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THE REFERENCE MODEL OF SUPPLY CHAIN OPERATIONAL CONTROLLING IN VALUE MANAGEMENT

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ABSTRACT. The systemic approach of the controlling function to supporting the operations management results from its complex analysis of the supply chain business and operating results and from influencing the operations management factors - products, processes and resources that determine the achieved result (revenues, costs, profitability and assets turnover as well as the return on invested capital). All product features which stand for customer value and its competitiveness are the basis for designing, planning and controlling the interconnected processes responsible for manufacturing and delivery of products. The effectiveness of methods applied in developing products, processes and resources depends on the precise analysis and appraisal of the operating conditions that justify their application. Supporting the operations management, focused on the product value and improving the company's financial result, apart from financial, technical and economic analyses requires transferring the product value to activities control methods and to developing the resources in the product supply chain already at the stage of planning. As a result of an analysis of requirements supporting the development of processes and resources in the supply chain, a reference model of operational controlling in product value management was developed. The multicriterion selection and appropriate application of material flow management methods in the supply chain is each time preceded by an operating and financial analysis as well as by an appraisal of operating conditions that influence the choice of control methods.

Key words: controlling, value management, process management, supply chain, reference model.

INTRODUCTION

The contemporary research regarding operations management distinguishes four principal factors - customers, products, processes and resources - which make up a system of strongly interconnected economic variables that shape the scope and range of operations management in business activity of enterprises [Krajewski, Ritzman 1990; Kasiewicz 2002; Waters 1996]. Operations management is a function of management and is responsible for all the activities that directly pertain to product manufacture and delivery [Loader, 2006], which results in a need to develop multidimensional process interdependencies in product supply chains, co-production and distribution. According to the results of theoretical research of both management science [Ackoff 1973, Drucker 1993, Koźmiński 1995, Zimniewicz 2009] and supply chain management [Christopher 2005, Giunipero 2004, Lambert 2000, Krawczyk 2001, Kisperska-Moroń 2000, Ciesielski 2009, Rutkowski 2000, Witkowski 2003], a supply chain is treated unanimously as a system, i.e. a purposefully determined set of elements and relations between those elements and their properties. According to Peter Drucker, the most important features of a management system include the permanent and comprehensive monitoring, and improving the effectiveness of activities aimed at the fundamental and vital result - a satisfied

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customer [Drucker 2005]. Customer satisfaction is an effect derived from many activities that are interconnected by means of both internal relationships and relations with the market environment, which add up to make the delivered product [Waters 1996]. Product value management is interconnected with influencing the product over the complete supply chain through deliberate shaping of multidimensional process interdependencies of supply, manufacture and co-production as well as distribution of the product to the target market. Moreover, the systemic interconnection of the implemented processes and applied resources influences the product value within the flow in the supply chain for both the customer and the product supplier, creating a value chain [Porter 1998, Rother, Shook 1999]. According to Philip Kotler, a value chain constitutes a process of adding value to the product, starting from activities connected with purchasing the materials necessary for the manufacturing process, through manufacturing operations and ending up with sales operations and rendering extra services [Kotler 1994].

