Inventory and Supply Chain Management for E-Commerce based Supermarkets Enabled by Cloud Services with Actor Dependency Models

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Abstract

This paper presents a comprehensive view of advantages of cloud services for interconnecting various member stakeholders relevant to efficient and cyclical functioning of an e-commerce based supermarket supply chain for timely delivery of consumer goods ordered online through digital platforms. Through the use of open modelling tools the interaction between various member stakeholders of any e-commerce supply chain can be presented easily for both supply and demand side. The actor or stakeholder entity based dependency models provide an interactive representation of key operational and financial activities performed by major stakeholders in the supply chain supported over cloud based network. The internal requirements of each stakeholder along with external dependencies is presented through multiple hybrid SD-SR diagrams for these major actors in the supply chain network. These representations provide an insight into the functioning of online supermarket stores in emerging markets in South Asia with its services hosted on a global cloud platform. The operations of all member stakeholders can be integrated and streamlined by real time information exchanged over cloud, thus aiding in demand based Inventory management. The rural economy can be also supported by inclusion of village agricultural markets acting as suppliers of perishable food products.

Keywords
Cloud, supermarket, e-commerce, SD-SR diagrams, Inventory management

1. Introduction

With the advent of Information and communication technologies a new culture of ordering consumer goods online to be delivered at your doorstep has come into existence rather than visiting a supermarket store in person and bearing additional costs every time (Wu et. al 2019). The same supermarkets have now come up with either web based or application-based service platform to facilitate online ordering by customers and scheduling delivery of those ordered goods based on their time preferences.

These supermarkets now function using their own e-commerce websites accessible by consumer's digital devices such as desktop or smartphones. The supply chain network which acts to bring consumer goods from supplier units and warehouses to your doorstep in a co--ordinated manner includes a whole group of actors. It comprises of large manufacturers and suppliers who deliver finished consumer goods which in turn are procured by supermarket stores at their distribution centers, logistics (storage, packaging and transport) services providers (either supermarket owned or third party) for transit of procured/supplied consumer goods from/to distribution centers and local storage stations/warehouses to be subsequently delivered to consumer households (Vallandingham et. al 2018, Wu et. al 2019).

Also, in cases where fresh and perishable food products are to be delivered there are local vendors /supply and delivery agents for picking up such food products from village/town markets. The same vendors ensure either vehicular or in person delivery of all kinds of consumer products to city as well as remote town households. In case there is a shortage of specific products demanded by consumers, a supplemental quantity of similar products are manufactured by supermarket's production units which are located near their major distribution centers. The raw materials required for manufacture of these consumer products are supplied by same entities which supply to large manufacturers.

The payments for these ordered supplies is facilitated through a Payment service provider (PSP) acting as financial intermediary between such entities which has its own application interface and has usually entered into a separate annual contract with each of these stakeholders in the supply chain (Rahi et. al 2017). Apart from these B2B payments and tax payments made to central/state government departments, all payments for online orders made by customers are usually fed through and handled by the same or different PSP.

1.1 Objectives

A hypothetical yet general case situation depicting integration of supply chain operations through cloud enabled services by an e-commerce based supermarket organization is presented in this paper. A cloud enabled solution (web service or app) is required to be developed to provide essential and non-essential goods to residents of adjoining cities or towns comprising of all classes of citizens differentiated based on quantity , nature and total value of goods ordered.

All these functions and operations are actively managed and carried out either on a single or multiple interconnected terminals/nodes hosting a cloud services provider network with real time information sharing and simultaneous data protection to prevent leakage of sensitive information among different collaborating actors (Molani et. al 2003 and Mylopoulous et. al 1999).

The online ordering process is facilitated using a web based application which fetches the price of all products whether branded or locally available in various categories , sale offers and bulk discounts for minimum quantity ordered or total goods worth, payment options and preferred time of delivery (Mylopoulous et. al 1999). All these features can be clubbed under a single application which can be accessed through any digital device (phone, laptop, tablet) over network.

2. Literature Review

The application of cloud computing for real time Inventory management and demand forecasting post data analysis was instituted by Walmart in collaboration with IBM as cloud services provider. Though the initial application of marketing of consumer goods and daily essentials was restricted to backorder linking i.e. for transport of goods from supplier / manufacturer warehouses directly to central stores / warehouses of Walmart to form pooled bulk Inventory and further down to supermarket's city based local retail stores (Cesarelli et. al 2021 and Vallandingham et. al 2018).

With further advancements in cloud network capacity and advent of new technologies for tracking of goods , the integration of transport services through cloud based applications was commenced shortly thereafter (Kopanaki et. al 2018). In the beginning the services of external logistics solution providers such as DHL and Free express were utilized but later Walmart constituted it's own logistics department to source items either directly from suppliers warehouses.(Cesarelli et. al 2021)

Further , to capture more customers who are unable to visit retail stores spread over geographically scattered locations , an online ordering facility providing the convenience of delivery of goods to consumer households was a next major thrust to online retail businesses (Wu et. al 2019). This increased competition among major players active in consumer goods industry.

As each of these competing e-commerce based supermarkets were trying to maximize their profit and protect customer goodwill at the same time by delivering products at competitive prices in minimum time duration, a separate division of transport/logistics was constituted for demand side as well for smoothening front end operations i.e. from retail stores / warehouses to end consumer households (Cesarelli et. al 2021).

