

Proposition d'indicateurs pour mesurer la performance de la gestion de commandes en ligne en distribution multicanal

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Résumé :

Bien gérer les commandes passées en ligne est un défi majeur pour un distributeur multicanal, car elles sont génératrices de coûts et la satisfaction des clients est déterminante. Il est donc crucial pour un distributeur multicanal de pouvoir piloter les opérations de la gestion des commandes en ligne en prenant en compte aussi bien la satisfaction des clients que la performance économique.

Basé sur une revue de littérature et l'analyse des résultats d'un questionnaire en ligne soumis à des distributeurs français et chinois, cet article propose une liste d'indicateurs clés de performance (ICP) qui permettent de piloter la performance des systèmes de gestion des commandes en ligne.

Mots-clés : distribution multicanal ; gestion des commandes ; Indicateurs Clé de Performance ; ICP

Proposing Key Performance Indicators for performance measuring of e-fulfillment systems in multi-channel retailing

Abstract:

Fulfillment of online orders is a major challenge for multi-channel retailers, as it is cost intensive and critical for customer satisfaction. It is therefore vital for multi-channel retailers to be able to steer their operations of order-fulfillment regarding, in parallel, the two dimensions: customer satisfaction and economic efficiency.

Based on a literature review and the analysis of the results of an online questionnaire submitted to French and Chinese multi-channel retailers, this article proposes a framework of Key Performance Indicators (KPIs) allowing to monitor the performance of multi-channel e-fulfillment systems.

Key-words: multi-channel retail; e-fulfillment; Key Performance Indicator; KPI

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Executive Summary

Fulfilling orders placed over the e-commerce channel is a major challenge for retailers operating physical store and online sales channels in parallel. The supply chain operations for replenishing the physical stores on the one hand and fulfilling the online orders received by individual customers on the other hand are very different.

Moreover, the e-fulfillment operations are highly critical for customer satisfaction, as delivery time and quality impact directly the customers' perception of the retailer and the customer loyalty.

It is therefore vital for multi-channel retailers to steer the operations linked to e-fulfillment, not only regarding the economic performance, but also regarding the customer expectation.

Monitoring the performance of these two criteria with Key Performance Indicators (KPIs) provides a way of steering simultaneously these two dimensions of economic performance and customer expectation.

The use of KPIs in companies to steer strategic and operational objectives is widespread. Our research analyses the use of KPIs by multi-channel retailers in France and China and examines which KPIs are to be used to monitor the two criteria.

The result of this research is a framework of 18 KPIs (10 describing the economic performance of the e-fulfillment system, 8 the customer expectation). This set of KPIs allows multi-channel retailers to choose the relevant KPIs for their particular set of infrastructure.

These findings are important for multi-channel retailers who want to be able to steer their fulfillment system in a way that it is economically efficient and at the same time satisfying the customer expectations, therefore providing support to pilot the trade-off between operational costs and customer service. Moreover, the identified KPIs prove helpful when setting up or restructuring the e-fulfillment operations in a multi-channel retail environment, by indicating the relevance of the specific criteria for the overall performance.

Proposing Key Performance Indicators for performance measuring of e-fulfillment systems in multi-channel retailing

Introduction

An important number of traditional store-based retailers are becoming multi-channel retailers by opening an additional online channel. At the same time, formerly pure online retailers are opening stores or physical pick-up points to allow their customers physical interaction.

Multi-channel retailing has received primary attention principally in the field of marketing by focusing on customer behavior (Belvaux and Labbé-Pinlon, 2009; Venkatesan *et al.*, 2007) and on the relations and conflicts between channels (Falk *et alii*, 2007; Filser and Paché, 2008; Poirel and Bonet Fernandez, 2008). The operational implications of online retailing in terms of e-fulfillment, defined as fulfilling orders placed over the Internet (Agatz, 2009; Tarn *et alii*, 2003), seem to be treated only as a minor issue among other issues in e-commerce (Bask, Lipponen and Tinnilä, 2012). Specific analysis of the operational implications of multi-channel retailing remains scarce (Agatz, Fleischmann and van Nunen, 2008).

