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Homework 1 – Requirements Analysis

Master Degree in Computer Engineering
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Objectives of the System

Inventory Management plays a vital role in a company. Companies need to have an Inventory Management System (IMS) in order to accurately identify which and how much stock to order at what time. In other words, each factory should manage its production in an efficient way in order not to waste resources and to avoid overstocking, as well as outages. To do so, an IMS shall be implemented. An IMS should assist all the different phases involving production, that are: orders issued by customers, manufacturing of the final good, and shipment. In particular, the company that makes use of such system can always keep track of item quantities – in order to hold in stock only the minimum amount, hence optimizing investments –, invoices, and deliveries. Putting all these benefits together, the production is optimized, thus increasing the company revenues.
With this system, both the customers will be able to get the product easily and the risk of the seller will be reduced.

Interviews

In order to obtain the proper information on the system and to define the requirements that our IMS must have, we had interviewed people in different categories of the systems:

- Employees (manager, salesman, data analyst and worker) who use the IMS, to understand what services are used every day and improve it to increases the efficiency of the entire systems
- Customers who use the platform to make orders, to understand what are their needed and therefore to improve their experience

Users and Stakeholders of the System

The users and stakeholders of the system are divided into:

- Data Analyst: will access the whole system to compute analyses.
- Manager: will manage data related to suppliers and contracts with them. This user will also be able to view the result of the analysis.
- Seller: will insert into the system the data related to customers and orders.
- Worker: will manage the data regarding orders and shipments, as well as take care of the production process.
- Customer: will interact with the seller to agree on the products to buy.

Natural Language Sentences

A major international food and beverage company is investing in a new set of technologies to increase profits. The company produces and distributes an average of X products every year, including drinks, juices, beers and snacks of various kinds.

The company's goal is to develop a new information management system that will help reduce excess and shortages of inventory. Furthermore, it is required to keep in memory as much information as possible about the commercial activity so that it is also possible to make analytics to monitor sales and expenses. In this system:

- technical employees manage products in the inventory, invoices, and employees;
- sellers, on the other hand, have to deal with customers, orders, shipments, and payments;
- managers are in charge of managing suppliers and contracts;
- data analysts have access to the acquired data for inventory, cost and profit analysis;
- a system administrator will be responsible for managing the access privileges for each user on the system.

The figure of the Manager is important for the management of relationships (and therefore of contracts) with suppliers. The latter are intended to supply raw materials to the company. For example, if the company produces sugary drinks, suppliers will provide ingredients such as sugars, additives, artificial colors, water and natural flavors. In addition to these elements, there will be suppliers who will provide different types of packaging, such as glass, aluminum latins, or double corrugated cardboard boxes. Suppliers must be registered in the system, along with their name and contact details. Managers stipulate and maintain contracts with suppliers. These contracts are characterized by the following parameters: type of contract, duration of the contract, monetary agreement, quantity requested, and an identification for both the supplier and the raw material the first provides. It will therefore be possible for managers to inspect, for example through a list, all the contracts stipulated with the different suppliers. Furthermore, through the identification of the raw materials, managers have the possibility to filter contracts based on the type of product. Therefore, it is possible that the company can purchase the same type of product from different suppliers. Contracts stipulated between managers and suppliers are of different types:

- Joint venture;
- Partnership;
- Collaboration-type network agreement;
- Network contract for joint operation.

Managers therefore work closely with suppliers and also with sellers. In fact, these two relationships allow the data analyst to optimize profits and limit losses. The data analyst has the task of carrying out some analyses on the internal data of the company to allow the latter to reduce the products that will be in excess (for example because they have expired). The management of the products inside the warehouse is carried out autonomously both when a new order is created (control of the stock of the requested product in the warehouse) and for the control of expiry dates. For example, once the expiration dates have been checked, the system will reassign the unsuitable products (and angle the items) to another department (invalid inventory). If the data analyst needs to carry out periodic analyzes on the expired items, he will be able to access this structure. Another automated control is that of the minimum quantity of products in the warehouse. Supported by the new automated system, the manager will manage this event.. The frequency on which this type of control is carried out will be in line with company policies. It is therefore possible that the company decides to carry out this check every quarter. In this case, at the end of the 3 months, the data analyst will carry out his analyzes, communicating the results to the managers through reports. In this way, in the event that the number of products discarded because expired is high, it will be the responsibility of the manager to reduce the quantities of raw materials purchased from the different suppliers. Furthermore, each product is characterized by a minimum quantity of stock in the warehouse. In the event that the number of products discarded is high, the manager will proceed with the

