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Autonomous Order Processing System for Supply Chain Management-An Initiative to Match Demand and Supply for Processed Food Industries in Bangladesh

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Abstract: *Sales order processing is accomplished in each business by its distribution channel consisting of distributors, wholesalers, retailers and customers. In a developing country like Bangladesh, the relationship between manufacturers and downstream intermediaries are not strong enough due to the infrastructure of the communication system of the country. As a result, a considerable amount of amplification of actual orders is seen throughout the supply chain for most of the manufacturers of Bangladesh. A business needs to create adaptive supply chain networks in which suppliers, manufacturers, distributors, and customers share information dynamically across the network. Supply chain performance solely depends upon the effective integration throughout the chain. Order processing is an important area for improvement to achieve efficiency in supply chain performance. Automation of sales order processing gives organizations more control and insight into what is happening on a daily basis. In most of the remote areas of Bangladesh, the only way to establish a strong relationship between customer and manufacturer is through mobile phone communication, where customers can place their orders through short message service (SMS). To achieve this, a research is done at a local company, Fiza and Co. to find the necessary requirements for building automated order processing software to help the manufacturer in keeping track with actual customer orders to satisfy customer needs and to gain competitive advantages. The waterfall model is used as a guide to develop the software. As a result the SMS based web integrated order processing software is developed. This software integrates the different divisions in the company and functions as a coordinator between the processes of handling customer orders through SMS. In addition to that, the software also generates reports for each division so that it could be analyzed by the management. The analysis done by the software would be able to help the management to make more informed and accurate business decisions in order to further enhance their competitiveness and overall performance.*

Keyword: *Automation, Order Processing, Short Message Service (SMS), Supply Chain Performance.*

I. INTRODUCTION

Sales order processing is accomplished in each business by its distribution channel consisting of distributors, wholesalers, retailers and customers. It acts as a powerful tool for increasing productivity and enhancing customer service (IBSolution 2013). Orders from wholesalers, retailers and customers go to distributors, who in turn place a cumulative order for products to the manufacturer. The manufacturer generates a production plan comprising the total amount of products that include sales orders. In addition to amounts that are planned to sell based on sales forecasting. This plan necessitates a good coordination among different stakeholders in the supply chain of the company, such as different sections of the company, suppliers or other subsidiaries for raw materials. Lack of integration among different stakeholders in the supply chain causes fall in business performance and reduced profit and market share of the business (Whitepaper 2007). An efficient sales order processing helps to simplify the process of ordering, save time and reduce errors of order processing (Schubring 2009).

Order processing is an important area for improvement to achieve efficiency in supply chain performance. For high-performing organizations efficiency in the processing of customer orders is a distinguishing characteristic (Esker 2013).

Automation of sales order processing gives organizations more control and insight into what is happening on a daily basis (Mayank 2003). It helps organizations better manage customer and supplier relationships, manage inventory and production, comply with regulatory requirements, control finances and sales forecasting, bring visibility to business processes and improve overall profitability (Peoplesoft 2011).

Organizations today recognize that they must deliver outstanding customer service in order to acquire new customers and retain existing ones. The ability to process and ship orders accurately and on time, and to provide quick feedback to customers about the status of their orders is the key to success (USoPM 1997).

To achieve the ability to process customer orders effectively and efficiently web based software are being used in the developed countries. Some developing countries like Bangladesh, where the infrastructure of information technology is developing, the web based softwares are partially feasible (Howladar et al. 2012). Only 0.7% people are internet users. (Internet world stats 2012). In the most remote areas of Bangladesh, internet facilities are not available, but cellular telecommunication supported Short Messaging Service (SMS) is available to Retailers (Customers) (Ahmed et al. 2011). The distributors to these retailers usually reside in the urban areas where internet facilities are available. So to make an integrated communication between manufacturer, distributors and customers an SMS based web integrated order processing software is to be used to increase order processing accuracy, reduce time of collecting and organizing data, and to increase customer satisfaction to achieve their loyalty.

II. SOFTWARE DESIGN BASED ON THE STUDY

2.1 Introduction

This part will discuss and explain in detail about the organization under research. Information such as the organizational structure, functions, and core business activities are explained in detail.

Apart from that, the as-is processes, business processes are pictured in the data flow diagram (DFD) and the entity relationship diagram (ERD). With the help of these graphical depictions or diagrams, the flows of information that exist within Fiza and Co. can be better illustrated and understood.

Solicitation of user requirements is a fundamental step because it would ensure that the software to be developed is what the users want and is relevant to the user. This step is also very important because the users know the current system better and can provide better feedback regarding the hidden or visible drawbacks and flaws of the system. These flaws can later be solved by the newer software. This part will also discuss the user requirements that were solicited from the users.
The overview of the newer improved software is illustrated through the use of DFD and ERD.

2.2 Organization under research

Fiza and Co. a well-known bakery food producer in Sylhet, Bangladesh. It is devoted to satisfy its customer by providing them scrumptious and tempting quality foods. Since 1985, and they have been serving people with various food items. They have six well known branches and more than 30 franchisees in Bangladesh. Their goal is to spread factory chain to whole Bangladesh. They are producing foods according to international standards and products are being exported in foreign countries especially in England and India. Major products that they export are biscuits, dry-cakes, sweets, spicy foods, traditional sweets and many other bakery foods (Fiza & Co. official website 2012).