Effective product management in view of customers' increasing expectations and the considerable changeability of the market environment requires a capacity to integrate and coordinate business activities throughout the supply chain, connecting all the areas of product management, processes and resources. Integration of activities (processes) consists in connecting individual elements of activities and information flows of various actions (processes) into a cohesive whole, ensuring effective cooperation and interoperability of processes. Coordinating the activities (processes) in a supply chain consists in harmonizing the actions implemented by different executors (enterprises, business units, individual employees) aimed at achieving a specified objective (e.g. the required product quality, reliability of deliveries, low costs, high sales volumes, high profit or high level of resource utilization). Simultaneously with operational shaping of the supply chain it is also important to analyse the impact of operations management on the customer service level and sales revenues, material flow rate and cash conversion cycle as well as the value of the working capital employed, the costs incurred and the total assets turnover. Interdependent dimensions of operations management (e.g. the time, place, quantity, quality, structure), management resources (e.g. employees, machines and equipment, capital, organisational resources and know-how) and management areas (e.g. purchasing, production, distribution, sales, finance, marketing), require that managers have to consider many scenarios of process implementation and resources allocation, which affects the final effectiveness of the company's assets and the employed capital. One of the methods applied to measure economic effectiveness of resources allocation is Kaldor-Hicks efficiency. According to its criteria, the solution leads to an increase in effectiveness, when, as a result of appropriate allocation of resources, it is possible to improve the ratio of result to the expenditure. If, given a specified allocation of resources, it is impossible to introduce such a solution, i.e. each change of resources allocation will result in a lower value of the result/expenditure ratio, then the current allocation is efficient in Kaldor-Hicks' meaning. In 1972, John Richard Hicks was granted the Nobel Prize for his achievements regarding the general economic balance and economic growth. In business practice, activities involved in controlling (understood as a management support system) are concentrated on inspecting, measuring numerous economic indicators, economic analyses and forecasting the revenues and costs, budget development and preparing reports for executives. Analysis of business practice shows that controlling in the enterprises involved in the research as well as described in numerous reference books [Nowak 2004, Sierpińska 2002, Vollmuth 1995, Leszczyński, Wnuk 2000, Horvath 1990, Weber 2001, Peemoller 1990], makes use predominantly of the achievements of managerial accounting. Controlling the efficiency in enterprises is mainly the duty of financial departments or financial controlling department, assuming that all the business operations are reflected in financial results and cash flows. However, in order to support the business management and to help it achieve its objectives, it is necessary to shift the emphasis from ex post analysis to the anticipatory action planning. The research results show there are not enough both theoretical studies and practical solutions for feed forward controlling that supports the management of operating activities and material flows in the supply chain in accordance with the assumptions underlying the planned result.

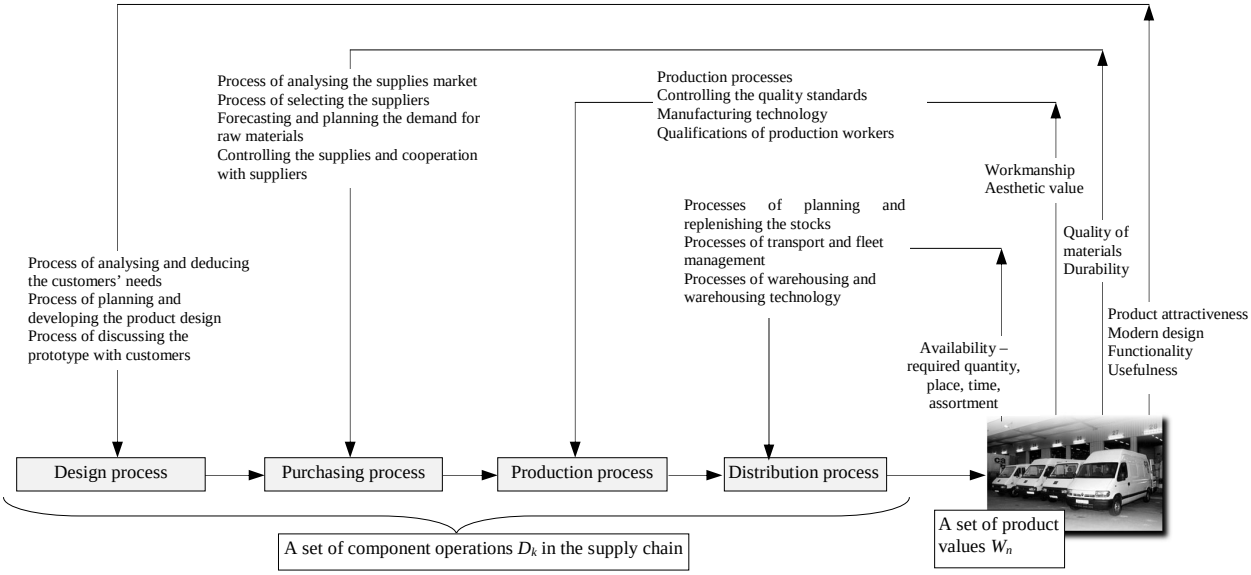
A complex system of operational conditions is an area of detailed, but fragmentary theoretical research and model-based simulations in the field of system integration and activities coordination [Krawczyk 2001, Kisperska-Moroń 2000], sensitivity analysis [Luenberger 1974, Mielcarek 2006],

theory of constraints [Goldratt 1997], trade off relations [Ullman 2001], multicriterial analysis [Szapiro 1991], reliability analysis [Kołowrocki 2001], queuing and bottleneck theory [Bozarth, Handfield 1998], and Value Stream Mapping [Rother, Shook 1999]. Supporting the operational controlling in the course of management process, focused on the product value and on improving the company's profit, requires (apart from applied financial, technical and economic analyses) control methods and relations between control factors and control parameter values to be specified already at the stage of planning the operating activities and flows in the supply chain.

