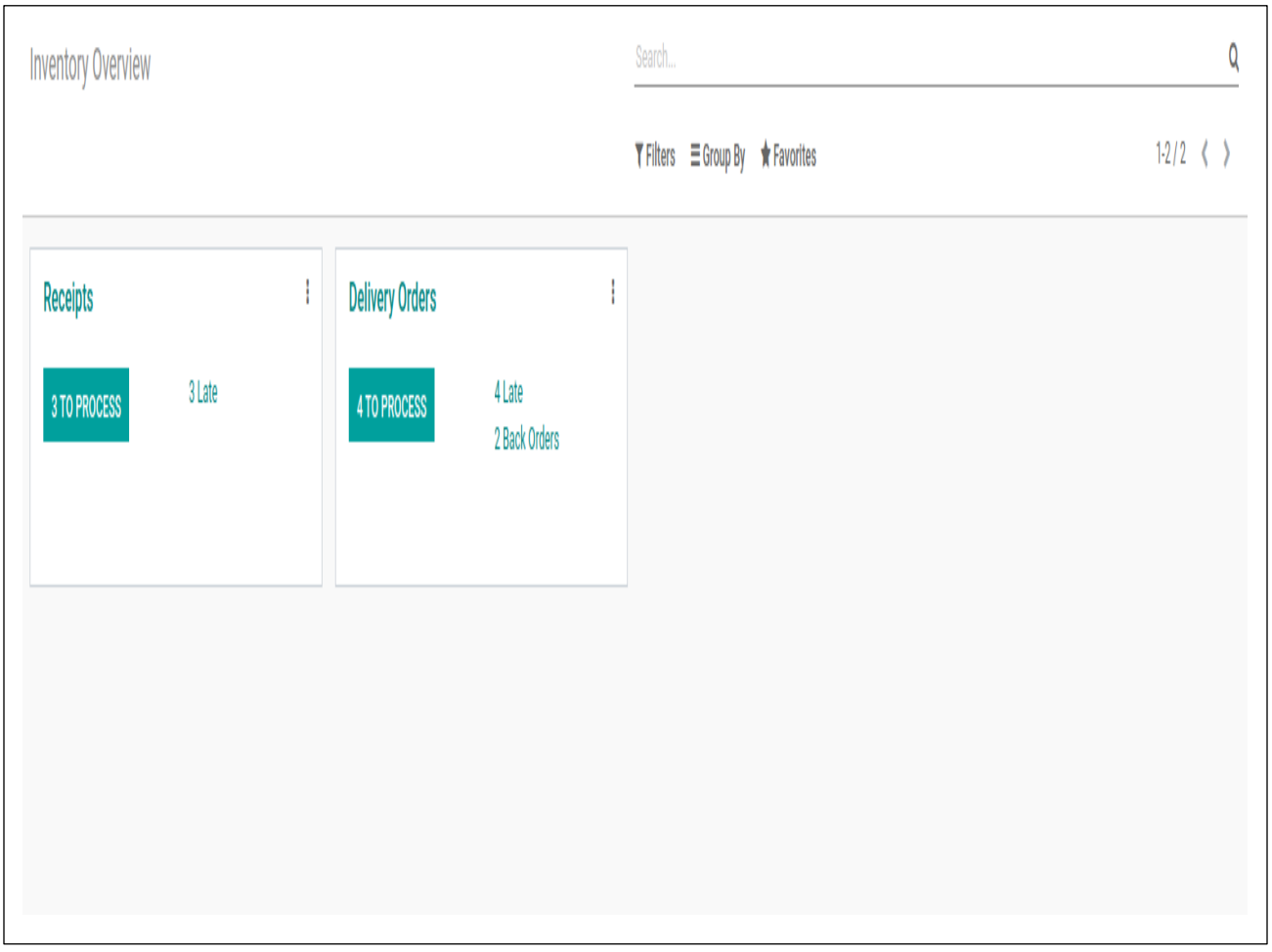


Fig24: internal view of inventory model.

Then we are going to explain each part in the module individually to make a clear view of it.

1- The inventory operations: it comes in five operations which are: transfer, replenishment, inventory adjustment, and scrap, run scheduler. And they are shown as following:

