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SOME APPROACHES FOR SHARING LOGISTICS INFORMATION FROM MANUFACTURING ENTERPRISES WITH DOWNSTREAM SUPPLY CHAIN PARTNERS

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Dedicated to
the 50th anniversary of Department of Informatics
at University of Economics—Varna

Abstract. Manufacturing enterprises sometimes cannot accept orders from corporate customers because their manufacturing capacity is busy. To solve this problem, this article proposes some approaches for information sharing with downstream partners of supply chains. The main approach is sending an XML file with free capacity by days from a manufacturing enterprise to its corporate customers. In this case corporate customers who send orders to the manufacturer are sure that their orders will be accepted and carried out. The practical implication of the proposed method is for manufacturing enterprises who have a lot of orders and sometimes reject some of the orders due to the lack of free manufacturing capacity.

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1. Introduction. Description of the problem. In terms of logistical information, the spark of information sharing does not come from the entity that provides the information but from the enterprise that needs logistical information. For example, employees of a supermarket (e. g., corporate customer – who make corporate orders to manufacture enterprises – producers) may be interested and find appropriate producers of bituminous roof tiles, to test the products of the manufacturer and to choose producers who produce bituminous roof tiles with best quality. Before the onset of the summer season, the employees of the supermarket can send requests and orders to the manufacturers of bituminous roof tiles. In the best case, manufacturers execute orders, if the production capacity is free. But in some cases, a producer may have accepted a lot of orders and his manufacturing capacity is full. In this case, the producer cannot accept more orders. In other cases, the manufacturing capacity is not full, but it is occupied to a high level, so a small order may be accepted. In this case if a corporate customer orders a big amount, his order will be rejected. All mentioned features indicate that the planning of production in the short term (in order to cover critical points in demand) is almost impossible, when the manufacturing capacity is full (or almost full) and there are more orders from corporate customers (downstream partners of supply chains).

2. Literature review. Problems with integration in supply chains are mainly connected with poor integration performance [26]. System simulations are done but usually they cannot simulate real supply chains. Moreover, horizontal information sharing between retailers is almost impossible, because they are competitors. Automatic data collection is raised as an idea, but only on a conceptual level – without technological solution of realizing it. Taylor says that retailers need to have trust among them in order to share logistics information. The acquisition of Taylor does not really solve our problem.

Some publications [19, 30] focus on the benefits of information sharing in supply chains. But these publications do not give technological solution to the problem, described in part one of this article. Such publications sometimes are questionnaire-based studies on the problems of information sharing in supply chains. Such publications may mark problems but cannot solve them.

Other publications focus on the type of information to be shared and information asymmetry between a manufacturer and a retailer. For instance [29, 10] focus on specific information to be shared between a manufacturer and a retailer concerning the after-sale process. Such publications offer abstract description of the shared information but do not offer standards for sending it in structured way and they do not give technological solutions.

Some authors [11] discuss more complex problems information sharing in a supply chain with multiple producers – distributor relationships. They note that information about product capacity should be shared. Their conclusions concern the structure and type of information shared among several manufacturers (producers). The coordination in a decentralized supply chain is quite difficult.

Bilateral information in several supply chains [27] is a discussed topic connected with the discussed problem in part one of this paper. The cited authors assume that the shared information in supply chains depends on the accuracy of manufacturer's or retailer's forecast. These authors are quite near to the technological solution offered in this paper. Optimal pricing strategies is stated as another factor for increase or decrease in sharing information.

B2B communication in supply chains [3, 17, 7] is offered as one of the solutions of the problem. B2B is often connected with e-commerce and not so much cases studies concerning B2B communication between a manufacturer and retailers.

VMI (Vendor Management Inventory) is a notation giving a conceptual solution of the problem [18]. But it is just a concept without a software realization.

Information system integration [28, 1] is stated as one of the main IT problems connected directly with information sharing in supply chains. The cited authors discuss the dimensions of supply chain capability and organizational capability. All cited authors mark the problem (that we have pointed out in the introduction). Authors try to find dependencies but do not give technological solution to the problem.

EDI, EDIFACT, API functions are given as the most popular ICT which help supply chain integration [2]. Logistics institutes are organization which try to find the solutions to the problem. But in most cases the impulse is from corporate customers which try to find solution of the problem and ask software companies or logistics institutes to have an adequate solution.

Supply chain integration and ERP systems is another interdisciplinary topic discussed by many authors recently [6, 5, 4]. Supply chain integration (SCI) is a term usually connected with "creating value", "company performance", "customer integration", "performance" and "benefits". SCI and IT is a multidisciplinary area that is not widely discussed in literature. Publications dedicated on SCI and "information technology" [14, 12, 20, 8, 13] usually discuss topics concerning benefits, financing sources, logistics capabilities. All theoretically oriented publications focus on: (1) vendor management, (2) demand forecasting, (3) inventory management and (4) order fulfilment. That is why we try to give in this article a technological solution to the stated problem in the introduction of the paper.

3. Technological solution—sharing information through XML files. In order to assist joint logistics, the supermarket (the corporate customer) may require production capacity information from the production plant (number of sheets bituminous roof tiles which can be produced in one day) and a calendar schedule for the planned production by day, according to the orders made by customers (Fig. 1).