Product features which constitute customer value are the basis for designing, planning and controlling of the interconnected processes responsible for manufacturing and delivery of products. Selection of control methods and control parameter values is coordinated within closed-loop feedback on the basis of operation and financial analysis results as well as operating conditions that make it possible to apply them. The proposed controlling model interconnects the feed-forward approach (which supports planning and controlling of operating activities in a supply chain) with feedback based on analysis of economic results and operational determinants.

PRODUCT VALUE TRANSFER IN A SUPPLY CHAIN

Product requirements (materials quality, product functionality, delivery timeliness and security, product availability) are transferred to the objectives of processes responsible for manufacturing and delivery of products to the market (Fig. 1).



Source: own study

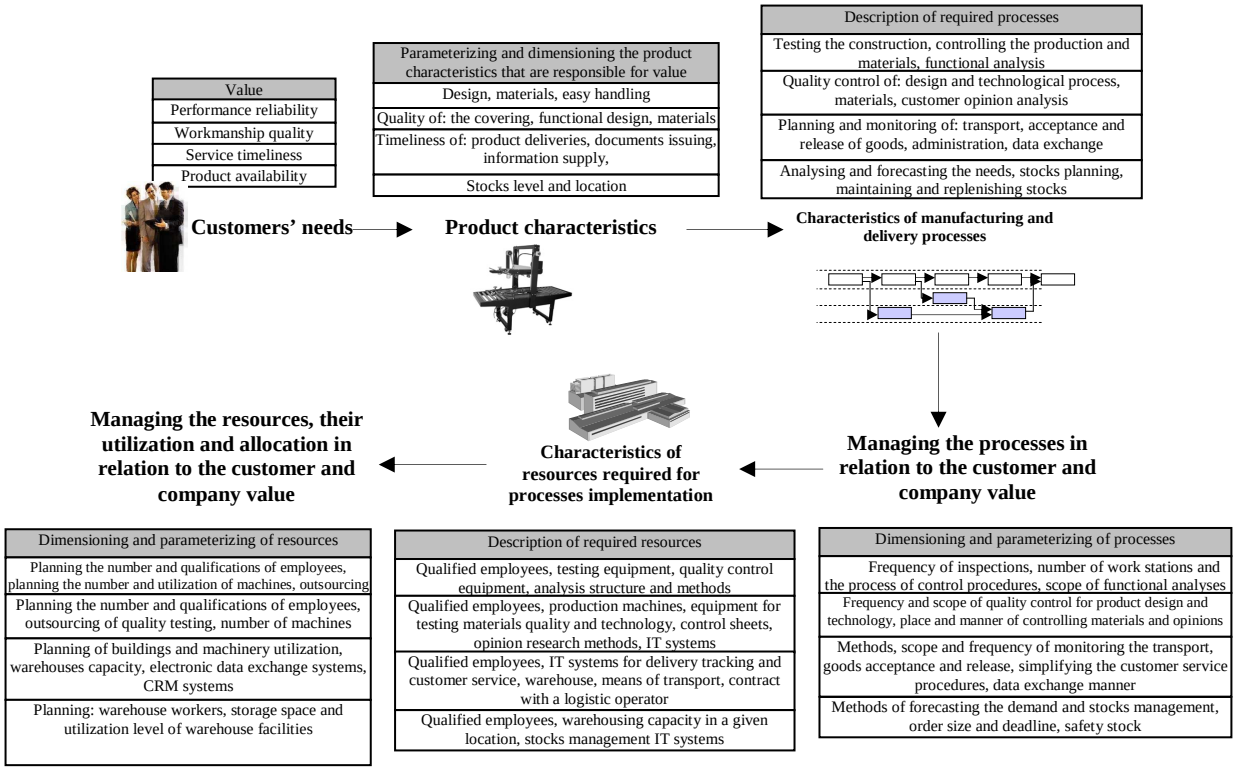
Fig. 1. An example of transferring product requirements to process requirements
Rys. 1. Przykład przeniesienia wymagań stawianych produktom na wymagania procesów

