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Proposed a Method for Increasing the Delivery Performance in Dynamic Supply Network

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Abstract**—**Supply network management adopts a systematic and integrative approach to managing the operations and relationships of various parties in a supply network. The objective of the manufactures in their supply network is to reduce inventory costs and increase customer satisfaction levels. One way of doing that is to synchronize delivery performance. A supply network can be described by nodes representing the companies and the links (relationships) between these nodes. Uncertainty in delivery time depends on type of network relationship between suppliers. The problem is to understand how the individual uncertainties influence the total uncertainty of the network and identify those parts of the network, which has the highest potential for improving the total delivery time uncertainty.

Keywords**—**Delivery time uncertainty, Distribution function, Statistical method, Supply Network.

I. Introduction

TODAY, companies are persuaded to collaborate with each other in a collaborative manner. Isolated companies may not be competitive any more in the current business environment. They may configure several types of networks in order to become successful and keep survival in the market.

Starting by supply chains companies have established their primary format of working together to achieve a unique target. This target has been preferably the profitability of the original equipment manufacturer (OEM). In order to achieve the competitive benefits for more shares from the transmit market; the manufactures have to work in flexible form of networks with their suppliers and customers.

A Supply Network (SN) can be viewed as a network of facilities in which customer orders flow through various business processes, such as procurement, supply, and production. Ultimately, it achieves the target of delivering the right products to the right customers at the right quality on time. In other words, Supply network adopts a systematic and integrative approach to managing the operations and relationships of the various parties in a supply network. One of the objectives of SN planning is to reduce inventory costs and increase the customer satisfaction levels.

A supply network consists of a specific number of suppliers and a manufacturer which represent nodes in a network. Hence, SNs interconnect companies such as suppliers, and a manufacturer to produce and sell desired products to customers.

One of the important goals of supply network coordination is to synchronize all processes to improve delivery performance. Thus, appropriate modeling and analysis techniques are important aspects of improving supply networks. For example, accurate supply network lead time and order-to-delivery time are important.

In this paper introduced a method for increasing the delivery performance with decreasing the uncertainty in delivery time.

II. Literature review

Modern markets are competitive business environments where customers require their suppliers to be dependable in delivering on-time. One of the important goals of supply network is to improve delivery performance [2, 15]. Results from recently published empirical studies have identified delivery performance as a key management concern among supply network practitioners (see for example [8, 14]). A conceptual framework for defining delivery performance in supply network is found in Gunasekaran et al. in 2001. This suggested framework classifies delivery performance as a strategic level supply network performance measure while delivery reliability is viewed as a tactical level supply network performance measure. The framework of Gunasekaran [7, 11] also advocates that to be effective, supply network management tools, delivery performance and delivery reliability need to be measured in financial (as well as non-financial) terms.

The failure to financially quantify delivery performance in a supply network presents both short-term and long-term difficulties. In the short term, the buyer–supplier relationship may be negatively impacted. A norm value of ‘‘presumed’’ performance is established by default when delivery performance is not formally measured [10]. This norm value stays constant with time and is generally higher than the

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organization's actual delivery performance.

It has been demonstrated that supplier evaluation systems have a positive impact on the buyer–supplier relationships, with these relationships ultimately have a positive impact on financial performance [1]. In the long term, failure to measure supplier delivery performance in financial terms may impede the capital budgeting process, which is necessary in order to support the improvement of supplier operations within a supply network.

Delivery time is defined to be the elapsed time from the receipt of an order by the originating supplier in the supply network to the receipt of the product ordered by the final customer in the supply network. Delivery time is composed of a series of internal (manufacturing and processing) times at each stage plus the external (distribution and transportation) times found at various stages of the supply network [6].

Early and late deliveries introduce waste in the form of excess cost into the supply network; early deliveries contribute to excess inventory holding costs, while late deliveries may contribute to production stoppages costs, lost sales and loss of goodwill. To protect against untimely deliveries, supply network managers often inflate in process inventory levels and production flow buffers. These actions can contribute to excess operating and administrative costs [5, 16].

