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Foundations of Databases A.Y. 2021-2022

Homework 1 – Requirements Analysis

Master Degree in Computer Engineering
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Objectives of the System

Inventory is one of the most important aspects of a manufacturing company. Efficient management of inventory is necessary so that losses are minimized and customers demands are met. This project aims to provide an efficient Inventory Management System (IMS) for a manufacturing company to accurately identify which and how much stock to order at what time by maintaining an appropriate level of inventory. 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, salesperson, data analyst and worker) who use the IMS, to understand which services are used every day and improve them to increase the efficiency of the entire system.
- Customers, to understand what their needs are 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

An international food and beverage company is investing in a new set of technologies to increase profits. The company produces and distributes many products, including drinks, juices and beers of various kinds.

The company's goal is to develop a new information management system that will help reduce excesses and shortages in the 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:

- managers are in charge of interacting with suppliers and concluding contracts with them;
- sellers have to deal with customers and create orders;
- the data analyst has access to the acquired data for inventory, cost and profit analysis;
- the system administrator manages the access privileges for each user on the system.
- workers take care of production and shipments;

Each employee must be registered in the system with name, surname, contact details, the department in which he or she is working, and his or her role. Since there could be more than one department in charge of performing the same job, each of them should have a number followed by its name. Examples of departments can be "Production line 1" and "Shipping 2".

The manager is important for the management of relationships (and therefore of contracts) with suppliers. These are intended to supply raw materials to the company such as sugars, additives, artificial colors, water, and natural flavors for sugary drinks produced by the company. In addition to these elements, there will be suppliers who will provide different types of packaging, such as glass, aluminum cans, or double corrugated cardboard boxes. Suppliers must be registered in the system, along with their name and contact details. Managers conclude contracts with suppliers. These contracts are characterized by type, duration, monetary agreement, requested quantity, and an identification for both the supplier and the provided raw materials. It will therefore be possible for managers to inspect all the contracts with the different suppliers. Through the identification of the raw materials, managers have the possibility to filter contracts based on the type of purchased material.

In order to get a realistic metrics for accounting and reports, demand forecasting should be take into account in the inventory management system. The data analyst is responsible for applying the analysis to the data collected by the system and communicating these to the manager through reports. In this way, if there is a high number of products discarded, the manager might need to reduce the quantities of raw materials purchased from a supplier to minimize excesses. Furthermore, the data analyst, by inspecting the DBMS, will be able to provide order trends which are based, for example, on the status of the order. They will also notify managers with sales trends within a certain period of interest, so that they can carry out market analyses. The frequency of these analyses is decided by the data analyst itself.

Salesmen are important because they are the ones who interact with the customer and create orders within the DBMS. Also, they will be responsible for setting up a profile for each customer within the system when they make their first order. Regarding orders, it will be possible to keep track of their status throughout all the process, i.e., from the production to the shipment. If the customer proceeds with the payment within a certain time span, the order will progress and the customer will receive the relative invoice, with order details such as which and how many products have been bought, total order amount, and which payment method has been used; otherwise the order will be canceled. The company offers the possibility to cancel the order only if the customer has not made the payment yet and, if this is the case, the order is marked as canceled. If the payment

is successful, a worker will receive the order, prepare the products and create a new shipment, advancing the order status once again. In this way, the worker will receive a unique tracking code, which will be communicated to the customer so that they can follow the delivery of requested products.

The items, as previously mentioned, are the raw materials the final products are made of. All the different types of items and their quantities are stored within the DBMS. These elements, which are the manager's responsibility, are characterized by a name, an expiration date, a brief description, and the supplier company. Products are stored in the inventory with name, expiration date, a brief description, and quantity as well. Furthermore, each product has a minimum quantity of stock in the warehouse, that is, the number of such products that have to be in stock at any time. The management of the inventory is carried out autonomously when a new order is created, to verify if there are enough products in stock for the order. A daily check is carried out on the expiration dates, to check if any item or product is expired. The system will reassign the unusable items or products to the expired inventory.