The supply chain processes exert a complex impact on individual elements of product value for the customer, which play a decisive role in establishing sales success and competitive position of the product on the market. Therefore the efficiency analysis process applies the techniques of Value Stream Mapping on the value stream in product supply chain processes [Rother, Shook 1999]. Product value analysis for n values making up a set of dependent variables is multifunctional in its nature. A set of values W_n at the end of the supply chain depends on the results of component operations D_k in the supply chain, e.g. the quality of supplied materials, timeliness and completeness of supplies,

production quality and reliability, exact order picking and shipments in the distribution process, timeliness of haulage or product availability in different locations within the supply chain.

$$W_{n=1}^{N}(n) \quad = \quad f\left[D_{k=1}^{K}(k) \right]$$

Transferring the value to strategic and operational decisions regarding the operations implemented in the supply chain is effected using the logic of the QFD (Quality Function Deployment) method. The objective is to translate the needs and expectations of the (external or internal) customer to features of the product, processes and resources in the supply chain. The processes that create the product value use up the resources, and the resulting return ratios of the company's assets or capital are determined as the ratios of the obtained results to the expenditure. Figure 2 presents the sequence of transition from the customer's needs to the required features of product, processes and resources, using the QFD logic.



Source: own study [Results of the research done by the Poznan School of Logistics under the research project KILiI 2/07: Analysis of product value factors]

Fig. 2. The transition from customer value to features of product, processes and applied resources, using the QFD method

Rys. 2. Przejście od wartości dla klienta do cech produktu, procesów i wykorzystywanych zasobów wg metody QFD

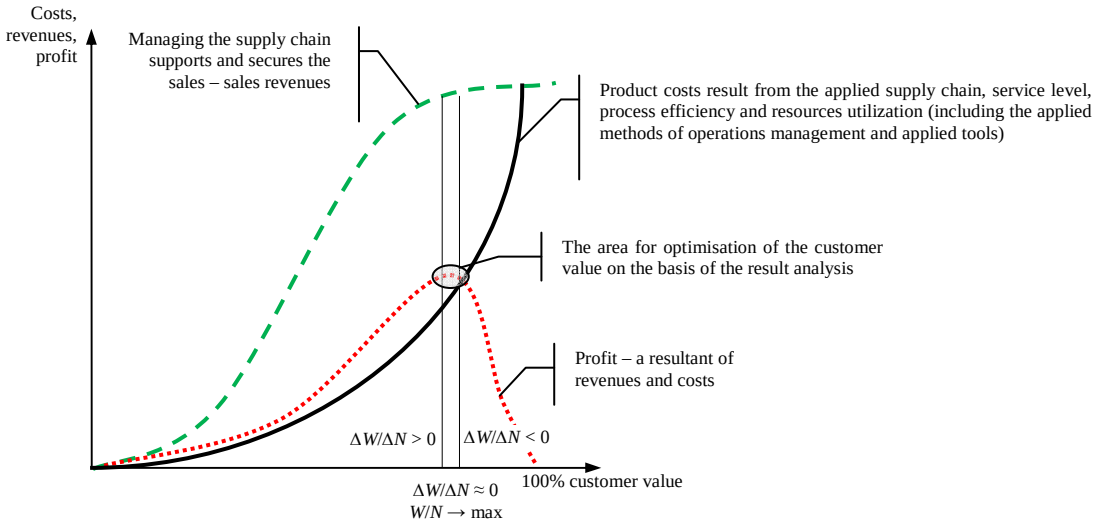
Supporting the company effectiveness improvement construed in accordance with Kaldor-Hicks definition as possible to achieve by means of deliberate shaping of processes focused on value, requires appropriate allocation of resources (e.g. supplies, warehouses, means of transport, employees, machines, capital). One of the methods applied to measure economic effectiveness of resources allocation is Kaldor-Hicks efficiency. According to its criteria, the solution leads to an increase in effectiveness, when, as a result of appropriate allocation of resources, it is possible to improve the ratio of result to expenditure. If in a given situation (given a specified allocation of resources) it is impossible to introduce such a solution, i.e. each change of resources allocation will result in a lower value of the result/expenditure ratio, then the current allocation is efficient in Kaldor-Hicks' meaning. In 1972, John Richard Hicks was granted the Nobel Prize for his achievements regarding the general