An extensive review of available delivery evaluation models by Guiffrida (1999) identified several shortcomings in modeling delivery performance. These concerns are threefold. First, delivery performance measures are not cost-based. Second, delivery performance measures ignore variability. Third, delivery performance measures often fail to take into account the penalties associated with both early and late deliveries. The inability to translate delivery performance into financial terms which incorporates uncertainty as well as realistically quantifying delivery timeliness (early as well as late delivery) hinders management's ability to justify capital investment for continuous improvement programs, which are designed to improve delivery performance.

III. Problem and Methodology

Today, value chains within the manufacturing in industry are implemented in supply networks. In general, a supply network is considered as the cooperation between suppliers and a manufacturer with the objective to realize a product. In those industries, where batch sizes are high (series production), the supply networks usually are stable in terms of involved companies and the related processes. Under stable conditions, the planning and controlling of the processes to reach reliable deliveries is based on experience and continuous improvement [4].

Due to the fact that market opportunities are more and more short term and customer expectations are dynamic, supply networks in many cases need to be designed, according to a specific market opportunity. In consequence, the configuration of supply networks becomes dynamic. The objective of these dynamic supply networks is to realize individual demands in a reliable way with short reaction times to the market need. In comparison to stable supply networks, the planning and controlling of the processes can't be based on its history. To ensure reliable deliveries of a supply network, a method to identify and to control potential uncertainties regarding the delivery is needed. An important issue to reach reliable deliveries is the consideration of delivery time uncertainties due to the fact that a predictable reaction time is a main success factor in the global competition.

Agility and accuracy in delivery time, product final cost and quality are the fundamental characteristics of competitiveness. The enterprises have to be able to provide consumer demand just in time, with desired quality and reasonable price [13].

Backlogs, delay in demand delivery, demurrages and product total prices increase as a result of higher uncertainty in delivery time. The way that enterprises interact with their supply network partners and type of relations has a large impact on uncertainty in delivery time. Design and organizing appropriate relations in the network in order to reduction of delivery time uncertainty can be assessed from the position of the network configuration that has to identify and build utilitarian relations in the network.

In the past, supply networks were stable. Estimations about delivery time could be based on experience due to the fact that stable supply network have a long history. In dynamic networks, this experience is not available, which means that a new approach to estimate uncertainties is needed. The development of an approach to estimate the delivery time uncertainty in dynamic supply networks is the purpose of the proposed research [3].

Delivery time uncertainty within a supply network can be understood as the ability of the network to guarantee a certain percentage of deliveries within a defined time frame. In Fig. 1, the delivery uncertainty is presented in a qualitative way.

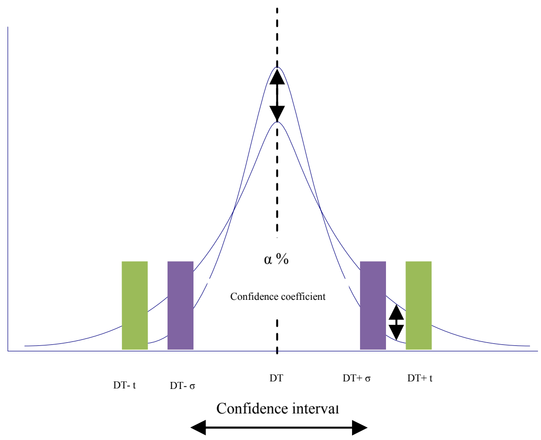

Fig. 1 Delivery time uncertainty

The curves show the relationship between the actual delivery times (horizontal axis) and the percentage of deliveries which have been shipped on these dates (vertical axis). The initially planned delivery time is defined as DT. From a mathematical perspective, the curves can be described by two parameters which are presented in Fig. 2.