In multi-channel retailing, customers expect at least the same level of service, counsel, and information in every channel. This channel hopping, which is a legitimate desire from a customer's point of view, may nevertheless prove to be very difficult to implement for the retailer (Vanheems, 2009). The challenge for retailers is to satisfy this customer expectation and maximize the economic performances of every channel. There is a lack of studies regarding the best practice companies can follow in order to meet the customer expectation and economic performance at the same time (Agatz, Fleischmann and van Nunen, 2008).

Based on a literature review in supply chain management and in marketing, this article identifies 35 Key Performance Indicators (KPIs) that measure the economic performance and the customer expectation of e-fulfillment systems in multi-channel retailing. In order to determine the most relevant KPIs (defined as those KPIs most widely used and best evaluated by multi-channel retailers), a questionnaire was completed by sixteen supply chain or marketing managers of French and Chinese multi-channel retail companies.

This article contributes to expanding the existing research on fulfillment systems to the specific configuration of multi-channel retailers (Agatz, Fleischmann and van Nunen, 2008) by combining existing analysis of customer satisfaction and physical distribution service quality (Xing and Grant, 2006; Xing *et alii*, 2010) with economic performance aspects (Gunasekaran, Patel and Tirtiroglu, 2001). The widely used criteria of customer service as

performance indicator for supply chains (Mitra *et alii*, 2010; Sambasivan, Mohamed and Nandan, 2009; Mitra and Bagchi, 2008; Gunasekaran, Patel and McGaughey, 2004) is therefore refined and completed with economic performance criteria.

This article is organized into four parts. First, the conceptual framework presents the 9 criteria of economic performance and customer expectation in multi-channel e-fulfillment systems and identifies the 35 KPIs that evaluate e-fulfillment systems' performance. Then, the methodology based on a questionnaire completed by supply chain and marketing managers of French and Chinese multi-channel retail companies is presented. The results then present the 18 most relevant KPIs (in terms of use and evaluation by multi-channel retailers) according to the economic performance or customer expectation criteria. The conclusion presents the managerial implications, the limitations and research avenues.

1. Conceptual framework

In order to offer an online channel to its customers, a retailer has to be able to manage its operations in a very different way from its physical store activity because the online channel has to serve individual customers with a large variety of small orders (Tarn *et alii*, 2003). E-fulfillment, defined as fulfilling orders placed over the Internet (Agatz, 2009; Tarn *et alii*, 2003), includes the processes of warehousing, picking and order preparation, distribution and delivery, and returns (Straube and Lueck, 2000). E-fulfillment is often considered to be one of the most expensive, critical, and challenging operations of Internet retailers (Agatz, 2009; de Koster, 2002; Lee and Whang, 2001; Ricker and Kalakota, 1999). From an operational point of view, e-fulfillment systems have to be time and cost efficient. Logistics and stock management are becoming core competencies (Benghozi, 2001). From a strategic marketing point of view, the e-fulfillment system has to be able to meet the customers' expectations.

Supply chain performance includes tangible and intangible factors (Chang, Tsai and Hsu, 2013). The overall performance of a multi-channel retailer is therefore influenced by a number of operational challenges (product availability, stock keeping, order taking and fulfillment, delivery to the customers, and reverse logistics...) and customer expectation parameters (delivery timing, availability, and returns...) that have to be managed in parallel by the retailer. This may lead to a trade-off for the retailer between operational costs and customer service (Agatz, Fleischmann and van Nunen, 2008).

