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Application of Supply Chain Management at Drugs Flow in an Italian Hospital District

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Application of Supply Chain Management at Drugs Flow in an Italian Hospital District

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Abstract. The globalization has pushed to change the organization of every companies, even the hospitals. The principal phenomenon in that period and fundamental today again, has been the Supply Chain Management (SCM), with which the company is no longer seen as an isolated entity but active part in an extremely complex supply network. In fact, the only way to guarantee the competitiveness of businesses in the new world economy is through the cooperation and the integration between customers and suppliers. The present work analyses the drugs flow of three Italian hospital: the Cardarelli Hospital in Campobasso, the Veneziale located in Isernia and the San Timoteo site in Termoli. The data was provided by MOLISE DATA SPA that collected the information from all ASREM with particular interest in the already mentioned hospitals. Particularly, will be highlight, using simulation model, the benefits deriving from the implementation of a new Supply Chain, creating a collaboration along the entire logistics-production chain. Thanks to a more efficient management of drugs will get a reduction of business costs and an improvement of the health services offered.

1. Introduction

The innovations that characterized the twenty-first century have profoundly changed the activities carried out by companies, which until then were anchored to archaic methodologies. Specifically, the internet was the element with the strongest impact, not only on a social level, but also from a management and economic point of view. Large production plants to manage sudden increases in applications, exploiting significant savings obtained through the economy of scale, are supplied with large quantities of materials, ready to be used at any time. This is also true in the health field, where a multitude of data are generated which, processed with new techniques, can be used to: analyse health-related [1–6] and biomedical data [7–13] to improve the overall hospital organization and optimize the several different procedures [14–20] as well as the logistics and resources management [21–30]. As far as the evolution of the logistics in both industry and healthcare, some models introduced in the end of the 80s are still in use in modern organizations. An example is the "Just in Time" approach, characterized by reduced stocking operations, supply speed and a production that aims to satisfy the customer's needs. However, the change also affected the logistics area, making changes to the entire logistic-production chain [31-33], with the aim of achieving totalising effectiveness. Each individual is no longer relegated to carrying out a single task, but cooperates and collaborates in every organizational phase, improving the integration between the various business processes [34].

A company with a good position on the market and good product quality will not be able to remain competitive if it does not manage the procurement and distribution phases.

In the era in which the market is global, only through an efficient management of the value chain, in addition to a flexible structure and a production targeted to the customer's needs, it is possible to guarantee and maintain a market share. The phenomenon that describes the following situation is called "Supply Chain Management" (SCM) [35–38]. SCM is a supply chain characterized by all actors that allow the existence of the company, from providers to consumers.

Despite the SCM it was born in the 80s, driven by concrete needs such as reduction of delivery times and increase in the range of products [39, 40], its concepts are still current for all the companies that have understand the obtainable benefits from its implementation. In particular, it has become the method to improve the position on market and increasing the quality of services offered to the customer.

Analysing the several definitions of SCM given during these years [41], emerges that the key point is to consider all business activities like a single large system. This strategy consents a quick identification and elimination of any inefficiency to guarantee the efficiency and the effectiveness of the management process [42, 43].

In this contest, the maximum efficiency and effectiveness can be obtained towards the reduction of production and storage cost and with an idea of business always revolt on customer satisfaction. The company is not an isolated entity, but operates within an extremely complex supply network, interacting with other companies that can be suppliers or customers. In other words, the structure can interact with actors that they can represent.

2. Methods

All drugs were bought by the ASREM (Molise Regional Health Authority) and was acquired in 2017. The analyzed data refer to three hospitals in Molise.

- Cardarelli di Campobasso;
- San Timoteo di Termoli;
- Venezial of Isernia.

For each drug, summary information was provided regarding:

- date of purchase;
- type of movement;
- product code;
- quantity handled;
- unit cost of the product.

In particular, attention has fallen on those drugs with high turnover / low cost and low turnover / high cost. The analysis reported 2 drugs presenting these characteristics:

- Vacutainer tube which is a low-cost and high-rotation drug;
- Soliris which, being an anticancer, has a high cost and low rotation.

Subsequently a year of demand was simulated for the aforementioned products considering the application case without lateral transhipment and the demand one with lateral transhipment. An application without lateral transhipment is characterized by the fact that the hospital can request the material exclusively from the supplier, while in an application with lateral transhipment, the hospital that at that moment has a lack of material, can request the same from another hospital. The objective of the work is to create a single virtual warehouse that unites the three hospitals in such a way that, maintaining the same level of service, the average level of stock is reduced, favouring a reduction in costs. A simulation model of the Supply Chain was developed through the use of a tool called Anylogic that allows to dynamically display the output data of the model in its application during the execution of the simulation and to export the data to other applications in text form. This can be done using various graphs and histograms with a simple and intuitive interface (Figures 1-3).