Specific case studies for certain organizations focusing on Inventory management and application of cloud services for eliminating bullwhip effect for cost savings and resource optimization can be found in literature (Zhang 2007). Also a few case studies provide methodologies to maintain substantial consumer demand at all times even during stock outs and adverse supply chain relationships (Rahi et. al 2017 and Vallandingham et. al 2018). Many of these case studies and discussions are driven towards development of a more efficient Inventory model and cost effective solutions aimed at smooth functioning of the supply chain elements.

3. Method

In this paper actor-dependency models for analyzing and representing the stakeholder dependencies (Yu 2009) have been used for a hypothetical online supermarket supply chain. It provides an insight into the detailed functioning, material and information transfer among all member stakeholders. No such model description has been provided in detail showing operational characteristics of supply chain for any case study considered in general. Though it represents a real-world example, but many case studies covering rural economy setup for online sales and marketing can be found in literature today.

This approach will help us to understand hierarchical relationships among supermarket sub-entities and peer-to-peer relationships between different stakeholders. Open modeling Environment (OME) tool and block diagrams are being used here to create such models explaining the interdependencies, intents and rationales behind the activities and behavior of participating member stakeholders (Yu 2009).

3.1 i* modelling

Using i* modelling language, we can effectively model a business process on a case by case basis which enables us to comprehend easily the important sub-components of the problem at hand. "The name i* refers to the idea of distributed intentionality which underlines the framework" (Yu 2009). A basic as well as detailed outline pertaining to any problem domain showing dependencies, processes and tasks, are presented through this model. This model offers multiple analysis of functionality as well as viability of the whole process.
i* modelling has two types of fundamental models namely, Strategic Dependency (SD) model and Strategic Rationale (SR) Model (Mylopoulous 1999 and Yu 2009).

- An SD model represents a network of inter-dependent relationships between various actors within an organizational framework.
- An SR models displays the reasons associated with activities performed by each actor due to their inter-dependencies and clarifies about achievement of goals and accomplishment of associated tasks by all principal actors with given resources (Mylopoulous 1999 and Yu 2009)

3.2 Steps for efficient modelling

The steps followed are (Yu 2009)

Step 1- Identification of actors with their dependencies
Step 2- Analysis of the current system while considering the actor's involvement
Step 3- Analysis of the stakeholder dependencies
Step 4- Development and implementation of the model.

3.3 Problem Description/Case Details

An e-commerce based supermarket organization requires a cloud based solution to cater to the needs of residents of 2 cities A,B & town C where A is a major metropolitan city, B is a medium sized city with more middle and lower class population and C is a town/village area with low/medium connectivity to major cities A & B. City A is a major metropolitan city where both working middle class and high net worth individuals reside and major non-essential industrial and consumer goods are available in plenty. Majority of population resides near city center where office premises and residential homes are located.

Town C is a major supplier of cereal grains, fruits & vegetables, dairy and meat products required by city dwellers. These are locally transported to local warehouses in adjoining areas bordering City A and other supply stations either adjacent to or within city B limits. Town C mostly comprise of rural and semi-urban population who occasionally require packaged FMCG products and non-essential edible products for consumption. The agricultural markets and food processing centers for supply of these daily essential food supplies (dairy , bakery foods , meat , poultry products, processed foods) as well as Perishables (freshly harvested fruits and vegetables) are usually situated at the border areas of city B with town C.

City A shares border with City B which in turn seeks supplies from Town C for daily essential items to be supplied largely to City A and a few necessary items to City B. The processed foods and packaged edible products (including non-essentials and FMCG products) are directly shipped from a central distribution to supply stations/city warehouses/franchise stores of supermarket in City A and City B periodically based on weekly demand. The food

processing units and local warehouses (for perishables & daily essentials) are located either in the periphery/outskirts of city A or at border areas with City B.

The residents of all the three regions are served by supermarket's distribution center (DC) in vicinity to a SEZ hosting manufacturing industries for FMCG products and associated raw material suppliers. The DC's serve a cluster of 2-3 cities/towns adjacent to it and is centrally located to reduce delivery time of goods and cost of transportation. The finished consumer goods (essentials and non-essentials) are transported periodically by a logistics service provider which is common to supermarket, large manufacturers and raw material suppliers. The online orders made by customers in these regions are delivered at their households by a third party vendor or by supermarket's own supply and delivery agents. The daily essentials and perishable consumer goods are sourced from local markets in town/village areas adjacent to city borders. All these supply chain movements and service processes are depicted in Figure 1 as shown.

