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Research on IT Tools Used in Flow Planning in Supply Chains

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The processes of globalization and increased competitiveness resulted in the fact that companies have begun to look for solutions and strategies that give opportunities for development and further market expansion. The intensification of competition on the global scale in the 1980s, forced companies to offer low cost, high quality and robust products with greater design flexibility. Various management concepts have been used to improve production efficiency and speed up the cycle. In the 1990s, many manufacturers and service providers began to focus on improving collaboration with suppliers and improving purchasing and supply management. Initially the cooperation was mainly developed in the area of purchasing policies and supply management in factories, but as time went on, it became increasingly popular among wholesalers and retailers who also decided to integrate their transport and logistics functions in a supply chain with a view to gain competitive advantage (Choon T.). The increase in customer requirements with the same pressures to reduce costs and accelerate time service delivery resulted in the growing importance of planning and anticipation of future events. The increasing amount of data makes management depended on systems that allow for rapid decision-making. Apart from ERP systems, which mainly support the management of individual businesses, more and more companies invest in APS systems (Advanced Planning System), which provide better support in planning processes throughout the supply chain. The aim of the article is to present the idea of advanced supply chain planning, constraints and challenges facing the managing the flow of products and information. The study also addressed the role of Advanced Planning Systems in supply chain management and identify main problems and obstacles that users and decision makers come across while implementing and using IT systems

Keywords: supply chain, logistics, Advanced Planning System

1. INTRODUCTION

Recently, supply chain planning has become one of the most challenging aspects of companies operations. The essence of planning changes from management of individual operations, specific for a given company, into a holistic vision of products flow, in which suppliers, production plants and customers are all part of an integrated network.

Globalization processes and increase in competitiveness forced companies to search for solutions and strategies which allow them to develop and give them opportunities for further market expansion. The complexity of offered products, cost cuts, and increase in customers' expectations encouraged enterprises to start cooperating with one another. The aim of this cooperation is constant improvement of product flow processes, optimization of stocks in distribution channels, and rise in product availability. Companies started to connect and create more or less formalized networks called, in studies, supply chains. Along with the attempt to raise the effectiveness of products flow among different participants of a supply chain, integrated planning concept, which can span across the wholelogistic chain, has been given greater recognition. The idea of this concept can be summarized by three objectives (Witkowski J., 2003):

- An attempt to minimize costs of information and products flow, at the same time maintaining a high quality of supply service, required by customers.
- An attempt to ensure the shortest time of order completion and the highest possible delivery reliability, frequency and flexibility of deliveries, concerning a set level of costs flow.

- An attempt to optimize stock level in a supply chain along with a flexible adjustment to preferences of delivery service required by different market' segments.

The main goals of this paper are:

- To show some key approaches, described in source literature, to planning processes in a supply chain.
- To present some IT tools supporting planning processes, and specifically APS.
- To identify the main problems and obstacles that users and decision makers come across while implementing and using IT systems.

This paper is divided into two main parts. In the first theoretical part, the author analyses source literature on supply chain planning and IT systems implementation. The second – research part points out to some problems while using and implementing planning systems.

2. PLANNING IN A SUPPLY CHAIN

In a source literature, which brings up the subject of planning in a supply chain, there are several research streams described.

Table 1. Main areas of Supply Chain Planning in Literature

MAIN AREAS OF SUPPLY CHAIN PLANNING IN LITERATURE	REFERENCES
Logistic network configuration	[26], [37], [23],
Cooperation	[3], [5], [6], [7], [8], [9], [14], [15], [33], [36], [42],
Planning horizon	[22], [26], [32], [40],
Forecasting, S&OP	[1], [7], [17], [24], [27], [28], [31], [41], [44],
IT systems in SCP	[4], [11], [13], [19], [20], [21], [25], [30], [38], [39]
Optimizations, Scheduling	[2], [10], [18], [29], [34], [35],

Source: own elaboration

Bozard C. and Handfield R. B. (2007) recognize common plans and possibility to operate according to the accepted rules as one of the main elements facilitating cooperation among different entities. Cooperative planning, data exchange, sharing resources, cost sharing and profits distribution represent the best form of business relations called strategic partnership or collaboration.

Cooper and Ellram (1993) describe the role that planning should have in a supply chain, including: stock management in the whole channel, chain costs effectiveness, exchange of information and operation' monitoring, coordination, short- and long-term goals, relations with suppliers, division of risk and profits.

