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Research Paper

On

Inventory Management of a Fast Fashion Retail Network

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EXECUTIVE SUMMARY

This paper was developed by working with the fashion brand Zara. The paper focuses on the problem of distributing a small amount of inventory across all its stores. The main problem was the short product life cycles and Zara's policies which stated the removal of articles from display whenever there was a stock out of one particular size or colour. To work towards solving this model we speak about the single store to inventory model. This helped us to calculate store shipment quantities which would maximize overall predicted sales. Zara implemented this model and conducted a controlled pilot experiment to compare the model's performance as compared to the previous model they were using. The results suggested that the new allocation process increased the sales from 3% to 4% which equals to $275 Million in annual sales. Zara uses this model currently for all its products worldwide.

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1. INTRODUCTION

Operation research is the study of optimum resource allocation .The fashion industry can be a complex affair made up of fibre and fabric industry, garments industry, retail industry. OR tends to a wide assortment of issues of above enterprises in transportation, stock arranging, methodology arranging, budgetary resource, risk administration, and innumerable different fields where refining business openings are principal. OR reflects an analytic method of problem solving and informed decision making which is a necessity in the operations of organizations in the fashion industry. OR improves the effectiveness and efficacy of business. The topic of this research paper is Zara.

Zara is by far the most internationalized of the chains .Its marketing strategy focuses on product variety ,efficient and speedy transfer of materials to market and store location. Its achievement is based on a business structure that depends on vertical integration, local production, centralized distribution centre, quick response and low advertising cost. Zara faced rough competition internationally with companies such as H&M ,Gap and Benetton .Zara offers on average 11000 articles in a given season compared to 2000-4000 items from key competitors .Hence Zara customers visit the store 15-17 times on an average every year .15%–20% of Zara's sales are typically generated at marked-down prices compared with 30%–40% for most of its European peers, with an average percentage discount estimated at roughly half of the 30% average for competing European apparel retailers. The fast-fashion retail model just mentioned gives rise to some challenges. The task described here, which has been conducted in association with Zara, addresses the specific problem of distributing, over time, a inadequate amount of merchandise inventory between all the stores in a retail network. Note Legacy process and new process intended to determine weekly shipments to stores.

According to the legacy process, each store manager would receive a weekly statement of the subset of articles available in the central warehouse for which he/she may request a shipment to his/her store. In any case, it would not say the aggregate amount of inventory accessible in the warehouse for each article recorded. In the wake of considering the stock staying in their particular stores, store supervisors would then transmit back asked for shipment amounts. A group of workers at the distribution centre would then accommodate every one of those solicitations by adjusting (ordinarily bringing down) these asked for shipment amounts with the goal that the general amount sent for each article and size was attainable in light of the rest of the warehouse inventories. Some of the shortcomings of this model were that the warehouse inventory were often limited , the store managers had large amount of tasks to monitor beyond determining

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shipment quantities, including building, sustaining, and managing a team of several dozen sales associates in environments with high employee turnover, hence subject to important time pressures.

The large amount of data was also difficult to manage which made the task of balancing inventories among store inefficient .However, with the rapid expansion of Zara worldwide, using “Legacy Process” to assign Therefore, Zara conducts a innovative process demonstrated in figure (b) involving a optimization model which uses regression forecasting to foresee the demand for each article and scope at every retail store, and an optimization model which integrates the warehouse and retailers inventory level, predicts consumer demand, and coordination among all the retail stores in the network in order to determine the weekly shipment quantity. The forecasting model takes input from store managers about their shipment requirements, which is the similar input they deliver in the legacy process.

