A Component-based Approach to Realize Order Placement and Processing in MSMEs

M. Saravanan[1] and J. Venkatesh[2]
[1]*Ericsson Research India, Chennai, India*
[2]*Department of Information Technology, MSE College, Chennai, India*

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Abstract: Micro, Small and Medium scale Enterprises (MSMEs) hold an unfailing distinction of being pillars of equitable economic growth. Lack of proper business platforms and knowledge of marketing strategies render MSMEs vulnerable to middlemen exploitation. In view of the advancements and customers' growth in the telecommunications field, we utilize the mobile platform to offer trading solutions to MSMEs. In this paper, we propose a mobile phone-based Order Placement and Processing components for MSMEs that can achieve disintermediation and is developed as an android application integrated with cloud services to provide easy access - anytime, anywhere. Our proposed component-based framework encompasses essential trading operations and extends 24 x 7 supports to MSMEs. An economic order calculator and order parallelizer sub-components helps limited budget MSMEs with small warehouse to survive the market by efficiently managing the warehouse, scheduling payments and parallelizing the order depending on its requirements. The other two sub-components custom specific negotiator and effective Order tracker helps in customizing the product and keeps track of the parallelized order respectively, thus assisting buyers in tracking their order to give an end-to-end solution. The envisioned framework will boost MSME margins, build healthy business-ties and transform MSMEs into self-sufficient establishments equipped with full-fledged trading systems that operate in mobile distributed environment.

1 INTRODUCTION

Micro, Small and Medium Scale Enterprises (MSMEs) hold a trustful distinction of being pillars of equitable economic growth and account for 90% of global businesses. The current MSME market requires small-scale manufacturers to depend on group of middlemen like wholesalers, distributors, agents and brokers to carry out essential trading tasks. These middlemen hold business-ties with various consumer MSMEs in order to negotiate and sell products on behalf of the seller MSMEs and in return they charge a per cent of the MSME's revenue as commission. Hence these intermediaries primarily focus on identifying interdependencies in the market, in terms of 'exchange opportunities' between MSMEs, so that they can misuse their market knowledge and business leads to rather reap excessive profits, than to promote small-scale businesses. Realizing this, MSMEs often lay claim of middlemen pocketing their margins besides indulging in unfair trading practices like adulteration and hoarding. This middlemen involvement not only has an effect on the revenues of MSMEs, but they also affect the cost of the end product. The only solution to the above problem is to eliminate middlemen completely to boost MSME revenues, which is assumed to be possible through several existing web based and E-commerce solutions. But in reality, MSMEs turn to another class of middlemen to carry out their online trading. Consequently, MSMEs end-up paying two different classes of middlemen; hence they fail to obliterate intermediation. However, small business owners are unable to comprehend and use PC-based Internet solutions due to limited knowledge of technologies. Also, these web based solutions for order placement and processing do not specifically solve the problems of small-scale manufacturers or MSMEs with a small warehouse and limited financial budget.

All the above said issues were addressed in our proposed solution for a new order placement and

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processing component that automates the activities performed by middlemen and extend 24 × 7 support to MSMEs through mobile phones. Hence we have provided a specific solution for emerging organization with a small budget to survive at the market and achieve greater profits. For this, we have developed an android application along with the mobile cloud to support the calculation of the optimal order quantity and the minimal buffer quantity of raw materials using the Optimal Inventory Calculator sub-component. When the inventory nears the minimal buffer quantity, the system suggests the reorder quantity from statistical analysis of purchase history. The system also provides provisions to parallelize order to efficiently use the small warehouse, though they have a limited budget using a Just-in-time inventory technique, thus reaping extra profits.

Custom-specific negotiator component is used to help buyers order custom-made products according to their interests and requirements. We also have an order tracker which keeps track of the undelivered and pending orders, making it easy for the MSMEs to keep track of them. The invention on the whole provides a never before seen platform for MSMEs to hold direct negotiations with each other, thereby eliminating need for intermediation.