1.1. The criteria of economic performance and customer expectation in multi-channel e-fulfillment systems

Past research has identified five economic performance and four customer expectation criteria in multi-channel e-fulfillment systems (Lang and Bressolles, 2013). The economic performance criteria take into account the process steps included in the fulfillment system (warehousing, picking and packing, distribution and delivery and returns) as defined by Straube and Lueck (2000) and the infrastructure and investment aspects of fulfillment systems (Agatz, Fleischmann and van Nunen, 2008; de Koster, 2002). The *five economic performance criteria* are (1) *Stock and inventory efficiency*, indicating the performance of the warehousing process; (2) *Picking and order preparation efficiency*, indicating the performance of the picking and order preparation process; (3) *Delivery cost efficiency*, indicating the performance of the distribution and delivery process; (4) *Return handling efficiency*, indicating the performance of the return process and (5) *Fulfillment infrastructure costs*, indicating all the investments, rents, or outsourcing costs for the fulfillment infrastructure. The *four customer expectation criteria* developed by Xing and Grant (2006) and Xing *et alii* (2010) are retained to assess the customer expectation of the e-fulfillment system in a multi-channel retail context : (1) *Timeliness*, speed of delivery, choice of delivery date, delivery within specified time slot, etc. (2) *Availability*, confirmation of availability, substitute or alternative offer, order tracking and tracing system, waiting time in case of out-of-stock situations, etc. (3) *Condition*, order accuracy, completeness, damage in-transit, etc. and (4) *Return*, ease of return and return channels options, promptness of collection and of replacement, etc.

1.2. KPIs of the performance of e-fulfillment systems

Based on a literature review on performance metrics and key performance indicators used in supply chain management, e-logistic, retailing and marketing, 35 KPIs have been identified that measure the performance of e-fulfillment systems in multi-channel retailing. In order to identify these KPIs, we searched academic databases (EBSCO and Emerald) and Google Scholar for "KPI" and the 9 criteria defined before (5 economic performance and 4 customer expectation criteria). Out of the KPIs found, we retained only those mentioned in at least two different references and corresponding to the criteria (exact match or very similar definition). Table 1 lists the 35 Key Performance Indicators identified (see appendix for detailed definition and references for each KPIs).

KPI number	KPI Name	KPI number	KPI Name
KPI 1	Total investment of the warehouse	KPI 19	Cost per shipment
KPI 2	Labor cost per unit of output	KPI 20	Percentage of shipments arriving in good condition
KPI 3	Processed number of orders per m3	KPI 21	Average delivery re-planning time
KPI 4	Stock unit utilization	KPI 22	Recall cost
KPI 5	Working inventory	KPI 23	Cost of returns
KPI 6	Inventory cycle time	KPI 24	Enquiry-to-response time
KPI 7	Inventory carrying costs	KPI 25	Average fulfilment cycle time
KPI 8	Safety stock volume	KPI 26	Percentage of on-time deliveries
KPI 9	Rate of obsolete inventory	KPI 27	Order fill rate
KPI 10	Order to delivery time	KPI 28	Stock out rate
KPI 11	Percentage of error in goods picking	KPI 29	Shrinkage
KPI 12	Revenue per order	KPI 30	Order entry accuracy
KPI 13	Pick rate per employee	KPI 31	Warranty claims
KPI 14	Units shipped per employee	KPI 32	Number of damage claims
KPI 15	Order entry time	KPI 33	Invoice accuracy
KPI 16	Average delivery time	KPI 34	Notification-to-refund time
KPI 17	Ratio of transportation cost to value of product	KPI 35	Average return rate
KPI 18	Shipping accuracy		

Table 1: The 35 identified Key Performance Indicators

2. Methodology

In order to identify the most relevant KPIs (in terms of use and evaluation by multi-channel retailers) of the e-fulfillment systems' performance, an online questionnaire was sent to 100 supply chain or marketing managers of French and Chinese multi-channel retail companies. The focus on these two countries was chosen for two reasons: First, these two countries host a very significant number of multi-channel retailers and second, France historically has a strong retail sector as well in store as in mail-order retail whereas China's retail sector is rather an emerging one. Results of this exploratory study are therefore not limited to one specific country sector context.

The companies were chosen because of the variety of their sectors (grocery, electronics, books & CDs, cosmetics, luxury products ...). The respondents were identified and approached from a database of alumni of a major French supply chain management master program. We sent the list of the 35 KPIs with their definition to the respondents and asked them to indicate the KPI they used in their company in order to evaluate the performance of the e-

fulfillment system (KPI USE). We also asked them to give a mark (out of 100) of the 35 KPIs in order to evaluate the general importance of the KPI (KPI GRADE). Furthermore, we asked them to specify if they used the KPI under one specific of the 5 economic performance or the 4 customer expectation criteria.