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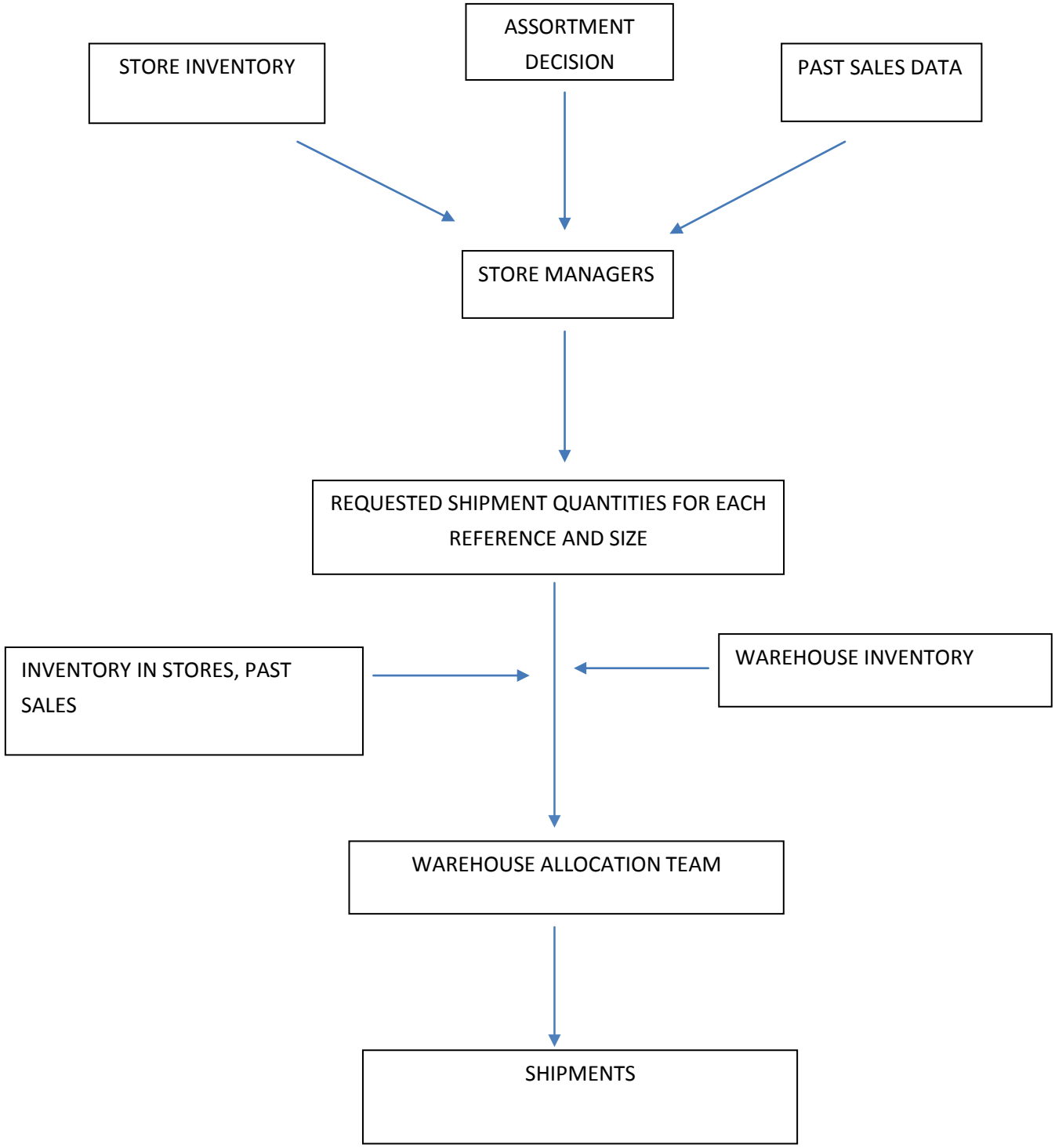
A. Legacy Process