Flows coordination requires plans adjustment made by different members of a supply chain and including a level of planning hierarchy. Planning, according to the authors, is an action oriented to choose a scheme of procedures, sequence and assessment of further actions for a decision-making unit (e.g. company, supply chain).

Frazelle E. D. (2002) suggests that a supply chain management should not have a form of imposing the rules of supply chain operations on other entities. Instead, all participants should cooperate in operations planning, so that product flow could be as "fluent" as possible

Reutterer i Kotzab (2000) stress the importance of logistic network configuration which can give a competitive advantage. They point out that a proper configuration of a supply chain allows to obtain good efficiency of processes.

Christopher M. (2011) describes the role of planning in terms of demand forecasting and management. In the past "demand" was treated as a value that a company must react to. One could only prepare future sale by looking at better or worse forecasts. Today, companies that are best managed are more proactive. Business operations of a company, which can have an influence on sales, are recognized, e.g. launching new products, advertising campaigns, sales promotion. One can deal with market instability by appropriate supply chain planning. Demand management is a notion,

which was used to describe different tools and procedures which allow to control supply and demand more effectively, and to understand reasons for demand changeability. Demand planning is an explanation of cause of a real market demand. It can also ensure us that products can be made available at a proper time and place. Today, a lot of companies decided on a formal approach to demand management and planning, known as the procedure of sales and operations planning (S&OP). (Tuomikangas N., Kaipia R., 2014; Laurent L., Alpan G., Penz B., 2014; Mansfield, A., 2012; McCall, A., 2013).

Fiedler G. (2003) points out that nowadays planning in a supply chain is a cooperation on different levels. He presents a concept of CPFR (Fiedler G., 2003; Ali M., Babai J., 2017) which stands for collaboration, planning, forecasting and replenishing. This approach is based on partnership and management of company's resources in a supply chain. The idea is based on a known VMI procedure, in which a supplier, not a customer, plans and manages customer's product flow. CPFR's main idea is to create agreed frames concerning the way of information sharing between partners, and a manner of decision making regarding replenishment(Revilla E., Knoppen D., 2015). The key element of CPFR is generating a common forecast, which is agreed and signed by both suppliers and customers.

Lambiase A., Mastrocinque E. and Miranda S. (2013) stress the importance of the fact that every planning process in a supply chain has to take into an account a planning horizon. Manzini, R., Bindi, F. (2009), Ahumada, O., Villalobos, J.R. (2009) divide planning processes into three groups, according to the horizon:

- Strategic planning: this level is related to a long-term time horizon (3-5 years) and is oriented to identify strategic decisions concerning production and to define an optimal network configuration of a supply chain. It also encompasses decisions connected with planning, which include vertical integration, choice of size, purchasing and location of facilities, choice of production technologies, assignment and transfer of production, pricing policy.
- Tactic planning: this level is related to a period of 1-2 years, and its main aim is to fulfil demand and to manage materials flow in a mid-period horizon. It includes coordination of a supply chain, transport policy, methods of stock management and reduction (lead time) of supply chain processes completion,
- Operational planning: this level is related to a short period of time (from one day to one year) and its aim is to specify material/logistic demand. It includes: customer's demand planning, setting transit routes, scheduling warehouse and plant operations.

A lot of research devoted to supply chain planning refer to the use of IT tools in planning decisions. Authors such as Chandrashekar and Schary (1999), D'Amours S., Montreuil B., Lefrancois P. and Soumis F. (1999), Humphreys, P.K., Lai, M.K. and Sculli, D. (2001) point out the increase of supply chain planning competitiveness while using ERP systems, advanced planning systems and Internet technologies. Their research shows that the misuse of IT tools or lack of them can have a dramatic influence on every decision connected with planning in a supply chain.

3. ADVANCED PLANNING SYSTEMS (APS) IN A SUPPLY CHAIN

Complexity of planning processes in a supply chain results in a need for implementation of professional software supporting decision-making. Functionality of commonly used in enterprises ERP system which registers and supports economic processes is not suitable in the field of integrated planning between different entities (Stadler H. 2005). As a result, there is a need for systems supporting integrated planning in the range of the whole supply chain.

Advanced planning and scheduling (APS) systems already have a long, more than twenty years, history. Plenty of research papers discussing the various aspects of APS systems have been published. However, it seems that none of them concentrates on the modelling and implementation challenges in APS (Lupeikiene A., Dzemyda G., Kiss F. Caplinskas A., 2014). Term of APS is still ambiguous. According to product-oriented point of view, APS system does not substitute but only supplement or extend the existing ERP system (Meyr H., Wagner M., Rohde J., 2002).