Fiza and Co.'s head office is located at 51, Sagor Dighir Par, Sylhet. The objective of this company is to carry out the business as a manufacturer of quality foods for domestic and export market. To fulfill the needs of its customers, Fiza and Co. utilises sources for their raw materials from other subsidiaries within the local companies. These other companies thus act as the suppliers for Fiza and Co. The company sources the related packaging materials (tin cans, carton, tray, spoon and cap) from the suppliers.

The company currently operates one shift. Fiza's working hour starts from 8.00 a.m. to 6.00 p.m. for five working days. The plant is divided into three zones for good hygiene practice which is 1) GHP (Good Hygiene area), 2) Caring Area and 3) High Care Area. The employees need to look ahead to classify production areas into various zones for good manufacturing practices (GMP) purposes.

After the new set up of operations for good hygiene practice, Fiza and Co. has become a vehicle to enhance its status of competitiveness, and at the same time providing value added services. Thus the company is fully committed for serving quality foods to its consumers and continues to upgrade its operation in order to continue improving the industrial development.

2.2.1 Organizational structure of Fiza and Co.

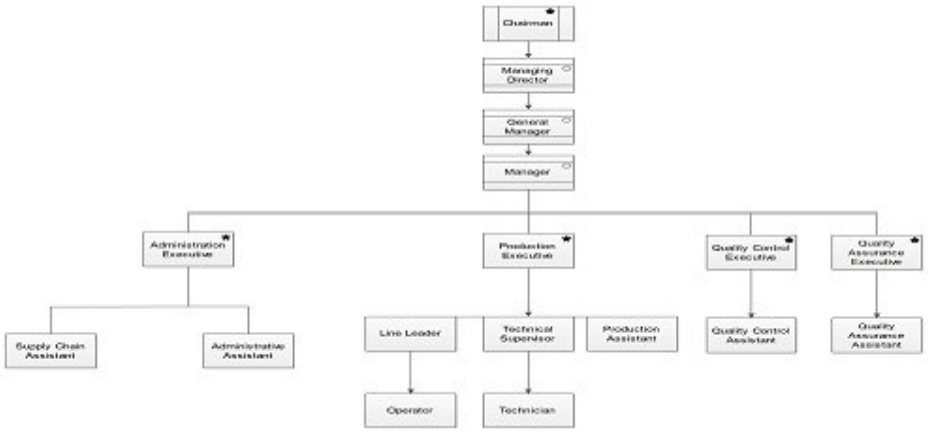

Figure 1: Organizational structure of Fiza and Co.

The chairman sits at the top of the management hierarchy. Next responsible persons in the management hierarchy is the managing director of Fiza and Co. The general manager is responsible for monitoring the responsibilities of all other managers of different departments. There are four departments: administration, production, and quality control and quality assurance departments. There are several staffs under these departments such as leader, supervisor, assistant, operator, technician etc.

2.3 Current business process and data model

Context diagram, data flow diagram (DFD) and entity relationship diagram (ERD) are used to give a clear picture of the as-is Process.

2.3.1 Context diagram and data flow diagram

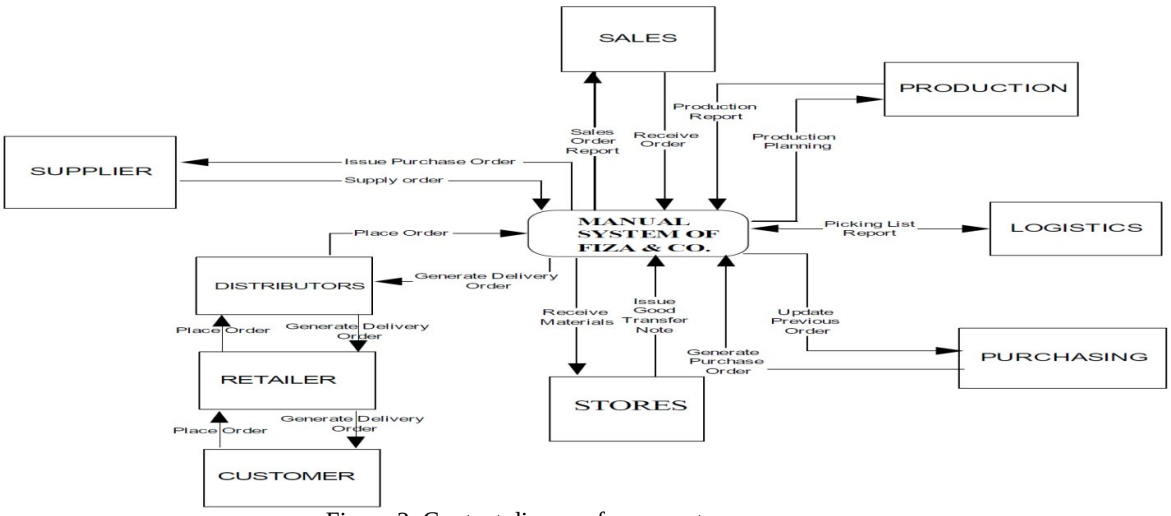

Figure 2: Context diagram for current processes.