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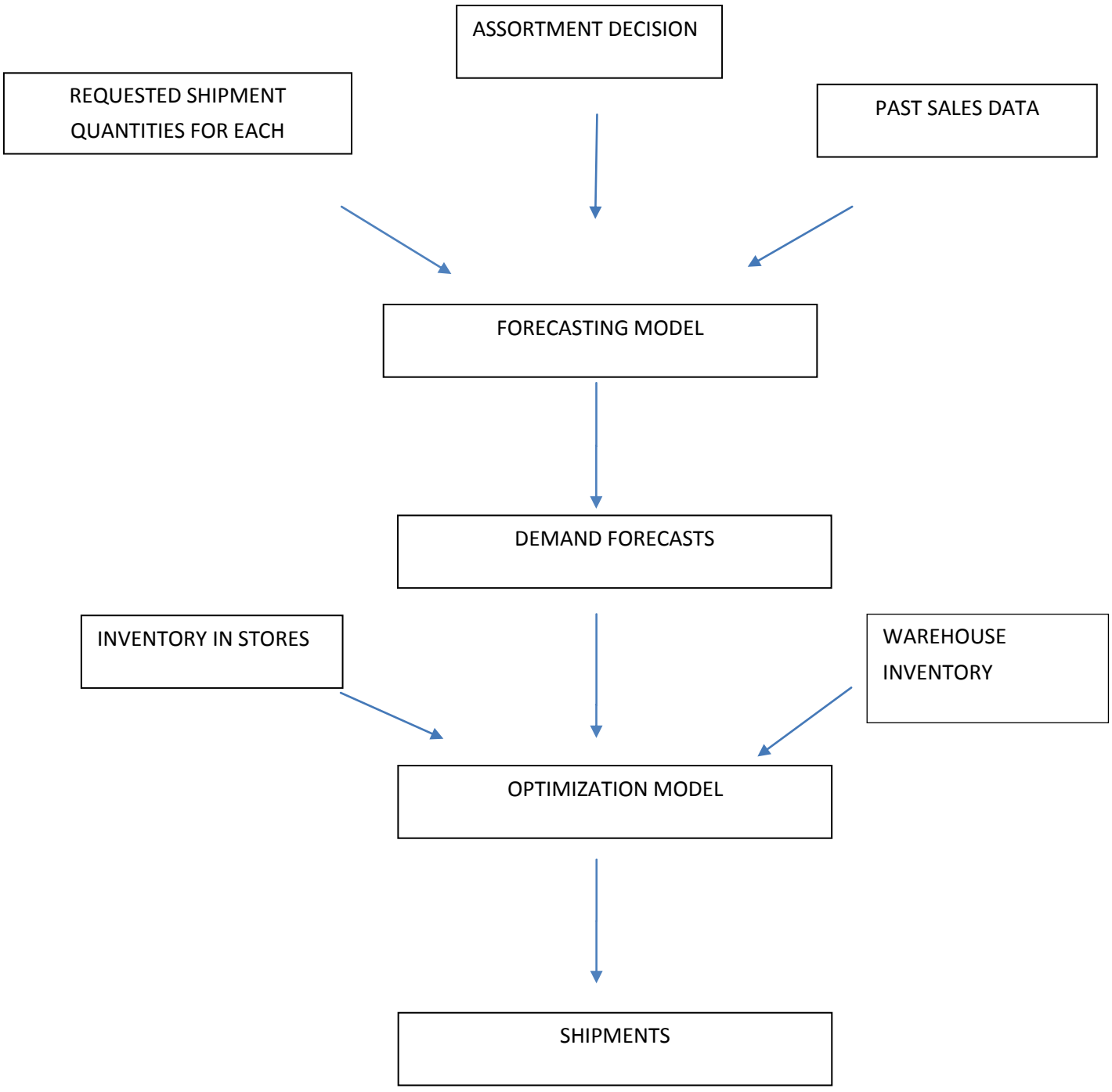
B. New Process



