Supply Chain Management in LSRT industry: differences between theory and practice

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Abstract: The large scale-retail trade (LSRT) is an industry worth over 80 billion euro in 2017 only considering the turnover of the eight major Italian groups. However, such high levels of turnover are typically characterized by very low margins. Therefore, more than in other industries, companies here strive for process efficiency and cost reduction. From an academic view, literature is plenty of theoretical contributions addressing optimization in operations, logistics, distribution and warehousing processes. However, because of the LSRT industry historical evolution, most attention is traditionally devoted to commercial policies rather than engineering methods, and best practices in these areas are uncommon. On top of this, LSRT company supply chain processes are extremely complex, due to a number of peculiarities, mainly originating from the vast variety of products along with their assorted characteristic. Indeed, traditional supply chain mathematical approaches always require significant simplifying assumptions or hypotheses when approaching LSRT company problems; this often impede the practical applicability of the proposed optimization models. The aim of this paper is investigating if and how the main Operations & Supply Chain Management (O&SC) approaches and techniques in scientific literature can be actually applied in the LSRT industry. This is reached through an extensive review of all the simplification and assumptions hypothesized in the theoretical models in literature, and the relative weighting of their criticality, achieved through a survey to managers of two major LSRT Italian companies. The results show which simplification and assumptions shall be accepted to apply a model or technique to the specific industry, and which are unacceptable or too simplistic. This evidence may help academics in the development of studies and researches to address real and practical issues in the LSRT industry, while also providing a support to LSRT companies managers in the decision to exploit a certain analytical model or technique for their case.

Keywords: Large scale-retail trade; optimization; assumptions; theory vs practice.

1.Introduction

"In theory there is no difference between theory and practice. In practice there is.". This popular quote by Yogi Berra, a baseball player, is often used to criticize the academic scientific approach and emphasizing the gap between scientific research and the real world. Although this statement is not always valid, it is grounded in truth; for this reason, it is important to give evidence to researchers of the possible risks related with the separation between academic research and practical needs, showing the right direction for future researches. This concept has a general validity in all research fields, but it assumes greater importance when focusing the attention on the industrial management, where scientific – or quantitative – approaches are used to optimize processes which impact on the balance sheet. The risk of separating theory and practice has been masterly described by Hopp and Spearman in their textbook "Factory Physics" (2000), well known among the major operations management schools around the world: "Although the separation between models and reality existed right from the start of the operations management (OM) literature, it grew steadily worse. As OM became increasingly established as an academic discipline, fewer and fewer researchers drew directly on manufacturing facilities as a source of problems. Stylized standard problems became objects of volumes of research […]. A classic example of this trend occurred in the field of flow shop scheduling, which was initiated by the publication of a paper by Johnson in 1954. Johnson's paper considered the problem of minimizing the total amount of time to process a fixed number of jobs (called makespan) on a two-machine production line. The processing times were assumed fixed and known, but not identical. The only issue, therefore, was the order in which to do the jobs on the machines. Johnson derived a simple and intuitive algorithm for computing an optimal schedule for this problem. Unfortunately, the problem itself virtually never occurs in industry. Most manufacturing settings have jobs entering the system continually, so the issue of how to schedule a fixed number of jobs to minimize make span is not relevant. However, the problem is of interest mathematically, because when the number of machines in the line is larger than three, it becomes very difficult (in a theoretical mathematical sense). Because researchers drew their inspiration from the literature and not from industry, Johnson's paper spawned an enormous number of follow-on papers addressing variations of his original problem. For the most part the variations were no more realistic than the original, and a recent survey of the flow shop scheduling research could find almost no evidence of influence on scheduling practice. Dudek, Panwalkar, and Smith (1992) summed up the history of this research area as follows: "At this time, it appears that one research paper (that by

Johnson) set a wave of research in motion that devoured scores of person-years of research time on an intractable problem of little practical consequence. Similar stories can be told for other areas of the operations management literature, such as aggregate planning, inventory control, equipment replacement, and capacity planning. Throughout the OM field, far more was published than practiced" (Hopp and Spearman, 2000). Previously, in an article in the Journal of Operations Management in 1980, Buffa suggested that: "we should look for topics from practice that deal with broader problem definition sand performance criteria in order to narrow the gap between theory and practice", and in 1990 McCutcheon and Meredith in their paper "Conducting case study research in operations management" stated: "Knowledge of how operations systems work can be enhanced significantly through contact with the "real-world" conditions that OM models seek to describe". Also Sheikhzadeh and Heidari (2012) concluded that there is a significant gap between research and practice in OM while, more recently, Sodhi & Tang (2014) presented a way for senior researchers to help future doctoral students in Operations Management claiming that: "there is growing pressure for conducting collaborative research that is relevant to practice […] there should be a real world situation that motivates the research stream and a potential (or actual) application for external consistency". In general, the topic is timidly recurring in literature, as it seems the academic community fears to remind that any research must be applicable to real world; differently, may be dramatically labelled as useless. Beyond this, to the authors it appears that there are no notable contributions analysing the gap between mathematical models and industrial application in details. Restricting to a specific industry and to a specific scientific area, aim of this paper is investigating the applicability of supply chain optimization methods to Large Scale Retail Trade (LSRT) through a detailed analysis of the reasonableness of the hypotheses, assumptions and simplifications used in their formalization and described in the scientific literature. The research focuses on this specific industry following some previous researches which already evidenced the peculiar constraints and characteristics that strongly limits the application of optimization models (Lucci, Schiraldi, & Vincenzi, 2017). The research methodology is based on an extensive literature review of the supply chain management models specifically applied to LSRT cases. From this review, contribution by contribution, all the hypotheses, assumptions and simplifications defined by the various authors have been identified, classified and reorganized into four areas: purchasing, warehousing, distribution, shelf management. Then, a survey has been built and submitted to a panel of 16 experts from LSRT companies. These experts have been asked to evaluate the reasonableness of the hypotheses, assumptions and simplifications choosing between:

- totally acceptable;
- sufficiently acceptable;
- acceptable or inacceptable according to cases;
- hardly acceptable;
- completely not acceptable.

The results highlight which hypotheses, assumptions and simplifications are more or less acceptable in a real context; this is especially useful to guide future development of optimization models aiming at solving LSRT problems. This contribution therefore intends to provide an important element of reflection for the development of future research when this is oriented towards this specific industry.