Figure 2 describes the context diagram for the current process. The current manual system of Fiza and Co.'s functions as follows:

Sales: Customers place orders through Retailers. This process is discussed in the retailer section. Distributors place replenishment orders to sales department. Sales order consist of order information such as previous balance order, item ordered, quantity and delivery date. Sales order is a document that records all the information about customer order.

Production: Sales department gives sales order to production department to plan their production schedule and line. Production department will also check with the warehouse to ensure that all the materials are sufficient to produce the ordered items. If the raw material inventory is not adequate to produce the ordered items, production department will request to buy the insufficient materials to the purchasing department. When the ordered item is produced, production report will generate and store in filing software.

Purchasing: When the purchasing department receives material requisition from production department, purchase order will be issued to the supplier to supply the materials required. Besides that, purchasing department also will monitor the previous balance order.

Supplier: Suppliers will supply all the materials ordered. Delivery order document will be recorded in filing system upon receiving the materials.

Store: Store will receive the entire item from supplier and store all the items produced by production. Store will update all the incoming and outgoing items record. Store will ensure that all outgoing items will be delivered to the correct customer, in right quantity and at promised time.

Logistics: List record is a record that gives the information of items to be picked by the logistics to send all the finish good to the customer.

Customer: Customer can also place order to sales. When the order is fulfilled by production department, store will issue delivery order document to be sent with the finished good. Logistics will send the ordered items to the customer.

Distributor: Fiza and Co. has several distributors throughout Bangladesh and they pick orders from retailers. This company has been trying to coordinate its distribution system for efficiency, but due to several constraints, this aim is not completely fulfilled.

Retailers: Apart from direct selling from its several branches (six all over Bangladesh), there are a number of retailers who keep the products of Fiza and Co. These products are supplied from the designated distributors of Fiza and Co. These retailers make direct sell to the customers.

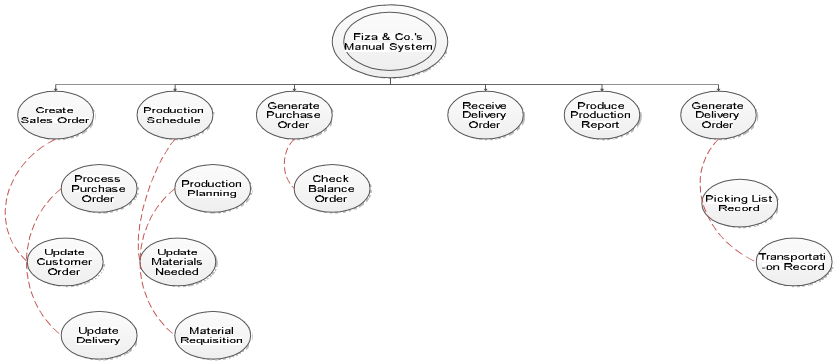

Figure 3: Decomposition diagram for current process

Figure 3 shows the decomposed view of the order processing activities such as creation of the sales order, scheduling production, generating purchase order, receiving of delivery order, preparation of production report and generation of delivery order.

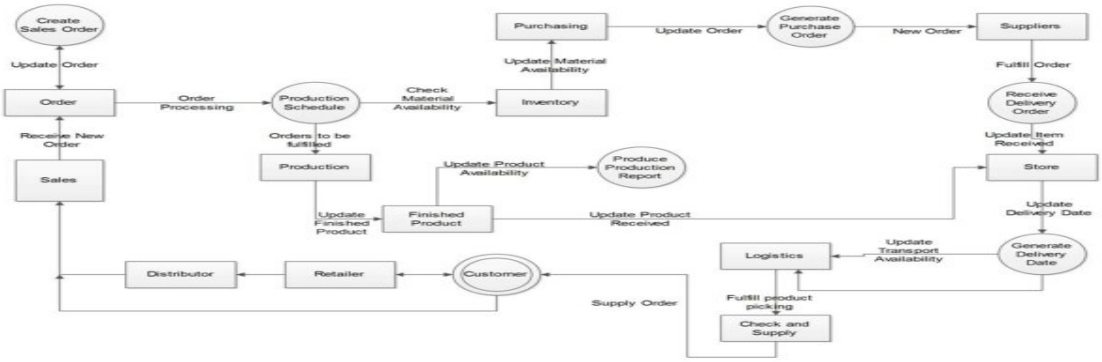

Figure 4: Data flow diagram for current processes

Figure 4 shows the data flow diagram for the current process. It shows all three supply chain activities: upstream supply chain, internal supply chain and finally downstream supply chain. The activities of supply chain begin with the intake of customer's order. All orders from downstream supply chain are processed by the sales department. Sales department gives demand requisition to production department for production. Production department procures materials from the suppliers when the required inventory level drops down. Upon successful production, production department passes the produced goods to stores. Stores department then deliver the goods to the downstream supply chain through logistics department.

