# COMPLEXITY IN HANDLING ORDERS OF SPARE PARTS

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## ABSTRACT
Spare parts supply, often associated with rush orders,is studied through a single case study of an advanced sanitary product supplier. This supply process is emergent. Difficulties of determining and dealing with root causes, unexpected effects, and interventive solutions for rush orders are discussed. This provides conceptual foundation for considering complex systems thinking to handle rush orders.

**Keywords**: rush orders, spare parts supply, networking, customer services, complex systems.

## 1. INTRODUCTION

Wang and Chen (2008) provide a systemic framework from a single-firm perspective, and apply a neo-fuzzy-based forecasting approach that describes how to manage rush orders by pointing out various causes and corresponding methods, including: implicit customer priority; concern for extra returns, outlays, and usuries; special orders authorised by higher-ups; and production disturbances. This time constraint classification indicates that from the viewpoint of the focal firm managing downstream logistics to its customers, rush orders are not limited to technical discrepancies, and may also be caused by marketing or managerial factors, for instance. Wang and Chen (2008) also describe three methods for use in solving the rush-order problem: (i) improvement in forecast accuracy; (ii) approaches to better receive and handle rush orders; and (iii) a mechanism to increase reserve capacity for queuing requests. Since uncertainty is one of the prime features of customer relationships, forecasting systems are limited in terms of detecting emerging issues related to both supply demand and its technical provision, although they provide valuable management indicators for directing supply-related activities. Wang and Chen's (2008) approach is deterministic, applying a single-firm focus rather than a complex, networking-sensitive approach. This study attempts to understand supply-process coordination as a complex system embedded in supply-chain management (SCM) thinking (Cooper et al, 1997, Mentzer et al, 2001). This implies a fundamental view of rush orders as both an inter- and an intra- organisational problem. In addition, this study ultimately seeks to consider how such rush orders must be treated as a complex phenomenon in this SCM context. When viewed as a complex entity, a "supply chain" conceptually implies the view that management is more preoccupied with achieving connectivity and capacity for adaptation rather than weaning the organisation away from the perceived managerial threat of rush-order problems, in a deterministic fashion. Following Rzevski and Skobelev's (2014) understanding of complex systems, the organisational challenge is to develop the sensitivity of emerging processes so as to better navigate the complexity of supply chain networks. The empirical findings of this study include a description of the industrial network of a high-tech sanitation product supplier. Its customers are mainly industrial, with its products mainly found on ships, aeroplanes and trains, but to a limited extent, it also supplies products to individual consumers in locations that have limited access to plumbing. This supplier receives rush orders, making it the focal firm in this single-case study. The following three issues are covered from the perspective of this firm, in order to empirically ground the way in which rush orders are handled by the firm's customer services department:

- *How do rush orders occur?*
- *What impacts do they have?*
- *What could be done to improve the current situation?*

Together, these research issues contribute to collect data and thus describe the as-is situation of the firm, focusing on the relationships it has with the customers generating the rush orders. However, this does not exclude the potential for interactions with its own suppliers to solve the rush order problem. In addition to answering these questions, this study seeks to highlight the potential of complex systems thinking as a solution to organising rush orders at this firm.

## 2. CONCEPTUAL FRAMEWORK

Six factor are studied as part of the conceptual framework providing basis for analysis:

1. **Rush orders characterisitcs:** These are special and urgent orders with limited research carried out (Yao & Liu, 2009; Trzyna et al, 2012).
2. **Customer services and planning:** Rush orders are handled by the supplier, and outbound logistics challeng also realted to a firm's marketing effort (Gourdin, 2006; Chopra & Meindl, 2010; Wang & Chen, 2008; Svensson & Barfod, 2002) Rush orders are normally handled by the customer service function of a firm. Customer
3. **Organising in uncertainty:** Uncertainty is a key feature of the logistics of rush orders. In this setting prioritising rush orders flow is vital. Furthermore, handling rush orders is associated with organizational anxiety (Plossl, 1973; Angkiriwang et al, 2014; Yao & Lin, 2009; Chen, 2010; Kim & Duffie,2004; Ehteshami et al, 1992).
4. **Documentation and the customer voice on product criticality:** Rush orders are associated with both process criticality and control criticality. Customer voice appears in reciprocally interdependent relationships characterised by intensive exchange involving mutual adjustments. Huiskonen (2001), Yan-Hai et al. (2005) Thompson (1967) (Hammervoll, 2014).
5. **Networking to prioritise resource use:** Postponement, information sharing with downstream partners such as retailers, enhanced information and communication technology use, and strategic buffer stocks characterise the planning of rush order flows Simangunsong et al. (2011). Securing capacity, developing organisational resources, balancing needs of in-stock with make-to-order goods, and developing a simple classification of the spare parts are modes of do spare parts logistics (Davis, 1993; Wang & Chen, 2008; Tryzna et al, 2012; Yan-Hai et al, 2005; Fortuin & Martin, 1999, Huiskonen, 2001).
6. **Complexity and research issue:** From a process viewpoint, complexity is defined as "[a] property of an open system that consists of a large number of diverse, partially autonomous, richly interconnected components, often called agents, has no centralised control and whose behaviour emerges from the intricate interaction of agents and is therefore uncertain

