A Non Tradıtıonal Vendor Managed Inventory: A Servıce Orıented based Supply Chaın Modelıng in Health Servıces

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Abstract

Since 90s, the healthcare sector has changed rapidly. These changes oblige the healthcare sector to adopt the management principles applied by the other sectors. Many studies have been realized to reveal and emphasize the significant competitive advantage and cost reduction resulting from supply chain management (SCM) practices. However, the healthcare industry has been extremely slow to embrace these practices because of its own different nature. Principally, in healthcare sector, pioneers must perform a highly accurate work because the cost of an error may simply be someone's life. In healthcare industry, "Right product must be in the right place at the right time" is really a must. Besides, the nature of this sector's includes some barriers such as lack of executive support; misaligned or conflicting incentives; need for data collection and performance measurement; limited education on supply chain; and inconsistent relationships with group purchasing organizations and other supply chain partners. The paper describes a service oriented based Vendor Managed Inventory (VMI) model to manage healthcare supply chain application. The proposed architecture has the capability to meet the contingency demand requirements of dynamic healthcare supply chain without affecting the pioneer's workload. The design and implementation details of the SOA solution are given, which are supported through a software prototype. The core theme of this paper is to provide the best kind of process systems by using service oriented architecture patterns and to model a vendor managed inventory in order to ensure an effective management in healthcare supply chain management.

Keywords
Healthcare Supply Chain Management; Continuous Replenishment; Vendor Managed Inventory (VMI); Service-Oriented Architecture (SOA).

1. Introduction

A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers (Kaihara 2003). The International Center for Competitive Excellence (Liu et al. 2005) defined it to be ''the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders". Effectively integrating the information and material flows within the demand and supply process is the main concern for Supply Chain Management (SCM) (Soroor ,Tarokh & Shemshadi 2009). The potential for improved productivity, cost reduction, and customer service are enormous (Soroor & Tarokh 2006). Effective coordination between units in a supply chain has come to play a key role in focusing on the innovation, flexibility, and speed that serve as the sources of competitive advantage necessary for survival in global competition (Lee 2002).

Healthcare supply chain management differs from other applications in terms of key elements. The healthcare supply chain is plagued by misalignment, high costs for healthcare providers and heavy dependence on third parties, distributors and manufacturers. Also one cannot deny that there is an extremely big political and public pressure on healthcare sector pioneers in order to control costs while increasing the quality of services. Despite this pressure, the institutions are reluctant to adopt supply chain principles to their business because of these reasons:

- Role of consumer (patients) and the role of customer (hospital) differ from each other
- The difference in the operations realized and the vitality of the services given by healthcare institutions compared to other industries
- Material, information and cash flow are totally different from the other sector's supply chain management.

Vendor Managed Inventory (VMI) is one of the supply chain strategies to get the competitive advantage through the effective supply chain. In VMI, the vendor or supplier is given the responsibility of managing the customer's stock based on the shared information between them. Vendor-managed inventory (VMI) approach can improve supply chain performance by decreasing inventory-related costs and increasing customer service. Unlike a traditional supply chain wherein each member manages its own inventories and makes individual stocking decision, VMI is a collaborative initiative where a downstream customer, shifts the ownership of inventories to its immediate upstream supplier and allows the supplier to access its demand information in return. The key characteristics of VMI are thus short replenishment lead times, and frequent and punctual deliveries that optimize production and transport planning (De Toni & Zamolo 2005).

In practical, many supply chain members are unwilling to accept the VMI, although they agree with the idea that the integrated decision will be beneficial to improve their supply chain performance, due to some obstacles such as the expensive technology investment or special personnel training. It is obvious that the most important rejection reason among these is the lack of reciprocal trust (NCR 2005). The information gains a confidential importance especially in **healthcare supply chain** management (Flowers, Tomlinson, Levy, Deponio & Rosenbaum 2009). Using emerging technologies while adopting a VMI method to a healthcare supply chain will strongly eliminate these suspicions about information sharing particularly in a real-time system. Different industries and businesses are currently struggling to implement techniques that can reduce supply process duration and cost, even as improving productivity and performance (Emigh 1999). In this regard, there has been a movement towards the use of collaborative processes that leverage the Internet platform, thereby allowing participation of the supply chain members, from the very early stages of the supply process.