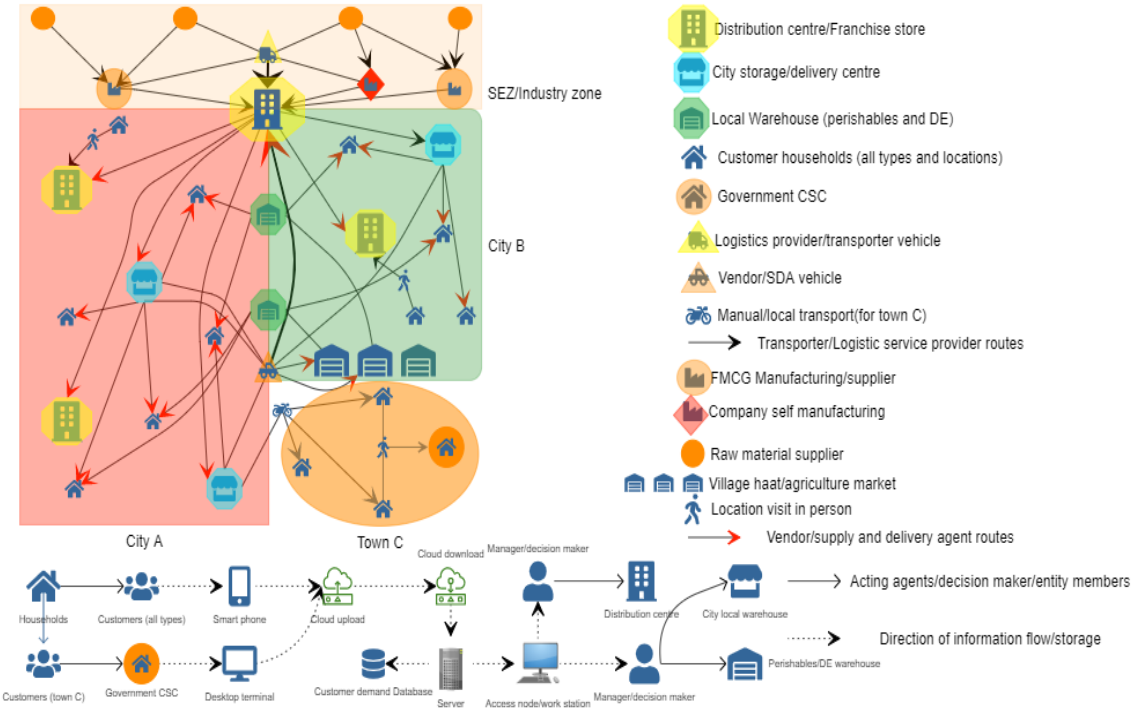

Figure 1. Figure showing layout of cities served by e-commerce supermarket with storage locations, households, supply and delivery routes and online order processing methodology

3.4 Cloud based solution for Supply Chain Management

All these processes are integrated over a cloud network which monitors and regulates real time online order acceptance, supply & delivery of products ,vehicle tracking through GPS, packaging, storage and Inventory management followed by periodic Inventory review, real time tracing and tracking of all procured and delivered consumer goods by smart labelling (Owunwanne and Goel 2010) whether essential or non-essential. The real time inventory level of all consumer goods either manufactured, traded and finally sold by the supermarket is managed using dynamic Inventory management system (IMS) implemented at all storage levels such as DC, city based warehouses/storage stations/franchise stores and supermarket's own manufacturing units (Cesarelli et. al 2021 and Owunwanne and Goel 2010)

This supermarket inventory management is carried out using a hierarchical framework consisting of a centralized command centre (CC) , Regional centres (RC) at state level and multiple distribution centres (DC) attached to any particular RC and serving a specific region within the state. Usually the CC is setup in a few major metropolitan cities of country to cater to the needs of different zones i.e. northern, southern, Western, eastern & central zones. Each centralized command unit encapsulates numerous regional centres within every state and hence forms a unified governing structure differentiated further into RC's followed by DC's and thereafter local warehouses/supply stations

and franchise stores in each city within the region. The DC's procure and supply all kinds of consumer goods except daily essentials and perishables to the local warehouses of adjacent cities and towns which are further delivered to the customer's households by either third party vendors or supermarket's own supply and delivery agents.

The e-commerce based supermarket has its own private cloud network which hosts its own web based application for accepting customer orders. In order to receive online orders by customers and in turn procuring orders from suppliers/manufacturers/vendors (by supermarket stores/warehouses) a desktop or smartphone based application in the form of SAAS hosted on supermarket's local cloud server, is provided as an interactive user interface with various functionalities and features specific to different users based on categories (Wu et. al 2019). The government CSC provides an option for residents of Town C to access supermarket's cloud for online purchases and making corresponding payments using its terminals.

Based on the customer demand database collected and retrieved from supermarket's centralized servers the RCs then direct DCs and in turn city based supply stations/warehouses and franchise stores to review and order all kinds of consumer goods after a fixed duration based on predicted aggregate mean demand in entire region for different products. This Inventory management model is adopted by local supply stations/franchise stores meant for order delivery when inventory level (for individual products) at each of these falls below a fixed or variable (seasonal) reorder point. This is to maintain sufficient inventory level in each zone within City A & B served by respective supply station/franchise store/ warehouse and hence to maintain a specific safety stock for different products in every sub-region. The reorder quantity level for every product is determined based on previous quarterly demand and varies seasonally according to changing customer preferences. This information on product specific consumer demand is utilized by supermarket's central command to forecast future demand for all consumer goods and create supply and delivery schedule for inventory management at different locations accordingly which is communicated to all relevant stakeholders via cloud network (Selvaraj and Anusha 2021).

The entire local cloud network is controlled by supermarket's main administration unit housed at central headquarters or central command using a dedicated centralized server with a huge data storage facility (IAAS) and constant cloud connectivity which forecasts demand for all manufactured and externally sourced consumer goods and thereby helps in formulating inventory policy for every local warehouses/franchise stores established in cities (Selvaraj and Anusha 2021). The central command can keep vigil over all economic activities of purchase, transport, manufacturing, sales & delivery through a network connected interface of a single software application installed on multiple nodes/ workstations present in all RC's, DC's , local city warehouses/supply stations and franchise stores (Kumar et. al 2018).