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2. LITERATURE REVIEW

A major area of importance covered in the literature is the problem of allocating goods from a central warehouse to several stores having different demand streams. The scope of inventory decisions taken into context in the paper are: ***ordering*** which refers to replenishment of the warehouse from a retailer; ***withdrawal*** refers to the quantity of goods transferred from warehouse to the stores; ***allocation*** refers to the division of goods withdrawn from the warehouse and distributed it between stores. Zara's strategy is that of offering a large number of items during the selling season. These articles have a short life cycle spanning over only a few weeks. Also, a single manufacturing order is placed for each article and that order is fulfilled as a single delivery to the warehouse without subsequent replenishment. Ordering on one hand and withdrawal and allocation occurs at different times. Therefore in this paper inventory available at the warehouse is an exogenous input. An important point is also that Zara does not take orders from its customers from items not available in the store's inventory.

At Zara, when there is a stock out of certain key sizes or colours, the entire set of that particular item is removed. This is done to balance out sales and avoiding negative customer experience which takes place due to incomplete sizes or colours as the case may be. Studies in other research papers have shown that customers are particularly unsatisfied when they notice an item they want to buy but soon realise that one of the key sizes is missing. This affects the store's image and people avoid visiting the store again because of the fear of getting dissatisfied. Therefore there are clear implications of having key items in a product category. Studies also show that stock out of key items has a greater impact on an apparel store as compared to a grocery store.

The goal or objective of this paper is to develop an operational system for computing actual store shipment quantities for Zara. The paper is the only one which conducts a pilot implementation study for the inventory allocation model developed.

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3. MODEL DEVELOPMENT

The following model is a descriptive model and focuses on the modelling of the relationship between the inventory of a specific article available at the beginning of a replenishment period in a single store and the resulting sales during that period. The model is called as the *Single-Store Inventory-to-Sales Model.*

A. Store Inventory Display Policy at Zara

In fast-fashion clothing stores most of the negative customer moments of truths occur when the customer actively searches the store and finally finds what he/she likes only to find out that it is not available in their desired size. The customer then asks the store attendant to go to the back store to search for the item in the desired size. This increases labour requirements. When this is not successful the customer leaves the store in frustration. This impacts the store's brand perception in the customer's mind. Proper management of the items of different sizes is critical for a store like Zara where a large number of items are produced in small series throughout the season.

Therefore their inventory management policy is as mentioned below. Zara differentiates among the sizes of the items based on ***major sizes*** (i.e. S, M, L) and ***minor sizes*** (i.e. XXS, XXL). When the store faces a stock out of one of the major sizes, the store attendants move all the remaining inventory from the display shelf/racks to the back room and replace it with a new item. The same is not done in case if the store faces a stock out of the minor sizes. The removed items may return to the display/shelf racks if incomplete sizes can be re-ordered from the warehouse or they are sent to another store where there are consolidated sizes or they ultimately are brought out during clearance sales. It is also noteworthy to mention that Zara does not keep a product catalogue. This thus maintains a sense of scarcity and continuous assortment freshness. Because of this customers do not come into the store looking for a specific product and also do not expect articles not displayed in the store to be available in the back room. This reduces customer dissatisfaction.

The definition of major and minor sizes does not only take into account that some sizes (e.g. M) are more in demand than others (e.g. XXL) but also but also the psychological effects associated with the sizes.

For example: When a customer likes an item which has sizes XS, M, and L but does not find her size which is "S", she will blame it on Zara's inventory mismanagement. However customers will place less blame on Zara if the desired size was an "XS", this is because customers do not realise that the said item is made in XS in the first place as not all items are available in extreme sizes. Secondly, the customers may blame

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themselves for having unusual dimensions. Thus, Zara managers define major sizes as a single size (e.g. M) or a continuous set of sizes (e.g. S,M,L) even in many common cases where an extreme size such as XS or XL create more demand.