Service Oriented Architecture (SOA) becomes a suitable solution for this kind of problems where each participant has different type of IT infrastructure but to work collectively. Service-oriented architecture (SOA) may be seen as the new face of Enterprise Application Integration (EAI) (Papazoglou 2007). We can also define SOA as a business – driven IT architectural approach that helps businesses innovate by ensuring that IT systems can adapt quickly, easily and economically to support rapidly changing business needs. With the rapid development of web services and their quick adoption into IT sectors, SOA becomes most preferable architecture. With SOA, institutions can be integrated in supply chain management infrastructure by reengineering their processes without changing their own systems.

Although there exist a large amount of literature that examines various aspects of VMI, SOA and supply chain management separately, there isn't any survey to model the three all together. The aim of this paper is to model the VMI system's business processes of a healthcare supply chain according to SOA principles in order to minimize trust problem caused by VMI between pioneers, provide cost reduction, solve the inventory problems and decrease the inventory cost while increasing the drug and medical supply's availability.

The other contribution of the paper can be seen from the following two perspectives. First, this paper takes a few steps further from the existing research efforts about the nature of information system used in VMI supply chain. Second, as SOA not only an infrastructure, this paper shows a brief example about how business processes are modeled according to SOA principles and which software can be used for this modeling

The rest of the paper is organized as follows: In the next section, we describe the traditional VMI implementation. Then we explain our new VMI approach with SOA and our experiment design in section.

2. Healthcare Supply Chain Characteristics

Ironically, the healthcare supply chain is itself extremely sick and needs immediate attention (Singh et al, 2006). Although supply costs do not constitute a major portion of the direct overall healthcare bill, High availability, reduces counterfeits, increase responsiveness, increase resilience, increase choices, reduce waste, increase drug utilization, and play a role in reducing medication errors (an efficient supply system will relieve the caregivers of the duties and stress associated with this function allowing them to focus on what they do best i.e. patient care). In a healthcare setting, critical supplies which constitute a small number of items are typically extremely expensive (on a per unit basis), have a short shelf-life, and/or require expensive storage facilities on site (e.g., inject able medical supplies, pharmaceutical supplies, and surgical supplies). On the other hand, all the other multitude of supplies are considered as being non-critical (e.g., tubing, suture sets, latex examination gloves, and plastic/disposable sheeting).While the majority of the total inventory investment is in critical supplies (around 60%), the large number of non-critical supplies typically accounts for the remaining inventory investment for these networks (Nicholson et al, 2004) .

3. Traditional Vendor – Managed Inventory (VMI) Implementation

Vendor-Managed Inventory (VMI) is a partnering initiative in supply chain management. With VMI, the supplier monitors the customer's inventory, so the customer no longer needs to place orders to the supplier. The supplier orders from its upstream suppliers on the basis of end-consumer demand and strategically distributes inventory between the supplier's and the customer's locations. This approach can improve supply chain performance by decreasing inventory-related costs and increasing customer service.

Unlike a traditional supply chain wherein each member manages its own inventories and makes individual stocking decision, VMI is a collaborative initiative where a downstream customer, shifts the ownership of inventories to its immediate upstream supplier and allows the supplier to access its demand information in return (Cachon & Fisher 2000). The supplier thus makes the replenishment decision, rather than waiting for the customer to reorder the product. Such approach let the downstream customer to have reductions in holding costs and some operational costs plus cash flow benefits (Benefield 2005), while an upstream supplier needs to bear the burden of inventory carrying and demand forecasting. However the upstream supplier may probably gain chances to improve other production and marketing efficiency because instead of just putting more pressure on supplier's performance by requiring ever faster and more accurate deliveries, VMI gives the supplier both responsibility and authority to manage the entire replenishment process (Cottrill 2001). The measure for supplier's performance is no more delivery time and preciseness; it is availability and inventory turnover. This is a fundamental change that affects the operational mode both at the customer and at the supplier company. Therefore the advantages to both parties must be evident to make the shift to VMI happen (Lee & Whang2000).