The supermarket has entered into separate detailed contracts with finished goods manufacturers/ suppliers, transporters/ logistics service providers, supply and delivery agents and third party vendors for aggregating, fetching and delivering online orders, procurement and transport of goods between various locations in different regions of different states. It also enters into separate agreements with franchise store owners, godowns and warehouse unit owners (for raw material storage required for their own consumer goods manufacturing and essential perishable goods management respectively).

Apart from SAAS provided by online supermarket organization for accepting customer orders and delivery supply chain management there exist major cloud service providers (Google ,Amazon) which provide a centralized online cloud platform and integrates logistics service providers, large manufacturers and raw material suppliers, payment services intermediaries together on a common network. The global cloud server acts as a PAAS accessible to all these principal stakeholders. It enables all these stakeholders to collaborate more effectively using ICT (Shee et. al 2021). All the external members of this supply chain are assimilated in this cloud network through limited access to certain features on common application platform specific to their role and functions. An alternative information and communication channel (email notification or pop-up display) can also be provided over supermarket's local cloud network for enhanced supply chain collaboration.

These global cloud services also provide an underlying platform on which the web applications of e-commerce based supermarket have been developed (Zhang 2007). A few organizations making use of common network platforms (including suppliers, manufacturers, transporters, vendors , Payment services providers) have started using IoT enabled cloud integration of consumer goods supply chain (Kumar et. al 2018 and Shee et. al 2021). There is a gradual increase in the use of IoT (Internet of things) enabled devices and RFID technology for real time tracking of

goods-in-transit all the way from supplier/manufacturer warehouse to consumer households without requiring access to online database and software resources of stakeholders involved in the supply chain (Kumar et. al 2018 and Shee et. al 2021).This is the latest development in the area of cloud integration for mobilization, procurement , marketing and sale of consumer goods by e-commerce based supermarkets. The vehicles of supply and delivery agents (supermarket or third party vendors) and transport vehicles of logistics service provider are embedded with GPS for tracking movement of consumer goods in real time (Owunwanne and Goel 2010). A detailed layout of all activities and processes by relevant stakeholders within the supermarket supply chain is presented in Figure 2.

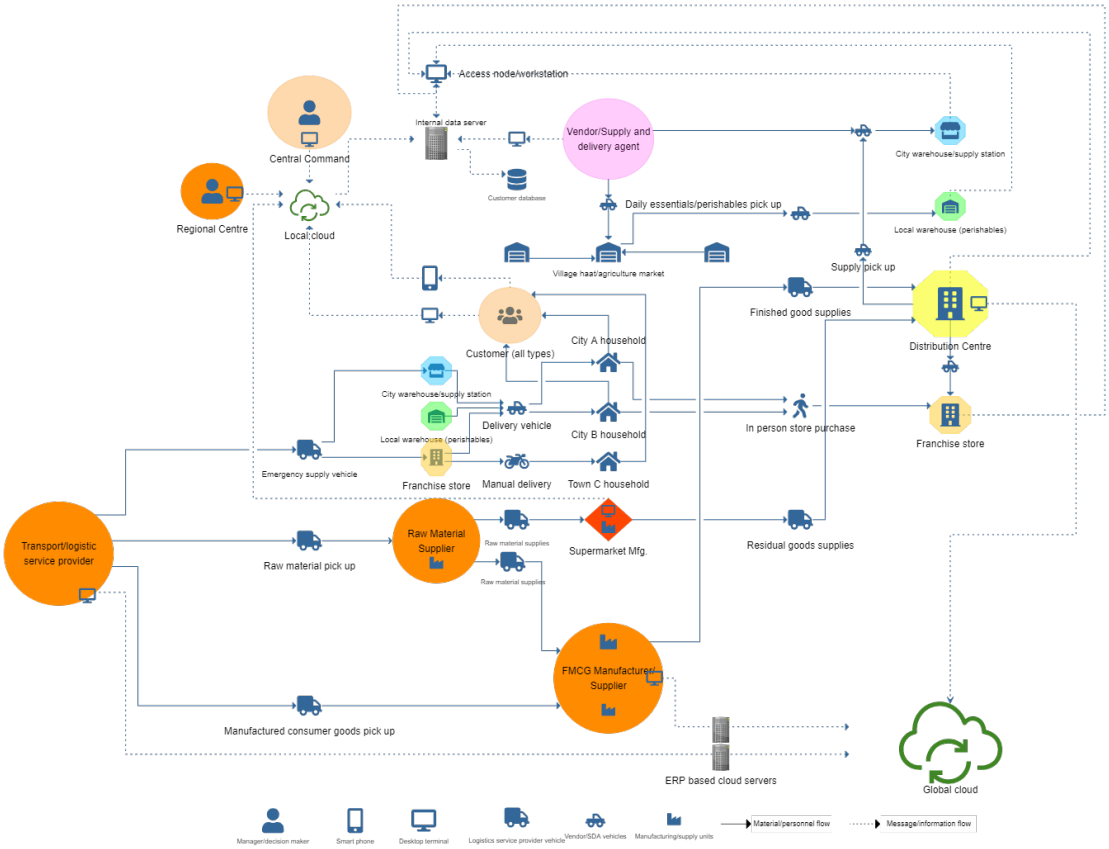

Figure 2. Figure showing detailed layout of all stakeholders following supply and delivery routes and forming a part of entire supermarket supply chain