2.3.2 Entity relationship diagram (ERD)

Entity relationship diagram for current processes in Fiza and Co. is shown below:

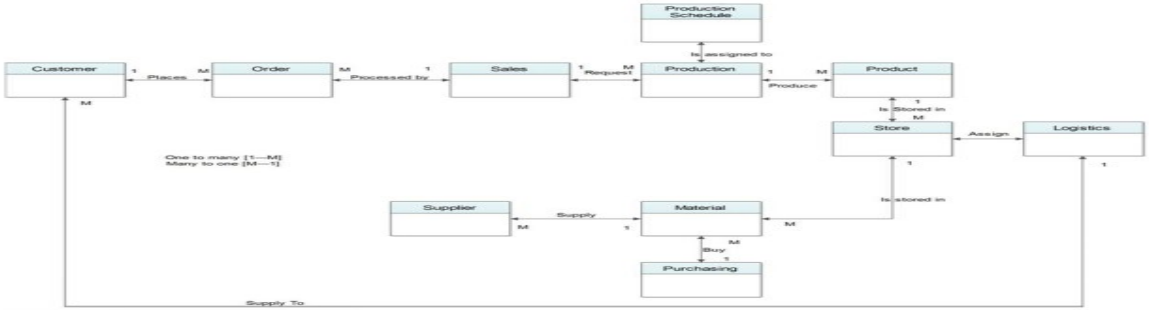

Figure 5: Entity relationship diagram for current processes

The system is entirely manual. When customer place order, the sales department will process the order and assign production department to process and complete the order. To carry out the production, schedule of production must be produced to help the production department to run the production. Production department will request for insufficient material from purchasing department to buy materials. Supplier supplies materials for store department of Fiza and Co. Store department issues raw materials to the production department. After order is fulfilled, the product produced is kept in store. Store will assign logistics department to supply the product to the customer according to delivery date given by the customer.

2.4 Requirements identified for software development

After conducting interviews to get the information from local retailers, distributors and the Manager of Fiza and Co., the following requirements are set to be fulfilled by the SMS based web integrated order processing software.

2.4.1 Sales module

- Allow retailers to order directly through SMS.
- Allow manufacturer to receive orders even when there is an unwanted situation like strike (e.g. Hartal) and natural calamities (e.g. Thunder storm).
- Ability to automatically generate sales order and reply that by SMS.
- Tracking of orders received.
- Specify and update standard costing.
- Determine the trend of demand of different products.
- Able to know the demand mean and standard deviation.
- Receive an order only when there is enough stock.

2.4.2 Distributor order module

- Allow to create bulk purchase order.
- Ability to produce documentation for delivery to customer.

2.4.3 Inventory module for distributors

- Ability to check for insufficient inventory level.
- Ability to check stock in warehouse
- Send SMS to customer about the available stock when order is greater than the available stock.
- Update stock in warehouse.

2.5 Conceptual design of the software

This section describes the models used to plan and build the software according to their requirements.

2.5.1 Business process and data Model

Figure 4.6 overviews how SMS based web integrated order processing software integrates all the databases into one central database. They share common data that are needed by all the departments involved in the supply chain. This information and data integration eases the flow of necessary information in the organization. In the SMS based web integrated order processing software, information that is needed can always be obtained in a much shorter time and more efficiently compared to other time-consuming systems.

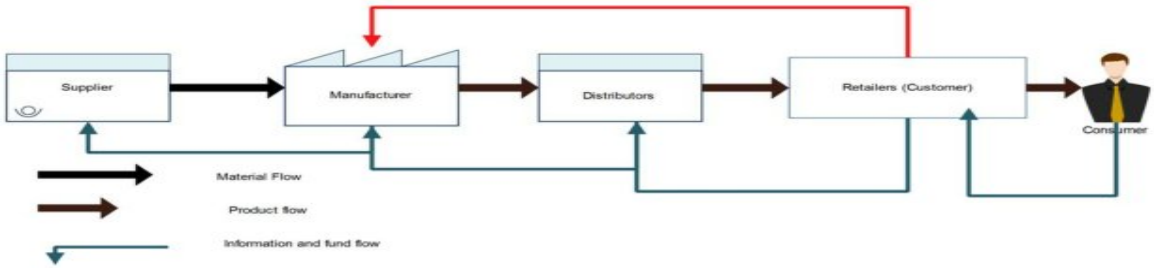

Figure 6: SMS based web integrated order processing software overview

In brief, the consumer or end customer gets the required product from the retailer. In the traditional system, the retailer places the orders to the distributor, the distributor places the accumulated orders to the manufacturer, which is illustrated by the dark blue lines in the figure 6. This traditional process leads to significant bullwhip effect. The new software attempts to accept orders directly from the retailers to the database installed in the manufacturer's side, illustrated by the red line in the above figure. The order is then redirected to the respective distributor for processing and delivery. This new software is expected to reduce the bullwhip effect in the supply chain.

The figure 7 below illustrates the context diagram for the SMS based web integrated order processing software:

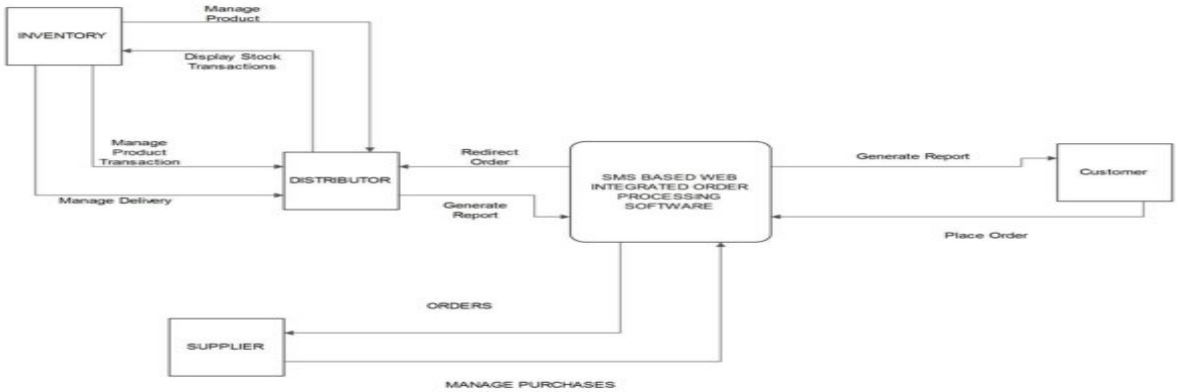

Figure 7: Context diagram for the SMS based web integrated order processing software