Researchers also learnt that the above explained removal policy was simply an observation by the store managers of customer store behaviour and not a part of their store policy. There was an absence of a record of items which were on the shelf and the ones in the back room. Thus to test how prevalent the policy was an analysis was made. To measure the adherence to the inventory display policy the ratio DPF_j / DPA_j was used. j referred to each Zara store, DPA_j refers to the number of days, summed over all articles, where there was a stock out of a major size but there was still some inventory available in another size. DPF_j referred to those days characterized by the additional requirement that no sales were observed for any size. Data of over 900 Zara stores was collected. Less than 2% of the stores showed an adherence lower than 80%. Thus they justified that the inventory display policy based on major and minor sizes can be used as a representation of store execution behaviour.

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4. PILOT IMPLEMENTATION STUDY

The team helped Zara in application of the new inventory allocation procedure, and try it on a small scale like a real pilot experiment. The major objectives of the pilot were (i) demonstration of feasibility of the new procedure visualised through real execution; (ii) recording of responses of the real users to improve the interface and features of the software used, and (iii) estimation of impact of the new procedures on some key operational performance metrics.

A. Methodology

a). Experimental Design

Since Zara comprises of three sections (women, men, and children) that are organizationally distinct, it was thus felt that a pilot study be best organised within a single section. Selection of 15 articles was made from women's section as a test bed for the new procedure, with the goal of constructing as accurate a sample as possible. Now since there is a division between the articles on the bases of a life cycle and style like basic group which consist of clothes that are sold throughout the season and fashion group which consist of trendy clothes which have a shorter life cycle and are produced in limited numbers, the comparable proportions of these two groups in the sample selected were in particular representation of the entire article population. The experimental setup described in the paper took into consideration the fact that Zara had only two major warehouses worldwide, the first in Arteixo (northwest of Spain), shipping to about five hundred stores in Western Europe, and the second in Zaragoza , shipping to about the same number of stores located in the rest of the world. Particularly, the new inventory allocation process was only in Arteixo only at some point during the life cycle of the 15 articles mentioned whereas the legacy process was used in distribution of articles (inclusive of these) in Zaragoza. The approximation of impact paired with the new procedure was based on a contrast between that sample group of articles and selected control group of matching articles, conducted using data from stores assigned to Arteixo.

For each article in the sample group, the warehouse team in Arteixo thus switched to new process form that of legacy, potentially after that article had already been offered in stores for weeks, and the new process was used until the end of the pilot which was by the end of 2006. An important thing to note in the application was the recommendation of using the optimization model to compute shipments that were only presented as

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a proposition to the team at warehouse, which could be changed as per convenience. This gave rise to the problem of the positive results not being associated with the new procedure but it turned out that very few changes were made to the procedure. Data of only 10 out of 15 articles could be taken due to circumstances , thus only those were taken into consideration as it had ratio of 2:3 between basic and fashion group which made up for the same proportion of the assortments

b). Operational Performance Metrics

Evaluation framework for Zara's distribution performance was made in order to counter 2 major problems of overstock which means additional than what was required at the store, results in high inventory cost and under stock when customers want a certain article and that isn't present at the store, sales suffer.

C). Shipment Success Ratio

This matrix was used to quantify overstocking at Zara. Represents the goods delivered to the store at the start of the year and how much are actually sold. Zara had well been using this matrix.

d). Demand Cover Ratio

This matrix was used to check the sales that were not realised due to unavailability of inventory thus under stocking. This was a new matrix introduced to Zara since they had this problem was prevalent due to its practice of removing article from display when major sizes were unavailable

A combination of these two gave Zara a holistic approach to increasing their sales.