4. Results and Discussion

4.1 Supply side solution

The population needs of essential non-perishables and non-essential items (for city A, B & C) are fulfilled by a number of supermarket supply stations/ local warehouses located within City A or franchise stores present in few locations of City B. The inventory replenishment of supply stations in City A delivering these online orders is done through the DC located outside but close to consumer goods SEZ which acts as supplier to these local supply stations on a regular basis. The logistics service provider organization utilizes the same global cloud platform for information sharing and transporting goods from supplier/FMCG industries to the supermarket's DC periodically. Also in case of urgency arising either due to time constrained preferred bulk delivery or to prevent inventory backorders it directly ships to City A supply stations and franchise stores from where it can be delivered to customers via supermarket's supply and delivery agents.

The inventory level of different local supply stations , franchise stores within city A and city B as well as inventory level of DC is determined after pooling aggregate demand from city A,B & town C. It is constantly reviewed in real time by a common regional center (RC) within a particular location of state which also reviews the level of demand in other DC's attached to it. Though inventory levels of different products and their demand is constantly reviewed, inventory replenishment orders are made either periodically or below a minimum threshold stock quantity by DC's

and local warehouses/supply stations/franchise stores respectively at different points in time (weekly, monthly etc.) which may be fixed or variable.

The company earns additional profit without losing its customers by supplementing existing unmet or residual demand of products in every period (month , quarter) by their own manufactured products/supplies based on information provided by central command using previous order logs and frequency of specific product requests generated online by customers. For the supply of these unavailable non-essential products, the supermarket manufactures its own set of consumer goods to fulfill the real time demand without going for backorders or losing product sales in case demand exceeds supply. The manufacturing units are setup either close to DC or at the outskirts or border areas of City A and City B for faster procurement of finished goods to supplement the shortages that have occurred . These manufacturing units fulfill the residual demand for non-available similar products at a comparatively lower price. It also helps the company to retain higher profit margin as it acts as an original supplier in these cases.

The supermarket organization also hires specialized transport vehicles which are provided by third party vendors/logistics services provider with temperature and humidity control (reefers) to maintain freshness of fruits, vegetables, dairy & meat products being shipped to customer households. It also has a special cold storage/warehouse optionally for storage of perishable items which empties and refills on a daily basis. These reefer vehicles can be interchanged with general supply cum delivery vehicles operated by either supermarket organization or third party vendors as these are always stationed in border areas adjoining City B & Town C. A hybrid SD-SR diagram capturing supply side activities is shown in Figure 3.

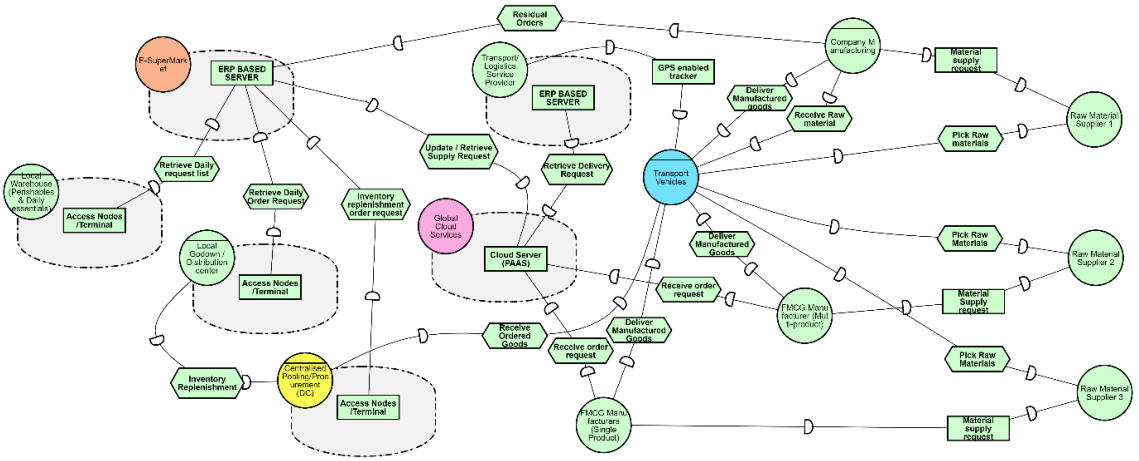

Figure 3. Figure showing supply side SD-SR diagram.

4.2 Demand side solution

The vendor services within the city limits of city A and city B for order pick-up and delivery are provided by supply and delivery agents of supermarket themselves as well as through third party vendors in town C.A few locations in City B which are located near borders of city A as well as locations in the outskirts of City A are served less frequently by supermarket's delivery agents.

For residents of Town C online orders are made through government CSC located within the boundaries of town C with desktop terminals using supermarket's web application over network. The mode of payment is cash-on-delivery here but with advances in ICT the rural population can install apps on their smartphones and make digital payments .These orders are processed at local supply stations or franchise stores of supermarket located within city A (based on nearest delivery location) but delivery services are provided by manual delivery agents associated with supermarket.