2 RELATED WORK

The recent past has witnessed development of a multitude of applications and services to assist MSMEs. Popular web applications provide CRM systems (Achuama and Usoro, 2010) and human resources management (Andersen, 2003) solutions. Research has also been carried out to introduce ERP systems for MSMEs (Upadhyay and Dan, 2010). Most of the web solutions aim at providing a business platform for the small-scale firms to sell their produces in the online market. E-commerce applications have been developed to cover business transactions (Olatokun and Kebonye, 2010). In reality, MSMEs are unable to comprehend the technology involved. They turn to another class of middlemen to carry out their online trading (Cooke, 2000). Consequently, MSMEs end-up paying two different classes of middlemen.

A method (Nakamoto et al., 2002) processes a simplified order placement and reception in a system comprising a host computer and a PDA. The method includes storing stocked-product data and estimation data in an order placement and reception information database provided in the host computer, then transmitting from the host computer to the PDA, and placing an order from the screen on which the stocked-product data are displayed in the PDA. These features support the order processing and in addition, it allows the buyer to choose the most nearby MSME to prioritize the orders depending on the cost, thus reducing the delivery time when the product is needed immediately without any compromise on the price as well.

Mobile cloud, considered as the next generation technology, is extensively used to provide services to mobile phone networks (Taylor et al., 2011). Location-based services are highlights of mobile cloud applications. Main reason for utilizing mobile clouds for businesses is the ability to carry out remote computing. Mobile phones have limited processing and storage capabilities. Hence storage and computing tasks are delegated to remote Virtual Machines (VMs) on mobile cloud that provide Infrastructure As A Service (IAAS) (Sushil et al., 2010).

Moreover, cloud developing platforms like Eucalyptus and OpenStack (Pepple, 2011) extends infinite scalability in processing of orders. Nowadays, mobile phones are increasingly used as entry points to cloud services (Giurgiu et al., 2012). The Amazon EC2 is one of the recent developments in the field of cloud computing that offers many cloud related solutions as web services (Varia, 2010). The other paper describes a highly scalable system developed for MSMEs using the ontology engineered framework that uses cloud for data storage and processing (Saravanan et al., 2012). The android application has remote access to framework components that run on cloud, for effective and efficient processing.

3 COMPONENT-BASED APPROACH

The proposed order placement and processing component has the following four sub-components under them which executes linearly for each product's order placement and processing as shown in Fig 1. The involvement of these components improves the order processing system in MSME sustainable development.

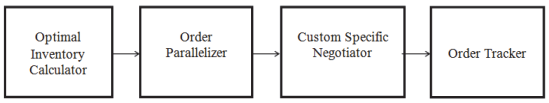

Figure 1: Order Placement & Processing.

3.1 Optimal Inventory Calculator

Unlike any online website this in-built component calculates profitable order quantity based on statistical analysis of stocking, ordering and holding costs. And whenever the MSME inventory is in the verge of being empty, a re-order point is set and helps in advising the MSME that it has to order new inventories when the re-order point is reached. Thus it protects the warehouse with undisrupted continuous business as shown in Fig 2.

We first obtain user input for annual demand quantity, fixed cost per order, annual holding cost, daily demand quantity, lead time, and safety stock to calculate economic Order quantity and re-order point quantity. We then order the optimized quantity from the preferred supplier MSME through the Order Parallelizer component. The MSME then starts the manufacturing and sale of finished products, and after that it verifies whether the remaining available quantity is less than or equal to the re-order point quantity. If re-order point is reached, MSMEs re-order new set of products (optimal quantity). Else, continue with manufacture and sale of finished products.

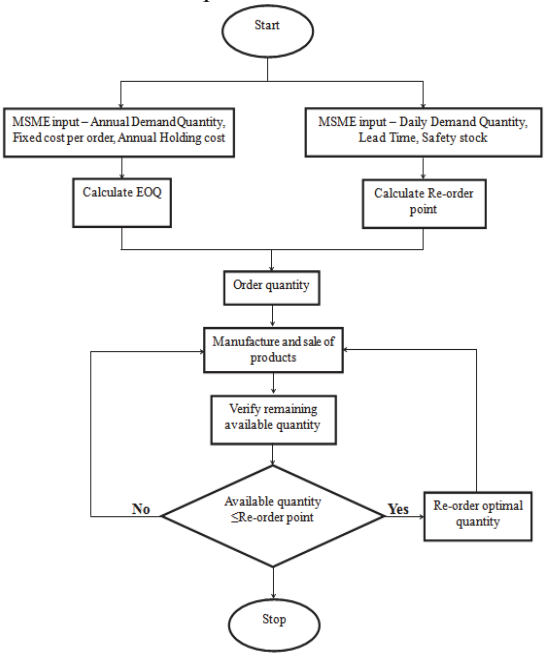

Figure 2: Workflow of Optimal Inventory Calculator.