As can be seen from Fig. 1, in healthcare supply chain, there is any coordination of orders from different hospitals, even from the different departments of same hospital. It is even rare to plan regularly the orders from the same suppliers for different hospital's departments. Orders often arrive simultaneously, making it impossible to fulfill all delivery requests at one time. With VMI, greater coordination supports the supplier's need for smoother production without sacrificing the hospital's service and stock objectives.

The other problem faced in hospital inventory management is the absence of a proper classification schema. There are so many different drugs and medical supplies. Each of them is produced by a different manufacturer and may be used as a substitute for another one. It is practically impossible or at least inefficient to organize all these products without a proper classification since it is not is not possible to make a contract for each of them. On the other hand, although the hospitals keep an important amount of various items in store, they generally do not pay enough attention to the management of the inventories of these items. (Nicholson et al, 2004)

Furthermore, as we mentioned above, in healthcare supply chain, "right product must be in the right place at the right time" is really a must and supplier must respond spontaneously to hospitals' requests. Without VMI, the supplier has a difficult time prioritizing customer shipments effectively. VMI structure orients the customers, hospitals in our case, to see the supplier more dependable. Thus the supplier has a more accurate view of demand and can plan more effectively the customer shipments. This helps the supplier to ensure more predictable delivery schedule also, and respond quickly to hospitals' requests.

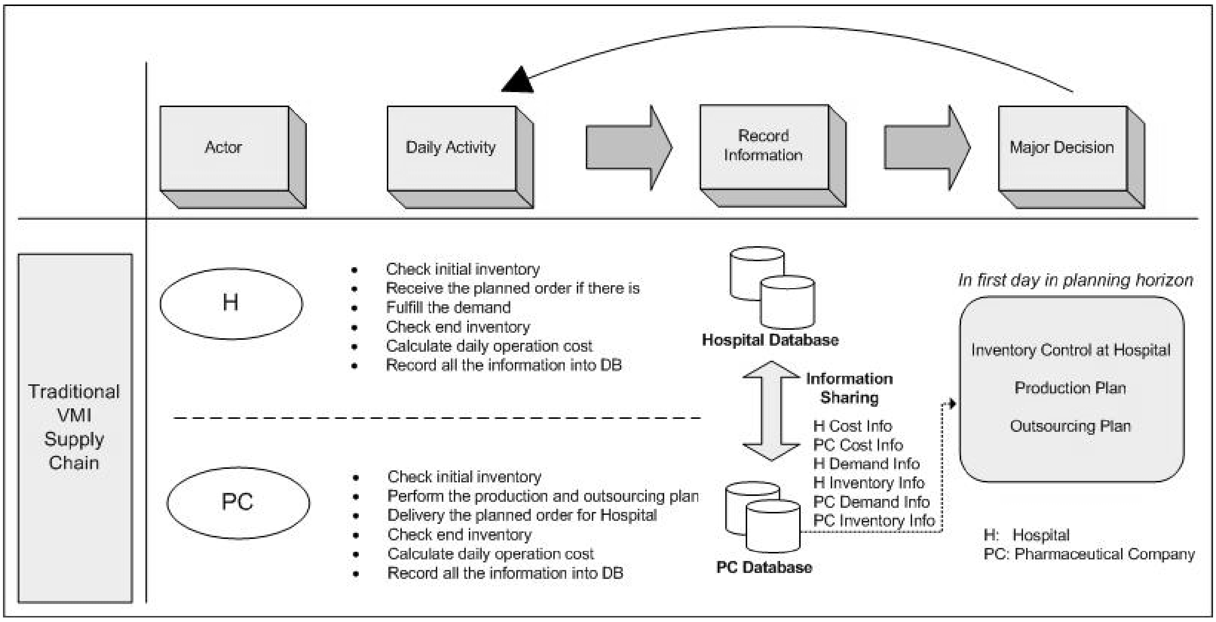

Figure 1: Traditional VMI Supply Chain

To provide a successful VMI implementation, two important novelties must be taken into consideration:

- Reengineering on both sides (supplier and customer) all the business processes according to VMI structure.
- Establishing fully integrated data flow between partners of supply chain

In our case, before implementing VMI, it was the pharmacist's mission to manage the inventory which resulted in inefficiencies. The adoption of VMI is started by doing contracts with among suppliers and hospital. These contracts are realized not only on the paper but also via web services too, (which will be described in the next section). In the contracts, the role of controlling inventory level of each drug or medical supply is given to an appropriate supplier by defining the unit price and payment schedule.

With this system, the suppliers' experts control the stock level instead of pharmacist. The new system let the pharmacist do his/her own job, and also create the time available for the supplier to plan deliveries. It is obvious that the more time the supplier has for planning, the better it is able to serve hospital and optimize operations.

We already mentioned that the healthcare organization's inventory management will be controlled by suppliers' experts. Here, the main question is who will decide for order quantity. We didn't let decision of order quantity neither to supplier's expert nor to pharmacist. Order quantities are calculated by the information system based on demand forecasting and safety stock levels. The model has adopted from the model cited in De Toni and Zamolo's paper (2005).

In any other sector except the healthcare sector, manufacturing and production is to be controlled by market demand, its trends, and seasonal nature, in other words by the actual sales but in healthcare sector production can't be controlled directly by the hospitals. As the usage amount of each hospital's department varies from each other and this variation is very versatile, the supplier company must guarantee to cover a determinate safety stock level. In De Toni and Zamolo's paper, this determinate safety stock level is called as target stock – TAS. One can define target stock TAS as the device used to absorb any unexpected fluctuation in sales until the next arrival of goods (De Toni & Zamolo 2005). The supplier and hospital pharmacy have to agree on the value of TAS in days (TAS_{dd}), that is, the number of days covered by the supplies in warehouse.

According to De Toni and Zamolo's paper, to determine the level of stock in the hospital's departments' warehouse that the supplier has to guarantee, a calculation is made starting from the TAS_{dd}, its equivalent in pieces depending on the department' s needs calculated by evaluating a predetermined horizon of visibility:

$$TAS_{drug} = \frac{\sum_{i=1}^{n} forecast(i)}{nd}\, TAS_{dd}$$

where TAS_{drug} is the Target Stock in drugs, TAS_{dd}, is the Target Stock in days, *forecast (i)* is the forecast of usages in the i^{th} period, n is the number of weeks of the temporal horizon (generally fixed at 4), d is the number of days (fixed at 7), $\sum_{i=1}^{n} forecast(i)\ /nd$ is the forecast of average usage per day during the period considered.

After fixing the TAS value, supplier must calculate the Replenishment Value (RN) in order to ensure the stock level of hospital's warehouse for this specific period. Replenishment value will be calculated by subtracting the sum of the current stock amount of a particular drug and its order amount in delivery from the sum of target stock amount of this drug defined for a specified period of time and its requirement value. Among all these values, requirement value differs from the others because it must be calculated while the others are the significant values. The requirement value is the relative need which varies according to the period considered and represents the maximum value between sales forecast and the sum of back orders and customer orders.

It is not difficult to see that to promote collaborations between suppliers and customers, VMI structure needs successful information sharing and business process reengineering. As mentioned in de Vries's paper, the effectiveness as well as the efficiency of the inventory system could be improved by integrating the information system of the hospital pharmacy and the system used by suppliers of pharmaceuticals. (de Vries,2010) . As a result, to ensure successful information sharing, supplier and hospital must be **totally** integrated by their information system but the partners may not be very willing to share totally their information system. To overcome this problem, it is essential to develop trust between the pioneers or to display an infrastructure that will enable the systems to exchange the data without being totally integrated. In terms of business process reengineering, this will eventually mean that processes will be optimized and the workload of employees will be reduced in the hospital.