The majority of consumers comprise of City A dwellers as their requirements of daily essentials as well as non-essential products are serviced by multiple local warehouses/supply stations of supermarket which are distributed in different regions within City A based on consumer demand and total population to be served within sub-regions of City A. The frequency of online order delivery is highest in this city based on population size and customer's average

purchasing capacity. The daily essential needs are fulfilled through local warehouses stationed in border areas with City B. The supply markets for daily essentials (including processed food products) as well as locally manufactured non-essentials goods are either located in agricultural / general markets of town C or in local markets situated in border areas of City B adjoining City A.

In case of City B the mode of delivery is almost the same as that of Town C (manual delivery agents) but major non-essential FMCG products, exotic and branded food products can be made available only through supermarket franchise stores situated within City A or City B. Orders are received online and major bulk orders are delivered through supermarket's supply and delivery agents. Demand is less frequent compared to City A and only a few local warehouses/franchise stores are setup in vicinity to both city center within city B and daily essentials commodity market (at borders adjacent to Town C). The delivery of daily food essentials and perishables is carried out only for residents of City A and B (excluding border areas with Town C) as Town C is self-sufficient in these products. A hybrid SD-SR diagram illustrating demand side processes in detail is shown in Figure 4.

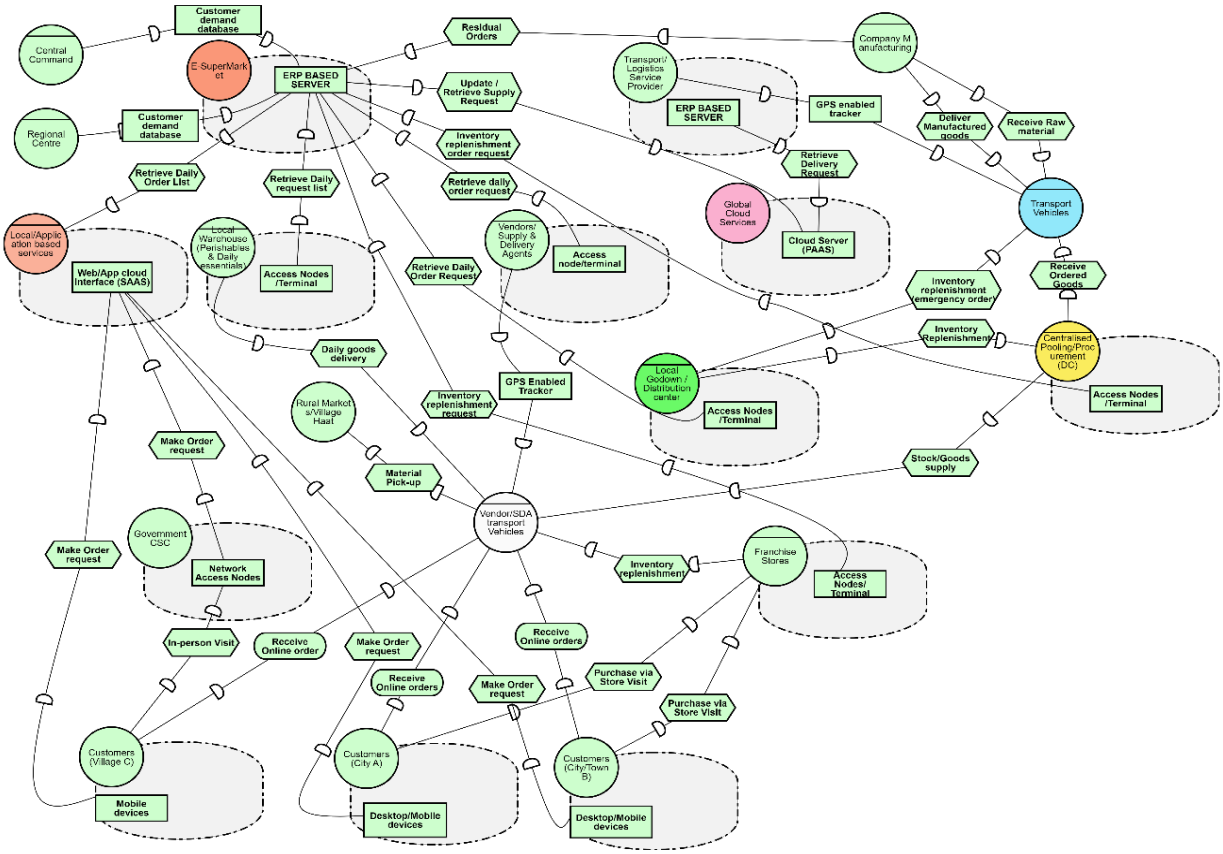

Figure 4. Figure showing demand side SD-SR diagram.

4.3 Payment services system

The e-commerce based supermarket organization enters into an annual contract with major payment service providers which either have their own local cloud (server based) network integrating all other important stakeholders involved in manufacture/purchase/transport/storage and sales process (entire supply chain) or leases its interface for inter-party cross payments hosted on global cloud services provider network common to all aforementioned stakeholders. This payment service provider facilitates online sales revenue collection through customer payments, B2B payments from one set of stakeholders to another (external), salaries and payments made to employees and local supply and delivery agents (internal) of supermarket and finally B2G payments (rent and taxes) for utilizing government resources (land, electricity and water) for running of supply stations , franchise stores and warehouses necessary for handling orders and pushing sales in urban/semi-urban/rural areas. In case a DC, local warehouse, supply station or franchise stores are set up on government leased land or privately owned property site, an annual rent payment can also be made using

PSP (payment service provider) cloud interface. A PSP can have its own standalone and independent cloud interface or can be integrated with a larger cloud network as a separate module. A PSP therefore interlinks both payers (one making online payment) with payees (one receiving online payment) using a common cloud interface irrespective of type and scale of services offered by multiple stakeholders. The SD-SR representation of payment service processes involving all stakeholders (both supply and demand side) is shown in Figure 5.