At business objective level, the family of APS systems can be defined by the following common objectives (de Santa-Eulalia *et al*., 2011; Ozturk and Ornek, 2014; Fleischmann *et al*., 2005): (1) to minimize losses of the material, financial, workforce and other recourses; (2) to better manage the risks and more adequately respond to them; (3) to increase

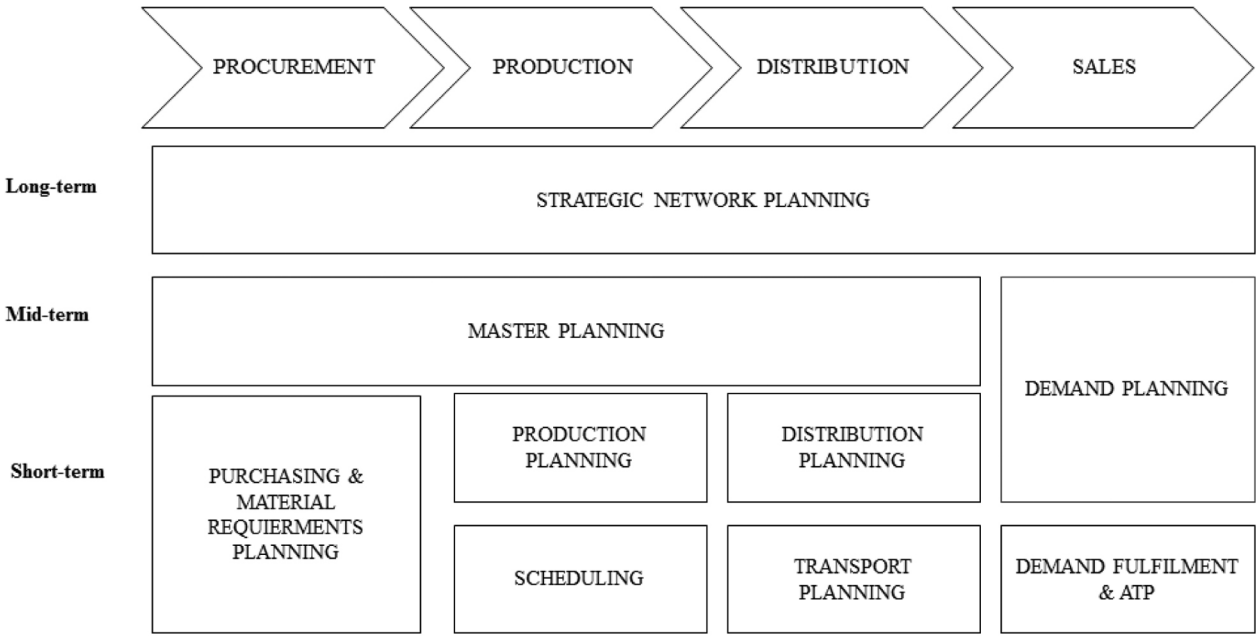

Fig. 1. APS modules
Source: Meyr, H., Wagner, M., Rohde, J., *Structure of advanced planning systems.* In: Stadtler, H., Kilger, C. (Eds.), *Supply Chain Management and Advanced Planning—Concepts, Models Software and Case Studies*, Berlin, 2002, s. 99–104

robustness and agility of the production and other plans; (4) to reduce planning time and to improve responsiveness of the planning system; (5) to link the strategic, tactical, and operational level planning decisions in more effective way, emphasizing the integration of planning and scheduling processes; (6) to increase the integration of the internal supply chain; (7) to extend the risk management from an internal to an external supply chain point-of-view (holistic optimization) paying more attention to the stochastic behaviour of this chain and to the multi-tier collaboration among its entities (collaborative planning); and (8) to make the order fulfilment and other processes more transparent (Lupeikiene A., Dzemyda G., Kiss F. Caplinskas A., 2014).

There are a lot of APS software providers. All products have the same design in common, based on the rules of hierarchical planning. The main goal of APS is supporting goods flow in a supply chain in the area of supply, warehousing, production, transport, distribution and sales (see figure 1).