On the other hand, the supplier may have much more responsibility than before and this may make them to hire more staff to meet this increasing responsibility. Then again, expenses at the supplier often increase as managerial responsibilities increase. Finally, and perhaps most critically, for supplier and hospital, it is necessary to employ advanced technology, which is often very expensive to build such a system. Despite to all these disadvantages, we can’t deny the advantages of VMI in terms of service improving and cost reducing. So we have to propose a troubleshooting model. The solution to the problems mentioned above, will be provided by service oriented architecture.

4. Modeling Supply Chain System with VMI via Service Oriented Architecture (SOA)

4.1. VMI within Healthcare Supply Chain & Information Technologies

Since its adoption in the arena of supply chain management in early 1980s, the VMI concept has received a great deal of attention, as the model differs significantly from the traditional practice in that the chain members shift their relationships from an arm’s length to a strategic partnership. The studies by Vergin and Barr (1999) and Lee et al. (2005) conclude that VMI is becoming an effective approach for implementing the channel coordination initiative, which is critical and imperative to improve the entire chain’s financial performance. Waller, Johnson, and Davis (1999) indicate further that the VMI method can improve inventory turnover and customer service levels at every stage of a supply chain. Disney and Towill (2002) find that the main goal of VMI chains, which is minimizing the channel cost while simultaneously satisfying some degree of customer service levels, is achieved primarily by sharing demand and inventory information.

It is indisputable that the implementation of VMI in supply chain will reduce the costs and increase the performance of overall system. On the other hand, as we mentioned before, hospitals and suppliers may be reluctant to accept the VMI because of the expensive technology investment or special personnel training. Also, to prevent the patients’ right and their private information, it will be prejudicial to intervene directly to the hospital’s information system.

In their study, Xu, Dong, and Evers (2001), examine the impacts of EDI and Internet-based technologies on the practice of VMI. They also find that the application of VMI will improve the demand and inventory information sharing between the upstream and downstream members. Despite the huge investment cost of IT technologies, companies should be flexible and agile and stimulate cooperation in their supply chain. This coordination requires the capability to exchange information through the supply chain in a timely, responsive and usable format (Defee & Stank, 2005). Without question, IT must satisfy these trends (Edwards et al., 2001; Kocharekar, 2004), being flexible, easily interconnectable and quick to change whenever required (Helo & Szekely, 2005). In contrast, a survey conducted by Tyan and Wee (2003) points out that aside from the computer technologies, the key of implementing VMI lies in the abilities of the related chain members to cooperate and to understand the flows and processes concerning their products or services delivery. Moreover information technologies can be a conduit for information transfer, but it also can introduce risks to confidentiality, integrity and availability in the supply chain (Smith, Watson, Baker, & Pokorski, 2007).

On the other hand, as mentioned in the paper of Zhang et al., though information and internet technology could offer major strategic benefits such as an effective and efficient delivery of healthcare, the uptake of web technology in healthcare sector is limited. Also, there is limited research into e-adoption in healthcare from a supply chain management.

Due to all these problems, it is certainly needed to develop not only a VMI model that will only support healthcare supply chain, but also to remodel VMI processes according to SOA principles for a strong IT infrastructure that will support this system

4.2. Service Oriented Architecture

Service oriented architecture (SOA) is a model in which information sources and software functionalities are delivered as individual distinct service units, which are distributed over a network and combined to create business applications to solve complex problems. SOA enables the dynamic reconfiguration of supply chains, making them readily adaptable to changing business models, growing globalization and increasing coordination. Using the SOA approach, information sources and systems are converted into modular service components that can be discovered, located and invoked by other applications through a standard protocol. The service components can be reused by multiple applications or other services residing on a network. This “plug-and-play” capability allows agile development and quick reconfiguration of the system, which are essential for building a flexible system for fast changing supply chains

SOA is not a technology, it’s an architectural style whose goal is to achieve loose coupling among interacting software agents, built around existing technology (He, 2003). It allows designing software systems that provide services to other applications through published and discoverable interfaces, and where the services can be invoked over a network (Channabasavaiah et al., 2003). SOA advocates a set of practices, disciplines, designs, and guidelines that can be applied using one or more technologies and being an architectural concept, is flexible enough to lend itself to multiple definitions.