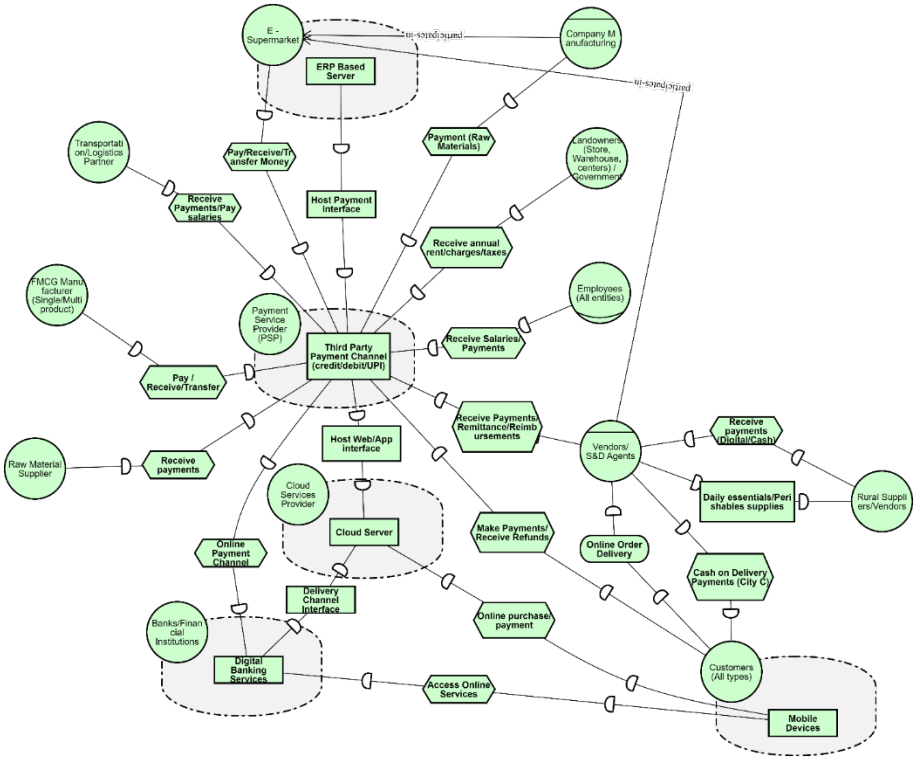

Figure 5. Figure showing SD-SR diagram for Payment Service Provider (PSP) Interface over cloud.

4.4 Inventory Management system (IMS)

The supermarket has a central database which maintains a repository of all previously and currently procured, sold , exchanged and returned (voluntarily or due to expiry or damage during transit) consumer goods at all points in time which provides a useful historical customer demand data records of seasonal aggregate mean demand and demand deviation (variance) observed over past periods. This helps in making approximate demand forecasts for all kinds of consumer goods sold by supermarket. Thus the inventory replenishment cycle can be calibrated based on these forecasts for all local supply stations and distribution centers. The IMS adopted can be internal when product demand analysis is made within the supermarket's own cloud network and external after including supply chain constraints visible within global cloud provider network. It is important to shield internal data of participating stakeholders and sharing only relevant details with other stakeholders comprising the supply chain.

The inventory level of daily essentials (including perishables) is managed by supermarket (Vendor managed inventory) on an everyday basis. These are procured from town and village marketplaces by local supply and delivery agents or third party vendors and stored either in local warehouses at border locations adjoining large cities or exchanged with on road delivery agent's vehicles on their way to deliver online ordered goods to customers residing in city households. For delivery of manufactured consumer goods in small cities and town areas a team of manual delivery agents is usually deployed who pick up respective orders from local warehouses/supply stations or franchise stores present in large cities.

The function of central command and RCs is to just manage and regulate the supermarket's supply chain by ensuring collaboration between all stakeholders over both local (internal) as well as global cloud network after processing relevant information from customer demand database collected during online order process.

4.5 Inventory Management, information and data storage and demand forecasting

The historical multi-period sales data is usually collected for medium to long shelf life essential as well as non-essential consumer goods. Over long duration a Normal demand distribution is usually assumed with S-s inventory model can be adopted by local warehouse/supply stations which order up to a pre-decided maximum Inventory level (base stock) only when the specific product quantity falls below a minimum threshold level (safety stock) while a periodic review Inventory system (S-R) can be adopted by DCs (multi-echelon inventory system) with weekly orders up to maximum level (base stock) which varies periodically and adjusted seasonally for each different consumer good. In case of emergency orders or abrupt demand these are supplemented with company's own similar manufactured goods as residual supply.

