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EXECUTIVE SUMMARY OF THE THESIS

Transition in the Transportation Management System: the Esselunga's delivery e-commerce case

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1. Introduction

In the new millennium, through the information technology development, the online sales are increased a lot, especially after the Covid-19 pandemic. The customers' habits have undergone a radical shift, enhancing the trust in purchasing through e-commerce channels, particularly on the e-grocery sector. [1] Many companies have understood that the online channel is an opportunity to complement the traditional way of selling products through physical stores. While companies decided to include online services in their offers, the online customers have also raised their expectations in terms of level of service. [2] The continuous challenge for companies operating in the online sector is to be able to grasp the transformations and innovations taking place and to provide solutions that best fit with the consumers' needs in terms of price, quality, convenience, selection and experience. [3]

2. Methodology

The thesis work has been intended to analyze the e-commerce sector, especially e-grocery, with a specific focus on the last mile home delivery planning and logistics, that is the online purchases distinguish feature but also the least efficient leg of the companies supply chain.

The methodology adopted in the work followed a theoretical and practical approach. The aspects highlighted in the state-of-the-art review of the e-commerce and last mile delivery activities have been carried out in a real case presentation of Esselunga delivery e-commerce concerning the transition in the routing planning delivery through a Transportation Management System (TMS) software.

Finally, the last chapter is dedicated to the theme of the Dynamic Time Slotting in the order booking and planning, as it represents the future development of the new TMS implementation, expected by Esselunga.

3. Literature review

3.1 E-commerce

Electronic commerce is a new way of buying goods or services which is over the Internet without a physical intermediary. The basic process of online purchases is searching goods, selecting products, making payment and waiting for the product delivery. [4] E-commerce has been the fastest growing channel in the retail industry over the last decade and the companies' competition is increased since many businesses chose to sell their products online, as a complementary channel to the traditional ones. [5] There are mainly 6 models of e-commerce and each one has its challenges to be faced. The common factor is that the Internet of Things (IOT) technology is an essential technical tool for e-logistics value chain management, involved from the user experience to the order preparation to the last mile delivery. [6]

The Covid-19 pandemic has accelerated the consumer's purchase habits shift from shopping at traditional brick-and-mortar stores to shopping online. [7] The expectations of the customers are increasing in such a way that a good home delivery service must ensure speed, response, convenience, quality, care, and a seamless experience through the e-commerce platform marketplace. The key to success for retailing in e-commerce is the understanding of the evolving and complex trends set forth by customers. [8]

3.2 Last mile delivery

Online shopping has increased the demand for last mile delivery services. Last mile delivery bears on the last step of the delivery process when a package is moved from the nearest transportation hub to its final destination, which usually is a personal residence or retail store. [9] Since, for the shippers, last-mile delivery is the most complex and expensive part of the product's journey, last mile logistics planning is more and more an area of interest. The superior goal of last-mile delivery is to enable every delivery to reach its destination every time, on time, accurately, efficiently, and sustainably, since last-mile logistics have taken center stage as a key factor that consumers evaluate when deciding where to purchase their online goods. [10]

The last mile delivery high relevance is mainly triggered by the following general developments and challenges [11]:

- Increasing volume;
- Sustainability;
- Costs;
- Time pressure;
- Aging workforce.

Operational research has contributed to decision making in several areas of supply chain management. The systemic direction suggests that better solutions to problems can be identified when broader parts of the supply chain are jointly modeled and optimized. In the area of vehicle routing, several papers have studied more global problems with respect to the classical routing problems aimed at finding the routes of vehicles only, given locations, demands of customers, time windows. Integrated vehicle routing problems is the expression increasingly used to denote the class of problems where the routing decisions are tackled together with other decisions. [11] [12] [13]

4. Case study: Esselunga

Esselunga S.p.A. is an Italian company operating in the large-scale retail trade in northern and central Italy with supermarkets and superstores. Esselunga, since 1957, operates in Italy mainly in the large-scale retail food sector. [14]

The company has approximately 8.7% control of sales in Italian supermarkets and hypermarkets with more than 170 outlets present in the regions of Lombardy, Veneto, Piedmont, Emilia-Romagna, Tuscany, Liguria and Lazio. From 2001, it is operative the e-commerce service, through the online web site Esselunga a casa. [15] [16]

The case study presented involves the decision of a transition in the Transportation Management System, which is the software adopted for the planning of the orders delivery routes through the vehicles. This activity, as result of the online network expansion and the choice of centralize the delivery e-commerce management, has become a

strategic and time consuming activity, that needed an updated infrastructure in order to obtain better results.