The key element of SOA is the service. A service can be described as "a component capable of performing a task" (Sprott & Wilkes, 2004). Although a service can be seen as a task or an activity, it is more complicated than these concepts. This is due to the fact that every service has a contract, an interface, and an implementation routine. Web services are the building blocks of SOA. A "web service" can be described as a specific function that is distributed on the Internet to provide information or services to users through standardized application-to-application interactions. Leveraging well established Internet protocols and commonly used machine readable representations, web services can be located, invoked, combined, and reused.

The second important issue is to define explicitly two key roles in a SOA: the service provider and service consumer. As can be seen from Fig. 2 service provider publishes a service description and provides the implementation for the service, whereas service consumer can either use the uniform resource identifier (URI) for the service description directly or can find the service description in a service registry and bind and invoke the service.

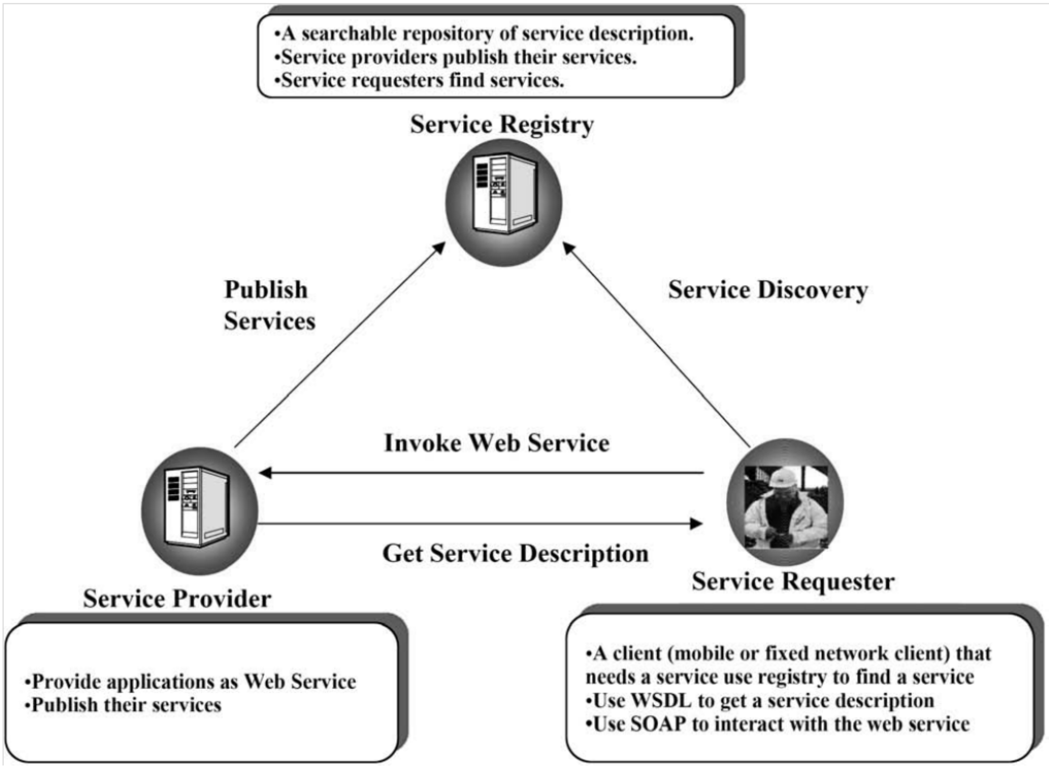

Figure 2: Three entities of Web Services architecture (Soroor & Tarokh 2006).

The first aim of SOA is the simplicity. SOA aims to provide interconnection between organizations without obliging them to change their IT infrastructure. Organizations can take its existing assets also into future as well as build its new applications. Moreover as the web services have became more widespread and removed the barrier by allowing the interconnection very easily, modeling system according to SOA principles is more cost effective. Because consuming a service is usually cheaper and more effective than doing the work from the scratch.