All customer orders arrive in the software's database first. Then they are sorted according to distributor code. The software automatically redirects the order to the respective distributor. The distributor then delivers the requested order to the respective customer (retailer). The distributors can also order in bulk amount to the manufacturer through this software for replenishing their inventory. The manufacturer can order to the suppliers for raw materials through this software.

The figure 8 describes DFD (data flow diagram) for SMS based web integrated order processing software from conceptual view:

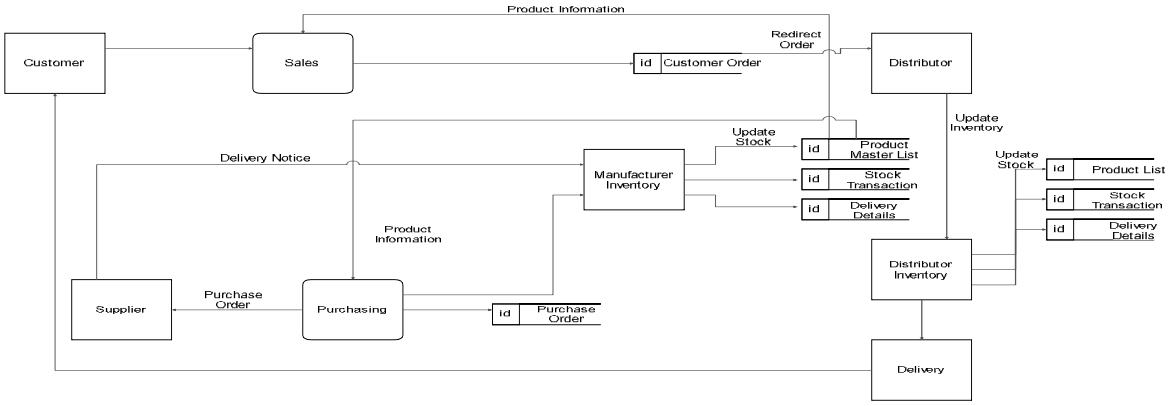

Figure 8: DFD (Conceptual view) for SMS based web integrated order processing software

When an order arrives, it is processed by the software and redirected to the distributor. First the software checks from the manufacturer's product master list about the detailed information of the requested product. Then the system checks from the inventory data of that distributor whether the distributor is capable of processing the order or not. If the inventory balance is insufficient, then the system notifies the customer that inventory balance is insufficient. If the balance is sufficient, order request is accepted. The distributor then processes the order for delivery. The system virtually acts as sales department for coordinating the order processing activities. Similarly all other activities are coordinated by the software as depicted in DFD diagram.This figure illustrates the process of customer registration and the process of sending a SMS for placing an order.

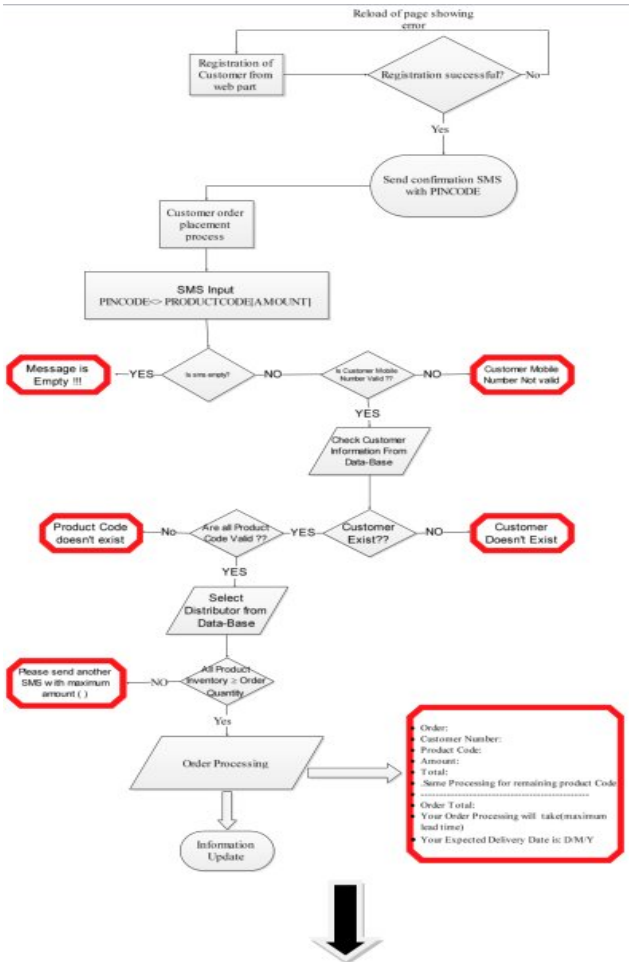

Figure 9: Decomposition diagram for SMS based web integrated order processing software

As shown in the figure 9, the customer is first registered from the web part of the software. Upon registration, the customer receives an SMS with pin code, which is to be used for placing an order to the system. When a customer sends an SMS with the proper format, the system first checks whether the customer's mobile number and pin code match or not. If the software finds a mismatch, it sends an SMS stating the user's information mismatch. If the mobile number and pin code is matched, then the software's logic proceed forward. Then the software checks the validity of the product code. If the amount requested is greater than the available inventory, then an SMS is sent stating the maximum available quantity. If all of these conditions are satisfied, the system accepts and processes the order request.

