RETAIL STORE STOCK INVENTORY ANALYSIS: A LITERATURE SURVEYAND INFORMATION GATHERING

[1]. **Author** : R.Ishfaq, C.C.Defee, B.J.Gibson, U. Raja.

Title : "Realignment of the physical distribution process in omni-channel fulfillment".

Abstract : The purpose of this paper is to identify the realignment of the physical distribution process for store-based retailers in their efforts to integrate the online channel into their business model. Multiple attributes of the physical distribution process are evaluated to identify associations with order fulfillment methods adopted by omni-channel retailers. Design/methodology/approach – A multi-method approach is used which includes qualitative evaluation of 50 interviews of supply chain executives from large retailers. Additionally, secondary data about firm size, store and distribution networks, online sales, distribution configuration, and order delivery options are used. The findings of qualitative analysis are incorporated into a quantitative classification-tree analysis to identify associations among distribution attributes, order fulfillment methods and order delivery services. Findings – Retailers are developing a consistent omni-channel physical distribution process in which stores undertake a bigger role in order fulfillment and delivery. Level of online sales, size of distribution network, number of sales associates at a store, and number of years engaged in the online channel are identified as having strong associations with the type of order fulfillment method used by omni-channel retailers. The study finds that retailers are focussed on integrating their store and DC inventories and have the benefit of scale with a large store network. Practical implications – Retailers are reconfiguring their physical distribution processes in the complex omni-channel environment can use the findings of this study to evaluate their strategy and identify the level of realignment effort that is needed. A better understanding of the requirements of physical distribution in an omni-channel setting will guide retailers in developing requisite operational capabilities. Originality/value – This paper provides a first in-depth look at order fulfillment choices in omni-channel retail and identifies efforts that are underway to realign key elements of the physical distribution process.

[2]. **Author** : J.Kembro, A. Norrman,

Title : Exploring trends , implications and challenges for logistics information systems in omni-channels : Swedish retailers' perception"

Abstract : The purpose of this paper is to explore the current trends, implications and challenges of information systems (IS) related to omni-channel logistics. Design/methodology/approach: An exploratory survey study is conducted with 23 Swedish retail companies transforming to omni-channel logistics. The study investigates the retailers' current situations regarding logistics IS as well as their perceptions of the future development. Findings: From the perspective of leading Swedish retailers, omni-channel requirements drive the implementation of new IS to support effective and efficient material handling across the network and in the respective nodes. The shifting roles and increase in the

number of handlings nodes will require flexible IS platforms that can support multiple flows and integrated inventory. The major increase in the implementation of new, critical functionalities is related to real-time, multi-criteria decision making on order allocation to different handling nodes. More advanced IS functionality is also required in material-handling nodes to support the increased degree of automation and continuous improvements with the aim to shorten order-to-delivery lead times. A number of challenges are identified that must be addressed during the transformation to omni-channel logistics, especially related to the growing complexity and decentralization of networks, tougher lead-time requirements and larger product assortments. Research limitations/implications: To support further theory development, 11 propositions related to trends and a schematic framework conceptualizing implications and challenges are submitted for testing in future research. Practical implications: The study highlights several aspects related to logistics IS that are important for practitioners to consider as they undergo the transition to omni-channels. It provides insights into IS functionalities that are likely to grow in use and criticality for supporting material handling and inventory management in increasingly complex and decentralized networks. In particular, the authors stress the need to implement functionality that works across previously separated handling nodes and decision areas. Managers can also use the propositions to reflect on what the near future holds and as input for their own scenario analyses. Originality/value: Previous research has primarily focused on technology that supports the front-end customer experience. This study is original in that it explores the trends, implications and challenges for logistics IS in omni-channels – an area that has not been explored in detail previously. It also studies both perceived and expected changes over time related to the transformation toward omni-channel logistics.

[3]. **Author** : G.Hançerlioğullari, A.Şen, E.A.Aktunç,

Title : "Demand uncertainty and inventory turnover performance:an empirical analysis of the US retail industry".

