Sentiment Analysis in Supply Chain Management

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INTRODUCTION

The supply chain is a sequence of activities which are conducted in separate companies. Materials flow along the supply chain progressively becoming transformed into a product that a consumer wishes to buy. On the other hand, information is transferred from consumers to producers, impacting on the future delivery plans for the suppliers. Ideally, feedback about the behaviour of the end consumer should be driving the coordinated behaviour of the supply chain. When consumers begin to buy more products, the sensible initiative for the supply chain to do is to match the demand with an increase of the product output - in a process of demand and supply integration to improve operational efficiency (Esper et al., 2010). However, a well-studied phenomenon known as the bullwhip effect can often be observed. This is where significant fluctuations occur in the output of members along the supply chain, as members further away from the consumers tend to over-react to changes in the final marketplace; even in response to just small changes in consumer demand (Lee et al., 1997).This is largely due to the supply chain members' lack of information about market-based activities. This phenomenon makes coordination and management of the supply chain challenging and creates additional costs and reduces chain responsiveness. Rather actual market-based information being shared along the supply chain, it is more common that suppliers take orders from consumers as an indication of market demand. As a result, many firms find themselves confronted with potential asymmetries of information along the supply chain and fail to respond efficiently on the market-based demand by responding to orders being placed by their direct consumers (O'Leary, 2011). This inability to determine consumer demand changes can be overcome using analysis of social media and opinions posted online.

Analysis of social media can be used to sufficiently predict social behaviour (Abbasi et al., 2012). The use of 'sentiment analysis' or 'opinion mining' can allow firms to derive an understanding of changes in consumer demand or preferences as expressed in social media, . Thus, 'demand sensing' of market-based demand allows firms to detect shifts or changes in trends in market-based demand (rather than orders from consumers) which then can feed into planning processes without requiring cooperation or coordination with other firms in the supply chain (Qin, 2011). Using business analytics approach of textual 'sentiment analysis' creates the opportunity to ultimately enable the prediction of sales. At present, commercial tools have been more readily applied to marketing and sentiment analysis rather than focus on supply management applications (Zitnik, 2012).

Sentiment analysis has great value for all suppliers independent of their distant from the actual end consumers. Suppliers closer to consumers, such as those in food and beverage supply chains,

tend to have well-established information-sharing connections that help supply chain members to be more aware of consumer demand changes and respond accordingly; this is exemplified in the Beer Game (Sterman, 1989). However, all suppliers can benefit from both forecasting and sentiment analysis as a large proportion of their supply is directed through their supply chain; a change in demand for one product or category can have significant ramifications and thus should be monitored. In some cases, firms directly serves consumers (such as supermarkets in food and beverage supply chains) may be reluctant to share insights about consumer demand; in these cases, sentiment analysis can prove to be exceedingly valuable to suppliers in short supply chains.

Suppliers that are distant from the consumer are disadvantaged by the relative difficulty in retrieving or accessing consumer demand information; sentiment analysis can prove to be advantageous in this respect. This value is, however, balanced by the fact that their output through any one supply chain going into one product/category that is affected by consumer shifts is a smaller proportion of their overall output. Thus, a shift in consumer demand for a particular product/category may have a smaller impact on their overall business, yet sentiment analysis may be the only practical method for them to gain insight and forewarning that this shift is about to occur in the first place.

In this chapter, we evaluate existing methods of gaining consumer demand information but focus on sentiment analysis as a key approach for firms without direct consumer contact, making the approach suitable for firms that are removed from consumers and marketplaces. We introduce supply chain management and other relevant concepts to provide context to the reader. We use the Beer Game (Sterman, 1989) as an example for a simple supply chain, allowing users to easily understand how information can be shared in supply chains, the overall effect of sharing information, and how delays in information affect the overall performance.

BACKGROUND

Supply chain management is the management of different companies and activities relating to the flow of materials and information in the supply chain. All material is harvested or extracted, processed, formed into components, which are then assembled into final goods, which undergo physical transportation and distribution to locations where consumers wish to buy them in the end marketplace. Supply chains have two important reverse flows from the consumer to the members of the supply chain. First in a reverse logistics process damaged or defective products flow from consumers for repair or disposal. Second, there is a flow of information about consumer demand, quantity requirements, and product features to manufacturers. The consumer demand is 'independent demand' as it cannot be directly influenced by the supply chain. Using the independent demand and the production plan and required components or products allow firms to calculate the 'dependent demand' for various components and products in the supply chain that are used in these finished goods (Helms, Ettkin, & Chapman, 2000). The difficulty in coordinating and managing the whole supply chain lies in the delays in the transfer of information to suppliers and manufacturers, preventing provision of relevant and accurate information to aid decision making.

Consumer demand in the marketplace is not equivalent to orders transferred along the supply chain. Consumer demand can remain unfulfilled simply due to retailers failing to hold desired inventory; e.g., there may be consumer demand for blue and red coloured jackets yet consumers may be buying blue jackets only as there are no red jackets in stock. The blue jacket stocks are replenished and this provides an erroneous indication (when observing order information) that there is only consumer demand for blue jackets, leaving consumer demand for red jackets unperceived by retailers and, by extension, unperceived by the supply chain.

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