The following entity relationship diagram illustrates the software database structure:

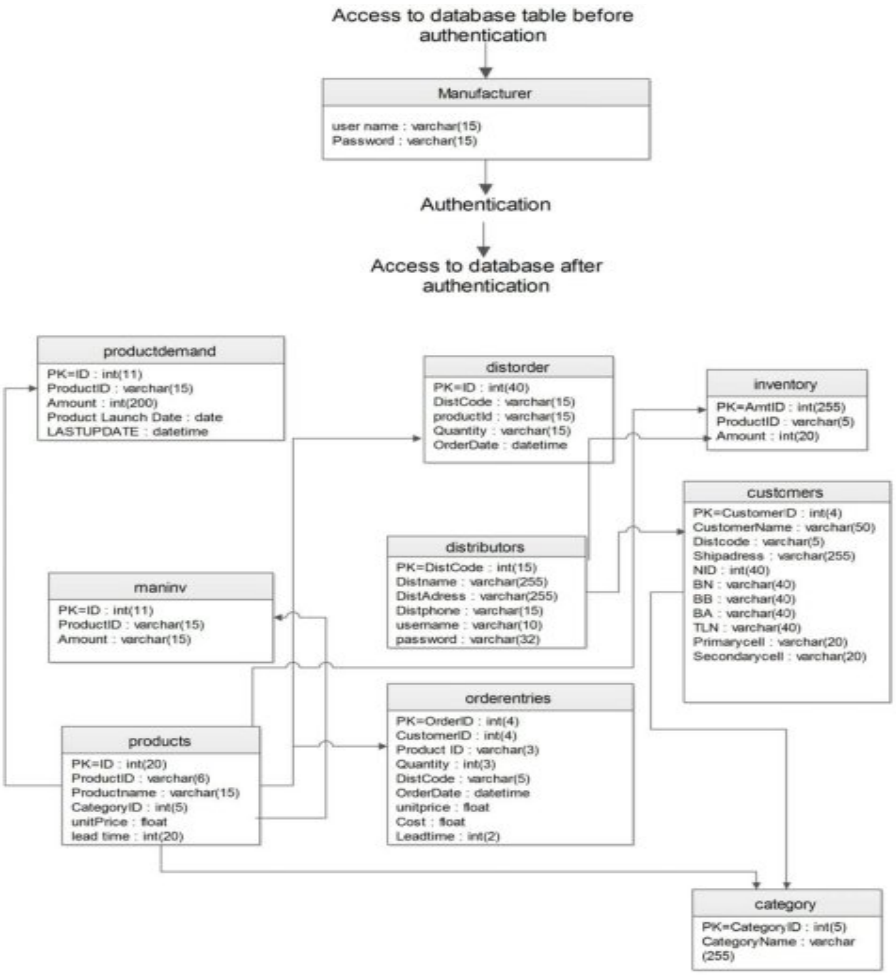

Figure 10: Entity relationship diagram (ERD) for conceptual design

Figure 10 above shows the ERD of the order processing software. ERD is used to model Fiza and Co.'s requirements. Each of the entity is assigned one Primary Key (PK) which uniquely identifies the entity. Each of the entities consists of attributes which represent the data that is required by the software. The relationship among all the entities exists between one or more entity. The 'Customer' and 'Orderentries' entities have one-to-many relationship. This explains that a customer may place many orders or many orders can be placed by only one customer. Similarly other such relationships are shown on the ERD of the new software.

2.5.2 Architecture of developed software

The SMS based web integrated order processing software is an application that is accessible from manufacturer and distributor's computers. The software is placed on an application server where all relevant clients can access it. By structuring the software accessibility this way, authentication and authorization of users can be centralized and managed more efficiently. A set of clients that call on service offered by the server will only be the set that has been granted the necessary permissions.

Communications between the clients and the server is done using internet connections. Since the software is to be used by different clients (Manufacturer and Distributors), it is therefore logical and practical to connect the users and the server through the internet connection. It is also possible to connect the clients and server through LAN and WAN

connectivity. The use of internet to this software has made it highly flexible. The customer (In our case, Retailer) does not need internet connectivity for placing an order. A mobile phone with the Short Messaging Service (SMS) feature is enough for this.

The software is designed in a way which supports user concurrency. This means that it allows the application to be opened by different users, now designed for 500 users, accessing multiple modules at the same time. This feature gives the Fiza and Co.'s users to access the software and complete their tasks without having to wait for their turn, unlike using log books in a manual system. The following figure shows the software architecture for SMS based web integrated order processing system.