2.Literature review

The literature review represents the central point of this research: the search was led by the following key words on Science Direct database: <"supply chain management" OR "operations management" OR "warehousing" OR "distribution" OR "purchasing" OR "shelf management"> AND "large-scale retail trade"; the strings have been first searched in "title and abstract" beyond in the author-specified keywords. Due to the few results found, in order to expand the research base, the search has been widened to the entire article text. This has yielded a number of contributions not specifically focused on LSRT; those articles not excluding the application of the proposed models to this specific industry have been included in the review. As a result, the total number of the considered contributions is 113. A deep dive analysis of these contributions has been done identifying all the hypotheses, assumptions and simplifications in the text. This work required considerable effort because, as known, these hypotheses, assumptions and simplifications are seldom clearly listed in a specific paragraph; rather they are very often scattered throughout the article text. On top of this, a malpractice of not evidencing the hypotheses, assumptions and simplifications emerged in various contributions, especially when these were particularly binding for the proposed model applicability.

All the identified hypotheses, assumptions and simplifications have been divided into the four cited areas, according to the focus of each contribution: purchasing, warehousing, distribution and shelf management. The results are listed in the appendix. It is important to note that the same hypotheses or assumptions or simplifications can be repeated in different tables, since these can be used in different contributions focusing on different supply chain management aspects. Going through all the list it is interesting to note that some of the hypotheses would seem unreasonable even from a purely academic perspective, for example: "Products can still be shipped to the stores even if expired"; "Truck capacity is unlimited"; "All stores have the same capacity"; "The warehouse has unlimited capacity"; "All products are of the same family". Although some of these hypotheses, derive from the fundamental theoretical models where the modern OM studies are based on, e.g. Wilson's model, it should be clear to any researcher that keeping these hypotheses in the development of models oriented to solve real world problems may easily preclude their applicability.

A survey has been designed and addressed to 16 experts, belonging to four major companies in the Italian LSRT industry. The results are reported in the graphs in Fig.1-4.

3. Discussion

Important considerations can be drawn analysing the opinions of the managers and the frequency with which each hypotheses, simplifications or assumptions have been adopted in the scientific literature. Among the hypotheses, assumptions and simplifications more critical because of they have been judge to be completely not acceptable, we can find: " Products can still be shipped to the stores even if expired"; "Products can still be shipped to the stores even if damaged"; "There are no discounts or similair when purchasing products"; "The warehouse has unlimited capacity"; "Handling activities happen in zero time"; "Trucks' capacity is unlimited"; "The stores can be reached by every type of vehicle"; "All stores have same capacity"; "All products have the same facing (occupy the same shelf space)". These are the main hypotheses, assumptions and simplification that researchers should take into consideration for future model developments of LSRT industry. Other hypotheses, assumptions or simplification, although widespread, are less critical because they are judged more acceptable by the panel, for example: "The life of the product is known in advance"; "Selling prices are known in advance"; "Replenishment time is known and constant"; "The holding cost of a product is known and constant"; "Seasonality is known and predictable"; "Transportation time is known and constant". The frequency of hypothesis, assumptions and simplification such as "Products can still be shipped to the stores even if damaged"; "Handling activities happen at zero costs"; "There is only one type of internal transport system", is fortunately limited as they have also been rated as unreasonable. Finally, hypotheses, assumptions and limitations such as "The holding cost of a product is calculated as a percentage of its price; Seasonality is known and predictable; Selling prices for back-orders are known in advance; The shipper is perfectly reliable;

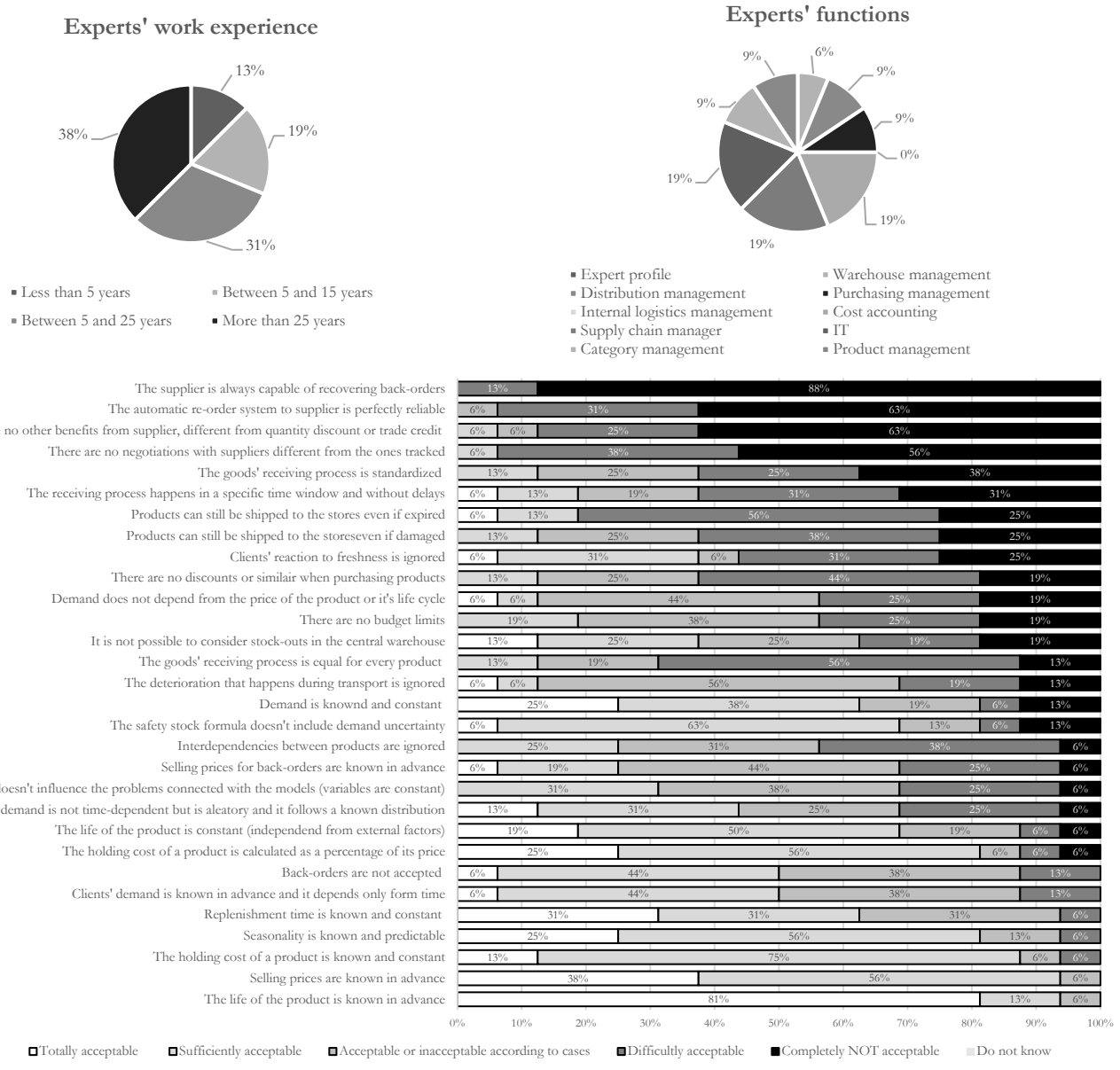

Figure 1: Purchasing area hypotheses, assumptions and simplifications acceptability survey results