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, i.e., possible roles:

- manager, which handles suppliers and contracts stipulated with them, and minimum inventory levels;
- salesman, that creates customers' profile when making their first order, insert orders in the system on behalf of the customers, and handle payments made by them;
- data analyst, which performs periodic analyses and predictions based on the collected system data to avoid excess, lack of items, or expiration of products and communicate analysis results to the manager that changes the contract with the supplier or increases/decreases the minimum product number in stock;
- worker, that is responsible for managing the inventory, shipments, generating invoices, and manufacturing products, depending on which department it is assigned;

Each employee is defined as: name, surname, e-mail address, phone number, department, and role.

The departments are identified by a name and number (as there may be more than one department regarding the same operations).

Suppliers are registered in the system with name and contact details, along with the relative contract. The latter is described by:

- type of contract
- 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

Items are stored in the inventory along with:

- expiration date
- a brief description
- the supplier providing them

Finished products are also stored in the inventory and they are characterized by:

- name, expiration date, and a brief description
- a minimum quantity to be held in stock

When the inventory periodic check is carried out, any item or finished product that turns out to be expired is moved to the expired inventory. This is necessary to let data analysts estimate how many items and products are wasted in a given time span. Once the analyses have been carried out, the expired inventory is flushed.

Invoices are generated when an order is payed. They contain the following information:

- which products have been bought
- quantities bought for each product
- total cost of the order
- which payment method has been used

Payments consist in:

- a reference to the order the customer is paying for
- a reference to the generated invoice
- the payment method used
- currency used for the payment
- total amount payed

Shipments are created each time the products requested by a certain order are packaged and handed to the courier. They consist of a reference to a certain order and a tracking number that is communicated to the customer.

Term Glossary

Term	Description	Synonyms	Connection
Inventory	A collection of items and products, with relative quantities, present in the warehouse	Stock	Item, Order, Product
Expired Inventory	A collection of items and products, with relative quantities, present in the warehouse that are expired	Stock	Item, 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, Salesman, Product
Product	The final good to sell to customers	Merchandise	Item, Inventory, Order
Invoice	Commercial document issued to customers	Bill	Order, Payment, Customer
Customer	A customer who buys the products	Client, Buyer	Salesman,Order, Payment, Shipment
Employee	A generic employee of the factory	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 creates orders and new customer's profiles	Seller	Customer, Order
Data Analyst	Business operator who accesses the data to be analyzed and performs the analysis		Customer, Order, Item, Product, Inventory, Expired 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 shipment the products		Employee, Shipment, Inventory
Department	The sector of the company in which one or more employees work	Division, Branch, Sector	Employee
Supplier	A company that supplies the items		Item, Manager, Contract
Contract	Agreement made between the factory and a supplier	Deal, Arrangement, Agreement	Manager, Supplier, Item
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, Customer, Invoice

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:

- stores all the details of the employees, customers and suppliers in the organization
- allows the employees to update their personal information
- stores details of all on-hand products in the warehouse such as item code, item description, quantity and expiration date
- allows 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.
- shows and generates the list of inbound and outbound transactions
- 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
- inventory stocks will be automatically updated whenever there are inbound and outbound transactions
- shows and generates the current inventory balance or stock inquiries
- receives and processes the Customers' order, specifying which products they want and respective quantity
- modification and cancellation of orders

- allows users to view order and shipment status of finished products
- generates invoice whenever payment has been made
- permits transfer of items and products
- grants Cycle Counting in order to validate the accuracy of inventory
- re-ordering the previous orders is allowed

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
- Being capable of handling simultaneous access of at most 100 users;
- Guarantee secure and asynchronous processing of transactions along the production pipeline;
- Restrict the submission of new entries to the role: salesmen should be able to enter and modify only customer-related data, workers should be able to enter only shipments, and data analysts should only be able to access data but not to create any new entries, managers should be able to enter and modify only suppliers-related data and admins should be able to access and modify any entry in the database;
- perform efficient automatic creation of new entries when a new order/contract is entered
- perform 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 or 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.