economic balance and economic growth. APICS (American Production and Inventory Control Society) definition means assigning, reserving, allotment of a given resource to the process. Creating the product value, companies often incur excessive outlays that are inadequate to the created value, thus decreasing the efficiency of the implemented processes and used resources, and at the same time the efficiency of employed assets and capital of the company. An example of using the QFD method may be the decision to adapt the production processes as well as the machines and equipment of the rolling stock repair facility ZNTK in Ostroda to the needs of railroad carriage production (and not just repair). Another example is the decision to introduce changes in the delivery supply process and steel service at Gonvarri (a global company manufacturing steel products), so as to adjust to the needs of the automotive industry (e.g. Volkswagen AG), engineering industry and producers of house appliances. The QFD sequence ensures an internal cohesion of the operating strategy (the product design, processes and resources in the supply chain), making it possible to achieve the objective that was set in the company's strategy - the product competitiveness.

The results of the operating analyses of sales with regard to the product (e.g. the product group or category) and of the customer and market (geographic location, demand concentration level, required quality and quantity, price, time) constitute the parametric description of the conditions in which companies interweave the methodologies of supply chain operations management. An example of shaping the operating relations as presented in Fig. 1.5 may be management of the product category by the supplier in the sales network as well as managing the supplies for the production line by the logistic operator applying the Just In Time / Just In Sequence system.

Successful impact on the customer value and on the company's financial results requires some support for the functions of planning, organising and controlling the flow of materials and activities in the supply chain. The financial result in product value management is most often achieved through exerting simultaneous influence on the sales revenues and expenditure N (costs) incurred in the supply chain in order to provide the required customer value. The value results from the lowest costs of functions fulfilled by a given product [Gabrusewicz, Hamrol, Kurtys 1998]. Decisions pertaining to the sales market and customer, the product price, the product quantity and range or time of selling the product affect the company's revenues. At the same time, due to the customer's requirements regarding the material quality, applied technology and quality of the product manufacturing, availability of stocks, order lead time or delivery flexibility, they have a considerable impact on the product cost. The dynamic approach to the ratio $\Delta W/\Delta N$ as presented in Fig. 3 makes it possible to streamline the customer value while providing the highest possible financial result for the company.

An example of an operating activity that affects the result/expenditure ratio in the process of value creation may be the optimisation of planning the transport routes, which contributes to cost reduction, improving the utilisation of transport means and assets rotation, while maintaining the customer value (e.g. timeliness and quality of deliveries is not changed). Another example may be improving the planning of works in the order picking and releasing areas of the warehouse, which will make it possible to improve the capacity of the warehouse and to reduce unit costs of the cargo as well as the delivery timeliness.



Source: own study [Buxton 1975]

Fig. 3. Impact of the product management on the customer and company value
Rys. 3. Wpływ zarządzania produktem na wartość dla klienta i przedsiębiorstwa

Table 1. A sample income statement for a supply chain
Tabela 1. Przykład rachunku wyniku łańcucha dostaw

Sales markets	Net sales of products						Market total	Market share
	A	B	C	D	E	F		
A	420.508			515.655			936.163	11,15%
B			549.805		238.573		787.661	9,38%
C		1.139.088	232.900	1.128.476			2.500.464	29,77%
D	615.225		175.540		461.340	226.070	1.478.175	17,60%
E		805.760		873.420	592.204	425.400	2.696.784	32,10%
Product total	1.035.733	1.944.848	958.245	2.517.551	1.292.117	651.470	8.399.247	100%
Share in sales	12,33%	23,15%	11,41%	29,97%	15,38%	7,76%	100%	