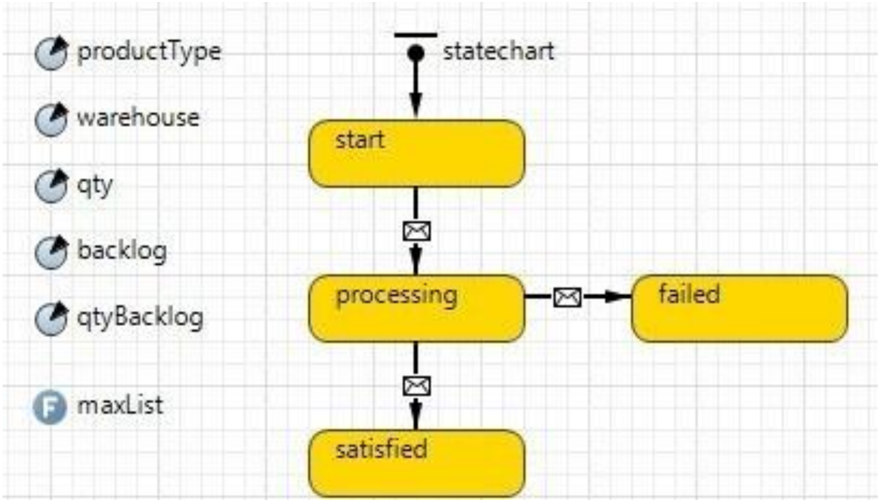

Figure 1. Demand order structure with related parameters.

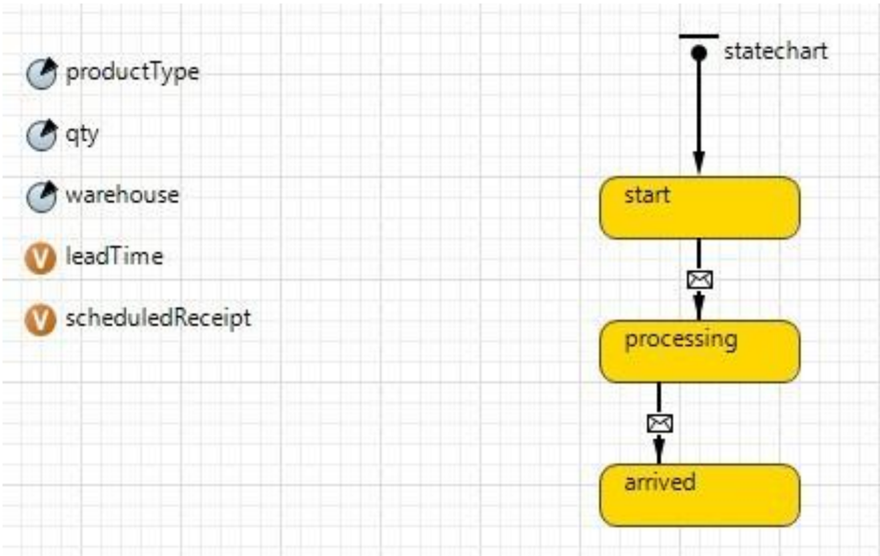

Figure 2. Structure of LT Order and Supply Order with related parameters.

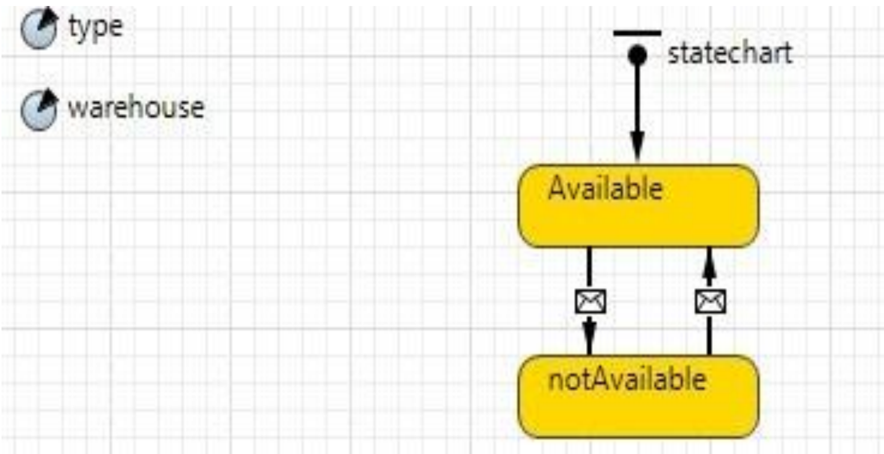

Figure 3. Product Structure.

3. Results

Each configuration generated through the combination of different safety stock values for the two drugs Soliris and Test tube Vacutainer (high cost / low rotation and low cost / high rotation respectively) was replicated ten times, for a total of 2430 simulations.

A synoptic table of the 9 most efficient results is reported for the two cases analyzed through the following tables (Tables 1 and 2).

Table 1. Safety stock, stock level, service level and total cost values, for configurations with lateral transhipment.