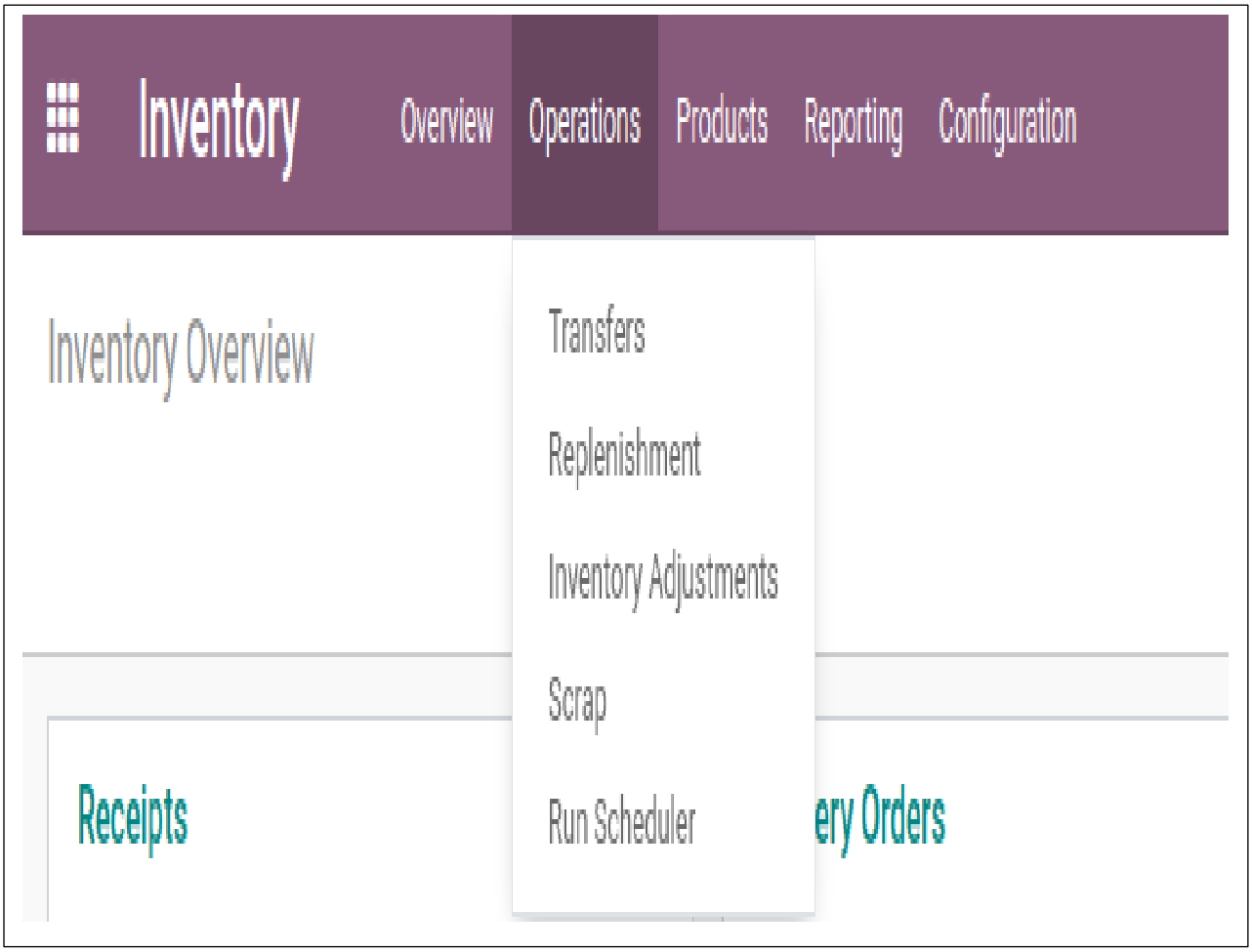
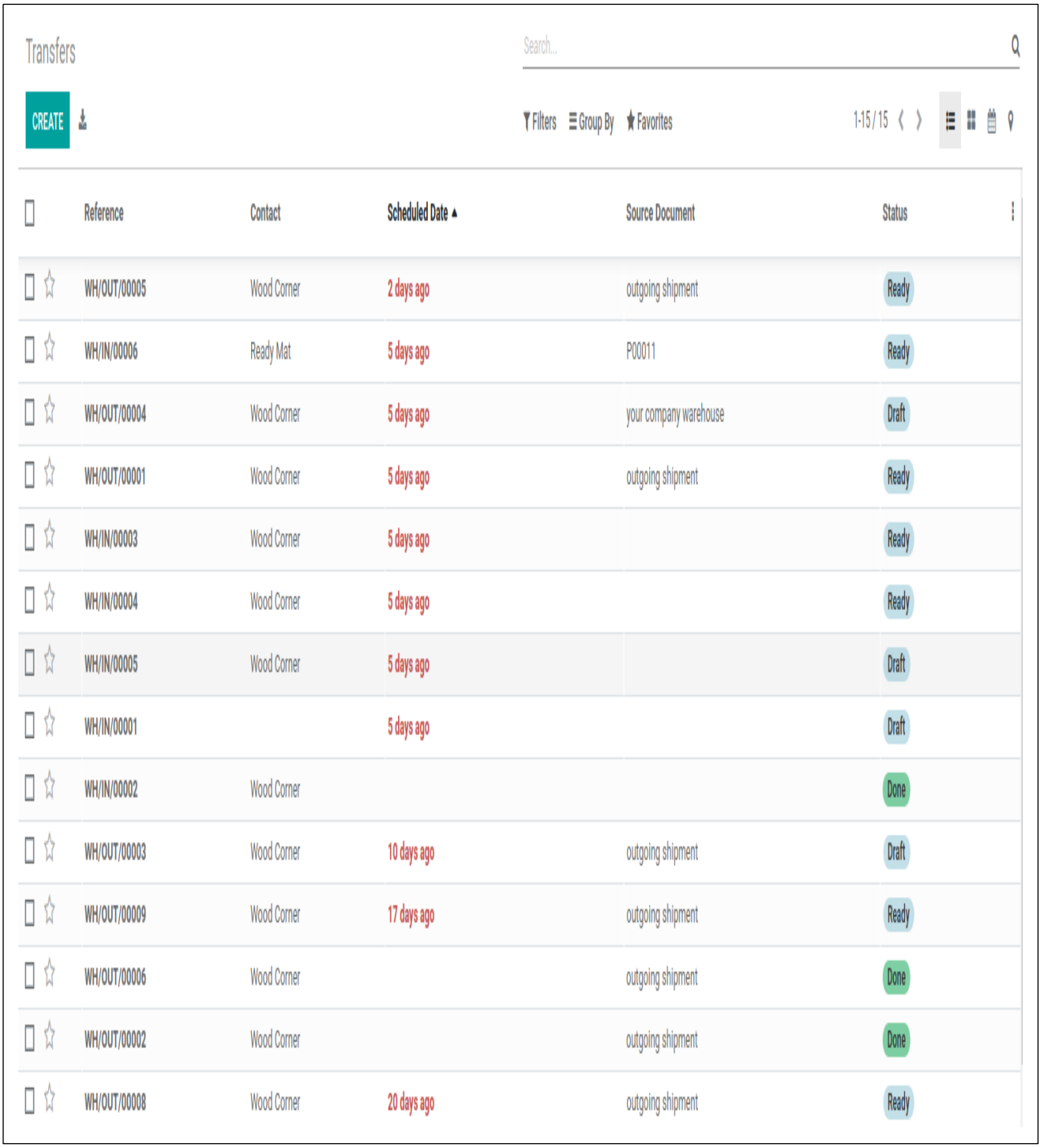


Fig25: inventory operations dropdown menu.