Abstract : Purpose The purpose of this study is to investigate the impact of demand uncertainty on inventory turnover performance through empirical modeling. In particular we use the inaccuracy of quarterly sales forecasts as a proxy for demand uncertainty and study its impact on firm level inventory turnover ratios. Design/methodology/approach We use regression analysis to study the effect of various measures on inventory performance. We us a sample financial data for 304 publicly listed U.S. retail firms for the 25-year period from 1985 to 2009. Findings Controlling for the effects of retail segments and year, it is found that inventory turnover is negatively correlated with mean absolute percentage error of quarterly sales forecasts and gross margin and positively correlated with capital intensity and sales surprise. These four variables explain 73.7% of the variation across firms and over time and 93.4% of the within-firm variation in our data. Practical implications In addition to conducting an empirical investigation for the sources of variation in a major operational metric, the results in this study can also be used to benchmark a retailer's inventory performance against its competitors. Originality/value We develop a new proxy to measure the demand uncertainty that a firm faces and show that this measure may help to explain the variation in inventory performance.

[4]. **Author**: Y. Wang, S. W. Wallace, B. Shen, y T.-M. Choi,

Title : "Service supply chain management:A review of operational models".

Abstract: Given the growing importance of service supply chain management (SSCM) in operations, we review a selection of papers in the operations research and the management science (OR/MS) literature that focus on innovative measures associated with the SSCM. First, we review and discuss the definitions of service supply chains (SSCs) and categorize SSCs into the Service Only Supply Chains (SOSCs) and the Product Service Supply Chains (PSSCs). Second, by classifying the literature into three major areas, namely service supply management, service demand management, and the coordination of service supply chains, we derive insights into the current state of knowledge in each area, and examine the evolution of the SSCM research over the past decade. Finally, we identify some associated research challenges and explore future directions for research on SSCM from an operational perspective.

[5]. **Author** : S.Mahar, P.D.Wright.

Title : "The value of postponing online fulfillment decisions in multi-channel retail/e-tail organizations".

Abstract : Many retail/e-tail organizations assign responsibilities for online sales immediately and to the closest fulfillment location that has available stock. Unfortunately there is little research on the value of using such policies in retail/e-tail companies. To fill this gap, this paper examines two aspects of the online fulfillment assignment decision that differ from current practice. We propose that online sales should be accumulated before they are assigned to a fulfillment site and that more inventory position information should be leveraged into the fulfillment decision. Specifically, we develop and evaluate a "quasi-dynamic" allocation policy that assigns accumulated online sales to fulfillment locations based on expected inventory, shipping, and customer wait costs. Computational results show that our policy can reduce costs (i.e., holding, backorder, transportation cost) at the fulfillment locations by as much as 23% on average over a commonly used transportation cost policy. In addition, postponing the allocation decision and allowing sales to accumulate can reduce inventory costs at the fulfillment sites by 14% over common practice of instantaneously assigning online sales responsibilities. The magnitude of the benefit depends critically on the number of allocations made each period and the fraction of total sales coming from the online channel. Although postponement delays receipt of online sales, our findings suggest that explicitly incorporating customer service in the allocation decision can improve product availability at little or no additional cost.

[6] **Author** : A.Hübner, A.Holzapfel,H.Kuhn.

Title :"Operations management in multi-channel retailing:an exploratory study".

Abstract: Multi-channel (MC) shopping is revolutionizing retail operations. For traditional retailers, the growing importance of online sales means creating new supply chain models. This requires a solid understanding of the operations processes. Current literature on MC