Main functional models of APS are described in figure 1). They indicate the design and organization of the system and planning areas, which are supported. The most popular modules of APS are:

- Planning a supply chain network (Kahraman C., Öztaysi B., 2011; Jonsson P., Kjellsdotter L., Rudberg M. 2007) – supports long-term decisions in the field of logistic network planning. It allows to analyse the influence of resource allocation (production plants, logistic centres, suppliers, etc.) on the time and effectiveness on a products' costs flow. It also analyses shipping capabilities of means of transport (ships, lorries, trains, etc,) while planning a supply chain configuration.
- Central planning – coordination of products flow along the whole supply chain. It involves decisions concerning orders, transport, production and distribution. Supply chain is perceived as cooperation and integration of logistic processes (supply, production, distribution, sale). It is a basis tool on meetings coordinating supply chain work as a part of S & OP procedure balancing demand with resources (van Landeghem H., Vanmaele H. 2002).
- Demand planning – it makes possible to create accurate demand forecasts based on
- Entry data to decision-making models. Creating sales estimates is possible by using forecasts model and analyse mistakes in the same time. Demand planning is not merely related to sophisticated forecast methods. Only analysing customers' behaviours, influence of external

Tab. 2. Chosen Planning systems

Producer's name	Software name	Description	Business Size:
ROYAL4 SYSTEMS	**WISE Supply Chain Management Software**	System designed for different businesses. Based on functionality connected with warehousing in a broad sense. Available in different language versions, also through a web browser.	S M
SLINGSHOT	**Slingshot Enterprise Business Suite**	The system is based on a Cloud service. The software offers an integrated suite with procurement and order fulfilment, supply chain planning, demand planning, forecasting, supplier management, strategic sourcing, warehouse management and contract management features. Slingshot offers integrated applications that are fully customizable and optimized for multichannel enterprises. The software is used across multiple industries such as chemicals and energy, discrete manufacturing, healthcare, and wholesale, distribution and logistics.	S M L
Halo	**Halo**	Halo offers a supply chain management analytics platform that helps businesses plan and forecast inventory needs. Deployment options for Halo include on-premise, SaaS (Software as a Service) or PaaS (Platform as a Service, which allows users to develop, access and run custom apps in the cloud). Halo offers modules to support companies looking for supplier management, demand planning, order fulfilment, procurement, warehouse management, and strategic sourcing. Modules can be integrated or be implemented as standalone solutions.	S M L
JOHN GALT	**Atlas Planning Suite**	Is a cloud-based supply chain management solution designed to suit the needs of scaling businesses in various industries. Companies in manufacturing, agriculture, industrial equipment, hospitality and travel, medical equipment, consumer goods, pharmaceuticals, electronics, high tech, and other can tailor the solution to streamline their sales and operations. The solution can also be deployed on premise.	S M L
ORACLE	**Oracle SCM Cloud**	Oracle SCM Cloud is a cloud-based supply chain management solution that offers distribution, manufacturing, inventory management and fleet management within a suite. The product features product development, which allows users to create bill of material from a conceptual design. The solution also enables users to define the manufacturing workflow using visual assembly drag and drop functionality.	M L

	**SAP Integrated Business Planning**	Fulfil future demand profitably with real-time supply chain management. Powered by in-memory computing technology within SAP HANA, this cloud-based solution combines capabilities for sales and operations; demand, response, and supply planning; and inventory optimization. • Cloud deployment • Real-time scenarios and simulation • Social collaboration • Powerful predictive analytics	M L
	**Infor Supply Chain Management**	Infor provides supply chain solution designed for the enterprise-level organizations. It provides information on the details of the supply chain, forecast, planning, scheduling and execution. Infor SCM is suitable for a number of specialized industries including food and beverage, pharmaceuticals, specialty chemicals, distribution, consumer goods, electronics, logistics providers and more. Key applications include sales and operations planning, supply planning, demand planning, manufacturing planning and scheduling, strategic sourcing, procurement and supplier management.	

Source: own elaboration on the basis of: Supply Chain Planning Software (https://www.softwareadvice.com: access of the day: 2018-06-18

factors, promotion, influence of subsidiary goods sale allow to estimate sale fully (Huchzermeier, A., Iyer, A., Freiheit, J., 2002). Demand forecast module is one of the most widely used parts of APS class, and it often creates entry data which supports other planning decisions.