decrease of this minimum quantity in stock, in such a way as to minimize losses. In the opposite case in which the number of orders is very high, it is possible that the quantities of some products are zeroed. In this scenario, the figure of the seller will be responsible for communicating this deficiency through a report to the managers. The latter will modify the contract with the suppliers linked to the production of these items, increasing the quantity to be purchased. Furthermore, the seller will be responsible for managing the relationship with the customer, proposing either to wait for new products to be made and then make a single order or to buy what remains in the warehouse and later make a second order. The seller is therefore responsible for creating a profile for each new customer within the DBMS. **However, it is important to underline that the stock inside the warehouse will be periodically checked by the data analyst, in order to make up for any quantity shortages of some products.** In both cases, therefore, the figure of the manager is of primary importance. In fact, it is he who, by decreasing or increasing (according to company policies) the quantities of raw materials purchased by suppliers, positively affects the total profit of the company. Furthermore, the data analyst, by inspecting the database, is able to provide order trends based, for example, on the status of the order. He will then be able to provide managers with sales trends within a certain period of interest, so that they can carry out market analyses.

The figure of the seller is important as well as it is the one who relates to the customer. In fact, he is in charge of interfacing with the customer **and receiving the different orders. Before placing the order in the system (database), the seller will have the task of checking the actual stock of the products concerned.** As explained above, he is in close contact with the manager to make up for any shortcomings. Assuming that the quantity of stock in question is sufficient, the seller will create a new order within the database. It will be possible to keep track of the status of the order throughout the production and shipping cycle. Once the order is confirmed, the customer has a limited period (established following the company policies) to make the payment through an external payment system. If the customer proceeds with the payment within the set period the order will progress and the customer will receive a notification from the company containing the invoice. In the event that the payment has not been made within this period, the order will be canceled. The company also offers the possibility to cancel the order only if the customer has not made the payment yet. If this happens, the order is marked as canceled. If everything is successful, the worker takes care of creating (also in this case through an external shipping system) a new shipment, advancing the order status once again. By creating the shipment, the worker will receive a unique code, which will be communicated to the customer so that he can check in detail the status of the order. In the event that the shipment is successful, the order will be considered successful. If, on the other hand, the package is lost or damaged, it will be the responsibility of the manager to manage the practice for the restoration to the company responsible for the transport, and then finally create a new order to be sent back to the customer.

The items, as previously mentioned, are the raw materials with which the final products are made. All the different types of items are stored within the DBMS in a single data structure. These elements are characterized by an expiration date, a brief description and the company of origin. Furthermore, the management of these is the responsibility of the manager. Furthermore, all the quantities of the various items that the company has purchased are stored within the inventory. These quantities will be managed autonomously by the system, each time the production of a product will start.

In the inventory, items are stored with name, relative quantity, and expiration date. In particular, when there is a shortage of one or more items, the supplier providing it will be immediately notified with an automatic e-mail. Also, when a product is manufactured but has not been purchased yet, it should be stored in the inventory as well, with name, quantity, and expiration date. When a shipment that contains a specific product leaves the factory, the latter must be deleted from the inventory. Of course, products – as well as items – that are expired, must be removed from the inventory as soon as possible

and disposed of, as they cannot be sold anymore.

Filtered Sentences

A manufacturing company needs a database to manage the overall inventories of the organization from the delivery of supplies to the production of goods and up to shipment of items. The objective of the company is to develop an Inventory Management System. There are four types of employee:

- manager, which handles suppliers and contracts stipulated with them
- salesman, that deals with customers and orders made by them, and payments
- data analyst, which performs analyses and predictions based on the collected system data
- worker, that is responsible for managing the inventory, shipments, generating invoices, and manufacturing products

Each employee is defined as: name, surname, e-mail address, phone number, department, and role.
Suppliers are registered in the system with name and contact details, along with the relative contract. The latter is described by:

- type of contract (joint venture, partnership, collaboration-type network agreement, and network contract for joint operation)
- monetary agreement
- the items the supplier is committed to provide
- quantity of items expected to be provided by the supplier

Also customers are registered in the platform with name and contact details. They interface with salesmen to make orders, which are characterized by:

- a timestamp, stating in which day, month, year, and at which time the order was issued
- products requested and their quantity

Data analysts:

- perform periodic analyses on inventory levels to avoid excess, lack of items, or expiration of products
- communicate analysis results to the manager through reports to let him solve the situation with suppliers providing the products in excess or in scarcity