We received a feedback from 16 companies, 9 from China and 7 from France. 10 respondents were from the supply chain department of the company and 6 from the marketing department. For confidentiality reason, we were not allowed to indicate the names of the multi-channel retailers, nor the names of the respondents. The companies were from different sectors: Grocery, general merchandise or perishable goods (7), Electronics (3), Office, books & CDs (3), Cosmetics or Luxury goods (2) and Medicine (1).

3. Results

Based on the feedback of the 16 companies having completed the questionnaire, we identified the most relevant KPIs that are used by at least half to the responding companies (50%) and that are evaluated by the companies with a grade at least 60 out of 100. At this stage, 22 KPIs out of 35 (63%) satisfied these conditions.

In the next step, we retained only the KPIs that are mentioned by at least 40% of the respondents to be used under the same criteria amongst the 5 economic performance or the 4 customer expectation criteria of the e-fulfillment systems' performance. The KPIs 9 (*Rate of obsolete inventory*), 12 (*Revenue per order*), 25 (*Average fulfillment to cycle time*) and 33 (*Invoice accuracy*) did not satisfy that condition. Those four KPIs were therefor not retained at that stage.

At the end of the process, only 18 KPIs out of 35 were retained (51 %) to evaluate the economic performance and the customer expectations of multi-channel e-fulfillment systems. One KPI (KPI 1) measures the "*Fulfillment Infrastructure Cost*" criteria. Two KPIs (KPI 6 and 8) evaluate the "*Stock & Inventory Efficiency*" criteria. Two KPIs (KPI 10 and 11) evaluate the "*Picking & Order Efficiency*" criteria. Five KPIs (KPI 16, 17, 18, 19, and 20) evaluate the "*Delivery Cost Efficiency*" criteria. One KPI (KPI 26) measures the "*Timeliness*" criteria. Two KPIs (KPI 27 and 28) measure the "*Availability*" criteria. Three KPIs (KPI 30, 31 and 32) measure the "*Condition*" criteria. And two KPIs (KPI 34 and 35) measure the "*Return*" criteria. We can note that no KPI were mentioned to be used by the respondents under the "*Return Handling Efficiency*" criteria from the economic performance aspect. This could be due to the fact that this criteria is very close to the "*Return*" criteria on the customer

expectation side and therefore applies company-internally in an identical manner for both. Table 2 indicates the results of the 22 KPIs retained after the first step and the 4 KPIs not having been clearly allocated to one of the 9 economic performance or customer satisfaction criteria.

KPI number	KPI	KPI Use (%)	KPI grade (/100)	e-Fulfillment criteria	
KPI 1	Total investment of the warehouse	62,50	61,18	Fulfillment Infrastructure Cost	Economic performance criteria
KPI 6	Inventory cycle time	87,50	66,50	Stock & Inventory Efficiency	
KPI 8	Safety stock volume	100,00	61,67	Stock & Inventory Efficiency	
<i>KPI 9</i>	<i>Rate of obsolete inventory</i>	<i>50,00</i>	<i>66,47</i>		
KPI 10	Order lead time	100,00	74,29	Picking & Order Efficiency	
KPI 11	Percentage of errors in goods picking	87,50	64,67	Picking & Order Efficiency	
<i>KPI 12</i>	<i>Revenue per order</i>	<i>62,50</i>	<i>73,33</i>		
KPI 16	Average delivery time	100,00	64,74	Delivery Cost Efficiency	
KPI 17	Ratio of transportation cost to value of product	75,00	60,00	Delivery Cost Efficiency	
KPI 18	Shipping accuracy	62,50	76,50	Delivery Cost Efficiency	
KPI 19	Cost per shipment	87,50	62,00	Delivery Cost Efficiency	
KPI 20	Percentage of shipment arrived in good condition	100,00	74,21	Delivery Cost Efficiency	
<i>KPI 25</i>	<i>Average fulfillment to cycle time</i>	<i>75,00</i>	<i>65,00</i>		
KPI 26	Percentage of online deliveries	100,00	84,67	Timeliness	
KPI 27	Order fill rate	75,00	81,58	Availability	
KPI 28	Stock out rate	100,00	81,67	Availability	
KPI 30	Order entry accuracy	75,00	69,38	Condition	
KPI 31	Warranty claims	75,00	60,00	Condition	
KPI 32	Number of damage claims	100,00	68,13	Condition	
<i>KPI 33</i>	<i>Invoice accuracy</i>	<i>50,00</i>	<i>79,41</i>		
KPI 34	Notification to refund time	50,00	60,00	Return	
KPI 35	Average return rate	87,50	67,06	Return	