3.1.1 Economic Order Quantity

Economic order quantity is the order quantity that minimizes total inventory holding costs and ordering costs. It is one of the oldest classical production scheduling models (Hax and Candea, 1984). Thus we determine the optimal number of units to order so that we minimize the total cost associated with the purchase, delivery and storage of the product.

- EOQ applies only when demand for a product is same throughout the year.
- New order is delivered in full when inventory reaches zero or when the re-order point is reached.
- Fixed cost for ordering
- Cost for storage (% of purchase cost)
- Lead time is fixed
- Only one product is involved
- Purchase price should be constant

The following variables were used for calculation

P = Purchase Price

Q = order quantity

Q*= optimal order quantity

D = annual demand quantity

S = fixed cost per order (*not* per unit, typically cost of ordering and shipping and handling)

H = annual holding cost per unit (also known as carrying cost or storage cost)(warehouse space, refrigeration, insurance, etc)

$$\text{Total Cost} = \text{purchase cost} + \text{ordering cost} + \text{holding cost} \quad (1)$$

- Purchase cost: This is the variable cost of goods: purchase unit price × annual demand quantity. This is P×D

- Ordering cost: This is the cost of placing orders: each order has a fixed cost S, and we need to order D/Q times per year. This is S × D/Q

- Holding cost: the average quantity in stock (between fully replenished and empty) is Q/2, so this cost is H × Q/2

$$TC = PD + (DS/Q) + (HQ/2) \quad (2)$$

To determine the minimum point of the total cost curve, partially differentiate the total cost with respect to Q (assume all other variables are constant) and set to 0:

$$0 = -(DS/Q^2) + (H/2) \quad (3)$$

Solving for Q gives Q* (the optimal order quantity):

$$Q^2 = \frac{2DS}{H} \quad (4)$$

$$Q^* = \sqrt{\frac{2DS}{H}} \quad (5)$$

Q* is independent of P; it is a function of only S, D, H.

3.1.2 Calculation of Re-Order Point

Another important technique used along with the economic order quantity is the Re-order Point (ROP) by maintaining safety stock.

- ROP quantity reflects the level of inventory that triggers the placement of an order for additional units**.**
- The quantity associated with safety stock protects the company from stock outs or backorders. Safety stock is also known as a "buffer"

  ROP= Daily usage*Lead time (in days) (6)

- When a safety stock is maintained, then the reorder point is written as the following :

  ROP = [Demand (Daily usage)*Lead time (in days)] +safety stock (7)

Demand - Quantity of inventory used or sold each day
Lead Time - Time (in days) it takes for an order to arrive when an order is placed
Safety Stock - The quantity of inventory kept on hand in case there is a unpredictable event like delays in lead time or unexpected demand.

3.2 Order Parallelizer

This sub-component helps in parallelizing the order, thus obtaining different quantities of same product from different sources. It helps the firms with small warehouse and limited budget who immediately want to purchase raw materials and start manufacturing their products by partially ordering an initial quantity of raw materials from nearby sellers (priority is given in the order of distance, cost and quality) and then order the remaining quantities of the same product from different distant sellers (priority is given in the order of quality, cost and distance). Quality depends on whether the two MSMEs have had previous business transactions. More priority is given to MSMEs with whom the buyer MSME has had previous transactions, as it makes that MSME transaction more reliable compared to the rest. This also reduces the burden on the buyer MSME, as he need not pay the cost of buying all the products from all sellers at the same time and is a cost-effective measure. He has to pay only for the product he buys from a particular seller as he has now parallelized the order. MSMEs with a small warehouse can use order parallelization as they will not have sufficient space to store all the required quantities in their warehouse by parallelizing the order quantity depending on the space available at the buyer's warehouse. This saves the buyer from renting a separate warehouse to store the products. The component is also designed in such a manner that the time required to empty the warehouse (manufacturing and sale of initially bought products) is the time to deliver the next set of parallelized products from another seller. Hence small firms which use this system can efficiently utilize the warehouse though it is small.