A. transfer operation: it shows the list of products that should be delivered from the inventory and the schedule of shipping:



Reference	Contact	Scheduled Date ▲	Source Document	Status
WH/OUT/00005	Wood Corner	2 days ago	outgoing shipment	Ready
WH/IN/00006	Ready Mat	5 days ago	P00011	Ready
WH/OUT/00004	Wood Corner	5 days ago	your company warehouse	Draft
WH/OUT/00001	Wood Corner	5 days ago	outgoing shipment	Ready
WH/IN/00003	Wood Corner	5 days ago		Ready
WH/IN/00004	Wood Corner	5 days ago		Ready
WH/IN/00005	Wood Corner	5 days ago		Draft
WH/IN/00001		5 days ago		Draft
WH/IN/00002	Wood Corner			Done
WH/OUT/00003	Wood Corner	10 days ago	outgoing shipment	Draft
WH/OUT/00009	Wood Corner	17 days ago	outgoing shipment	Ready
WH/OUT/00006	Wood Corner		outgoing shipment	Done
WH/OUT/00002	Wood Corner		outgoing shipment	Done
WH/OUT/00008	Wood Corner	20 days ago	outgoing shipment	Ready

Fig26: transfers operation view.

B. scrap: this operation will make a scrap orders to remove it from the inventory to be alerted when the amount of products is going to finish.

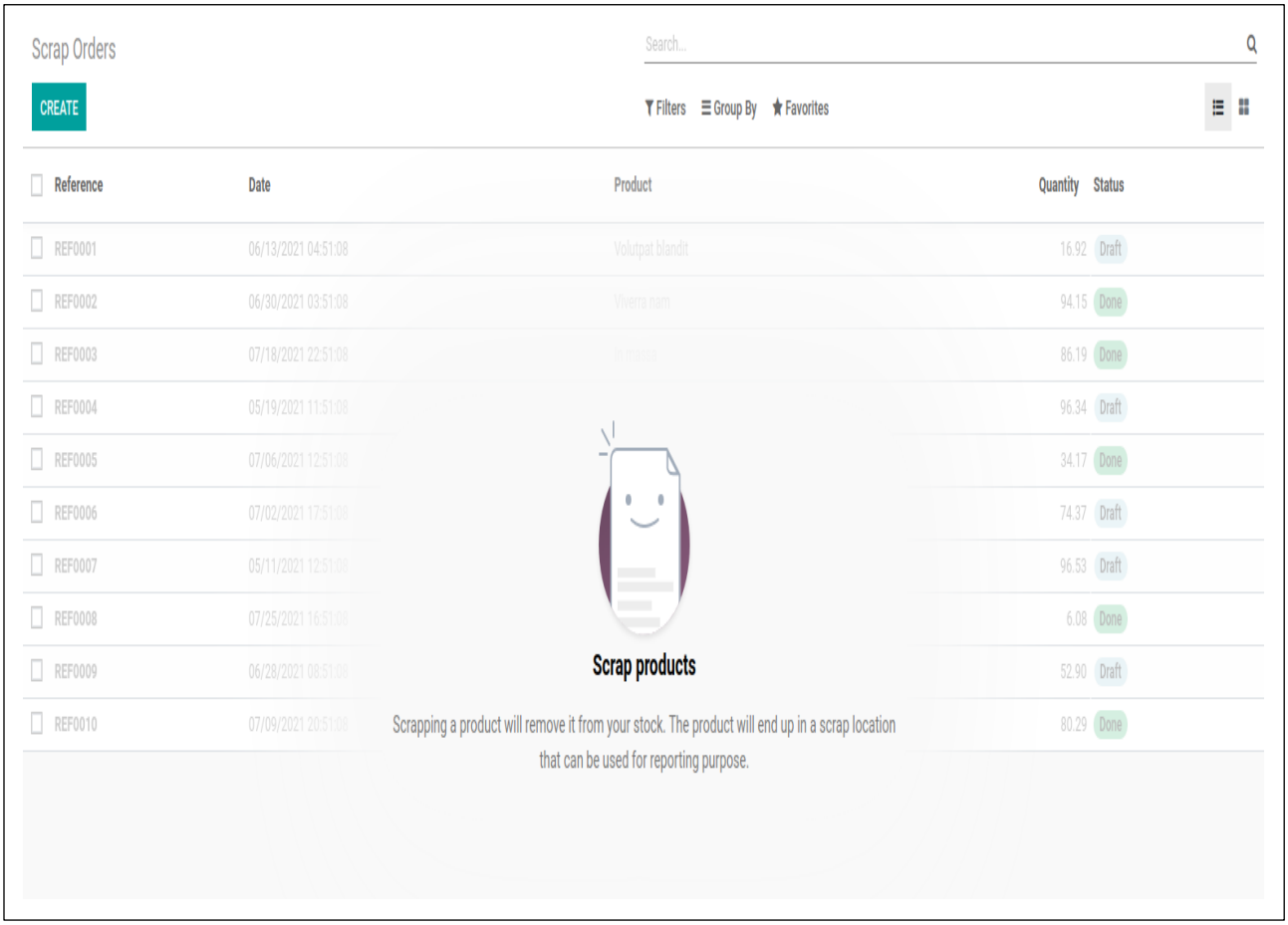


Fig27: Scrap orders operation view.