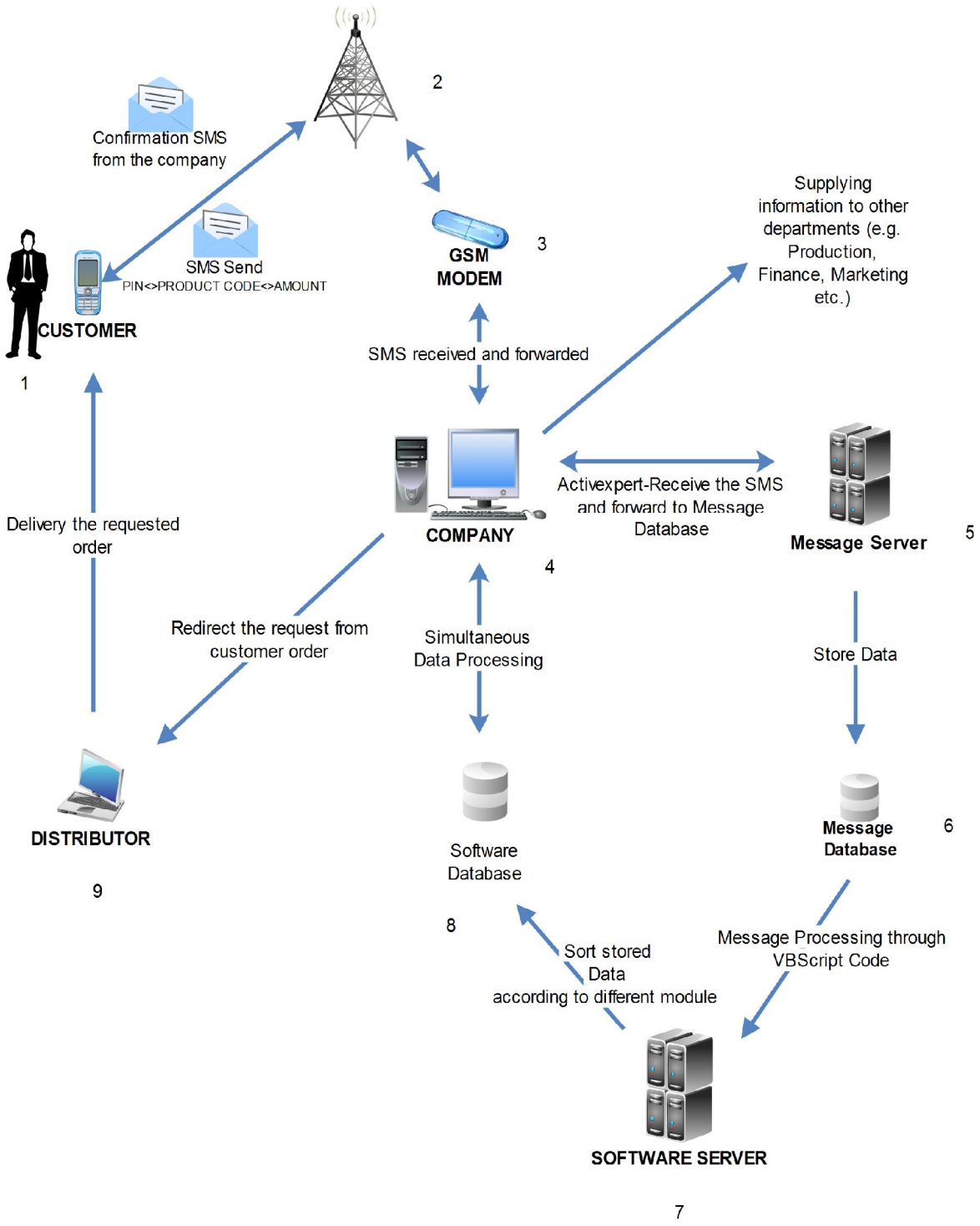

Figure 11: Software architecture for SMS based web integrated order processing software

2.5.3 Software capacity

A retailer can place 31 product orders in one SMS text (160 characters). [4 digit pincode+1 space+4 digit order code (2 digit product code+2 digit amount, the two digit amount is assumption, the software is capable of taking 3 digits)+1 space+30x{4 digit order code (2 digit product code+2 digit amount, the two digit amount is assumption, the software is capable of taking 3 digits)+ 1 space }=160 characters].

The product code database is made in a way that it supports 676 products. [AA+AB+AC+AD……..ZZ].

2.6 Physical design

In this section, the process flow of the software is detailed and explained. This section is composed of database design and software interface chart.

2.6.1 Database design

This database is made of the following tables:

1. Manufacturer (It stores the credentials for manufacturer login)
2. Distorder (It stores all orders from distributors to manufacturer)
3. Productdemand (This table accumulates the demand for various products from the time of product introduction)
4. Inventory (It contains the inventory status for various distributors)
5. Maninv (It contains records of manufacturer inventory)
6. Distributors (It contains login credentials and details about distributors)
7. Customers (This table contains the information about retailers, as this is the last end for the chain of this software)
8. Products (It contains all information about products the manufacturer has)
9. Orderentries (This table entries all the orders from customers)
10. Category (This table contains the information of different product categories)

2.6.2 Software interface chart

The SMS based web integrated order processing software consists of two level user login which describes as follows:

- Manufacturer login – administer the software and control the master file.
- Distributor login – Distributors use the software to do their own task.