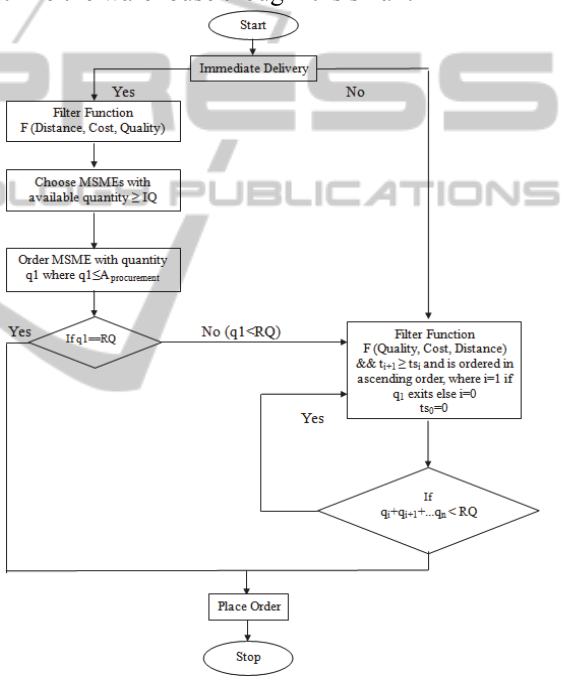

Figure 3: Work flow of Order Parallelization.

Let's consider the following variables for explaining the flow of events shown in Fig 3.
T = Total no of products the warehouse can hold
H = No of products the ware house is already holding
A = No of products that have space for storage at warehouse ($A_{procurement}$+$A_{produced}$)

$$A = T-H \quad (8)$$

IQ = Initially Required Quantity to start manufacture in case of immediate delivery
RQ = Required Quantity (Calculated by EOQ formula)
T_d = Time to deliver vector = t_1, t_2, t_3, ..t_n

T_s (Time to sell/produce vector = ts_1, ts_2, ts_3, ..ts_m where m<<n
Q_s = Quality bought vector = q_1, q_2, q_3,..q_n
P = Product Vector/Product Measurement

In this component we first check whether the order requires immediate delivery to start production at the earliest. If yes, choose MSMEs using a Filter Function F (Distance, Cost, Quality) which gives high priority to distance (nearest MSME), then to cost and then to quality. Then we further narrow down the search to find MSMEs whose available number of products for immediate sale, is greater than or equal to the IQ (Initial required quantity). After narrowing down, we order q1 quantity of products at the chosen nearest MSME. Note that q1 shall be lesser than or equal to $A_{procurement}$. If q1 is equal to required quantity, then the order placement process is complete. If not then we choose another set of MSMEs using a different Filter Function F (Quality, Cost, Distance), which gives high priority to MSMEs with whom there has been previous contracts, whose quality is good though they are at a farther distance. Also choosing MSMEs also has another criteria which specifies that the time to deliver the present ordered quantity $(t_i+1) \geq (t_{si})$ time to sell previous ordered quantity. This type of time constraint helps in efficient use of the inventory and is called the Just-in-time Inventory. The MSMEs are listed in ascending order of the time to deliver value, where (i=1) if q1 exits, else (i=0 and t_{s0}=0). Parallel orders are placed at different MSMEs, with variable quantities q1, q2, q3. Check if sum of (q1, q2, q3…) ≤ required quantity. If yes, repeat the above process, if not then the required quantity is ordered and the parallelized order placement component is complete the process.

Table 1: Product-wise Ordering.

MSME	Product Count	Distance	Price	Quality Service
MSME 1 (m_1)	p_1	d_1	pr_1	0
MSME 5 (m_5)	p_5	d_5	pr_5	1
MSME 7 (m_7)	p_7	d_7	pr_7	0
MSME 9 (m_9)	p_9	d_9	pr_9	1
….				
MSME n (m_n)	p_n	d_n	pr_n	1

3.2.1 How the MSMEs are Filtered

Let m_1, m_5, m_7, m_9, .., m_n be the MSMEs with available requested products.