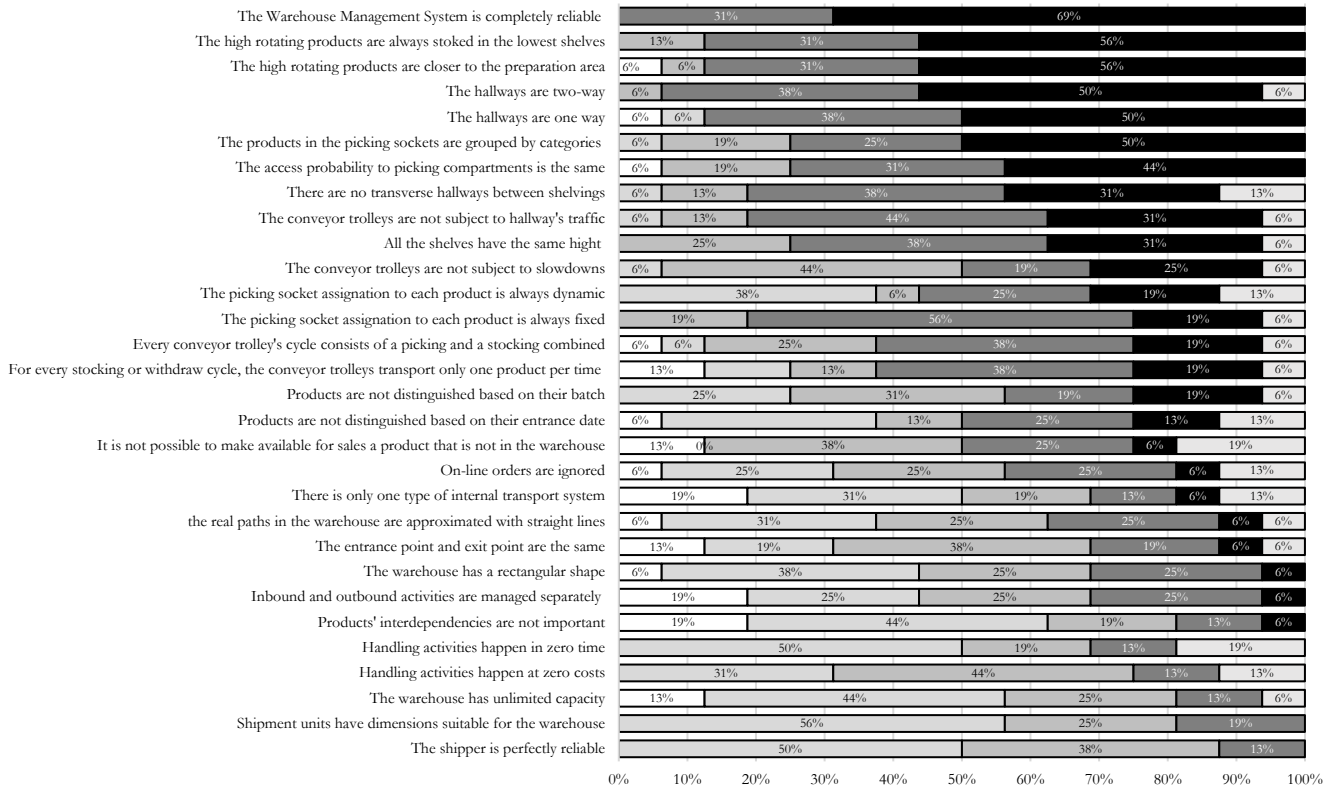

Figure 2: Warehouse area hypotheses, assumptions and simplifications acceptability survey results

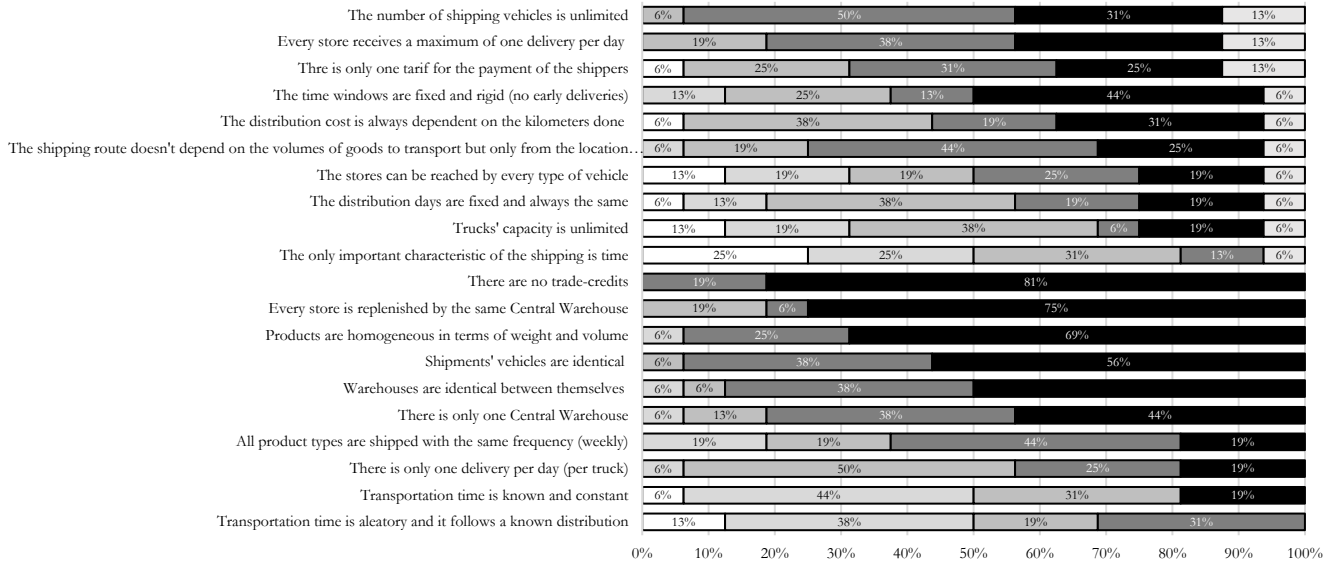

Figure 3: Distribution area hypotheses, assumptions and simplifications acceptability survey results