Table 2: The 18 most used and best graded KPIs by multi-channel retailers by criteria

Conclusion: managerial implications, limitations and research avenues

Based on a literature review in supply chain management and in marketing, this article has identified 35 KPIs that measure the performance of the e-fulfillment systems in multi-channel retailing. In order to identify the most relevant KPIs in terms of use and evaluation by multi-channel retailers, an online questionnaire was completed by 16 supply chain or marketing managers of French and Chinese multi-channel companies. The results enabled us to identify 18 KPIs that are used and important by that multi-channel retail companies and also to determine under which of the 5 economic performance or the 4 customer expectation criteria these KPIs might be linked. These results contribute to expanding the existing research on fulfillment systems for multi-channel retailers by identifying KPIs that combine existing analysis of physical distribution service quality and customer satisfaction with economic performance appraisal.

From a managerial point of view, these results prove useful for multi-channel retailers in various ways: it provides KPIs for evaluating the performance of the e-fulfillment systems and therefore identifies potential areas of improvement on specific criteria (economic performance or customer expectation criteria). When setting up or improving the organization of e-fulfillment systems, the information about how different e-fulfillment systems perform regarding the KPIs of economic performance or customer expectation is in fact extremely helpful.

These results have two main limitations: First, data was collected from retailers in two specific countries, France and China. Although this was made with the intention to cover a large scope of different retail markets, our results may be biased by local market and customer specificities. Second, our research does not take into consideration the impact of the different types of fulfillment systems a multi-channel retailer may operate. The importance of the different KPIs depends on whether a retailer is fulfilling online orders in a dedicated distribution center, in its physical stores or in both. It further depends whether orders are prepared for home delivery or for customer pick-up in the stores or pick-up points.

A further limitation may be the fact that the results do not address interdependencies among the different KPIs, as one KPI may give indication on more than one criteria.

Further research should therefore replicate this study including multi-channel retailers in different countries and sectors with different product types in order to explore the influence of the country, sector and product type on the performance of the e-fulfillment system. Moreover, the evaluation of KPIs should take into consideration the specific fulfillment system used

by the multi-channel retailers. This would allow to refine the results and to better be able to apply the KPIs for specific company settings.

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Appendix

KPI	KPI name	KPI definition	References
1	Total investment of the warehouse	Investment, rental cost and/or outsourcing cost	Ploos van Amstel and D'Hert (1996); Barnes (2002)
2	Labor cost per unit of output	Total labor cost of the warehouse per unit of output	Ploos van Amstel and D'Hert (1996); Barros and Alves (2003)
3	Processed number of orders per m3	Processed number of orders per m3 of the warehouse	Ploos van Amstel and D'Hert (1996); Hernant, Andersson and Hilmola (2007)
4	Stock unit utilization	Percentage of WIP (Work In Progress) inventory compared to the whole inventory kept by the company	Chan and Qi (2003); Ploos van Amstel and D'Hert, (1996)
5	Working inventory	Available inventory for the normal demand during a given period	Chan and Qi (2003); Ploos van Amstel and D'Hert (1996)
6	Inventory cycle time	Average time of items in inventory	Chan and Qi (2003); Chae (2009)
7	Inventory carrying costs	Total costs which contain materials handling costs, inventory capital cost, storage space cost, risk cost	Chan and Qi (2003); Morgan (2004)
8	Safety stock volume	Inventory held to meet uncertain demand because of mismatch between forecasted and actual consumption or demand	Chan and Qi (2003); Soni and Kodali (2010)
9	Rate of obsolete inventory	Products in stock without usage or sales capability because having reached the end of its product life	Chae (2009); Soni and Kodali (2010)