- *Product availability (m_1, m_5, m_7, m_9, .., m_n)*
- *Product count (p_1, p_5, p_7, p_9, ..., p_n)*
- *Distance (d_1, d_5, d_7, d_9, ..., d_n)*
- *Price of product (pr_1, pr_5, pr_7, pr_9, ..., pr_n)*

In Table 1, quality of service is defined as '0' and '1' depending on whether the buyer MSME has had previous business transaction with them or not respectively. From the above table using query processing, the information is filtered depending on the following condition:

- *When the order is immediate,*
  - *D = User specified distance*
  - *P = User specified price*
  - *F (distance, cost, quality)*
    - ✓ *Filter depending on distance < D*
    - ✓ *Filter the resulting rows depending on price < P*
    - ✓ *Display the MSMEs with quality of service = 1*
- *When the Order is not Immediate,*
  - *D = User specified distance*
  - *P = User specified price*
  - *F (quality, cost, distance)*
    - ✓ *Filter the MSMEs with quality of service = 1*
    - ✓ *Filter the resulting rows depending on price < P*
    - ✓ *Filter the resulting depending on distance < D*

3.3 Custom Specific Negotiator

This is a platform to negotiate product customizations, price and time-to-deliver. Predefined customizations are available along with their price and time to deliver. If the predefined customization is not suitable to the buyer's customization then this platform helps MSMEs to hold direct negotiations with each other about the buyer's custom-specific products, thereby eliminating need for intermediation. In order to hold direct negotiations, the component helps in making direct phone conversation with other MSME, thus making negotiations easier and eliminating intermediation completely.

According to Fig 4, this component first checks if the user wishes to customize the product. If yes, then the component checks if seller MSME's predefined customization is suitable to the buyer's customization. If yes the buyer chooses the

predefined customization, the buyer MSME should also be fine with the price and time to deliver of the predefined customized product. If not, then the component realizes that the predefined customization is not suitable to the buyer's preferences, so now the buyer MSME is given the details of the seller MSME so that direct negotiations of custom specific products can be done through the phone conversations. Once it is done, a customized product is successfully negotiated and ordered.

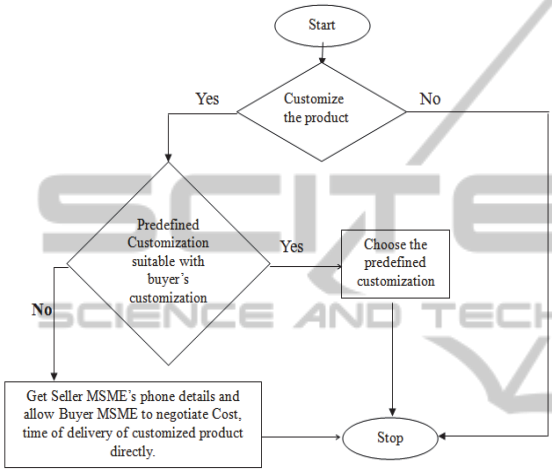

Figure 4: Workflow of Custom Specific Negotiator.

3.4 Order Tracker

Track pending orders module notifies the associated MSMEs and assist in easy management of bulk orders. The immediate available product quantity is dispatched by the supplier and the remaining quantity is calculated and is tracked by the order tracker. The order tracker holds information about the remaining amount of products yet to be delivered, along with the time taken to deliver the remaining product, thus summoning the MSME if the order is not delivered in time.