Term Glossary

Term	Description	Synonyms	Connection
Inventory	An ordered collection of items and product with relative quantities, present in the warehouse	Stock	Item, Order, Product
Invalid Inventory	An ordered collection of items and product, with relative quantities, present in the warehouse that are expired	Stock	Item, Order, Product
Item	The ingredients needed for the manufacturing of final products	Ingredient	Inventory, Product
Order	Set of products that a customer wants to buy		Invoice, Inventory
Product	The final good to sell to customers	Merchandise	Item, Inventory
Invoice	Commercial document issued to customers	Bill	Order, Customer
Customer	A customer who buys the products	Company, Client, Buyer	Invoice, Employee
Employee	A generic employee of the factory	Worker, Staff member	Customer, Role, Department, Manager, Salesman, Data Analyst, System Administrator, Worker
Role	The role that an employee can have		Employee
Manager	Company worker that manages suppliers and contracts		Supplier, Product, Item, Inventory, Contract
Salesman	Company worker who takes care of customers and creates orders		Customer, Order
Data Analyst	Business operator who accesses the data to be analyzed and performs the analysis		Customer, Order, Item, Product, Inventory, Manager
System Administrator	Administrator of the system who manages the roles of different users		Employee
Worker	Generic company worker who performs some tasks, such as use the machinery and ship the products		Employee, Shipment

Department	The sector of the company in which one or more employees work	Division, Branch, Sector	Employee
Supplier	A company that supplies the items		Product, Item, Manager, Contract
Contract	Agreement made between the factory and a supplier	Deal, Arrangement, Agreement	Manager, Item, Product
Shipment	The process of sending products to a customer by means of a courier		Order, Worker
Payment	The process of paying for products done by a customer		Order

Table 2: The terms of the system

Functional Requirements

An organization must have an Inventory Management System to properly track inventory levels, orders, sales and deliveries. In order to achieve this the system should be able to execute the following,

- The system will be able to store all the details of the employees, customers and suppliers in the organization
- The system allows the employees to update their personal information
- The system must store the details of all on-hand products in the warehouse such as item code, item description, quantity and expiration date
- It will allow the employees to log into the system and enter the inbound items they received with information item code, item description, quantity, expiration date and supplier.
- The system must allow the employees to view the list of inbound transactions
- It allows the employees to log into the system and enter the outbound transaction needed for the issuance of the products in the production and shipment to the customers
- The system allows the employees to view the list of outbound transactions
- Inventory stocks will be automatically updated whenever there is an inbound or outbound transactions
- It allows the employees to generate the list of inbound and outbound transactions
- The system must allow employees to view current inventory balance
- The database receives and processes the Customers' order, specifying which products they want and respective quantity
- Modification or cancellation of an order will also be allowed in the database

- The system allows users to view order and shipment status of finished products
- It generates invoice whenever payment has been made

Non Functional Requirements

The system should:

- allow to store data following the GDPR (e.g., customer data).
- be able to work with big amounts of data.
- have a back-up to avoid data loss in case of hardware or software malfunctioning
- guarantee privacy of the data using authorization and authentication to access the system
- be easy to use.
- Being capable of storing at most x1 Employee entities, x2 Customers and x3 Suppliers, x4 inbound transactions and x5 outbound transactions (together?);
- Being capable of handling an inventory of at most x6 elements (products and items);
- Being capable of handling simultaneous access of x7 Employees and x8 users (suppliers and customers);
- Guarantee secure and asynchronous processing of transactions along the production pipeline;
- Restrict the submission of new entries to the role: salesmen should not be able to access contracts info, technical workers and data analysts should only be able to access data but not to create any new entries, and managers and admins should be able to access and modify any entry in the database;
- Efficient automatic creation of new entries when a new order/contract is entered
- Efficient computation of queries such as:
    1. inbound transactions associated to a certain supplier
    2. outbound transactions associated to a certain customer
    3. set of elements filtered by certain characteristics (filtered research) in the current inventory, as well as in the past transactions
    4. entries submitted of modified by a certain employee
- User-friendly interface for submitting orders or contracts, editing and displaying data

Constraints

The Database Management System application should satisfy the following additional constraints:

- Be implemented to run on Windows operating system;
- Be implemented with PostgreSQL;
- Client side implemented as a Web application, to guarantee easy management through different devices (Html, css and javascript will be used);
- Server side implemented using Tomcat, java servlet, and REST web service.