"Inbound and outbound activities are managed separately" are considered the least critical because they are less common in the literature and also according to the experts' indications. Graph in Fig. 5 shows the total results divided by the four categories along two axes: the x axes is the hypothesis frequency occurs in the literature within each of the four areas, while the y axis represents the reasonableness level of the hypotheses according to the survey results. For each hypotheses, assumptions and simplification a value has been assigned by weighing the answers of the survey experts, i.e. 1 when the expert answer was completely not acceptable and 5 when it was totally acceptable. If the value of the weighted sum is high, a low level of hypothesis acceptability has been associated. From the graph in Figure 5 it emerges that the hypotheses used in the distribution models appear to be more acceptable with respect to those used in the shelf management and warehouse management models. The latter, specifically, seem to be more vulnerable to the criticism related to the difference between theory and practice.

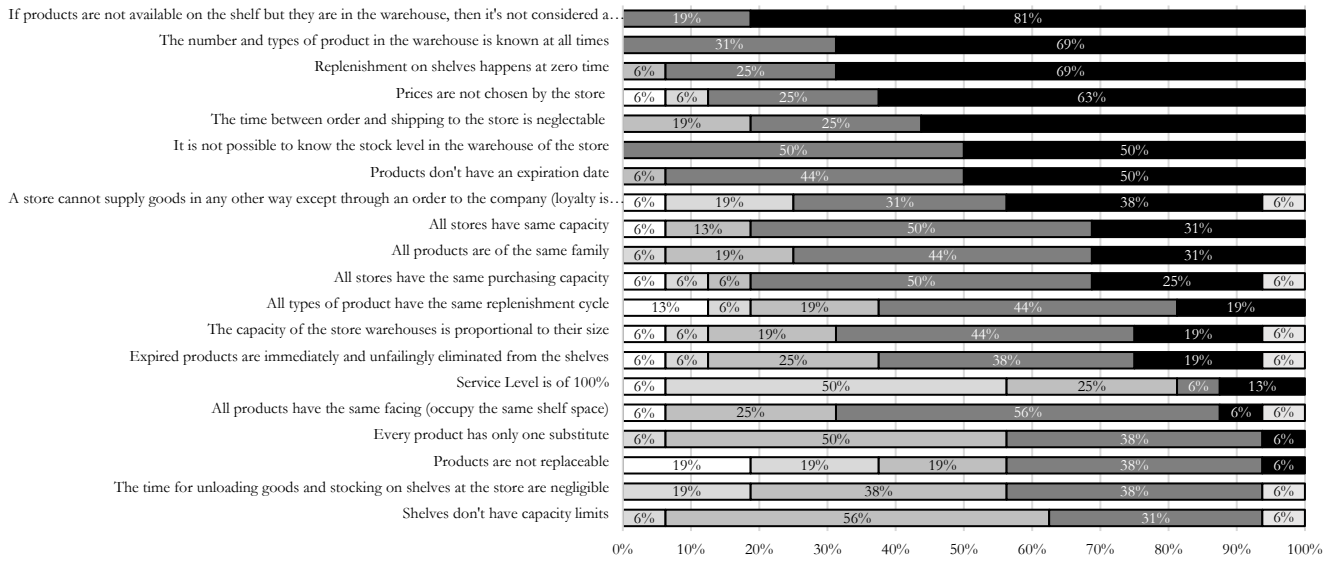

Figure 4: Shelf management hypotheses, assumptions and simplifications acceptability survey results

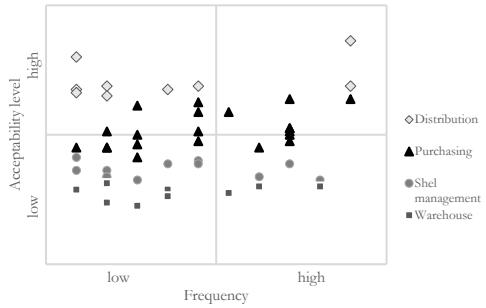

Figure 5: Hypotheses acceptability VS frequency

4. Conclusion

In this work the authors wanted to critically analyse the set of all the hypotheses, assumptions and simplifications used by researchers in the development of SCM models LSRT Industry. The methodology mainly leveraged on two activities: a complete review of 113 scientific articles and the consequent identification of the hypotheses, assumptions and simplifications there reported. Subsequently, a survey was built with the aim to ask to LSRT experts to evaluate the acceptability level of each hypothesis, assumption and simplification. As a result, it emerged that there is a great number of common hypotheses in scientific literature which shall be considered unacceptable, for applications in this specific industry. These hypotheses, probably inherited from the hystorical OM theoretical models, should be treated with caution by researchers. If it is true that a simplifying hypothesis can allow the development of a nice and easily computable model, it is also true that a drastic hypothesis can be unacceptable in practical cases. This does not mean that the specific hypothesis should be excluded at all; rather, the researcher has the responsibility to demonstrate that choosing to adopt it does not significantly shift the results when the proposed model is applied in a real context. Therefore, this research paper offers several points for reflection to academics for the development of future research; it does not intend to draw up a list of hypotheses, assumptions and simplifications to be banned; rather only suggests greater caution to use them, on top of reminding to young researchers to develop models with a practical applicability.

Main references

Buffa, Elwood S. "Research in operations management." Journal of Operations Management 1.1 (1980): 1-7.

Lucci, G., Schiraldi, M., & Vincenzi, M. (2017). Choosing the Minimum Order Size in Large-Scale Retail Trade Distribution, Proceeding of the Conference "Industrial Systems Engineering" Summer School, Palermo (Italy), 12-14 September 2018

McCutcheon, David M., and Jack R. Meredith. "Conducting case study research in operations management." Journal of Operations Management 11.3 (1993): 239-256.