management focuses on customer perspectives, but only touches on the operational aspects. The primary goal of this study is therefore to give a comprehensive overview of the operations structures of MC retailing, identify the operations systems in use and analyze their planning interdependencies. We identify network design, inventory management, warehouse operations and capacity management as the areas of MC operations planning. Their planning interdependencies are investigated. We analyze the different MC networks and the associated inventory management approaches as well as the various design concepts in warehouse operations. The efficiency of integrating warehouse operations is the core lever for integrated MC operations. While inventory pooling favors integrated networks, channel-specific operational challenges are a reason to simplify structures and operate separate networks. Specific operational design options (e.g., in picking and scheduling) are identified to optimally complement the network design selected. Company examples also give an idea of how to efficiently design the coordination of on- and offline logistics. Retailers can gain important insights into how to further develop their systems. We used an explorative approach to identify structures and processes in a relatively new research area. We questioned 43 executives from 33 different European-based leading companies in MC retailing in semi-structured, face-to-face interviews. This paper describes the results of what is currently the largest study on MC operations.

[7]. **Author** : A.Hübner, H.Kuhn, J.Wollenburg, A. Trautrims.

Title : "From bricks-and-mortar to bricks-and-clicks–logistics networks in omni-channel grocery retailing".

Abstract : The advent of grocery sales through online channels necessitates that bricks-and-mortar retailers redefine their logistics networks if they want to compete online. Because the general understanding of such bricks-and-clicks logistics systems for grocery is still limited, the purpose of this paper is to analyze the internal logistics networks used to serve customers across channels by means of an exploratory study with retailers from different contexts. Design/methodology/approach - A total of twelve case companies from six European countries participated in this exploratory study. Face-to-face interviews with managers were the primary source for data collection. The heterogeneity of our sample enabled us to build a common understanding of logistics networks in grocery retailing on multiple channels and to understand the advantages of different warehousing, picking, internal transportation and last-mile delivery systems. Findings - Bricks-and-mortar grocery retailers are leveraging their existing logistics structures to fulfill online orders. Logistics networks are mostly determined by the question of where to split case packs into customer units. In non-food logistics channel integration is mostly seen as beneficial, but in grocery retailing this depends heavily on product, market and retailer specifics. The data from our heterogeneous sample reveals six distinct types for cross-channel order fulfillment. Practical implications - Our qualitative analysis of different design options can serve as decision support for retailers developing logistics networks to serve customers across channels. Originality/value - The paper shows the internal and external factors that drive the decision-making for omni-channel logistics networks for previously store-based grocery retailers. Thereby it makes a step towards building a contingency and configuration theory of retail networks design. It discusses in particular the differences between grocery and non-food

omni-channel retailing, last-mile delivery systems and market characteristics in the decision-making of retail networks design.

[8]. **Author**: W.Zhou, S.Piramuthu.

Title: "Effects of ticket-switching on inventory management:Actual vs information system-based data".

Abstract : Inventory inaccuracies in retail stores result from a combination of controllable and uncontrollable factors such as theft, damage, spoilage, misplacement, process errors, ticket-switching, among others. While most shrinkage types affect only one (type of) item, ticket-switching simultaneously affects the inventory of multiple items. Ticket-switching is the process of switching the identifier or ticket of an expensive item with that from a (relatively) cheap item with the explicit intent of purchasing the expensive item by paying the cheap item's price. Ticket-switching incidents distort inventory records in store information systems. Inventory management decisions based on such data from store information systems are therefore sub-optimal. We study the effects of ticket-switching on optimal order quantity of the involved items and the resulting profit. Under uniformly distributed demand and yield conditions, we find that ticket-switching increases (decreases) the optimal order quantity of the expensive (cheap) items. Surprisingly, results from our analysis indicate that profit on expensive (cheap) items are higher (lower) in the presence of ticket-switching behavior than otherwise.

[9]. **Author** : Ö.Turgut, F.Taube, S.Minner.

Title : "Data-driven retail inventory management with backroom effect".