5. Transportation Management System

Especially after the Covid-19 epidemic, Esselunga experienced a considerable increase in the number of orders from online channels. The increase in the number of orders in 2020 prompted the company to invest even more strongly in the web channel, one of the investment proposed was the new TMS. The TMS is a software tool that has the task of solving in short time a large and complex optimization problem, in which the objective function is to minimize several parameters by translating them into costs by complying with constraints associated with a level of priority, while maximizing the number of planned orders. The TMS outputs is the routing of van, which consists of the time sequence of delivery of a certain number of orders in a single van.

5.1 Previous Routing System: PTV SmartTour

PTV SmartTour has been the software for routing planning used for years by Esselunga.

The software had pros and cons. The main con of the PTV SmarTour was that the optimization algorithm was strictly linked to the C-MAX of van, as the maximum number of orders to be inserted per time window, and the delivery area setting. The following list corresponds to the other cons of the system that have been the starting point in the new software implementation requirements:

- Orders weight and volume not take into consideration as limiting constraints;
- No vehicle type distinction in terms of available capacity;
- No possibility to limit the delivery activity in terms of hours;
- Routings completing time too long.

5.2 New Routing System: ORTEC Routing and Dispatch

The solution chose by Esselunga to overcome the limitations of the previous routing system is the implementation of ORTEC Routing and Dispatch, provided by ORTEC, a Dutch company operating around the world as supplier of advanced analytic and optimization vehicle routing softwares.

As the delivery e-commerce manager stated, the first objective for the route optimization is to maximize the number of orders planned, whilst minimizing the planning cost adhering to some business rules set as constraints to be respected as the minimization of number of vehicles used or the minimization of the total working hours. The second objective, more of an operational nature, is to have an efficient routing system, easy to use by the planners and quick in the execution of the planning optimizations.

This software has many pros, whilst the major drawback is the map visualization and interaction.

Among the major pros of the new software there are:

- The consideration of the order volumes and weights in the optimization algorithm as limiting constraints;
- The consideration of capacity limits in terms of maximum boxes and weight to be stored per vehicle profile;
- The optimization algorithm considering all the delivery area of the central-warehouse/transit point;
- The possibility to limit the resource activity in time;
- The system possibility to be customized according to the needs;
- The immediate graphical display, through icons, of what violations to business rules are found in planned shifts;
- The traffic congestion coefficients in the driving time.

5.2.1 Ongoing adjustments

The transition from PVT Smart Tour to ORTEC Routing and Dispatch was gradual. The process took nine months, from January to September 2022, where at about monthly intervals all the warehouses with their respective transit points were switched over to routing planning with the new software. During these months of transition, a software development activity was furthermore carried on in parallel, refining little details derived from experience.

These was the main interlinked objectives of the adjustment activity:

- Enhance the service level to customers;
- Simplify routing planning tasks for planners;
- Improve business cost performances.

The translation of the system needs into required developments led to the introduction of the following updates within the software:

- Specific graphic filter configuration on each depot;
- A new column in the orders grid helping the planners to choose the best route option for manual orders planning;
- Different color of orders based on the time window in the orders grid;
- Time window initial and final tolerance according to the delivery area in minute terms;
- Rule groups for maximum stops per shift and maximum working time for resource.