without being random" (Rzevski & Skobelev, 2014, p.5).The degree of product complexity affects how the goods to be supplied are technically produced. This also involves features oi interaction in relationships. Closs et al. (2008) Blackenfelt (2001) Svensson and Barfod (2002),

## 3. DISCUSSION

### 3.1 The causes of rush orders

It is almost impossible to plan for rush orders, which makes it difficult to predict the time thresholds and how they will affect normal operations. They are embedded in a network of reciprocally interdependent relationships. The supplier has many customers, and in the same way, the customers have many suppliers and many varying facilities demanding the spare parts. This is not a simple linear planning problem, especially given that the need for spare parts emerges suddenly and without warning. It is difficult to envision any form of planning that would rule out the necessity of the supplier managing these supplies in an efficient and effective way. Rush orders represent the everyday reality of production in the case study company. The company in the case example has no clear concept of rush orders, and has not classified what defines a rush order; it is simply a service they provide to their customers. Customers have the fullest understanding of the causes of rush orders, as described in the customer interviews. Many of the incoming rush orders were a direct consequence of their dealers and representatives failing to keep stock of the most important parts, which could help to reduce the demand uncertainty. In 2016, approximately 8% of the orders received by the supplier were rush orders, which disturb the normal production process and can cause delays.

### 3.2 Effects of rush orders

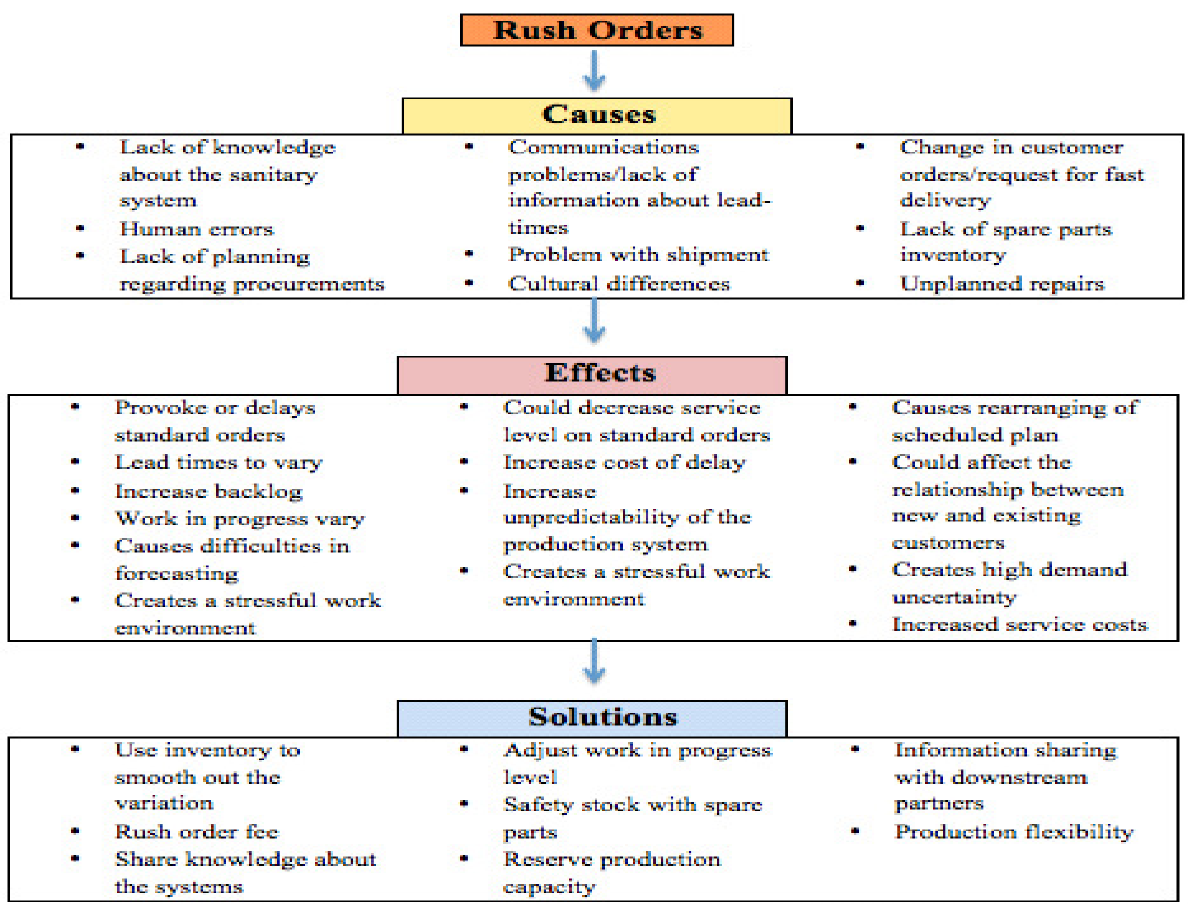
Regarding the service provided to customers, the supplier has no clear set of standards to explicitly define the service level they are providing to their customers. Their customers set the service level in terms of customer requirements, but by heeding these customer requirements, the supplier sets the ideal service level at 100%. This is clearly more a motivating aim than a realistic practicality. It also seems that the supplier has not been able to handle the transition to being an innovator in the sanitary system market, and has gone from only a few customers to possibly now too many. Providing excellent service to a few customers is manageable, but complexity increases as the supply system grows, rendering it increasingly difficult to plan and manage in accordance with pre-set supply processes. Parts may be needed within a very short timeframe so as not to delay the overall building process of a cabin, for example. This is also the case in shipbuilding, where The supplies must be coordinated with the overall construction process. If the supplier does not plan adequately, this can lead to the creation of rush orders. In this case, the communication between the supplier and their customers was good, with a sufficient degree of established trust, and the transactions described here are recurring encounters. However, there were sometimes problems with communication, which could cause rush orders based on a form of misunderstanding rather than a lack of formal documentation.