In anticipation of the discovery of new business opportunities or threats, the SOA architectural style aims to provide enterprise business solutions that can extend or change on demand. SOA solutions are composed of reusable services, with well-defined, published and standards-compliant interfaces. SOA provides a mechanism for integrating existing legacy applications regardless of their platform or language.

To obtain a better performance, reengineering the business process according to SOA principles is a must. SOA creates an adaptive and responsive business model by offering a new perspective that was previously unavailable: It offers a real-time view of what is happening in terms of transactions, usage, and so forth.

4.3. Modeling VMI business processes according to SOA principles

As a requirement of the definition of VMI, the supplier needs to manage the hospital's overall inventory control system and order processing system and then makes the order delivery schedule according to the contract signed by the supplier and the hospital. In a traditional VMI system, the supplier takes both responsibility and authority to manage the entire replenishment process. The customer company provides the supplier access the inventory and demand information and sets the targets for availability (Kaipia, Holmström & Tanskanen 2002). Here, instead of allowing the supplier to intervene directly to the legacy system used by the hospital, we believe that it would be more appropriate to produce the information needed by the supplier by a service architecture and orchestration on the system. Although one may think that such a business process modeling may be realized by other modeling types like Object Oriented Design (OOD) or Enterprise Architecture (EA), it is certain that Service Oriented Architecture Design will be more efficient in defining the human based task that we eventually need in this modeling.

In this project, we used IBM Websphere Business Modeler 6.1.to model the business processes according to SOA principles. In our scenario, there is a medium scale hospital which is currently working with different pharmaceuticals company. Hospital uses its own legacy system and each pharmaceutical company has its own information system to fulfill the hospital's orders. Normally, it usually takes time to configure and establish the communication between hospital and suppliers in order to provide electronically data interchange. Therefore, we tried to implement service oriented architecture as infrastructure architecture and remodel the processes according to its principles. This allows easy and quick integration of system users.

We first model the supplier's business process. Normally supplier's business process consists of following steps: Supplier receives the hospital's orders by phone, fax or via its own webpage and try to fulfill the order. After implementing VMI into the supply chain system, supplier must calculate manually TAS drug value and Requirement Value. When this process is remodeled according to SOA principles, a service is created to realize this process. As can be seen in Appendix A, **Supplier Service** (SS) begins to work by using an XSD document as an input. This XSD document contains the necessary information sent by the hospital legacy system in order to calculate TAS drug value. Moreover, the Supplier Service updates also this document according to the same TAS drug value and uses this value to calculate the Requirement Value as well. On the other hand, this service may update the same XSD document with the Requirement Value that has been recently calculated. Finally, Replenishment Need Value also can be calculated similarly and this may lead, in turn, to the updating of XSD document once again.

While designing this service, the architecture leads to a need for another sub service. This sub service, called **Schedule Service** (ScS), is mainly responsible to log the time periods. After invoking ScS, SS prepares another web service request to call Order Service which is an independent service but works also coordinately as a sub service with Supplier Service.

The second stage in the scenario is to realize the order instead of hospital's pharmacy. Appendix B represents the **Order Service** (OS) which is mainly responsible of hospital's orders which are under control of supplier. OS works within SS as a sub-service. When OS receives the web service request, it takes XSD document mentioned above into consideration. This XSD document contains the latest updated values such as the order quantity. The ScS works also within Order Service (OS) in order to log the time periods to write into XSD document. After all this operations, the dispatch plan is prepared and the information is delivered to Hospital Service. As can be seen in Appendix B, Hospital Service also works within Supplier Service as a sub-service.

Final stage is to inform the hospital about the orders. In Appendix C, **Hospital Service** (HS) is modeled. HS is responsible to warn the hospital's pharmacist. When the items come to the hospital, the pharmacist and the employee must verify the boxes and approves the task waiting on the system, to declare the order is correct. If it is not correct, they must specify the details, and a new job will start for the mistakes. When they approve that the order is correct, the supplier's legacy system will produce the invoice and send the invoice via web services to hospital to get the payment.