10	Order to delivery time	Time between order receiving and goods delivery	Gomes, Yasin and Lisboa (2006); Morgan (2004)
11	Percentage of error in goods picking	Number of goods picked with errors compared to total number of goods picked	Gunawan, Ellis-Chadwick and King (2008); Ploos van Amstel and D'Hert (1996)
12	Revenue per order	Revenu per order	Gunawan, Ellis-Chadwick and King (2008); Singh, Sandhu, Metri and Singh (2003)
13	Pick rate per employee	Employees number compared to total number of picked items	Morgan (2004); Ploos van Amstel and D'Hert, (1996).
14	Units shipped per employee	Employees number compared to total number of shipped units	Chris Morgan (2004); Fawcett and Cooper (1998)
15	Order entry time	Time between an order received and when it is entered into a paper or electronic system	Aronovich <i>et alii</i> (2010); Kilger and Meyr (2008)
16	Average delivery time	Transit time from when a shipment leaves the order preparation facility until it arrives at its destination (end customer)	Aronovich <i>et alii</i> , (2010); Gunasekaran, Patel and Tirtiroglu (2001)
17	Ratio of transportation cost to value of product	Total transportation costs divided by the total value of product shipped	Aronovich <i>et alii</i> , (2010); Lee and Whang (2001)
18	Shipping accuracy	Number of units shipped without error divided by the total number of units shipped	Krauth <i>et alii</i> (2005); Morgan (2004).
19	Cost per shipment	Total cost divided by the total number of shipments	Soni and Kodali (2010); Baumol and Hrishikesh (1970)

20	Percentage of shipments arriving in good condition	Percentage of shipments arriving in good condition without damage during a defined period of time	Forslund (2007); Aronovich <i>et alii</i> , (2010)
21	Average delivery re-planning time	Total re-planning time divided by times of return for a period	Krauth <i>et alii</i> (2005); Zhao, Xie and Lau (2001)
22	Recall cost	Cost of recalling a product	Morgan (2004); Kinard, Capella and Bonner (2013).
23	Cost of returns	General cost of returns	Morgan (2004); Jiang and Rosenbloom (2005)
24	Enquiry-to-response time	Time between customer enquiry and retailer response	Gunawan, Ellis-Chadwick and King (2008); Ploos van Amstel and D'Hert (1996)
25	Average fulfilment cycle time	Total time between the customer order and the customer receipt of the product divided by total number of orders	Tarn <i>et alii</i> (2003); Hult, Ketchen and Nichols (2002)
26	Percentage of on-time deliveries	Percentage of orders delivered by the requested delivery date	Morgan (2004); Neely, Gregory and Platts (1995)
27	Order fill rate	Percentage of items ordered filled from stock compared to total items ordered	Chan and Qi (2003); Kleijnen and Smits (2003)
28	Stockout rate	Rate of stockout and the duration of stockout compared to the total number of units in stock	Chan and Qi (2003); Beamon (1999)
29	Shrinkage	Average inventory divided by average daily Cost Of Goods Sold (COGS)	Thomas <i>et alii</i> (1998); Koh, Kim and Kim (2006)

30	Order entry accuracy	Percentage of orders entered completely and correctly into the records compared to total number of orders entered	Kilger and Meyr (2008); Aronovich <i>et alii</i> (2010)
31	Warranty claims	Request for reimbursement of material costs, labor costs and external service costs that incurred while repairing damage	Morgan (2004); Gomes, Yasin and Lisboa (2006)
32	Number of damage claims	Number of damage claims over a specific period of time	Morgan (2004); Ploos van Amstel and D'Hert (1996)
33	Invoice accuracy	Percentage of correct invoices (reflecting products, quantities and price) issued compared to total invoices issued	Morgan (2004); Kasilingam (1998)
34	Notification-to-refund time	Time between customer notification and getting refund	Gunawan, Ellis-Chadwick and King (2008); Gunawan (2010)
35	Average Return Rate	Number of product returns out of the total number of processed orders	Ofek, Katon and Sarvary (2011); Gomes, Yasin and Lisboa (2006)

Table : The 35 Key Performance Indicators