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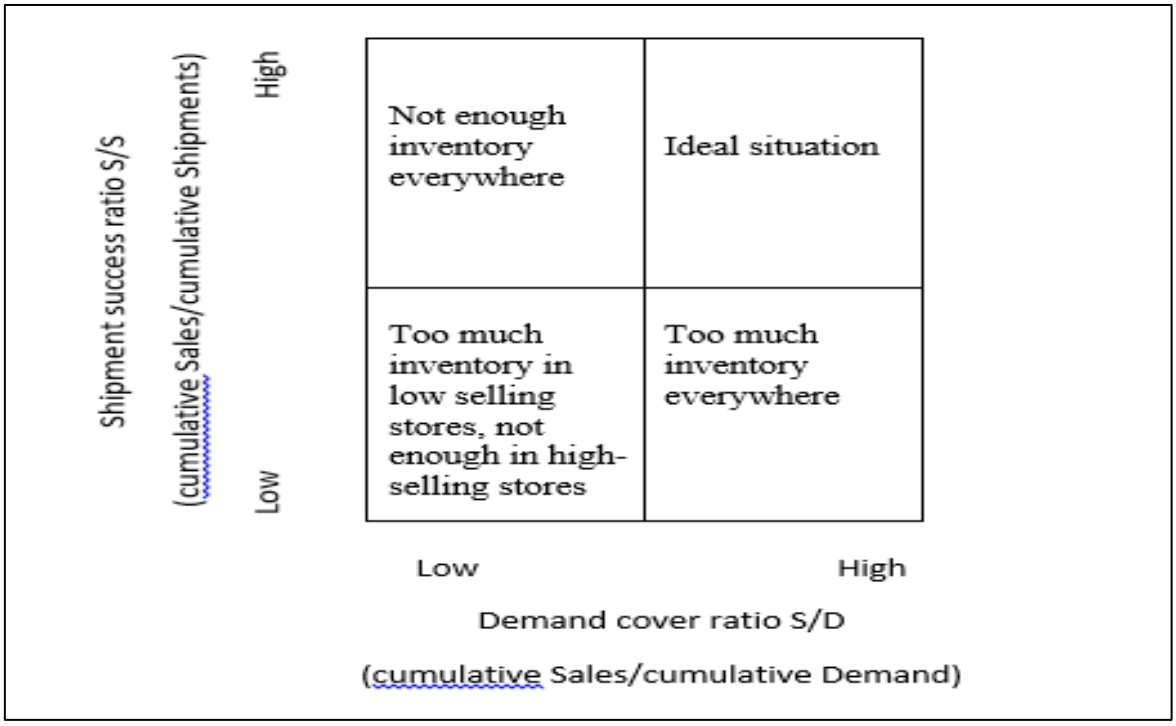

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5. RESULTS

By implementing new operation research process, Zara could quantify the increase in sales specifically attributable to the shipment decisions based on operation research techniques, relative to the legacy manual process they had been using so far. This experiment demonstrated very clearly that the implemented operation research model had a positive impact on sales. The increase sales can be explained by the model's ability to move excessive inventory away from low selling stores where it is not needed and send it instead to high performing stores where it reduces missed sales due to stock outs. This positive impact is also due to the model's ability to ship individual sizes of each article to every store in a concerted manned, likewise sending inventory of specific sizes only where it is likely to sell. In addition to increase in sales, Zara also observed that the model helps to reduce Trans-shipments between stores and increase the time an article spends on display within its life cycle. Though the financial impact of this is harder to measure. For a couple of years now, we have been at a point where any item found in any Zara's outlet worldwide has been shipped to the store based on the output of the new distribution process. All our shipment decisions are supported by operational research and remarkably this is not diminished but rather expanded the role of employee in the distribution team. Prior to the introduction of the new distribution system. Zara thought that they need to increase the staffing level of the distribution teams. However, on the implementation of the new system, they realized that they now have a more stable structure in accordance with the growth of our company. The big change consisted in going from a fully manual process to one highly automated based on systematic data analysis.

This project has also had a cultural impact on Zara. Specifically, Zara has initiated two additional major operational research projects in the areas of purchasing, pricing and Zara is now actively seeking to recruit graduates with strong operation research backgrounds. In addition, within the Inditex group there are plans to deploy the new inventory distribution process in some of the other retail chain such as Massimo Dutti. The success of this project has shown that operation research can significantly contribute to Zara's strategic goal of improving the scalability of its operations to support its continued growth.

