The operational and supply chain implications of errors in OTIF calculations

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Introduction

Within the context of operations and supply chain management key performance indicators such as On Time In Full (OTIF) or Delivery In Full On Time (DIFOT) are measurements of logistics or delivery performance within a supply chain. Typically, it would be expressed as a percentage, measuring whether the supply chain was able to deliver: the ordered product; in the quantity requested; to a location specified by the customer; within the time period requested by the customer.

Even though OTIF is primarily a measure of logistics performance it can also be used as a measure of the effectiveness of the operations of a company. This is because in order to achieve a high OTIF performance there is an inherent need for the entire operation to work well. Ranging from procurement and suppliers to manufacturing operations to sales. This study examines the ways in which OTIF for suppliers and for the company can be incorrectly calculated, the causes and the operational and reputational ramifications. Focusing on a fast-growing manufacturing company that had been experiencing stock shortages of component parts which had led to lead-times increasing and increasing inventory levels to try and mitigate the impact of shortages.

Background

Literature review

Improving the performance of a manufacturing supply chain is a continuous process. This process requires both an analytical performance measurement system, together with a mechanism to initiate steps for realising the key performance indicator (KPI) goals (Cai et al., 2009).

OTIF or DIFOT are a form of supply chain KPI which are numbers or percentages that can be compared against targets set either internally for company performance, or externally for “benchmarking” evaluation of performance. In general KPIs can relate to data collected or calculated from any process or activity.

As product delivery performance (OTIF) can be used to evaluate incoming and outgoing products it can be broken down into OTIF to customers and from suppliers to provide greater clarity (Ahmad and Dhafr, 2002). In a study of European companies the OTIF goal for a world-class operation was considered to be 99% (Restivo, 2004).

The purpose of customer OTIF is to measure the delivery of the product in question to the customers of a on time and in full. Therefore OTIF measures the ability of a company to adhere to the agreed due date for each order. In has been noted that there need to be rigorous process and systems in place for recording this information either by the company itself or by the logistics provider if this aspect is out-sourced (Ahmad and Benson, 1999).

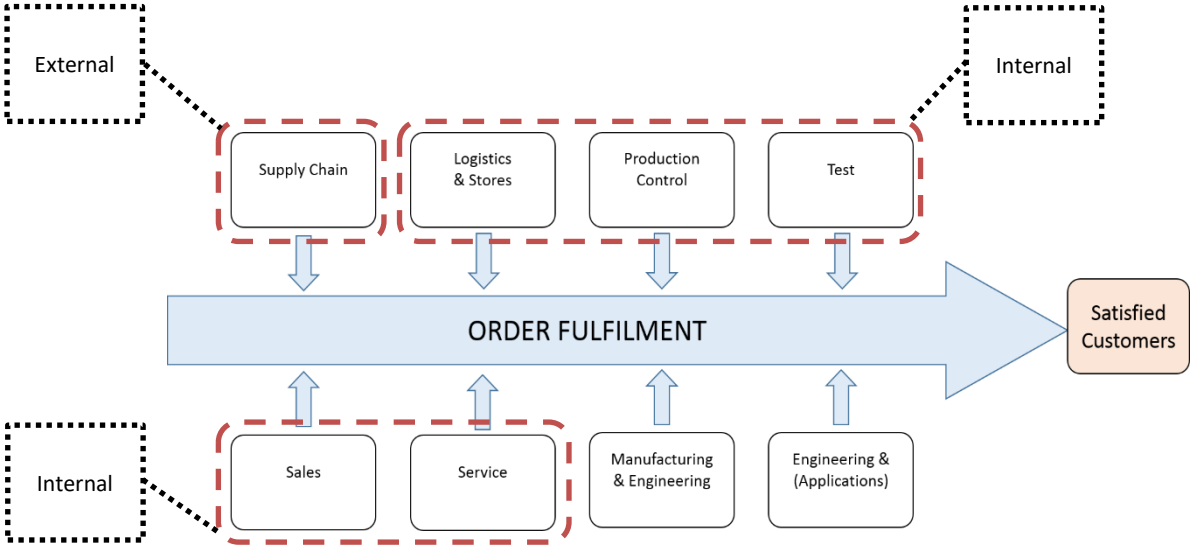
The purpose of supplier OTFI is to measure the receipt (by a company) of materials and parts on time and in full. Once again the measure could potentially be expanded to include factors such as product being in working condition and undamaged in transit. The supplier OTIF could have a big impact on the operations of the customers, whether they are component parts or just packaging. OTIFs therefore

measure the ability of the suppliers to adhere to the due date for each order as such it is a commonly used metric for evaluating the service level of a company (Otto and Kotzab, 2003).