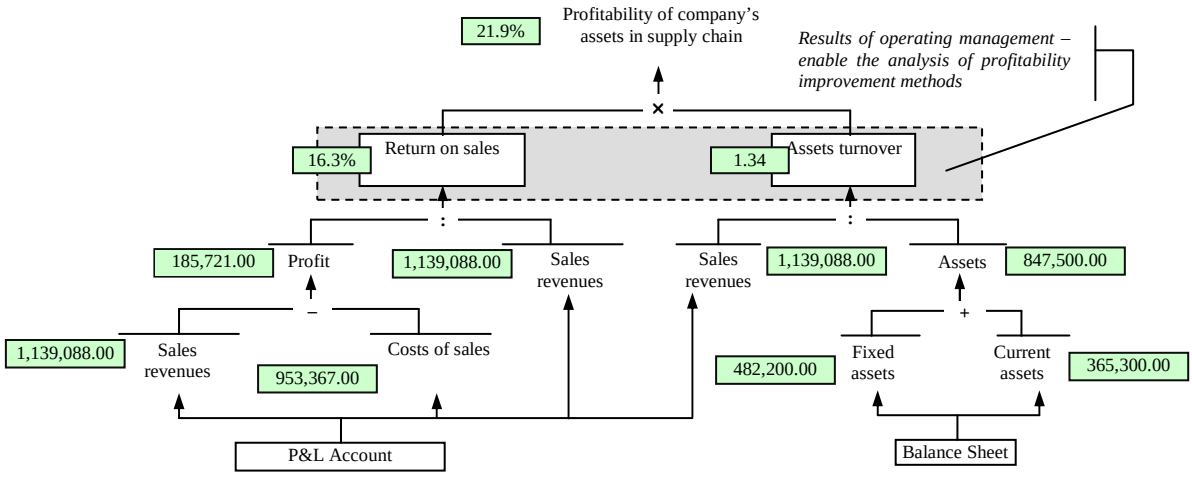
Item in the supply chain cost account	Product B in the supply chain to market C		
	PLN	%	
1. Gross sales revenues (sales *quantity* × *price*)	1 238 140.00	100	The result of the decision of a revenues centre regarding sales market C, price and quantity of product B, customers, product sales time period
2. Reductions in the revenues (*cash discounts, sales discounts, customer complaints, product returns*)	99 051.20	8	
3. Net sales revenues (1 - 2)	1 139 088.80	92	The result of the decision of a cost centre, regarding the organization of supply chain for product B, process implementation manner for market C, stocks level and allocation, warehouse, transport, production etc. resources utilization level
4. Direct variable costs (e.g. materials, labour in supply chain – e.g. at the stage of purchasing, production, order picking, lading, transport) – *sales volume x variable unit cost*	383 823.40	31	
5. Contribution margin I (3 – 4)	755 265.40	61	
6. Fixed costs (overheads) based on costs centres: - purchasing, production, warehouse, transport, …	420 967.60	34	
7. Contribution margin II (5 – 6)	334 297.80	27	
8 Company fixed costs related to given profit centres (*overheads – e.g. administration and management, accounting, HR – transferred by means of cost allocation codes*)	148 576.80	12	
9. The result of the supply chain as the profit centre (7 – 8)	185 721.00	15	

Source: own study [Results of the research done by the Poznan School of Logistics under the research project KILiI 2/07]

The measure of the capital employed in a product is the sum of all the costs incurred in connection with the product in the supply chain - direct costs, indirect costs (general expenses and overheads) and financial costs. The measure of the product value is the current and future revenue resulting from the price paid by the customer or profit after deducting the incurred costs. Analysis of the ways of process implementation and resources utilization as well as their interconnections includes researching the systems of purchasing, production and co-production, distribution and activities implementation conditions in all the processes of the supply chain that are responsible for creating value of the final product. One of the significant operating objectives is improving the flow efficiency in supply chain and effectiveness in resources utilization through elimination of bottlenecks, queues and downtimes. Table 1 presents sample detailed data on product management in the supply chain based on results of research on sales and costs in the supply chain. The data are presented in the form of a variable cost account, thus making it possible to interpret the results of the applied operating strategy. The analysis of the consequences of strategic decisions regarding operations in the supply chain - e.g. production outsourcing, commissioning the order picking and product delivery to a logistic operator, or direct delivery to the customer without using distribution centres - makes it possible to assess the different options in terms of value creation (including sales revenues and costs) and their impact on the product profit in the supply chain.

The value of the company's assets located in the operating resources of the supply chain (e.g. the share of machines and production facilities, warehousing facilities and equipment in the value of the total fixed assets of companies) calls for an analysis of the resources utilization in the material flow and sales operations. An ex post analysis of the impact of operating decisions on the condition of the company's (fixed and current) assets, as well as the costs incurred and revenues obtained, is one of the actions to be taken according to the discussed model of operational controlling.

Linking the data on fixed and current assets featuring in the company's balance sheet with the data on product sales and the costs incurred in the supply chain as per the Profit and Loss Account (Fig. 4) makes it possible to analyse the obtained sales revenues and profits, the structure of assets used to obtain the sales revenues, the assets turnover and profitability of sales and assets employed in the supply chain processes.