Abstract : The backroom effect (BRE) constitutes the handling effort of a replenishment that does not fit on the shelf of a retailer. This effect needs to be included in the decision making of inventory policy parameters as it influences the handling effort, which constitutes a major part of the retailer's operational cost. We propose a mixed integer linear program to calculate the parameters of a periodic review (s, c, S, nq) policy while considering the BRE. The (s, c, S, nq) policy triggers an order when inventory drops below the reorder point s. Also, an order is triggered whenever the inventory drops below the can-order point c, provided at least one other product's inventory level is below s and thus ordered. The order then comprises the smallest integer number n of case packs with size q that brings the inventory level to or above S. As retailers face stochastic non-stationary demand, a data-driven approach based on historical data is applied to this joint replenishment problem.

[10]. **Author** : R.Ishfaq, U.Raja.

Title : "Empirical evaluation of IRI mitigation trategies in retail stores".

Abstract : This study evaluates the effectiveness of mitigation strategies currently employed by retailers to manage operational issues related to inventory record inaccuracy (IRI) in retail stores. A simulation study of different IRI mitigation strategies, grounded in empirical data, indicates varying levels of amelioration across items with different IRI profiles within the store inventory. The cumulative negative effect of inventory errors is

shown to be strong enough that adding more inventory to match the error rate would not recover the corresponding loss in inventory position. On the other hand, a replenishment-based approach works better at mitigating the effect of inventory errors. The study concludes that correcting IRI errors through technology-driven inventory audits would be the best approach for retailers to improve store performance as compared to other mitigation strategies.

[11]. **Author** : J.G.Wilson, C. K. Anderson.

Title : "Joint Inventory and Pricin g Decisions".

Abstract : The problem of assigning inventory to different pricing levels is considered. The problem is motivates by hoteliers assigning rooms to an opaque discounter. It can also be thought of as assigning seats and fares to two different classes where the cheaper class sells out first. The approach can be used for retail promotions such as "all items 20% of during the first hour of business". While the operations literature has looked extensively at joint pricing and inventory decisions in the single product setting, we extend the literature and provide closed form solutions to the multiproduct setting where demand across the products is dependent and the products share resources.

[12].**Author** : R.Ishfaq, U.Raja, S.Rao,

Title : "Seller-induced scarcity and price-leadership:Impact on product returns in the internet retail supply chain"

Abstract : The purpose of this paper is to evaluate the interaction between inventory availability (scarcity) and pricing levels (price-leadership (PL)), and its effect on product returns in the internet retail supply chain. Specifically, this paper investigates how supply chain managers can use inventory (seller-induced scarcity) and pricing (PL) levers to control product returns. Design/methodology/approach – Empirical data of sales and product returns from an internet retailer is analyzed to identify the scale of the effect that product scarcity and PL has on product returns. These factors are considered in developing a sales-return process model which is used with empirical data in a simulation study. The study evaluates changes in product returns for different policy settings related to PL and inventory levels. Findings of the simulation study are validated using statistical analysis of empirical data. Findings – PL and seller-induced product scarcity affect the rate of product returns; however, the scale of this effect depends on inventory and pricing decisions. The results identify an inflection boundary based on scarcity and PL levels which reverses this effect. This reversal is explained by underlying principles at play regarding buyers' valuation of the sale and corresponding product attributes. Practical implications – Supply chain managers in internet retail can leverage lower inventory under the seller-induced scarcity approach to improve revenues. However, reducing inventory levels beyond a threshold is counterproductive, due to an associated increase in product returns. Similarly, setting market competitive prices (PL) can help reduce product returns. Under the seller-induced scarcity condition, this effect is reversed for inventory levels below a threshold. Retailers can implement the methodology developed in this paper to identify the inventory-price threshold that can help increase revenues while keeping the rate of product returns at a manageable level. Originality/value – This research extends prior work regarding the role of product scarcity and pricing on product

returns and develops a deeper understanding of how these factors can be managed to control product returns in the internet retail setting.

[13]. **Author** : F.Thiesse, T.Buckel.Title : "A comparison of RFID-based shelf replenishment policies in retail stores under suboptimal read rates".