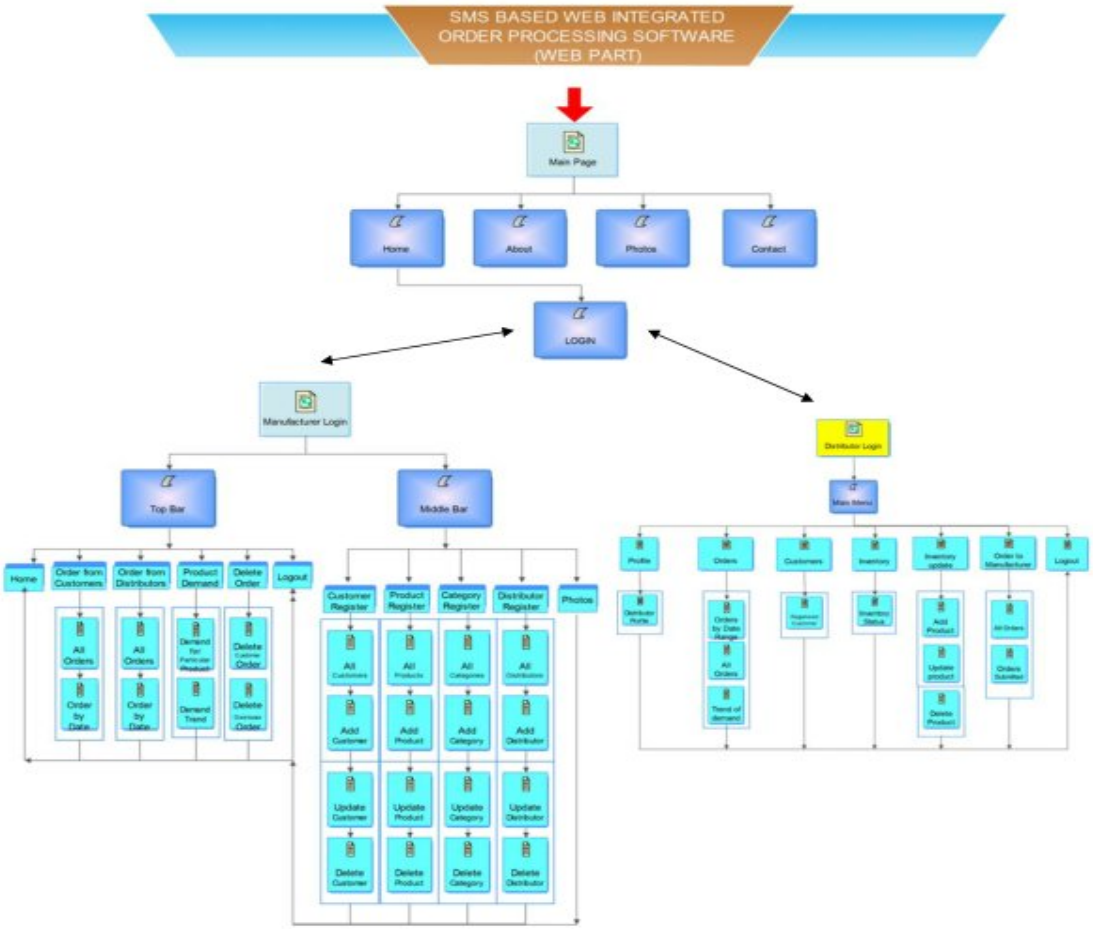

Figure 12: SMS based web integrated order processing software Interface chart.

2.7 Hardware requirement for smooth running of the software

In order to run the software, the minimum hardware requirements should be met so that the software can perform at its optimum level. The minimum hardware requirement designated for the software is as follows;

- PC with Core2 Quad 2.0 GHz processor
- Hard Disk: 250GB
- Memory: At least 2GB RAM
- Some backup solution for recovering data in case of an accident.

III. CONCLUSION

A software package was successfully developed, tested and used for the complete management of customer orders. It is a complete package for analyzing product demand with a focus on tracking actual demand. The accuracy of the results obtained is of publishable standard, and compares quite favorably to other available web based supply chain software packages.

A rather inconspicuous outcome of this study, albeit a very important one, is the level of automation of the software. Considering the large amount of order processing time reduced, this software brings real time automated order processing through SMS.

The drawback of the automation is that if too many SMS arrive at the same time, some messages are queued for processing, which takes a little bit time to send the confirmation message to the customer. But this software is able to reliably reduce more than 85% of the order processing time with great accuracy. This is quite a high percentage for software to achieve on its first release.

In the competitive business world, a company needs to get information flow faster and accurately. In a developing country like Bangladesh, SMS has been of great advantage in this area. Along with SMS, web is used to connect the all parties involved in fulfilling customers need. In the business world, most of the things are designed for improving effectiveness and reducing cost. In present competitive age, competition between business organizations shifts from company vs. company to supply chain vs. supply chain. To compete at the supply chain level, companies must adopt appropriate SCM strategies. Such strategies need integration and coordination throughout the supply chain to enhance the performance of supply chain members. An efficient supply chain strategy aims at cutting cost and eliminating non-value activities, which can be realized from the SMS based web integrated order processing software, as the supply chain activities begin with the customer order.

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