5.2.2 Implementation operative results

The main equations calculated, confronting a same period of time in 2021, were as follows:

- $Vehicle\ saturation = \frac{\#Orders\ delivered}{\#Planned\ trips}$
- $Incidence\ of\ late\ deliveries\ [\%] = \frac{\#Late\ deliveries}{\#Orders\ delivered} \times 100$
- $Average\ distance\ between\ customers = \frac{Planned\ trip\ distances\ [km]}{\#Orders\ delivered}$

As reported in Table 1, the overall vehicles saturation, has reached a higher quantity. In percentage terms, there was a 5.5% increase in vehicle saturation, which resulted in a 5.1% saving from the perspective of planned trips compared to the last year. In the meantime, the company, as results of the investing and incentives policies, reached a +17.3% of orders booked from online channels. In spite of the expansions of the territories served by the Esselunga web network, the new TMS outperformed the old one, signing a -13% in the average distance between two consecutive customers. This was the result of a better planned sequencing optimization, without considering the delivery area as limiting constraints but leaving the route optimizer free to create the best trips with a wider range of application.

The only performance indicator that appears to have worsened has been the incidence of late deliveries after 30 minutes. Specifically, it went from 0.61% in the reporting period of 2021, to 1.09% in 2022. This was consistent with the choice of a different scheduling logic, which resulted in having more orders to be delivered within the same trip.

Table 1: Operative results

	2022 vs 2021
Vehicle saturation	+5.5%
Average distance between customers	-13%
Incidence of late deliveries	2021: 0.61% 2022: 1.09%

On the planners' side, the upgrades introduced also seem to have been beneficial, in the sense that just as the manual iterations required are decreasing, late routing deliveries are also occurring with decreasing frequency.

6. Future developments

This chapter has been intended as the outline of which the Esselunga's idea as a future development of the implementation of the new Transportation Management System. The main idea is to combine the order booking system with delivery routing planning. This union is called Dynamic time slotting.

Before it has been reported a review of the state of the art on the implementation of dynamic time slotting in the e-commerce world, followed by an in-depth look at Dynamic pricing.

6.1 Dynamic time slotting in Attended Home Deliveries (AHD)

Attended home delivery (AHD), with the boom of e-commerce, has imperceptibly changed consumption habits of customers benefiting from its convenience and efficiency. AHD services emphasize that customers must be present to receive deliveries. When customers must attend the delivery of products, they expect narrow delivery time slots that fit their personal schedules. [17]

As during the day there are time windows less popular to customers, Dynamic slotting decisions proposed by the system must depend on the current request, the already accepted orders, and orders still expected to arrive in the remainder of the order horizon. [17]

The link between AHD and the Dynamic time slotting represents a vivid research field, with contributions focusing on tactical, operational, quantitative, and qualitative aspects. Current research advises the use of demand management policies to profitably assign delivery time slots to customers. Operational time slot management can be strived to maximize either revenue or profit. Revenue is the gain from ordered goods and delivery fees, while profit maximization considers revenues minus delivery cost. [18]

Organizations can impose dynamic pricing on top of pre-existing dynamic routing and scheduling tools. A dynamic pricing system is an automated pricing based on how much a consumer is willing to pay at a specific time, with a price generated based upon pre-set business rules. [19]

6.2 Dynamic Time Slotting development in Esselunga

After the introduction of the new Transport Management System by the software ORTEC Routing and Dispatch, Esselunga is looking to improve the way logistics operations are planned for the home delivery e-commerce.

The objective is to pass from a time slot loading on the back-office and the booking manually steered and rigid to a dynamic system.

The following are the benefits proposed by the ORTEC Home Delivery solution:

- Offer the best delivery option by improving the last mile customer experience through timely and sustainable delivery options;
- Offer more time slots resulting in more booked orders and increased customer loyalty;
- Execute more deliveries with the same fleet by continuously optimizing scheduled orders.

7. Conclusions

From the review of the state of the art reported in the first section of the thesis, it can be seen that e-commerce is a developing industry, especially as a result of the radical shift in customers' buying habits that occurred after the outbreak of the Covid-19 pandemic. Since this event, companies have become increasingly aware of how relevantly e-commerce can be a complementary way of

selling products and services to the traditional way of shopping that sees customers physically go to stores.

Regarding Esselunga, the implementation of the new software, brought a significant change in the allocation of orders on the vans. The development of the new software will still go on, but it has already been evident that it has brought positive results from multiple perspectives, even as a result of the ongoing adjustments introduced over the months.

The dynamic time slotting can be a further occasion to grasp the needed requirements to increase overall performances.

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List of Tables

Table 1: 4