A detailed workflow of the Order tracker component is specified in Fig 5, here the component first checks whether the order has been parallelized, if yes the component keeps track of the order by storing MSME Name, last date for delivery of order, remaining quantity to be delivered of each supplier MSME in the parallelized order. If not then the component just keeps track of the order by storing only the single supplier MSME's Name, last date for delivery of order and remaining quantity to be delivered. The system continuously checks if the delivery time has reached, if yes then both the seller and buyer MSMEs are alerted. The algorithm used by order tracker is defined below:

If (order has been parallelized)
Track MSME Name, Delivery Time, (Remaining Quantity = Total Ordered Quantity-Delivered Quantity) for each MSME in the parallelized order
Else
Track that single MSME Name, Delivery Time, (Remaining Quantity = Total Ordered Quantity-Delivered Quantity)
If (Current Date ≥ Delivery Date-3)
Alert both buyer and seller MSMEs that the delivery date is nearing
If (Delivery Date ≥ Current Date)
Alert both buyer and seller MSMEs that the delivery has not yet arrived

4 REALISATION OF ORDER PLACEMENT & PROCESSING

A detailed sketch of the workflow is depicted in Fig 6. MSMEs have to register with the service provider by submitting appropriate identity proof. Once their identity is verified, the MSME can download the application on their android phones. A registered MSME has to undergo Password authentication. Once authenticated, the MSME can search for raw materials/products. Optimal order quantity calculation is carried out by employing Economic Order Quantity (EOQ) (Hax and Candea, 1984) concepts and techniques. The order quantity calculation performs statistical analysis of previous purchases and suggests the profitable order quantity. Besides, MSME can parallelize the order and split the quantity required to many divisions and purchase from a combination of MSMEs – similar to purchasing from assorted stock owned by distributors. Once the order is parallelized, then using the custom specific negotiator, the order can be customized according to the buyer's need. After that the order is placed at the click of a button. Later the ordered quantity, quantity delivered, last date of delivery of ordered components are all self managed by the order tracker, which continuously tracks these details and alerts the MSME if it is not delivered on time. For example, consider a buyer MSME who would like to purchase logs of Burma Teak wood, the MSME first logs into the application and specifies the inputs to calculate the economic order quantity. He also specifies whether the order is urgent or not. Then the application displays all

details of MSMEs whose available quantity is greater than the required economic order quantity; the MSMEs are listed depending on whether the order is urgent or not. Then order quantity is automatically initialized by the system, which can be changed if the buyer wishes. Once the order quantity is finalized, at the click of a button the order is placed, then the MSME is taken to the product customization where he can customize his order. The remaining process of tracking the order is completely taken care by the Order Tracker.

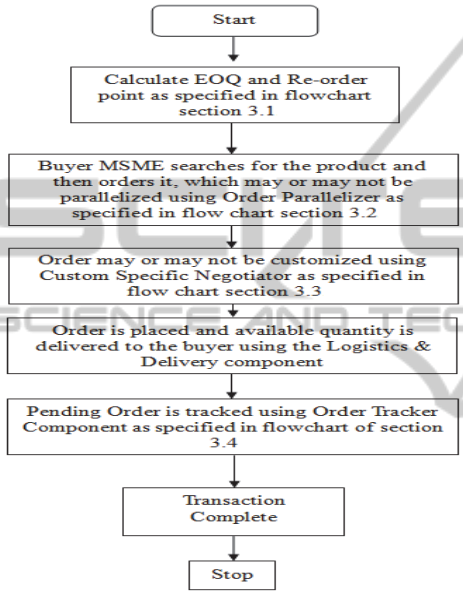

Figure 5: Workflow of Order Placement and Processing.

5 OTHER RELATED COMPONENTS

The proposed component-based approach executes on a mobile cloud for efficient information processing and storage. The architecture of the mobile cloud environment is very similar to that of EC2 (Varia, 2010) cloud. The mobile cloud extends various services to the mobile phone registered with the system. The cloud spawns a new virtual machine containing an instance of the framework for every new session. This ensures a highly scalable multiple-user environment. The entire system, with the framework on cloud accessible from android phone, is said to provide Infrastructure As A Service (IAAS) (Sushil et al., 2010). Infrastructures provided as service include persistent remote storage and remote computing.

The android application acts as an entry point to the mobile cloud. Using the android application, MSMEs can search for products, take advice on optimal order quantity, parallelize order quantity to purchase from a combination of different MSMEs, customize order specifications to suit the ever-changing needs. Hold negotiations and transactions directly with the concerned MSMEs to track products and obtain delivery updates as simple text messages.