Sheikhzadeh, Alireza, and Hamed Heidari. "Operations management research: a 10-year survey." Proceedings of the International Conference on Industrial Engineering and Operations Management, Istanbul, Turkey, 2012.

Sodhi, ManMohan S., and Christopher S. Tang. "Guiding the next generation of doctoral students in operations management." International Journal of Production Economics 150 (2014): 28-36.

Spearman, W.J, & Hopp , M. (2000). Factory Physics. New York: McGraw-Hill.

Appendix is available for download from www.dropbox.com/s/kdf9mwzyl46evg8/APPENDIX_Supply_Chain_Management_in_LSRT_industry.pdf?dl=0

List of bibliographical references cited in the tables (see appendix)

[1] A Gunasekaren, D K Macbeth & R Lamming, (2000) "Modelling and analysis of supply chain management systems: an editorial overview", Journal of the Operational Research Society, Vol 51 pp. 1112-1115

[2] A. G. Lagodimos, K. Skouri, I. T. Christou, P. T. Chountalas (2018) "The discrete-time EOQ model: Solution and implications" European Journal of Operational Research Vol 266 pp. 112–121

[3] Akkermans, H. A., Bogerd, P., & Vos, G. C. J. M. (1999). Virtuous and vicious cycles on the road towards international supply chain management. International Journal of Operations and Production Management, 19(5/6), 565-581.Amol Bhagata, N. K. (2016). Penalty parameter selection for hierarchical data stream clustering.

[4] Alexander Hübner, (2017) "A decision support system for retail assortment planning", International Journal of Retail & Distribution Management, Vol. 45, pp. 808-825

[5] Alexander Hübner, Heinrich Kuhn, Sandro Kühn (2016) "An efficient algorithm for capacitated assortment planning with stochastic demand and substitution" European Journal of Operational Research Vol 250 pp. 505–520

[6] Alexander Hübner, Kai Schaal, (2017) "A shelf-space optimization model when demand is stochastic and space-elastic" Omega Vol 68 pp. 139–154

[7] Alexander Hübner, Kai Schaal, (2017) "An integrated assortment and shelf-space optimization model with demand substitution and space elasticity effects" European Journal of Operational Research Vol 261 pp. 302–316

[8] Alexander Hübner, Manuel Ostermeier (2019) "A Multi-Compartment Vehicle Routing Problem with Loading and Unloading Costs", Transportation Science Vol 53 pp. 282-300

[9] Ali Akbar Shaikh, Md. Al-Amin Khan, Gobinda Chandra Panda and Ioannis Konstantaras (2019) "Price discount facility in an EOQ model for deteriorating items with stock-dependent demand and partial backlogging" Intl. Trans. in Op. Res. Vol 26 pp. 1365–1395

[10] Ali Diabata, Ehsan Dehghani, Armin Jabbarzadeh (2007) "Incorporating location and inventory decisions into a supply chain design problem with uncertain demands and lead times" Journal of Manufacturing Systems Vol 43 (2007) pp. 139–149

[11] Alin Constantin RĂDĂȘANU, (2016) "Inventory Management, Service Level And Safety Stock", Journal of Public Administration, Finance and Law Vol 9 pp. 145-153

[12] Anas M. Atieh, Hazem Kaylani, Yousef Al-abdallat, Abeer Qaderi, Luma Ghoul, Lina Jaradat, Iman Hdairis (2016) "Performance improvement of inventory management system processes by an automated warehouse management system" Procedia CIRP Vol 41 pp. 568 – 572

[13] Andreas Holzapfel, Alexander Hübner, Heinrich Kuhn, Michael G. Sternbeck, (2016) "Delivery pattern and transportation planning in grocery retailing", European Journal of Operational Research Vol 252 pp. 54–68

[14] Andreas Holzapfel, Heinrich Kuhn, Michael G. Sternbeck (2018) "Product allocation to different types of distribution center in retail logistics networks" European Journal of Operational Research Vol 264 pp. 948–966

[15] Anne-Laure Ladier, Gülgün (2016) "Cross-docking operations: Current research versus industry practice" Alpan Omega Vol 62 pp. 145–162

[16] Armin Klausnitzer, Rainer Lasch, (2019) "Optimal facility layout and material handling network design", Computers and Operations Research Vol 103 pp. 237–251

[17] Ata Allah Taleizadeh (2014) "An economic order quantity model for deteriorating item in a purchasing system with multiple prepayments", Applied Mathematical Modelling Vol 38 pp. 5357–5366

[18] B. Vipin, R.K. Amit (2019) "Describing decision bias in the newsvendor problem: A prospect theory model" Omega Vol 82 pp. 132–141

[19] Birger Raa, Wout Dullaert (2017) "Route and fleet design for cyclic inventory routing" European Journal of Operational Research Vol 256 pp. 404–411

[20] Biswajit Sarkar, S. S. (2013). An Inventory Model with Finite Replenishment Rate, Trade Credit Policy and Price-Discount Offer, Biswajit Sarkar, S. S. (2013). Hindawi Publishing Corporation, Journal of Industrial Engineering, Volume 2013, Article ID 672504, 18 pages

[21] Carole Camisullis Vincent Giard, (2008) "The New Need for Safety Stocks in a Supply Chain Dedicated to Customized Mass Production", An International Journal Vol. 9 pp. 88 96

[22] Chandra K. Jaggi, Mamta Gupta, Amrina Kausar, Sunil Tiwari, (2019) "Inventory and credit decisions for deteriorating items with displayed stock dependent demand in two-echelon supply chain using Stackelberg and Nash equilibrium solution" Ann Oper Res Vol 274 pp. 309–329

[23] Charles J. Corbett, (2001) "Stochastic Inventory Systems In A Supply Chain With Asymmetric Information: Cycle Stocks, Safety Stocks, And Consignment Stock", Operations Research Vol. 49, pp. 487–500

[24] Christian Larsen (2019) "A heuristic joint replenishment policy for the case of heterogeneity among items" International Journal of Production Economics Vol 209 pp. 164–171

[25] Christof Röhrig and Sarah Spieker, (2008) "Tracking of Transport Vehicles for Warehouse Management using a Wireless Sensor Network" International Conference on Intelligent Robots and Systems pp. 3260-3265, Nice, France, September

[26] Cinzia Muriana (2016) "An EOQ model for perishable products with fixed shelf life under stochastic demand conditions", European Journal of Operational Research Vol 255 pp. 388–396

[27] D. Suhardini, W. Septiani, and S. Fauziah (2017) "Design and Simulation Plant Layout Using Systematic Layout Planning" Published under licence by IOP Publishing Ltd

[28] Danhuai Guo, Kaichao Wu, Zhenhua Zhang, Wenting Xiang, (2012) "WMS-based Flow Mapping Services" Conference Paper (PDF Available) · June 2012 with 147 Reads Conference: IEEE services 2012IEEE services 2012

[29] Dennis Prak, Ruud Teunter, Aris Syntetos, "On the Calculation of Safety Stocks when Demand is Forecasted", European Journal of Operational Research Vol 256 pp. 454-461.