- Production planning – it makes possible to use different models supporting production scheduling. It allows to employ optimal and quasi-optimal methods which can take advantage of company's resources and, what is more important, the resources of business partners (Maravelias Ch.T., Sung Ch., 2009; Oboulhas C., Xiaofei X., Dechen Z., 2005; HerrmannJ.W., 2006; de Carvalho and Haddad, 2012).

APS supports advanced and integrated supply chain planning. Despite a lot of advantages, they demand from entrepreneurs good discipline in basic data maintenance in ERP systems, highly qualified staff and highly customized decision-making models to company's conditions.

4. PROBLEMS WITH SUPPLY CHAIN PLANNING BY MEANS OF IT SYSTEMS

The research was carried out among 101 employees who deal with planning in five production companies (employing more than 500 people). The enterprises that were analysed are all members of international supply chains: automotive companies (3 companies), energy technology and heating technology (2 companies). The author used an interview as a research tool. Interviews were carried out in 2016-2018 while coaching employees in SAP production planning modules and / or implementing abovementioned systems in companies. The questions asked by the author concerned issues connected with basic data configuration (for examples: Fig. 2 and 3) and planning processes (for examples: Fig. 4).

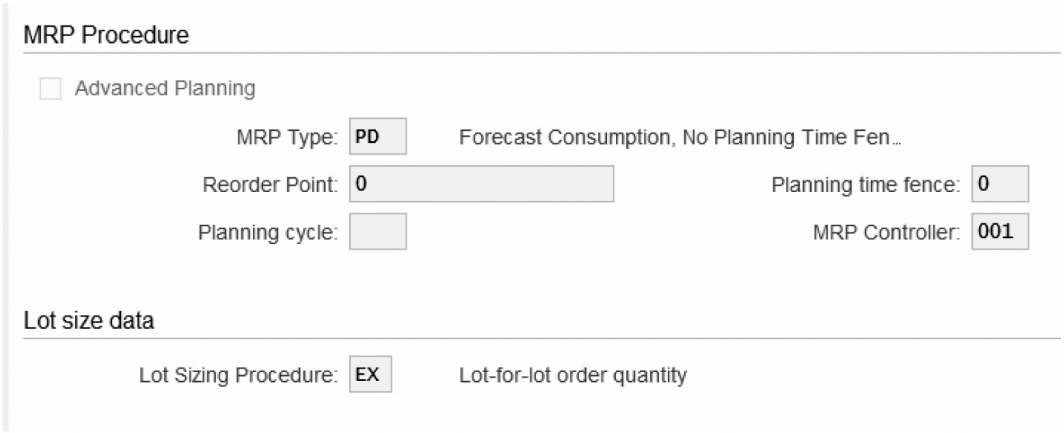

Fig 2. Material's basic data. (MRP procedure)
Source: SAP AG

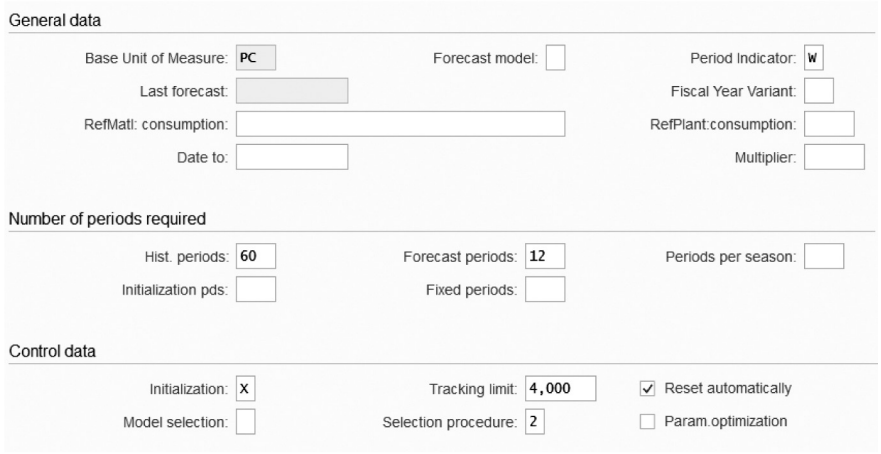

Fig. 3. Material's basic data (forecasted data)
Source: SAP AG

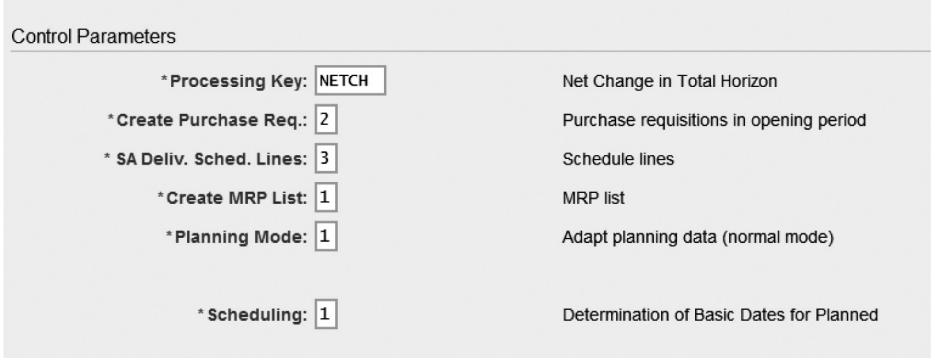

Fig. 4. MRP parameters
Source: SAP AG

The users were asked about system's functionalities while planning processes. Their answers showed their state of knowledge and problems they encounter. Thanks to obtained answers, the author managed to identify common problems a company can come across while implementation and use of planning systems.

Although managers are eager to plan a supply chain, they face different limitations. A human factor is the first one. Companies are understaffed and workers lack proficiency in planning. The research indicates that employees do not understand the consequences of planning parametrization and its influence on purchases, production, internal flows, etc. Employees work according to some set patterns which frequently are not adjusted to the surrounding which changes quickly. Barely 13% of employers, that deal with planning, were able to answer the question what models can support a forecasting process in a company (excluding movable average which was known and applied by everybody). Only in one company, the process of yearly basic data survey and change of settings in materials' planning parameters existed. Merely 16% of workers could answer the question connected with consequences of MRP parameters change in materials' basic data. Delloit report, carried out between January and April 2018, shows that 53% of employers are afraid that they will not find qualified workers, especially responsible for planning processes. This trend creates a challenge for universities which should level the knowledge of students as far as supply chain planning is concerned.