6 ADVANTAGES

This system completely removes intermediation and has automated the order placement and processing phase in the MSME business transaction cycle. It makes the whole process easier for those involved MSMEs because of its automation and user friendly where it uses the android environment.

- All the extra costs incurred in paying intermediaries can be avoided as this component helps in direct business between the MSMEs.
- The component automatically calculates the EOQ, ROP values, making it easier for the MSMEs to make decisions when it comes to deciding the order quantity. It also alerts the MSME regarding when it is supposed to re-order the quantity.
- This invention supports order parallelization. Through Order parallelization, even MSMEs with a very small financial budget can survive the market as they parallelize the order and need to make only partial payments of the products they buy. They are not burdened to pay the entire amount; hence even an industry with a small warehouse can be lead in the market.
- Custom Negotiator helps in producing customized products, making it more satisfying to the buyer as he gets the product with all his custom requirements installed. Also direct negotiations are win-win model, satisfying both the parties and there is no room for confusions in customization as it is specified directly to the manufacturer and not through any middlemen.
- Order Tracker helps the MSME in tracking the order. As everything is automated, the MSME can be tension free. The delivery date alert, along with the entire order is all maintained by the order tracker and can be accessed by the buyer MSMEs, even remotely using his mobile phone and the android application.

7 CONCLUSION

Our proposed component-based approach makes MSMEs independent on middlemen during order placement and processing that has been analyzed and provided with an mobile phone-based implementation. It is evident from the implementation with mobile cloud and android application surely avoids the vital role played by middlemen in the order processing task. From the experiments conducted, we understand that the proposed approach comparatively outperforms the other traditional systems and give an end-to-end solution in order placement and processing. Introduction of this type of component-based approaches improves the MSME business to new level and creates sustainable development in B2B sector.

REFERENCES

Abigail, T., Cooke, 2000. New Role for the Middlemen. *Inet2000 Proceedings on E-Commerce and EBusiness.*

Jinesh Varia, 2010. Architecting for Cloud: Best Practices, Amazon, Inc., *Tech. Rep*., Jan. 2010.

Pius M.Achuama, Abel Usoro, 2010. Dancing with the Stars: E-CRM and SMEs in Developing Countries, *Journal of Economic Development, Management, IT, Finance and Marketing.*

Stuart Taylor, Andy Young, Neeraj Kumar, James Macaulay, 2011. Taking Care of Business in the Mobile Cloud. CiscoIbsg Research Uncovers New Opportunities for SPS to Prosper in the Mobile Cloud Market.

Wole Michael Olatokun, Mohotetsi Kebonye, 2010. e-Commerce Technology Adoption by SMEs in Botswana, *International Journal of Emerging Technologies and Society.*

Yusho Nakamoto, Hiroshima; Tomio Muneishi, Hiroshima; Takamichi Teraoka, Hiroshima; Takashi Kanbara, Hiroshima, 2002 S*implified order-placement and reception processing method and system* Sep. 19, 2002

Saravanan, M., Amirtha Varsani, M., and Brindha, S., 2012. Ontology Engineered MSME Framework, International Conference on Data Engineering, DATA 2012, Rome, Italy.

Hax, AC and Candea, D, 1984. *Production and Operations Management*, Prentice-Hall, Englewood Cliffs, NJ, p. 135.

Ken Pepple, 2011. Deploying OpenStack (First Edition),United States of America : O'Reilly Media, Inc.

Sushil Bhardwaj, Leena Jain, Sandeep Jain, 2010. Cloud Computing: A Study Of Infrastructure As A Service (Iaas), International Journal Of Engineering And Information Technology

Upadhyay Parijat & Dan P.K, 2010, User's Perspective of Factor(s) influencing for ERP implementation in Small and Medium Enterprises in India, Innovation in Information and Communication Technology, ISBN-0230-63714-0, MacMillan Publication.

Andersen, T, 2003. HRM in SME's – first findings on structure and practices. LOK- conference at Kongebrogarden, Middlefart, Dec 1-2,2003.

Ioana Giurgiu , Oriana Riva , Gustavo Alonso, Dynamic software deployment from clouds to mobile devices, Proceedings of the 13th International Middleware Conference, December 03-07, 2012, ontreal, Quebec, Canada