[30] Deviani, V. Triyanti (2017) "Risk assessment of manual material handling activities", Materials Science and Engineering Vol 277

[31] Dongmin Shin, Rekha Guchhait, Biswajit Sarkar and Mandeep Mittal, (2016) "Controllable Lead Time, Service Level Constraint, And Transportation Discounts In A Continuous Review Inventory Model", Oper. Res. Vol 50 pp. 921–934

[32] Elaheh Ghazavi, M.M. Lotfi (2016) "Formulation of customers' shopping path in shelf space planning: A simulation-optimization approach" Expert Systems with Applications Vol 55 pp. 243–254

[33] Elena Katok, Douglas Thomas, Andrew Davis, (2008) "Inventory Service-Level Agreements as Coordination Mechanisms: The Effect of Review Periods", Manufacturing & Service Operations Management, pp. 1–16

[34] Erna Engebrethsen, Stéphane Dauzère-Pérès (2019) "Transportation mode selection in inventory models: A literature review" European Journal of Operational Research Vol 279 pp. 1–25

[35] Evren Sahin and Yves Dallery, Zied Jemai, Shouyu Ma (2018) "Analysis of the newsboy problem subject to price dependent demand and multiple discounts" Journal of Industrial and Management Optimization Vol 14 pp. 931-951

[36] F. Taube, S. Minner, (2018) "Data-driven assignment of delivery patterns with handling effort considerations in retail", Computers and Operations Research Vol 100 pp. 379–393

[37] Fredrik Olsson (2019) "Simple modeling techniques for base-stock inventory systems with state dependent demand rates" Mathematical Methods of Operations Research Vol 90 pp. 61–76

[38] G. C. A. DeRose Jr., A. R. Diaz, (2000) "Solving three-dimensional layout optimization problems using fixed scale wavelets" Computational Mechanics Vol 25, pp. 274-285

[39] Geoffrey A. Chua, Reza Mokhlesia, Arvind Sainathana (2017) "Optimal Discounting and Replenishment Policies for Perishable Products" International Journal of Production Economics Vol 186 pp. 8–20

[40] Gregory Dobson, Edieal J. Pinker, Ozlem Yildiz (2017) "An EOQ model for perishable goods with age-dependent demand rate" European Journal of Operational Research Vol 257 pp. 84–88

[41] Hamid Reza Sayarshad, (2010) "Using bees algorithm for material handling equipment planning in manufacturing systems", Int J Adv Manuf Technol Vol 48, pp. 1009–1018

[42] Harald Minken, Bjorn Gjerde Johansen (2019) "A logistics cost function with explicit transport costs" Economics of Transportation Vol 19 pp. 1-10

[43] Helena Gaspars-Wieloch (2017) "Newsvendor problem under complete uncertainty: a case of innovative products" CEJOR Vol 25 pp. 561–585

[44] Igor T. Peres, Hugo M. Repolho, Rafael Martinelli, Nathalia J. Monteiro, (2017) "Optimization in inventory-routing problem with planned transshipment: A case study in the retail industry" International Journal of Production Economics Vol 193 pp. 748–756

[45] Jakob Huber, Sebastian Müller, Moritz Fleischmann, Heiner Stuckenschmidt (2019) "A data-driven newsvendor problem: From data to decision", European Journal of Operational Research Vol 278 pp. 904–915

[46] Jiang Wu, Chun-Tao Chang, Mei-Chuan Cheng, Jinn-Tsair Teng & Faisal B. Al-khateeb (2015) "Inventory management for fresh produce when the time-varying demand depends on product freshness, stock level and expiration date" International Journal of Systems Science: Operations & Logistics Vol 3 pp. 138-147

[47] Jiang Wu, Jinn-Tsair Teng Konstantina Skouri (2018) "Optimal inventory policies for deteriorating items with trapezoidal-type demand patterns and maximum lifetimes under upstream and downstream trade credits" Ann Oper Res Viol 264 pp. 459–476

[48] Jonathan F. Bard, Ahmad I. Jarrah, (2009) "Large-scale constrained clustering for rationalizing pickup and delivery operations" Transportation Research Part B Vol 43 pp. 542–561

[49] José Geraldo Vidal Vieiraa, Milton Ramos Tosob, João Eduardo Azevedo Ramos da Silvaa, Priscilla Cristina Cabral Ribeiroc (2017), "An AHP-based framework for logistics operations in distribution centres", International Journal of Production Economics, Vol 187 pp. 246–259

[50] Ju Zhao, Yong-Wu Zhou, M. I. M. Wahab, (2016) "Joint optimization models for shelf display and inventory control considering the impact of spatial relationship on demand", European Journal of Operational Research Vol 255 pp. 797–808

[51] Karel H. van Donselaar and Rob A.C.M. Broekmeulen, (2010) "Determination of Safety Stocks in a Lost Sales Inventory System with Periodic Review, Positive Lead-Time, Lot-Sizing and a Target Fill Rate", International Journal of Production Economics

[52] Kee Kuo Chen, Ching-Ter Chang (2007) "A seasonal demand inventory model with variable lead time and resource constraints", Applied Mathematical Modelling, Vol 31, pp. 2433–2445

[53] Konstantaras, K. Skouri, A.G. Lagodimos (2019) "EOQ with independent endogenous supply disruptions" Omega Vol 83 pp. 96–106

[54] Larissa Janssen, Thorsten Claus, Jürgen Sauer (2016) "Literature review of deteriorating inventory models by key topics from 2012 to 2015" Int. J. Production Economics Vol 182 pp. 86–112

[55] Larissa Janssena, Jürgen Sauerb, Thorsten Clausc, Uwe Nehlsa (2018) "Development and simulation analysis of a new perishable inventory model with a closing days constraint under non-stationary stochastic demand" Computers & Industrial Engineering Vol 118 pp. 9–22