### 3.3 Solutions to rush orders

Eliminating all rush orders from occurring is not likely to be realistic for this supplier, and some of the effects of rush orders are difficult to solve. However, we propose some solutions to lower the number of rush orders and handle them in a way that can ease their adverse effects. Our empirical findings show that some solutions were already in place, but that there was also the potential to find more. The retailers and foreign representatives also provided some solutions. Our findings show that inventories of finished products/systems are organisationally challenging, due to the variation in orders and the lack of standardisation. The resources are only weakly integrated, and are therefore difficult to pool. Some finished products are available in the land and transportation segment, but there is great variation in the ship and offshore segment. Solutions for coping with demand uncertainty include postponement, information sharing, buffer stocks, and lead-time management. Postponement involves accepting delays, which would mean negotiating with the customer to accept waiting for an order that may be critical by an agreed-upon time. Variation in demand is uncertain, meaning that it is difficult to predict rendering and planning. It is possible to hold extra inventory (buffering) in order to keep rush orders under control; since the supplier does not know when unexpected repairs will be necessary, buffer stocks would safeguard against a meltdown in the system. Customers also experience intermediaries, so demand is volatile and often unexpected. Lead-time management could help in handling the level of uncertainty by allowing the representatives and dealers to create a space between the actual time it takes and what their customer knows. This would help the supplier to handle rush orders within a reasonable time. Lead-time management means using flexible organisational and technical resources to cut down the time of delivery of unplanned orders.

## 4. CONCEPTUAL MODEL

**Figure 1**. Causes, effects, and solutions related to rush orders.



The model presents an array of solutions mentioned both in the literature and by the informants. This study has not considered the degree to which the solutions are coordinated efforts, and whether this set of policies contains procedures that may conflict with each other. The literature review involved a search for how a complex, systems-based form of thinking may help in organising the efficient and effective handling of rush orders. The main statement made here is that complexity represents a higher level of analytical abstraction. These solutions are a complex phenomenon and can therefore be modelled using agent-based rules applied at a micro-process level. "Complexity" itself is not the major problem; our understanding that complexity is the prime characteristic of the handling of rush orders by the studied networks directs attention to the design of managerial procedures to cope with rush orders as emergent processes, from the moment the demand is incurred until the customer's problem is solved. Based on the empirical findings from this single case study, we suggest that one solution for effectively and efficiently handling rush orders would entail designing this form of exchange and supply as a complex system.

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