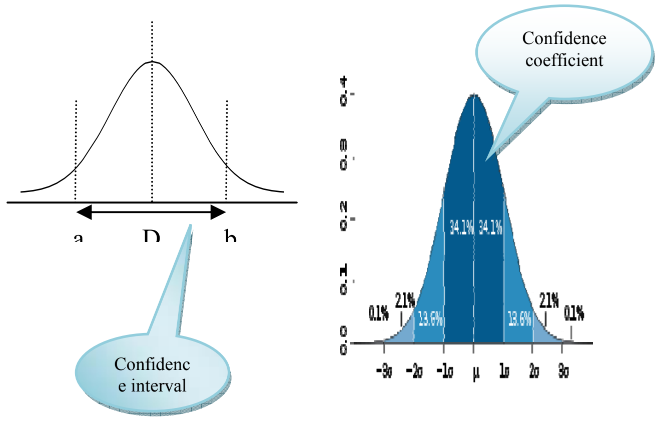

Fig. 2 Confidence coefficient and confidence interval in a distribution curve [9]

The confidence interval on the left side of the figure introduces the confidence interval which is the time frame; a supply network is able to deliver a certain percentage of orders. The confidence coefficient introduced on the right side of the figure represents the percentage of orders which are delivered within the confidence interval. In consequence, the delivery time uncertainty can be defined as the combination of the confidence interval with the related confidence coefficient.

The time related objective of planning and controlling strategies in supply networks is to reach a low level of delivery time uncertainty of the entire network - in other words, to reach a low confidence interval in combination with a high confidence coefficient.

The delivery time uncertainty of a supply network is caused by the individual delivery time uncertainties of the members of the network. To be able to estimate the delivery time uncertainty of the entire supply network, the impact of these individual uncertainties on the total uncertainty level has to be understood. The way how the individual uncertainties need to be accumulated depends on the network type.

Formally, a supply network can be described by nodes representing the companies and the links (relationships) between these nodes. From this perspective, a network type is defined as the structure how the different nodes are linked with each other. Figure 3 depicts the possible basic types of a network [12]. Generalized networks can be described as a combination of these basic types.

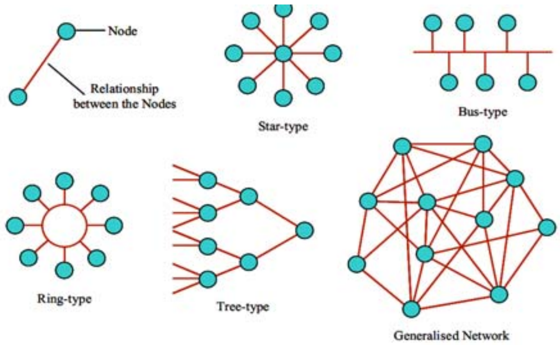

Fig. 3 Basic network types [12]

The proposed method tries to identify how the individual delivery time uncertainties of the members in a supply network need to be accumulated to the total delivery time uncertainty for different network types.

Considering the description given, uncertainty in delivery time depends on type of network relationship between suppliers. The manufacturer may evaluate the individual delivery time uncertainties of each single constituent (supplier); the problem is to understand how the individual uncertainties influence the total uncertainty of the network. The knowledge about the interdependency between a network type and the accumulation of the individual uncertainties is important to identify those parts of the network, which has the highest potential for improving the total delivery time uncertainty.

The suggested methodology and procedure is based on the following steps. First, the causes and effects of “time uncertainty” in each supply networks will be studied. Second, introducing the distribution functions definitions, interval confidence and confidence coefficient of delivery time for each supplier of the network, with paying attention to the past information. Third, identify the shape of curve for each statistical distribution functions of each supplier in supply network. With choose of different types of relationships between suppliers and manufacture find the best type of relationships for the supply network with pay attention to sensitive analysis on delivery time.

IV. Conclusion

The objective of this paper was to introduce a methodology to reduce the delivery time uncertainty of supply networks considering different types of networks. Superposition rules for the different basic network types will enable an estimation of the delivery time uncertainty also for more general network types. To achieve this objective, the following aspects should be solved:

1. Identification of effects of each node in a supply network on the final uncertainty in delivery time dependent on the network type.
2. Identification and mathematical description of typical statistical distributions of delivery time of each supplier
3. Calculation of the interval confidence and

confidence coefficient for delivery time uncertainty for each supplier in network (local uncertainty) and its accumulation to the total uncertainty level

The further contribution of the study was the development of a methodology to identify those parts of a network where local improvements have the largest effect on the total uncertainty level.

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