After the inventory operations it's the time to view inventory reports.

the reports comes in a viral shapes like warehouse analysis, inventory report, inventory valuation, and etc. each report contain some of important analysis that help the administrators and managers to make a decisions about required and unwanted products and deliver orders that has time delay.

First report we have is warehouse analysis: in this report it shows a summary statistics with some charts that contain useful information for managers to rely on them in the process of making a decision. Here is a screen for that.
The second report is the inventory report. This report is viewing the reports about shipped and required orders and viewing the available quantity of product and the total price of these quantity. And the report looks like the following figure:

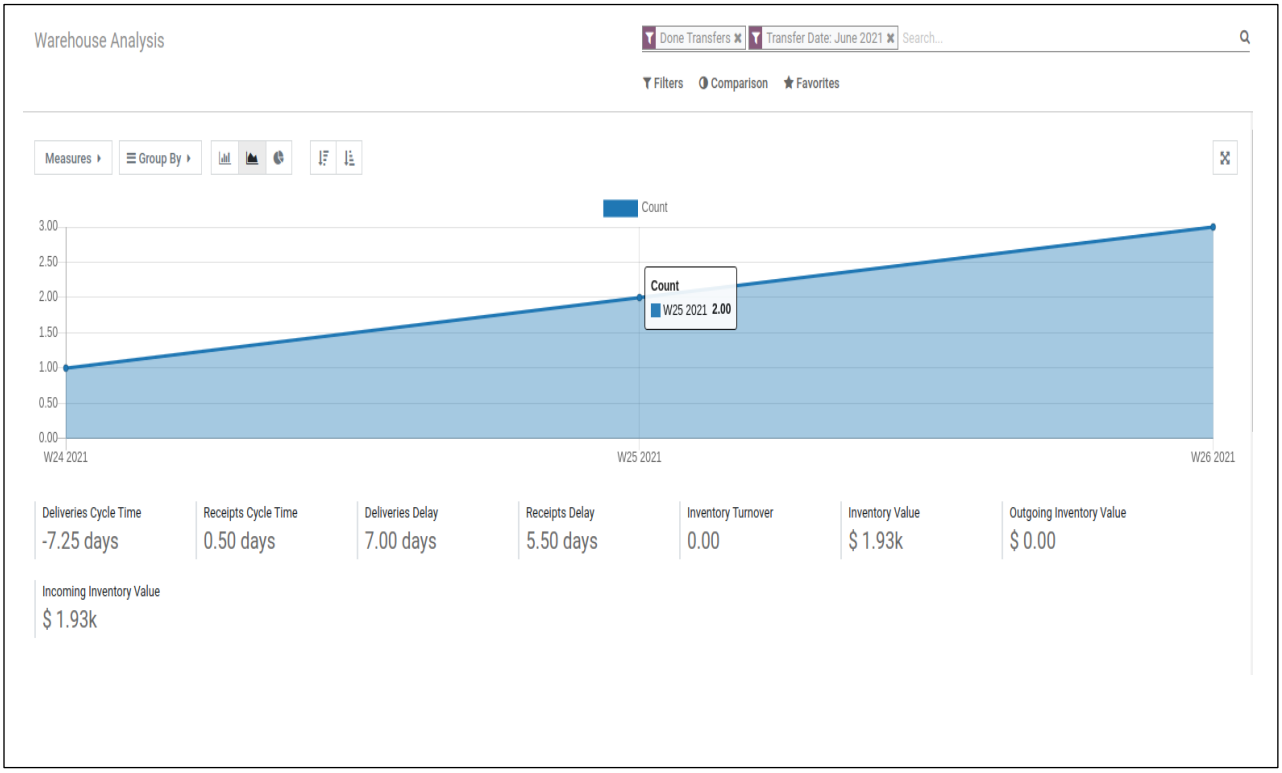


Fig28: a report about warehouse analysis.

Summary: in this chapter we have previewed the development life cycle of the project started from analysis phase to the implementation and testing phase. In analysis phase we presented the structure analysis and requirements engineering then we moved to the machine learning model and

Chapter 4

Conclusion

Conclusion:

One of the objectives of this research was to deter mine if the current cost pressures in the healthcare industry have resulted in price being the primary supplier selection criterion at the expense of other attributes. The answer is clearly no. Even with products that are, to a certain extent, regulated with respect to performance specifications, product/quality issues remain as key components of the supplier selection decision. While other criteria identified in the literature, such as service and delivery, are also important, price is low in importance. This implies that although the healthcare industry is under severe cost reduction pressures, purchasing decisions are still being made using multiple criteria, and price is not a driving force. While this is consistent with previous studies across diverse industry groups that indicate price is not usually the number one criteria, the findings are surprising in that price appears to be the least important factor. This could be explained, perhaps, by the extreme criticality of product quality in the health care industry. As stated by one respondent, "If the product is not acceptable, nothing else matters."

A second objective of this research was to deter mine whether the suppliers were performing to buyer requirements. The answer to that is also no. For both primary and secondary suppliers, performance scores were consistently lower than importance scores on selection criteria. Further, because all suppliers on average were underperforming, the level of performance did not appear to be related to share of business. This indicates that there are significant opportunities for a supplier to outperform competition. This is particularly true given that price does not appear to be a critical factor. By improving performance on attributes other than price, particularly delivery/service items, a supplier should be able to increase the value provided to the customer and thus command a higher price and also increase share of business.