[56] Liang-Yuh O., Bor-Ren Chuang, (2000) "Stochastic Inventory Models Involving Variable Lead Time With A Service Level Constraint" Yugoslav Journal of Operations Research Vol 10, pp. 81-98

[57] Luis A. San-Joséa, Joaquín Sicilia, David Alcaide-López-de-Pablo (2018) "An inventory system with demand dependent on both time and price assuming backlogged shortages" European Journal of Operational Research Vol 270 pp. 889–897

[58] M. Zhalechian, R. Tavakkoli-Moghaddam, B. Zahiri, M. Mohammadi, (2016) "Sustainable design of a closed-loop location-routing-inventory supply chain network under mixed uncertainty" Transportation Research Part E Vol 89 pp. 182–214

[59] M.E. Buisman, R. Haijema, J. M. Bloemhof-Ruwaard (2019) "Discounting and dynamic shelf life to reduce fresh food waste at retailers" International Journal of Production Economics Vol 209 pp. 274–284

[60] M.T. Alonso, R. Alvarez-Valdes, F. Parrenoa and J.M. Tamarit (2016) "Determining the best shipper sizes for sending products to customers", Intl. Trans. in Op. Res. Vol 23 pp. 265–285

[61] Marcello Braglia, Davide Castellano, Leonardo Marrazzini, Dongping Song (2019) "A continuous review, (Q, r) inventory model for a deteriorating item with random demand and positive lead time" Computers and Operations Research Vol 109 pp. 102–121

[62] Maurizio Lanfranchi, Carlo Giannetto and Angelina De Pascale, (2014) "Analysis and models for the reduction of food waste in organized large-scale retail distribution in eastern Sicily" American Journal of Applied Sciences Vol 11 pp. 1860-1874

[63] Maxim Bushuev, Alfred L Guiffrida, Mehmood Khan (2015) "A review of inventory lot sizing review papers" Management Research Review Vol 38 pp. 283-298

[64] Meenakshi Srivastava1 and Ranjana Gupta (2009) "EOQ Model for Time-Deteriorating Items Using Penalty cost" Journal of Reliability and Statistical Studies Vol. 2, pp. 67-76

[65] Michael G. Sternbeck, Heinrich Kuhn, (2014) "An integrative approach to determine store delivery patterns in grocery retailing", Transportation Research Part E Vol 70 pp. 205–224

[66] Min Guo a, Yu-wang Chen, Hongwei Wang, Jian-Bo Yang, Keyong Zhang (2019) "The single-period (newsvendor) problem under interval grade uncertainties" European Journal of Operational Research Vol 273 pp. 198–216

[67] Mohammad Moshref-Javadi, Mark R. Lehto (2016) "Material handling improvement in warehouses by parts clustering", International Journal of Production Research Vol 54, pp. 4256-4271

[68] Mu-Chen Chen, Chia-Ping Lin, (2007) "A data mining approach to product assortment and shelf space allocation", Expert Systems with Applications Vol 32 pp. 976–986

[69] N. Danloup, H. Allaoui, G. Goncalves, (2018) "A comparison of two meta-heuristics for the pickup and delivery problem with transshipment", Computers and Operations Research Vol 100, pp. 155–171

[70] N. Mahmoodi Darani, P. Bassiri, M. Yousefi Khoshbakht, (2016) "An Effective Algorithm in order to solve the Capacitated Clustering Problem", Journal of New Researches in Mathematics Vol 1 pp. 81-102

[71] Nita H. Shah and Monika K. Naik (2018) "Fresh produce inventory for time-price and stock dependent demand" Revista Investigacion Operacional Vol 39, pp. 515-527

[72] Nynke Faber, ReneÂ (Marinus) B.M. de Koster and Steef L. van de Velde, (2002) "Linking warehouse complexity to warehouse planning and control structure: An exploratory study of the use of warehouse management information systems" International Journal of Physical Distribution & Logistics Management, Vol. 32, pp. 381-395.

[73] Oualid Guemri, Placide Nduwayo, Raca Todosijevi, Saïd Hanafia, Fred Glover, (2019) "Probabilistic Tabu Search for the Cross-Docking Assignment Problem", European Journal of Operational Research Vol 277 pp. 875–885

[74] Pablo A. Miranda, Rodrigo A. Garrido, (2009) "Inventory service-level optimization within distribution network design problem", Int. J. Production Economics, Vol 122, pp. 276–285

[75] Panagiotis A. Makris, Ioannis G. Giakoumakis, (2003) "k-Interchange heuristic as an optimization procedure for material handling applications", Applied Mathematical Modelling Vol 27 p. 345–358

[76] Pancheng Wang, Chongjun Yang, Zhanfu Yu, Yingchao Ren, "A Load Balance Algorithm for WMS" Published in: IGARSS 2004. 2004 IEEE International Geoscience and Remote Sensing Symposium e Date of Conference: 20-24 Sept. 2004

[77] Pierre Duysinx (1997) "Layout Optimization: A Mathematical Programming Approach", University Of Liege Report OA-41

[78] R Bai, E. B. (2007). Heuristic, meta-heuristic and hyper-heuristic approaches for fresh produce inventory control and shelf space allocation. Journal of the Operational Research Society. Volume 59, 2008 - Issue 10

[79] R. K. Amit, Peeyush Mehta, Rajeev R. Tripathia (2015) "Optimal shelf-space stocking policy using stochastic dominance under supply-driven demand uncertainty" European Journal of Operational Research Vol 246 pp. 339–342

[80] Raúl F. Roldána, Rosa Basagoitia, Leandro C. Coelho (2017) "A survey on the inventory-routing problem with stochastic lead times and demands", Journal of Applied Logic Vol 24 pp. 15–24

[81] René B.M. De Koster Ale Smidts, (2013) "Organizing warehouse management", International Journal of Operations & Production Management Vol 33 pp. 1230-1256

[82] Riccardo Manzini, Sunderesh Heragu, Yavuz Bozer (2015) "Decision models for the design, optimization and management of warehousing and material handling systems" Int. J. Production Economics Vol 170 pp. 711–716

[83] Rob A. C. M. Broekmeulen, Michael G. Sternbeck, Karel H. van Donselaar, Heinrich Kuhn (2017) "Decision support for selecting the optimal product unpacking location in a retail supply chain" European Journal of Operational Research Vol 259 pp. 84–99

[84] Robert Huang-Jing Lin Peter Chu, (2006) "Note On Stochastic Inventory Models With Service Level Constraint", Journal of the Operations Research Society of Japan, Vol. 49, pp. 117-129