In case of daily essentials (perishables and short shelf life edible products) the inventory level at local warehouses and temporary storage locations is managed by local delivery agents/local supply and transport services as instructed by RC based on daily mean demand with negligible safety stock and is emptied with zero overstock at the end of each day. This is done through a vendor managed inventory (VMI) model adopted by supermarket in conjugation with third party vendors / external supply and delivery agents with revenue sharing agreement. A FIFO Model is usually followed during product storage, packaging (for raw and finished goods), retrieval for delivery and with real time tracking during transit thus aiding in real time monitoring of all items being procured and transferred between stations and eventually sold at customer households.

The historical sales and product procurement data is stored and retrieved from global or supermarket's private cloud network. All product related information available can be extracted any time based on preferential access rights granted to stakeholders as per accessibility policy conditions of the cloud services providing organization. All the consumer goods whether packaged or manufactured in industrial units are tagged with RFID to track not only it's end to end movement during transit but also when it enters or leaves different facility locations spread across geographical regions. For instance when a consumer good enters a distribution center the first time and finally exits a local warehouse/franchise store for delivery to an online customer.

This information on product specific consumer demand is utilized by supermarket's central command to forecast future demand for all consumer goods. In case daily demand is not met even with available products (demand exceeds safety stock) a dynamic pricing approach is adopted to regulate consumer demand and supplementing the existing unmet demand with company's own products as alternatives unless the entire inventory gets exhausted leading to empty stock and thereby resulting in accumulated backorders (in short sale periods) or permanently lost sales (over long term). The inventory level and thus prices of consumer goods sold are also varied based on existing and forecasted demand. Sometimes by deploying the tactics of dynamic pricing and bulk purchase discounts the consumer demand is modified by online supermarkets to their own advantage without incurring any backorders. Also any prospective backorders are eliminated by supplementing consumer demand with locally available goods or supermarket's own alternative goods which also helps in generating more revenue as well as protecting supermarket's goodwill in case of stock-outs for one or more consumer goods.

The strategy usually deployed to protect company's investment and efficient inventory management is to minimize overstocking cost is by maintaining lower inventory and safety stock levels for all products I.e. higher level stock at DC rather than local warehouses and adopting FIFO (first in first out) methodology for both procurement and sale of all kinds of consumer goods at each and every storage location from top to bottom to prevent obsolescence and hence loss in revenue.

4.6 Emergency orders fulfillment and disposal of unsold/expired/damaged consumer goods

In order to fulfil the goal of meeting immediate consumer demand (Inventory level of City supply stations/franchise stores falls below safety stock level) an emergency order fulfillment is exercised by direct transfer of ordered goods to City storage stations/ franchise stores bypassing DC, thereby preventing time delays in order procurement and associated loading/unloading period.

In cases where procured order couldn't be sold within sales period leading to overstock and obsolation or expiration of consumer goods, there is a provision of either bulk sales offering huge discount to customers periodically by the supermarkets or disposal of the same (in case of returned goods owing to damage during transit and expired products) by salvaging these through sale to scrap dealers/raw material suppliers or being utilized as starting raw material for supermarket's own manufacturing units to produce new consumer goods to save loss in value of initial investment

made during procurement. The damage due to improper product handling is reduced through in house employee supervision while packaging of all kinds of consumer goods.

In case of returned goods (undamaged non-essential products) with validated quality and remaining shelf life, these are placed ahead in Inventory of similar type of goods in order to sell them earlier than the remaining newly ordered products. Even then if these items are returned the second time, these are bundled with other products at stashed prices during sales offer period.

5. Conclusion

This paper provides a review of e-commerce solutions strategy deployed in consumer goods industry today but in the context of a hypothetical supply chain as our case study presenting cloud integration of online retail services and extension of e-commerce services to tier-2 cities and town/village population.

The detailed SD-SR diagrams presented above and block diagrams with layout showing material/personnel movement and information flow provide an insight into the functioning of entire supply chain by highlighting the interactions and associated responses from different participating actors/stakeholders. It also shows how interactions between one set of members affect the relationships and counter actions by another set of members and how selective actions and fulfillment of individual or group objectives of a depender element relies on a timely and collaborative response by the dependee which in turn results in smooth and continuous operation of the entire supply chain network thereby attaining the maximum customer service level objective.

Also a robust and interactive payment system mechanism, role of government departments in facilitating online orders and tax payments and use of GPS and RFID for real time product tracking whether in transit or storage paves a way for successful utilization of cloud technology which in turn helps in efficient Inventory management at all levels leading to customer demand fulfillment by supermarket organizations (dealing mostly in FMCG and edible products).

5.1 Scope of Future Work

A detailed study about different inventory management plans for different storage locations (DC, supply station, local warehouses, franchise stores) can be conducted in future for variable demand multi-product handling. Other food processing industries (bakery, beverages) situated in remote small city/ town /village areas can also be integrated further with the local cloud network of supermarket thereby promoting rural economic activities further and also enhancing total number of customers. The type of customers from each City A, B and town C can also be further categorized into regular, occasional and elite based on frequency and value of purchases exercised or purchasing behavior and based on their demand data, the inventory levels of different products can be optimized and sale offers for each separate type of customer can be customized accordingly.

The transportation routes of supply and delivery agents or third party vendors can also be planned and optimized daily for better fuel economy and simultaneous reduction in order delivery time which can significantly improve net profit margin due to reduced costs and increased sales for supermarket and other contributing stakeholders..

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