Whilst OTIF is a useful tool research has shown that there does need to be some care take when calculating OTIF as there can be nuances within the measure. For example, there are instances where OTIF targets are met when measured against a target of the promised due date provided by the manufacturer to the customer. However, these same manufacturers would often fail to meet the OTIF metric when the requested due date from the customer was used as the target (Godsell and van Hoek, 2009).

Company processes

The process of the company at the time the work was undertaken are illustrated in Figure 1 illustrating how internal and external factors influence the various business processes. Supply chain management and production control are separate functions controlled by different people, with one person at senior management level having oversight of both. The supply chain team looked after the purchasing, supplier management and new supplier engagement functions of the company. Whilst production control managed production and testing.



Research method

Primary data for the period in question was extracted from the company's ERP system that maintains detailed records of sales orders as well as goods receipts. A quantitative analytical approach was then taken to analyse the data based on the OTIF measure and potential interpretations of the measure.

The method used to generate the OTIF figure was reversed engineered for one problem supplier in order to determine how OTIF is being calculated. Through this process it should be possible to determine which variant of OTIF was used (if any). Furthermore it could highlight the conceptual errors in how OTIF is calculated.

Case study on OTIF

This study first of all examines whether OTIF has been calculated incorrectly and the ways in which this OTIF miscalculation may have occurred and the causes and implications. The method used to generate the OTIF figure was reversed engineered for one particular problem supplier in order to determine how OTIF was being calculated at the company. Over the period of the study the OTIF value used by the company for this supplier was 77% (73% if one special order line is included).

As a starting point several variations of OTIF that could be used were examined (as shown below). Eq.1 provides an On Time and In Full figure per order line; eq.2 provides a On Time (but not in full) figure per order line; eq. 3 provides an OTIF figure for the quantities ordered; eq.4 provides a On Time (but not in full) figure for the quantities ordered; eq. 6 provides an OTIF figure for the number of orders; eq.4 provides a On Time (but not in full) figure for the orders.

$$OTIF_{by\ line}\% = \left(\frac{Number\ Order\ Lines\ On\ Time\ in\ Full}{Total\ Number\ Order\ Lines}\right) \times 100 \qquad \text{eq. 1}$$

$$OT_{by\ line}\% = \left(\frac{Number\ Order\ Lines\ On\ Time\ in\ Full}{Total\ Number\ Order\ Lines}\right) \times 100 \qquad \text{eq. 2}$$

$$OTIF_{quantity}\% = \left(\frac{Number\ Items\ On\ Time\ in\ Full}{Total\ Number\ Items}\right) \times 100 \qquad \text{eq. 3}$$

$$OT_{quantity}\% = \left(\frac{Number\ Items\ On\ Time\ in\ Full}{Total\ Number\ Items}\right) \times 100 \qquad \text{eq. 4}$$

$$OTIF_{order}\% = \left(\frac{Number\ Orders\ On\ Time\ in\ Full}{Total\ Number\ Orders}\right) \times 100 \qquad \text{eq. 5}$$

$$OT_{order}\% = \left(\frac{Number\ Orders\ On\ Time}{Total\ Number\ Orders}\right) \times 100 \qquad \text{eq. 6}$$

OTIF variant	**OTIF value**
Excluding special order line	
OTIF by line	43%
OT by line	77%
OTIF by quantity	11%
OT by quantity	25%
OTIF by orders	27%
OT by orders	54%
Including special order line	
OTIF by line	41%
OT by line	73%
OTIF by quantity	11%
OT by quantity	25%
OTIF by orders	26%
OT by orders	52%

Table 1 OTIF calculations

The major implication of incorrect calculation is that the scale of the problem with the supplier will not fully realised and therefore addressed. Operationally it had been determined that the supplier in question is a problem yet the figures from the incorrectly calculated OTIF showed that whilst the supplier was far from perfect it couldn't be shown to be the sole cause (original OTIF was 77% / 73%). Taking the different interpretations of OTIF the figure could be as low as 11% (exacerbated by data entry issues and very high order quantities for consumables that are detailed in the section below) or with a very relaxed interpretation 77% or 73% calculated by the company. Using the standard by OTIF (by order line) calculation with allowance given for deliveries not processed until the next day 43% OTIF was achieved.