[85] Robert Michael Lewis, Virginia Torczona, Michael W. Trosset (2000) "Direct search methods: then and now" Journal of Computational and Applied Mathematics Vol 124 pp. 191-207

[86] Roshanak Mohammadivojdan, Joseph Geunes (2018) "The newsvendor problem with capacitated suppliers and quantity discounts" European Journal of Operational Research Vol 271 pp. 109–119

[87] Ruibin Bai, Graham Kendall (2008) "A Model for Fresh Produce Shelf-Space Allocation and Inventory Management with Freshness-Condition-Dependent Demand" Informs Journal on Computing Vol 20 pp. 78-85

[88] S. Armagan Tarim, Brian G. Kingsman, (2004) "The stochastic dynamic production/inventory lot-sizing problem with service-level constraints" Int. J. Production Economics Vol 88 pp. 105–119

[89] S. Kulturel-konak, a. E. Smith and b. A. Norman, (2004) "Layout optimization considering production uncertainty and routing flexibility", International Journal of Production Research, Vol. 42, pp. 4475–4493

[90] Sara Martins, Manuel Ostermeier, Pedro Amorim, Alexander Hübner, Bernardo Almada-Lobo, (2019) "Product-oriented time window assignment for a multi-compartment vehicle routing problem" European Journal of Operational Research Vol 276 pp. 893–909

[91] Shandong Mou, David J. Robb, Nicole De Horatius, (2018) "Retail store operations: Literature review and research directions" European Journal of Operational Research Vol 265 pp. 399–422

[92] Shib Sankar Sana (2015) "An EOQ model for stochastic demand for limited capacity of own warehouse" Ann Oper Res Vol 233 pp. 383–399

[93] Shilpy Tayal, S. R. Singh and Rajendra Sharma (2014) "A Multi Item Inventory Model for Deteriorating Items with Expiration Date and Allowable Shortages" Indian Journal of Science and Technology, Vol 7 pp. 463–471

[94] Shilpy Tayal, Sukhwinder Singh, Anand Chauhan (2014) "A Deteriorating Production Inventory Problem with Space Restriction" Journal of Information & Optimization Sciences Vol. 35 pp. 203–229

[95] Shilpy Tayala, S. R. Singh and Rajendra Sharma (2014) "An inventory model for deteriorating items with seasonal products and an option of an alternative market" Uncertain Supply Chain Management Vol 3 pp. 69–86

[96] Sifeng Lin, Jonathan F. Bard, Ahmad I. Jarrah, Xinhui Zhang, Luis J. Novoa, (2017) "Route design for last-in, first-out deliveries with backhauling" Transportation Research Part C Vol 76 pp. 90–117

[97] Soheyl Khalilpourazari, Seyed Hamid Reza Pasandideh (2019) "Modeling and optimization of multi-item multi-constrained EOQ model for growing items" Knowledge-Based Systems Vol 164 pp. 150–162

[98] Stanley E. Griffis, Thomas J. Goldsby, (2007) "Transportation Management Systems: An Exploration of Progress and Future Prospects" Transportation

[99] Sunil Chopra Gilles Reinhardt Maqbool Dada, (2004) "The Effect of Lead Time Uncertainty on Safety Stocks", Decision Sciences, Vol 35

[100] Tai-Yue Wang, Rei-Min Hu, (2008) "An inventory control system for products with optional components under service level and budget constraints", European Journal of Operational Research, Vol. 189, pp. 41-58

[101] Teresa Bianchi-Aguiar, Elsa Silva, Luis Guimarães, Maria Antónia Carravilla, José F. Oliveira, (2018) "Allocating products on shelves under merchandising rules: Multi-level product families with display directions" Omega Vol 76 pp. 47–62

[102] Teresa Bianchi-Aguiar, Elsa Silva, Luis Guimarães, Maria Antónia Carravilla, José F. Oliveira, João Günther Amaral, Jorge Liz, Sérgio Lapela (2016) "Using Analytics to Enhance a Food Retailer's Shelf-Space Management", Journal on Applied Analytics Vol 46 pp. 424-444

[103] Thomas Wensing, Michael G. Sternbeck, Heinrich Kuhn (2018) "Optimizing case-pack sizes in the bricks-and-mortar retail trade" OR Spectrum Vol 40 pp. 913–944

[104] Timothy L. Urban (2002) "The interdependence of inventory management and retail shelf management" International Journal of Physical Distribution & Logistics Management Vol 32 pp. 41-58

[105] Tulay Flamand, Ahmed Ghoniem, Mohamed Haouari, Bacel Maddah, (2018) "Integrated assortment planning and store-wide shelf space allocation: An optimization-based approach" Omega Vol 81 pp. 134–149

[106] U.L.J.S.R. Perera, Okitsugu Fujiwara, (1993) "EOQ models for continuously deteriorating products using linear and exponential penalty costs" European Journal of Operational Research Vol 70 pp. 104-114

[107] Wei Zhang a, Kumar Rajaram, (2017) "Managing limited retail space for basic products: Space sharing vs. space dedication", European Journal of Operational Research Vol 263 pp. 768–781

[108] Weili Xue, Ozgun Caliskan Demirag, Frank Y. Chen, Yi Yang (2017) "Managing Retail Shelf and Backroom Inventories When Demand Depends on the Shelf-Stock Level", Production and Operations Management Society Vol. 26, pp. 1685–1704

[109] Xiangling Hu, Ping Su (2018) "The newsvendor's joint procurement and pricing problem under price-sensitive stochastic demand and purchase price uncertainty" Omega Vol 79 pp. 81–90

[110] Yan Liu, Hongyan Shi, Nicholas C. Petruzzi (2018) "Optimal quality and quantity provisions for centralized vs. decentralized distribution: Market size uncertainty effects" European Journal of Operational Research Vol 265 pp. 1144–1158

[111] Yi-Feng Hung, Ching-Bin Chang, (1999) "Determining safety stocks for production planning in uncertain manufacturing", Int. J. Production Economics, Vol 58 pp. 199-208

[112] Yu-Chung Tsao, Qinhong Zhang and Tsung-Hui Chen, (2016) "Multi-item distribution network design problems under volume discount on transportation cost", International Journal of Production Research, Vol. 54, pp. 426–443

[113] Yves Crama, Mahmood Rezaei, Martin Savelsbergh, Tom Van Woensel (2018) "Stochastic Inventory Routing for Perishable Products" Transportation science, Vol. 52, pp. 526–546