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A. *Financial Impact*

These results are quite conclusive: the control- adjusted relative sales impact is positive for every single article. For each pair of articles and average 4.1% across all the articles considered even after subtracting the previous estimation error of 0.7% these results showed that, the new O.R.- based process increases sales during the selling season by 3 to 4%. This impact on revenue is easily explained by the model's ability, relative to the legacy process, of moving excessive inventory away from low- selling stores where it is not needed, and send it instead to high- performing stores where it thus reduces missed sales due to stock- outs. It is also explained by its ability to ship all sizes of an article to every store in a concerted manned, likewise sending inventory of specific sizes only where it is likely to sell. From a financial standpoint, if the optimization model had been used for all of 2007 and 2008, this relative sales increase would have implied approximately $310M (2007) and $353M (2008) in additional revenue or $37.2M (2007) and $42.4M (2008) in additional net income, with both measures of impact predicted to continue growing at a rate of 10% per annum in subsequent years. However, the full- scale deployment of the model started in late 2006 and was completed in June of 2007, so that the estimated actual realized impact of the model in 2007 is instead approx. $233M in additional revenue or $28M in additional net income.

B. *Operational Impact*

There are other operational metrics that are measured which are also very relevant to Zara but the financial impact is harder to estimate for instance. We measured the *display cover ratio* which is the fraction of time an article spends on display and not in the backroom during it life cycle after the pilot test. It was estimated that the model could improve the time on display by 3.5% from baseline levels. Another metric transhipments and returns ratio that is the fraction of items those are trapped to another store or return to their warehouse. Clearly, if the inventories are allocated correctly in the first place this ratio should be smaller. Indeed, they measured a 19% decrease due to the application of new distribution process.

C. *Other Impacts*

a). Technical OR Achievements: Zara became the first fast fashion company to apply operation research studies in use. It distributed IT implementation with many real-time users. Also, it experimented large controlled field to estimate its impact.

b). Human Impact: Positive transformation of 60 employees' daily lives.

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6. CONCLUSION

In the past, the fast fashion retails store have always been facing this problem of distributing scarce inventory across it's store, more over achieving optimality has been issue regarding this distribution. The research conducted in this paper has helped us create a developed method of allocating such scarce resources across the store networks of fast fashion retails. The optimization model capturing inventory display policies at the store level has laid a main emphasis on this research. The implementation and tests of these new processes are also a part of this research that's been conducted as a part of the live experiment. Results are improvising as they help increase in sales, decrease in trans shipment and increases in the proportion of time that a particular article is displayed (which of course indicates the increase in sale factor of the particular article). Zara the particular brand which we are emphasizing for the research purpose had benefited in many ways regarding its distribution networks.

This new allocation process has also had many organizational implications that are positive in ways. For example using this model, the responsibilities regarding the warehouse allocation team can be shifted from repetitive data entry towards exception handling, scenario analysis, process performance evaluation, and improvement. The warehouse team has plays a very significant role in the implementation of allocating this new model and also demonstrates the many distribution issues faced. This process will generate economies of scale if implemented by Zara.

This research may lead to some cultural changes in Zara. The intuitive thinking of its founder has gathered huge success in the past using its legacy method. So if by any chance Zara implements this method as a source for changes in the organization, there would be some drastic changes regarding the key aspects of handling human force in distribution channels. However, this research may help Zara realize other processes involving large amounts of quantitative data, such as distribution and pricing, formal operations research models may lead to better performance and more scalable operations.

This model is also useful for other fast fashion retailers, particularly those who are facing lost in sales and size dependencies from store display policies. Accounting for this may have a significant impact on the sales.

In future this methodology we developed may be applicable to other context beyond retailing (Performance evaluation model in MIP etc.). Research opportunities can be seen motivated by specific features of fast fashion retailers to traditional retailers.

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WEBLIOGRAPHY

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