The method used is best described as On Time By Line. However, as the calculations have shown if On Time In Full By Line was used the supplier would have an OTIF figure of 43% which is reflected in by the challenges that manufacturing face. Even OTIF by order is

Examination of order data

Once the calculation spreadsheet became available it could be confirmed that indeed the method used was not a conventional OTIF measure listed above but rather a form of On Time was used. An example of this is the product item that we will call AAA002 for the purposes of this paper. There were two separate purchase orders, for one for 100 and one for 200. The order of 200 was received in-full and on-time, but of the 100 order only 51 had been received. Within the spreadsheet (pivot table) the two orders were combined and classified as being not being late. Within the strict implementation of OTIF this would be 50% OTIF (one line OTIF, one line on time but not in full).

With regards to the 25% On Time (but not in full) and 11% OTIF by unit quality this performance is particularly poor. It was discovered that this is primarily because of an issue with the entry of consumables orders into the ERP. Orders that should have been spread across multiple lines were in fact entered as one line with one due date. An example of this is that over 30,000 units of one consumable were placed on one order line with a single delivery due date. Although after discussions with the company it transpires that the order should have been split into multiple lines with differing due dates. This does highlight the need to ensure that data is correctly entered otherwise a supplier that has a very good OTIF figure could be incorrectly identified as underperforming in certain circumstances.

Key findings

An important finding of this case study was that the company benefited great deal from a flexible workforce and resources. Having a multi-skilled assembly team allowed the company work around shortages in component parts. So that sub-assemblies could be produced ready for integration into the finished product when the missing parts arrive. Not all companies have this luxury and production could easily grind to a halt because of shortages.

The main finding of this case study was that there were three ways incorrect OTIF calculations and order data entry errors could negatively impact a company and its supply chain.

Firstly, OTIF can misidentify problem suppliers, potentially hiding or even protecting them. In this study the problem supplier in reality had an OTIF of 43%, whilst the reported OTIF was 77% (73%). This can lead to problematic suppliers inadvertently being shielded, so that whilst their supposed OTIF is not as high as a company would like it appears to be better than it is. There is a risk that this could be utilised for more nefarious purposes in that a problematic suppliers real performance could be deliberately concealed, either to mask their own failures or those of a supplier they have favourable relationship with. Furthermore, errors in order entry can result in companies being mis-identified as having problems.

Secondly, it can create divisions and friction between parts of a company, this is especially true if one party believes the figure to be indicating something it is. For example, a production manager might complain that shortages of parts from a particular supplier cause production issues. A purchasing manager can produce when they might believe are OTIF figures that indicate that whilst the supplier was far from perfect it isn't the sole cause. It could take the intervention of a third person to overcome this problem.

Finally, these can result in time and resources into fixing the wrong things. This could involve increasing inventory levels, potentially placing more pressure on suppliers who are struggling. Attention could be

focused on resolving problems with the wrong suppliers, although improving supplier performance is beneficial for the company if it's not the correct company then performance will not improve.

Conclusions and Outcomes

The work highlights some potential causes of errors that can creep into OTIF calculations including the incorrect application of the OTIF and data entry issues within an ERP system. Showing just how large the discrepancy can be between implementations of what is termed OTIF. It needs to be clear for everyone what measure is being used, in this case OT was being applied instead of OTIF, and what the limitations are of this measure.

Furthermore, it highlights that when operations indicate that there might be a problem with a supplier then it is good practice to ensure metrics are being correctly applied as errors can hide the magnitude of the problem. This is especially true when analysis produced by the purchasing department contradicts this.

As a result of this study highlighting the problems associated with the OTIF measure that was being used the company, together with further work conducted within the company there have been several changes made to strategy. Supplier issues have been addressed in two ways. Firstly, through bringing new suppliers on board. Secondly, through dual sourcing where necessary / beneficial.

The changes made in procurement and suppliers have enabled the company to reduce it lead-times, which has allowed the company to grow and expand.

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