Abstract : The use of Radio Frequency Identification (RFID) as a tool for improving shelf replenishment processes in stores has attracted the interest of several retailers. However, the performance of RFID-based inventory control policies is influenced by a variety of design choices, technology characteristics, and external influences. The present simulation study aims to analyze and discuss the impact that these factors exert on the economic efficiency of RFID. We consider policies for RFID tagging on both the item level and the case level and compare these to a traditional replenishment process using periodic reviews. Our model incorporates shelf stock information generated by RFID and accounts for imperfect read rates and technology-specific costs. Our results indicate that significantly different sensitivities to cost and time-related factors, demand rate, and read rate must be considered when choosing a particular policy. Moreover, we discuss the consequences of model extensions and additional constraints on process performance. The results support both researchers and practitioners in the modeling and implementation of RFID-based inventory control systems.

[14].**Author** : L.B.Sabir, J.A.Farooquie.

Title : "Effect of Different Dimensions of Inventory Management of Fruits and Vegetables on Profitability of Retail Stores: An Empirical Study".

Abstract : In today's challenging and competitive scenario, Indian retailers (organized sector) of fruits and vegetables need more dynamic strategies in order to provide customer satisfaction and retention. Purchasing, overstocking, stock-out, throw away, markdowns, etc. are different activities that are undertaken in a retail store selling perishable inventory, especially fruits and vegetables. These factors affect the profitability of the retail store, directly or indirectly; hence, proper control over these factors must be the primary objective of the retailer selling fruits and vegetables. This article aims to find out significant relationships within these parameters of inventory management so that retailers find it helpful in devising strategies for a better competitive edge. First, factors are identified, and then, statistical tests (chi-square and analysis of variance) are used to derive conclusions.

[15]. **Author** : C.Eroglu, B.D.Williams, M.A.Waller.

Title : "Using the Pack-and-a-Half Rule to Eliminate Backroom Inventories in Retail Operations".

Abstract : In the retail industry, backroom inventories are typically associated with higher labor costs and greater operational complexity. Thus, retailers look for ways to eliminate backroom inventories. A heuristic used for this purpose is the pack-and-a-half rule which suggests that the shelf space allocated for a product should be at least 50% larger than the case pack quantity in which the product is delivered. Despite its popularity among retailers,

the pack-and-a-half rule has been ignored in the academic literature. We introduce the pack-and-a-half rule, assess its impact on a retailer's profits, identify cost, demand, and product characteristics driving this impact, and propose a modification. Based on an analysis of data obtained from a retailer on 1,986 SKUs in 20 categories, we find that the pack-and-a-half rule decreases a retailer's profits, on average, by 10% when applied uniformly across all SKUs. Further, this decrease is significantly affected by product depth, product width, demand elasticity, case pack quantity, and inventory carrying cost. Finally, we develop a set of modifications based on these variables where the pack-and-a-half rule is applied selectively and in a stepwise fashion. These modifications limit the decrease in a retailer's profits to a range between 6% and 7%.

[16]. **Author** : T.M.Choi.

Title : "Inventory Service Target in Quick Response Fashion Retail Supply Chains"

Abstract : Different fashion brands have different inventory service targets. To achieve the desirable inventory service level without the need of holding a lot of inventory, fashion companies commonly adopt the quick response practice. In this paper, we conduct an analytical study on the influence played by the inventory service target on quick response fashion retail supply chains. To be specific, we consider the case when the fashion retailer, who is the channel leader, aims to achieve an inventory service target in its inventory planning. We explore impacts of the inventory service-targeted quick response program, in terms of expected profit, and profit risk on the fashion retailer, the fashion manufacturer, and the fashion supply chain system. We also examine the quick response's impact on social welfare. We show how three practical contracts, namely, the fixed-fee contract, the wholesale pricing contract, and the product variety contract, can be employed to achieve a win–win situation in the fashion retail supply chain system with the adoption of the inventory service-targeted quick response program. Closed-form managerial insights on how the inventory service target affects the expected benefit of quick response, the reduction of profit risk under quick response, the expected gain of social welfare, the achievability of the win–win situation, and the setting of contractual parameters, are derived.