When analyzed, it has been observed that the system that we try to establish has many benefits. First, thanks to the VMI application, the workloads of the pharmacists and the other employees have been decreased. On the other hand, thanks to this application, the pharmacist is no longer expected to be knowledgeable about the stock management or the cost reduction but on the contrary these operations will be realized by the real experts. Moreover, there are many benefits in the stock management as well. The drugs are the difficult materials to be stored and preserved. In fact, each drug has an expiry date. There are an enormous number of different drugs and most of the drugs may be used equivalently instead of each other. Besides, as we mentioned before, in the healthcare sector, the non existence may produce more serious results since the human life is concerned. Therefore, an effective stock management that has been structured in this way, and an efficient material handling at the same time, will certainly improve the quality of the service offered to the patients in the hospital.

Secondly, the information integration and a successful supply chain will eventually result in a strong integration among the partners of the system, i.e., the hospital and the wholesalers. Thanks to the services produced, all the required information may be used by the other institutions within the limit of the permission given by the service provider institution. The only constraint here is that each provider and the consumer must work with the same semantic so as to understand the web services.

Finally the applications open to the human mistakes, such as lost papers among the files, the products that are forgotten to be ordered, and numerous phone calls, will be totally removed. When the specific importance of the sector studied is taken into account, it is extremely important to minimize the deadlocks arisen from the human mistakes.

5. Conclusion

The importance of supply chain integration has been observed in different areas. The nature of the healthcare sector creates an ambiguous and unstable environment in supply chain management, which in turn, leads to a constant risk exposure both on the hospitals and suppliers. On the other hand cost of a simple error may be someone’s life. Under these circumstances, information technology plays inevitably a significant role for healthcare supply chain’s performance.

In this paper, we put forward a modeling approach to healthcare supply chain according to SOA principles. Although the whole supply chain is composed of row material suppliers, pharmaceuticals companies, wholesalers, hospitals and patients, we focused especially on implementing the model; non-traditional VMI system in hospital warehouse via web services between hospitals and suppliers.

In order to minimize the stock problems that may occur, to increase the availability of the medicines and the medical supplies, and most importantly to free the pharmacists that were only educated to provide medical services from stock management workload, a VMI system should be deployed on healthcare supply chain which will be a fruitful result. For obtaining good results from VMI, it is important to support it with a powerful IT infrastructure. This may cause high expenditure for hospitals and for suppliers. To eliminate these kinds of high expenditures, we decided that the hospitals and the suppliers should apply the principles of SOA to improve interoperability and to minimize data integration problems without disposing from their leg. Since SOA is not only a technology or an IT platform, we also modeled the business processes in accordance with SOA principles while modeling the supply chain system with services.

The service oriented approach has been leveraged and the system established provides a serious profit both in making the orders and in the stock management. Based on the characteristics of healthcare supply chains and the study in literatures, we have summarized especially four requirements for a collaborative system. These requirements are 1) low cost, 2) ease of connection and integration, 3) ability to integrate external systems and information, and 4) information privacy. All business processes remodeled are satisfying these requirements.

An example scenario which involves suppliers and hospital has been presented to illustrate how to model the business processes. The procurement scenario includes the hospital’s inventory management process, order process and verification process. With the processes models, system gains the interoperability and flexibility and supply chain becomes more agile. Besides, information sharing and application integration may be hindered in such a system because hospitals may be hesitant to share patients’ information with suppliers in accordance with patients’ rights.

The paper reveals that while applying VMI system, to reduce the greatest source of errors and inefficiency in the processes and to provide a cost – effective solution to both supplier and hospitals in healthcare supply chain, modeling according to SOA principles will be an effective solution to achieve this objective while not making any extra IT investment

To extend the benefits presented in this paper, all the business processes along the healthcare supply chain must be modeled according to SOA principles and system must be constructed by using web services which illustrate these processes. This will expose first an orchestration between these services which will invoke the service oriented web-based system. Secondly the standards for exchanging information electronically must be established and adopted in order to provide an application – to – application integration and this is where semantic of web services begins and takes big place in exchanging data.

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