The healthcare industry as a whole has become more competitive in recent years, with increased attention on both cost and quality factors. Suppliers that are able to identify the needs of their customers and meet those needs stand to gain substantially in this market. Given that, on average, most suppliers are underperforming relative to the important ratings of buyers, any one supplier could significantly improve its competitive position by improving performance on a few key attributes. The underperformance currently is not

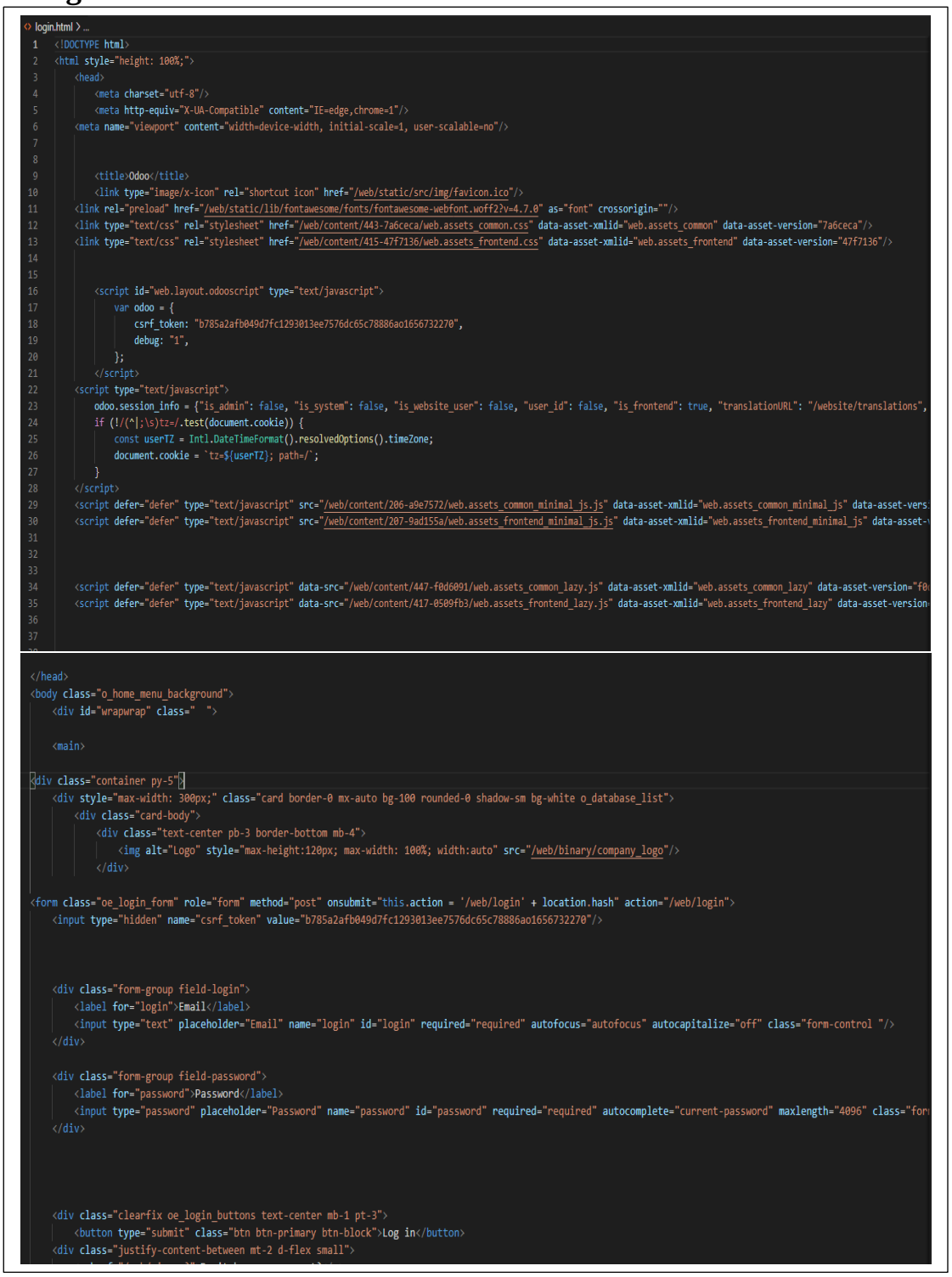
hurting suppliers, since it appears that most sup pliers are performing at relatively the same level.

However, because that level of performance is lower than what is desired by buyers, there is an opportunity for a supplier to improve its performance and to noticeably differentiate itself from other suppliers.

Appendices

Codes:

1- Login screen:



```
login.html > ...
<!DOCTYPE html>
<html style="height: 100%;">
    <head>
        <meta charset="utf-8"/>
        <meta http-equiv="X-UA-Compatible" content="IE=edge,chrome=1"/>
    <meta name="viewport" content="width=device-width, initial-scale=1, user-scalable=no"/>


        <title>Odoo</title>
        <link type="image/x-icon" rel="shortcut icon" href="/web/static/src/img/favicon.ico"/>
    <link rel="preload" href="/web/static/lib/fontawesome/fonts/fontawesome-webfont.woff2?v=4.7.0" as="font" crossorigin=""/>
    <link type="text/css" rel="stylesheet" href="/web/content/443-7a6ceca/web.assets_common.css" data-asset-xmlid="web.assets_common" data-asset-version="7a6ceca"/>
    <link type="text/css" rel="stylesheet" href="/web/content/415-47f7136/web.assets_frontend.css" data-asset-xmlid="web.assets_frontend" data-asset-version="47f7136"/>


        <script id="web.layout.odooscript" type="text/javascript">
            var odoo = {
                csrf_token: "b785a2afb049d7fc1293013ee7576dc65c78886a01656732270",
                debug: "1",
            };
        </script>
    <script type="text/javascript">
        odoo.session_info = {"is_admin": false, "is_system": false, "is_website_user": false, "user_id": false, "is_frontend": true, "translationURL": "/website/translations",
        if (!/(^|;\s)tz=/.test(document.cookie)) {
            const userTZ = Intl.DateTimeFormat().resolvedOptions().timeZone;
            document.cookie = `tz=${userTZ}; path=/`;
        }
    </script>
    <script defer="defer" type="text/javascript" src="/web/content/206-a9e7572/web.assets_common_minimal_js.js" data-asset-xmlid="web.assets_common_minimal_js" data-asset-vers
    <script defer="defer" type="text/javascript" src="/web/content/207-9ad155a/web.assets_frontend_minimal_js.js" data-asset-xmlid="web.assets_frontend_minimal_js" data-asset-


    <script defer="defer" type="text/javascript" data-src="/web/content/447-f0d6091/web.assets_common_lazy.js" data-asset-xmlid="web.assets_common_lazy" data-asset-version="f0
    <script defer="defer" type="text/javascript" data-src="/web/content/417-0509fb3/web.assets_frontend_lazy.js" data-asset-xmlid="web.assets_frontend_lazy" data-asset-version-
```

```
</head>
<body class="o_home_menu_background">
    <div id="wrapwrap" class="  ">

    <main>

<div class="container py-5">
    <div style="max-width: 300px;" class="card border-0 mx-auto bg-100 rounded-0 shadow-sm bg-white o_database_list">
        <div class="card-body">
            <div class="text-center pb-3 border-bottom mb-4">
                <img alt="Logo" style="max-height:120px; max-width: 100%; width:auto" src="/web/binary/company_logo"/>
            </div>

<form class="oe_login_form" role="form" method="post" onsubmit="this.action = '/web/login' + location.hash" action="/web/login">
    <input type="hidden" name="csrf_token" value="b785a2afb049d7fc1293013ee7576dc65c78886a01656732270"/>



    <div class="form-group field-login">
        <label for="login">Email</label>
        <input type="text" placeholder="Email" name="login" id="login" required="required" autofocus="autofocus" autocapitalize="off" class="form-control "/>
    </div>

    <div class="form-group field-password">
        <label for="password">Password</label>
        <input type="password" placeholder="Password" name="password" id="password" required="required" autocomplete="current-password" maxlength="4096" class="for
    </div>




    <div class="clearfix oe_login_buttons text-center mb-1 pt-3">
        <button type="submit" class="btn btn-primary btn-block">Log in</button>
    <div class="justify-content-between mt-2 d-flex small">
```

Fig29: login screen code

2- List of modules Screen:

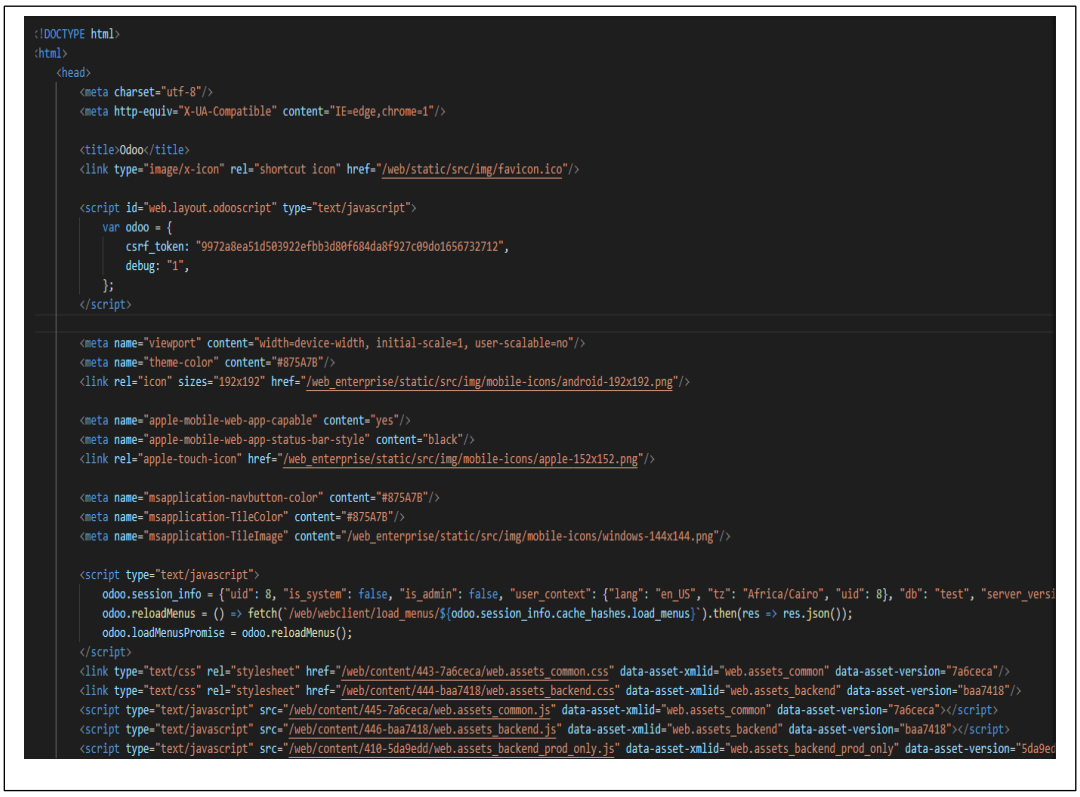


Fig30: list of modules code

3- Purchase module:

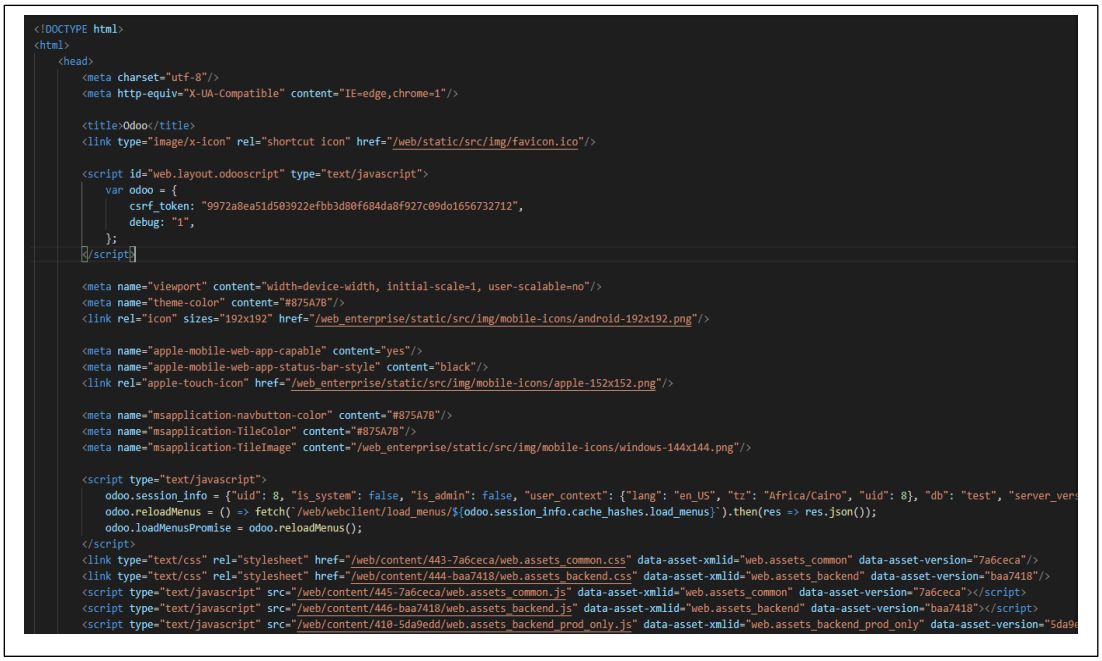


Fig31: purchase module code

4- Inventory Module:

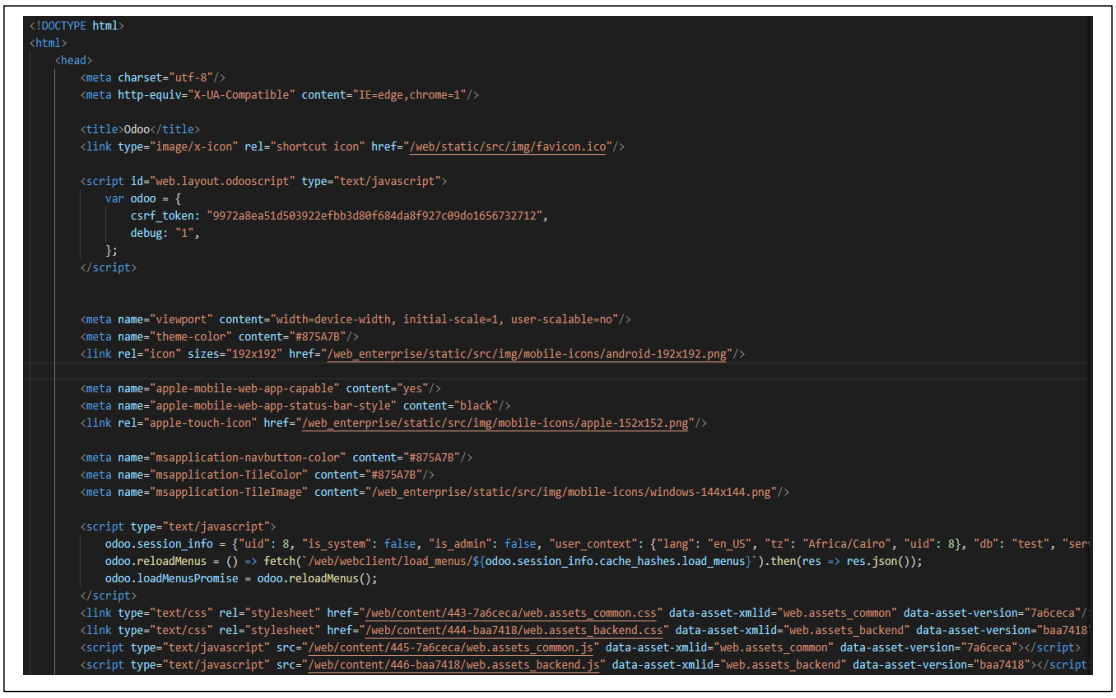


Fig32: inventory module code

5- Products' list:

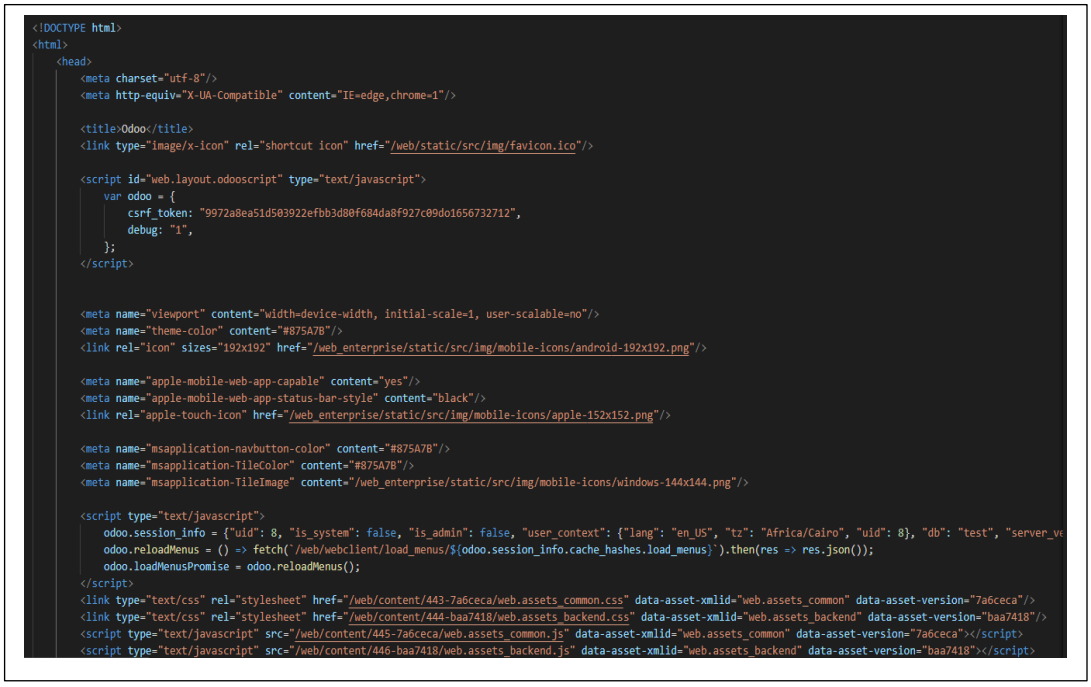


Fig32: Product's list view code

6- Vendors' list:

```
<!DOCTYPE html>
<html>
    <head>
        <meta charset="utf-8"/>
        <meta http-equiv="X-UA-Compatible" content="IE=edge,chrome=1"/>

        <title>Odoo</title>
        <link type="image/x-icon" rel="shortcut icon" href="/web/static/src/img/favicon.ico"/>

        <script id="web.layout.odooscript" type="text/javascript">
            var odoo = {
                csrf_token: "9972a8ea51d503922efbb3d80f684da8f927c09do1656732712",
                debug: "1",
            };
        </script>


        <meta name="viewport" content="width=device-width, initial-scale=1, user-scalable=no"/>
        <meta name="theme-color" content="#875A7B"/>
        <link rel="icon" sizes="192x192" href="/web_enterprise/static/src/img/mobile-icons/android-192x192.png"/>

        <meta name="apple-mobile-web-app-capable" content="yes"/>
        <meta name="apple-mobile-web-app-status-bar-style" content="black"/>
        <link rel="apple-touch-icon" href="/web_enterprise/static/src/img/mobile-icons/apple-152x152.png"/>

        <meta name="msapplication-navbutton-color" content="#875A7B"/>
        <meta name="msapplication-TileColor" content="#875A7B"/>
        <meta name="msapplication-TileImage" content="/web_enterprise/static/src/img/mobile-icons/windows-144x144.png"/>

        <script type="text/javascript">
            odoo.session_info = {"uid": 8, "is_system": false, "is_admin": false, "user_context": {"lang": "en_US", "tz": "Africa/Cairo", "uid": 8}, "db": "test", "server_ve
            odoo.reloadMenus = () => fetch(`/web/webclient/load_menus/${odoo.session_info.cache_hashes.load_menus}`).then(res => res.json());
            odoo.loadMenusPromise = odoo.reloadMenus();
        </script>
        <link type="text/css" rel="stylesheet" href="/web/content/443-7a6ceca/web.assets_common.css" data-asset-xmlid="web.assets_common" data-asset-version="7a6ceca"/>
        <link type="text/css" rel="stylesheet" href="/web/content/444-baa7418/web.assets_backend.css" data-asset-xmlid="web.assets_backend" data-asset-version="baa7418"/>
        <script type="text/javascript" src="/web/content/445-7a6ceca/web.assets_common.js" data-asset-xmlid="web.assets_common" data-asset-version="7a6ceca"></script>
        <script type="text/javascript" src="/web/content/446-baa7418/web.assets_backend.js" data-asset-xmlid="web.assets_backend" data-asset-version="baa7418"></script>
```

Fig33: Vendors' list view code

References:

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2- (Chris I. Bell-Hanyes, 2010)
3- (Toloei, Kalantay, 2011).
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5- Onut, S., Kara, S.S., & Elif, I. (2009)
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9- Yucel, A., & Guneri, A.F. (2011).
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12- https://github.com/mhammed98/SRM-Model.git

ملخص المشروع باللغة العربية:

يهدف المشروع الي ادارة الخدمات اللوجيستيه المتعلقه بسلسلة الامدادات لتوفير الوقت والمال عن طريق اختيار افضل الموردين والمزودين للاجهزه والمستلزمات الطبيه من حيث التكلفه الكليه والجوده والشحن من مكان التاجر الي مكان التخزين. كما يهدف المشروع ايضا الي تنبيه صاحب العمل او المسئول عن المخازن او مديري الشركات بالكميه المطلوبه تحديدا للمخازن بعمل تقرير ببيانات الاجهزه المظلوبه حتي لا تزيد التكلفه علي الشركه ويزيد وقت تخزينها مما قد يؤدي الي خسائر كبيره اذا كانت للاجهزه فترت صلاحيه او كان لها طرق تخزين خاصه.