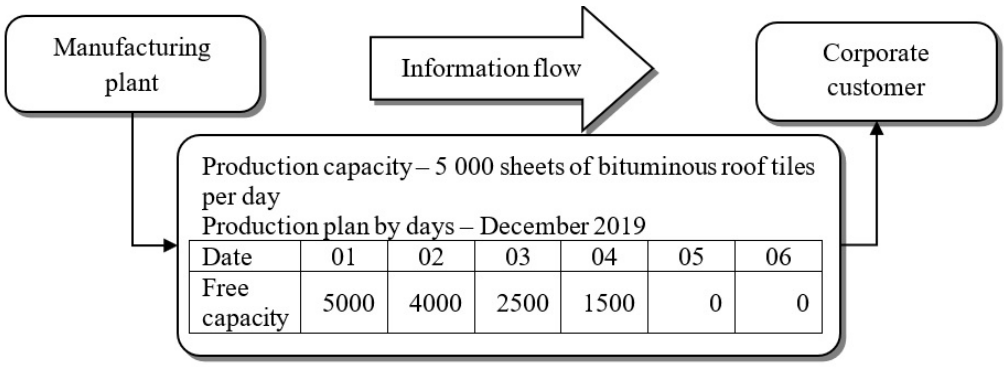

Fig. 1. Information flow between a manufacturing enterprise and a corporate customer

In the presence of such information, shared by the manufacturing company with the supermarket (at the request of the supermarket), the supermarket can decide whether to send an order to the manufacturer or not to send an order at all, to wait for an answer that will certainly be negative (due to the fact that the manufacturing facilities are insufficient or occupied). Fig. 1 shows that on 05.12.2019 and 06.12.2019 the manufacturing enterprise cannot accept requests, since its manufacturing facilities are busy. This paper proposes the following approach. One of the possible approaches to communication is by providing an XML file from the dealer's manufacturer.

The XML file structure is presented in Fig. 2. The XML file can be sent daily by the manufacturer to the supermarket (the merchant). A possible approach for information sharing is presented. Other known approaches to implement the communication are: (1) using the SOAP Protocol, (2) web services [21] and (3) communication by port.

The usefulness of sharing information is for both partners in supply chain. The manufacturer receives orders that are fulfilled. The trader sends an order which is accepted by the manufacturer (it is not rejected due to reserved manufacturing capacity for other orders). The salesperson waits for an answer whether the order will be executed. The probability of being executed is greater because

```
<?Xml Version="1.0" Encoding="Cyrillic-1251"? >
<Enterprise Capacity="5000">
</Enterprise>
<Plan Item=green bituminous roof tiles sheet">
<day1>01.12.2019</day1>
<free1>5000</free1>
<day2> 02.12.2019</day2>
<free2> 4000 </free2>
<day3> 03.12.2019</day3>
<free3> 2500 </free3>
<day4> 04.12.2019</day4>
<free4> 1500 </free4>
<day5> 05.12.2019</day5>
<free5> 0 </free5>
<day6> 06.12.2019</day6>
<free6> 0 </free6>
</Plan>
</Xml>
```

Fig. 2. XML file structure that is being prepared by the manufacturer and sent to the merchant

the trader has up-to-date information on production capacity and free production capacity. The investments for the manufacturer and the trader are in terms of expansion of the used software (the ERP system of the manufacturer and the ERP system of the customer). The functionality of the software application is extended, data could be extracted, transformed and loaded to databases in use [9]. According to some authors, such investments are an important factor for the application of the implemented software [22]. There are benefits for both customers and suppliers of the integrated relationship between them, namely: cost reductions, improving the effectiveness of actions, strengthening confidence among countries, adding value [15]. The process of generating an XML file from an ERP system requires minimal effort of system designers and programmers.

The process of reading an XML file from an ERP system takes more resources (time and people work) because an input filter is required (an analyzer for the correctness of the entered data in the XML file). After the initial validation of the XML file is checked, the data is used by the merchant. Again, we have several options: (1) examining the file manually and making a decision, (2) automated input of the data from the XML file into the trader's information system and

the removal of advice and (3) automatic transfer of data from the XML file (between trader and the manufacturer) without human participation. The first two options require a lot of manual work. We recommend the third option, because the "reading" of a received XML file can be done automatically.

We recommend the steps of the whole process of data exchange to be the following:

1. automatically generating an XML document with free capacity from the manufacturer (from the ERP system of the manufacturer),

2. automatically sending the XML document (from the ERP system of the manufacturer) to the merchant (or to multiple corporate customers),

3. automatically accepting data (within the ERP system of the merchant or corporate customer) from the XML document.

Steps 1) and 2) are repeated when new orders are accepted.

The sharing of order information (between the ordering and the organisation accepting orders) is a prerequisite for the execution of transactions between the two parties. As noted, in the e-commerce systems, where core business activities are carried out through dynamic online systems [24], an order from a customer to a supplier is entered the provider's web page. The supplier can provide the order to the customer as an electronic document.

Based on the research we offer in the area of e-logistics to share aggregated information about free production capacity by day. It is calculated by the formula:

$$\text{FPCD} = \text{TPC} - \text{COO}$$

FPCD—Free production capacity by day
TPC—Total production capacity by days
COO—Capacity occupied by orders

In addition, business processes and software systems in organizations in terms of participation, motivation and engagement of their users are improved [23]. Under the current conditions, when firms compete, betting on their supply chains, the task of managing managers is to strive for a complete synchronization in the work of customers and suppliers. Integration of business processes in the chain is a key factor in the development of successful supply chains [15]. The proposed method is also important for the company's marketing because it helps the management of customer relationships in order to keep current customers and to gain new ones with low-cost and on-time deliveries [25]. Under these conditions, one of the

main possible factors for competitiveness not only for companies but also for their supply chains is the relationship with the company's suppliers [16].

4. Conclusions. By applying the proposed innovative approach, additional information is provided in the supply chain, which allows better logistic and supply chain participation. Traditionally, the supply chain participants issue invoices. The issued invoices generate transactions both with the supplier of the product/service and the customer. In order to fulfil off-line data transmission, most often the invoices are structured as an electronic document in an approved standard and then they are sent to the client (electronically).

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