Badly prepared basic data and lack of a regular update becomes another limitation of IT tools application in planning processes. It concerns routing (with wrongly estimated operation time), bill of materials (with wrong connections and numbers od used materials, lack of a real data connected with planned supply/production time, work positions efficiency the most. Lack or inaccuracy of abovementioned data cause unreal results and therefore mistrust to planning process. Out of all people questioned in the survey, only 9% believe that MRP (Material Requirement Planning) gives credible results which reflect a real state of the company.

The way planning systems or mechanisms work, apart from basic data influencing planning processes, is based on company's real data, such as stock, demand, sale, etc. Registration of these data up to date proves to be a challenge for every enterprise. Every delay in this field can lead to inaccurate results obtained in planning processes. A high number of unused indexes is not helpful at all, because of them the information verification process is more time consuming. In companies, which were examined in the research, the number of unused material indexes had a value of 12% (the score based on the analysis made by planning department workers of companies in question).

Finally, the main problem while supply chain planning is a lack of data from business partners who participate in a product flow. APS class systems operate based on the rule of cooperation of different entities. Lack of cooperation and exchange of information limits possibilities which are given by modern IT systems.

The obtained results can contribute to more detailed research which the author will carry out among companies using APS or ERP planning software. The results, despite the fact that a more deep analysis and bigger research sample are needed, show that employees' knowledge of a planning process and the use if IT tools is rather small. It can result in a big problem while interpreting and using the results. Workers frequently do not believe in system's indications, arguing that there are mistakes in data and that the real process in the system is not reflected.

5. CONCLUSIONS

In recent times, more and more products are launched into the market. The variety of goods available gives customers a wide choice. They can choose between different producers. Clients do not want to wait for their products too long and want them at a low price, and that is crucial for a selling success. The market is really demanding and a competitive advantage is obtained when a given company can provide products according to potential buyers' expectations. Buyers' expectations are strongly expressed, even the smallest mistakes in customer service can cause multimillion losses. Good reputation is something that companies work for for many years. It can be easy to obtain, but once lost it is irretrievable. In this situation, with growing competition, planning is given a great importance. It is not only a process for individual companies and operations, but above all, it should encompass

all entities that take part in a product flow in a supply chain. The author, by mentioning different source literature, stress the importance of different aspects of a supply chain planning. The idea of advanced supply chain planning is also shown, as well as its limitations and challenges, for product and information flow managers. The paper also mentions the role of APS class systems in a modern supply chain planning.

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