Safety stock					Stock Level					Service Level						
Soliris		Vacutainer			Soliris		Vacutainer			Soliris		Vacutainer			σ	Total Cost
CB	IS	CB	TM	IS	CB	IS	CB	IS	TM	CB	IS	CB	IS	TM		
10	20	5000	2500	5000	11.60	20.70	192407.02	32543.12	6932.70	1.000	1.000	1.000	1.000	1.000	0.000	12428.49
20	20	5000	0	5000	20.69	20.98	194864.92	34246.66	6151.17	1.000	1.000	1.000	1.000	1.000	0.000	16024.16
0	20	5000	5000	5000	5.12	19.20	190612.38	32862.17	21140.60	0.999	0.999	1.000	1.000	1.000	0.001	9362.80
20	20	2500	5000	5000	21.07	21.00	184251.41	33111.15	20379.91	0.999	0.999	1.000	1.000	1.000	0.002	16181.36
10	20	2500	2500	5000	11.55	20.52	185546.37	33724.89	7779.68	0.999	0.999	1.000	0.998	0.999	0.002	12336.93
20	10	5000	2500	5000	20.95	11.23	193367.43	33099.77	8156.97	0.998	0.998	1.000	1.000	1.000	0.003	12380.50
10	10	5000	5000	5000	11.69	11.10	193655.68	34315.58	28525.19	0.998	0.998	1.000	1.000	1.000	0.003	8775.60
20	20	5000	2500	2500	20.30	21.07	194190.19	29979.70	7445.82	0.999	0.999	1.000	0.998	0.998	0.003	15907.44
20	10	5000	5000	5000	21.02	11.16	192020.03	33423.47	21886.41	0.997	0.998	1.000	1.000	1.000	0.003	12378.94

Table 2: Safety stock, stock level, service level and total cost values, for configurations without lateral transhipment.

Safety stock					Stock Level					Service Level						
Soliris		Vacutainer			Soliris		Vacutainer			Soliris		Vacutainer			σ	Total Cost
CB	IS	CB	TM	IS	CB	IS	CB	IS	TM	CB	IS	CB	IS	TM		
20	10	5000	0	5000	20.68	10.99	193147.51	33275.47	6693.42	1.000	0.998	1.000	0.992	0.994	0.010	12183.52
20	10	5000	2500	5000	20.94	11.23	190050.14	33184.70	6977.38	0.994	0.995	1.000	0.993	0.995	0.011	12375.76
20	20	2500	2500	2500	20.41	20.72	183298.27	30947.37	6803.88	0.996	0.996	0.998	0.992	0.994	0.012	15818.25
20	20	5000	0	5000	20.36	20.94	191548.85	32945.38	6501.07	0.994	0.994	1.000	0.993	0.994	0.012	15880.31
20	10	5000	0	2500	20.48	10.95	186801.15	30289.33	6651.56	0.996	0.993	0.998	0.993	0.995	0.012	12088.37

2	2	25	0	50	20.	20.	184419	32640	6767.	0.9	0.9	0.9	0.9	0.9	0.0	16030.
0	0	00		00	75	94	.98	.44	40	98	98	94	92	94	12	78
2	2	50	25	50	20.	20.	191676	33814	6527.	0.9	0.9	1.0	0.9	0.9	0.0	16111.
0	0	00	00	00	94	95	.78	.01	68	93	92	00	95	96	13	33
2	1	50	50	50	20.	11.	192069	34121	10785	0.9	0.9	1.0	0.9	0.9	0.0	12353.
0	0	00	00	00	85	26	.43	.42	.63	93	92	00	95	96	13	77
2	2	25	50	50	21.	20.	186348	33435	14222	0.9	0.9	1.0	0.9	0.9	0.0	16200.
0	0	00	00	00	16	97	.67	.13	.38	95	95	00	91	93	14	71

The results showed that:

−At the same service level, applications with lateral transshipment are more profitable in terms of costs;

−At the same total cost, applications with lateral transshipment are more efficient in terms of service level.

The analysis has therefore succeeded in highlighting the effectiveness of the actual advantage of a network with lateral transshipment: at the same level of service, the average level of stock is reduced, favouring a reduction in costs.

4. Discussion and Conclusions

In this work, the impact of lateral transshipment on the performance of a multi echelon SC was evaluated. To this end, a simulation model was implemented in Anylogic that integrates the concepts of Inventory sharing and Vendor Managed Inventory [44, 45] with the use of lateral transshipment to find the Lot Size and Service Level values of each local warehouse, which to minimize the total cost of SC.

Thanks to the analysis conducted on the problems related to the management of the SC, it is possible to identify the primary objective to be followed to develop an effective SCM. The correct configuration of the entire logistics-production chain will allow the company to operate immediately at maximum speed, minimizing the waste of resources and possible subsequent interventions, which would slow down the normal production process. Companies that successfully operate as singles will increase the benefits of the entire production chain [46].

All these processes do nothing but move the market towards a "make to order" strategy, using a logic called "pull", where demand is pull by production orders. Only through an approach of this kind is it possible to derive for the companies enormous advantages.

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