Source: own study [Results of the research done by the Poznan School of Logistics under the research project KILiI 2/07]

Fig. 4. Pyramid analysis of product B results in the supply chain for market C. Transfer from simple methods of balance sheet and P&L Account analyses to ratios of return regarding the company's assets.
Rys. 4. Analiza piramidalna wyników produktu B w łańcuchu dostaw na rynek C. Przejście z miar prostych bilansu i rachunku wyników do rentowności aktywów przedsiębiorstwa.

The detailed calculation of the sales value, incurred costs or resources utilisation level in relation to the time periods, products, customers or supply chains makes it possible to calculate respective ratios of profitability, productivity or turnover. A detailed process analysis and application of allocation codes in product stream management make it possible to calculate the presented operating results in relation to products, processes or resources in the supply chain. Managers tend to make more responsible decisions when they are aware that they exert an impact on the service level, financial results and the company's assets structures by making decisions that affect the operating resources (e.g. purchasing a warehouse crane or means of transport, purchasing materials to maintain stocks). ABC analysis of the share of individual products or sales markets (including their supply chains) in total sales makes it possible to assess the impact of the operating activities on the sales value.

The analysis of the impact of the operating factors on the value of the assets turnover ratio (Fig. 4) shows a correlation to both sales profitability and the assets turnover. The relation is called the market service quality and quantity formula.

The need to support the processes and resources development in the supply chain results from many premises deriving from sales operating analysis and operations aimed at preparing the Sales and Operations Plan:

- the structure of the most profitable business offer in terms of its quantity and assortment - which in connection with the analysis of the material streams profile in the supply chain influences the planning of, i.a.: the transport and fleet in the processes of delivery, warehouse space and operations, the machines and equipment utilization and reservation level, the production volume and assortment, materials supplies and conditions of cooperation with suppliers,
- the results of ABC classification of products (as per their share in sales value) and of XYZ classification (as per sales stability of individual products) - which affects the stocks allocation and structure, rational planning of direct and indirect deliveries as well as priorities in operations management,
- phases of product life cycle on the market, which affects, i.a. the planning of: parameters of customer service, supply chain resources development and investment decisions, stocks planning,

The Sales and Operations Plan comprises the programming of assortment and sales volume on individual markets as well as operations securing demand in the complete supply chain (Fig. 5).

Controlling is supported so as to select the most realistic and rational variant of the plan. The planned stocks (in weeks 3, 6, 7, 8 and 9) are one of the variants of the plan implementation and they result from the production capacity constraint (production bottleneck). Other possible variants of balancing the production needs and capacity include outsourcing, extending the working hours on week days or at weekends, purchasing new machines and employing more people, and other numerous solutions that are analysed in controlling. Stock planning performed already at the stage of production and sales balancing and planning results in forecasting the costs to be incurred before the sales proceeds, thus making it possible to plan realistic budgets and working capital. Based on the planned costs and sales revenues (Fig. 5) time periods and volumes of working capital to be replenished are identified (in weeks 6, 8 and 9), caused by freezing the capital in stocks.

Conclusions from the analysis are applied in the flexible planning of sales and operating costs budgets and of cash conversion cycle and financial liquidity. The change dynamics with regard to the needs of managing the flow in the supply chain and short-term deviation of the profit value for various flow variants give rise to the assessment of the supply chain efficiency and its operational management in the future.

Sales markets	Quarterly sales plan for products					
	A	B	C	D	E	F
A	4 500			15 600		
B		11 600	54 800		8 500	
C			23 900	12 800		
D	1 200		17 500		6 300	22 000
E		1 500			8 700	9 200	25 400
Total	**5 700**	**13 100**	**95 800**	**37 100**	**24 000**	**47 400**

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
Sales and delivery plan	2000	2800	3100	3900	2700	1900	2300	1900	2800	3900	4600	5200	**37 100**
Production capacity	3600	3600	3600	3600	3100	3100	2800	2800	3600	3600	3600	3600	**40 600**
Production plan	2000	2800	3400	3600	2700	2600	2800	2800	3600	3600	3600	3600	**37 100**
Planned stocks	0	0	300	0	0	700	500	900	800	0	0	0	**3 200**

Planned sale of product D on markets A, C and E

Realigned planning of production and stocks, accounting for the production capacity constraints

Total cost of purchasing, production, distribution and sales on the target market is PLN 32. The planned average sales price of product D is PLN 41 (taking into account the average level of price discounts and cash discounts).

Available operating capacity is planned at the level of 20,000 manhours a week, which means the plan is plausible and implementable.

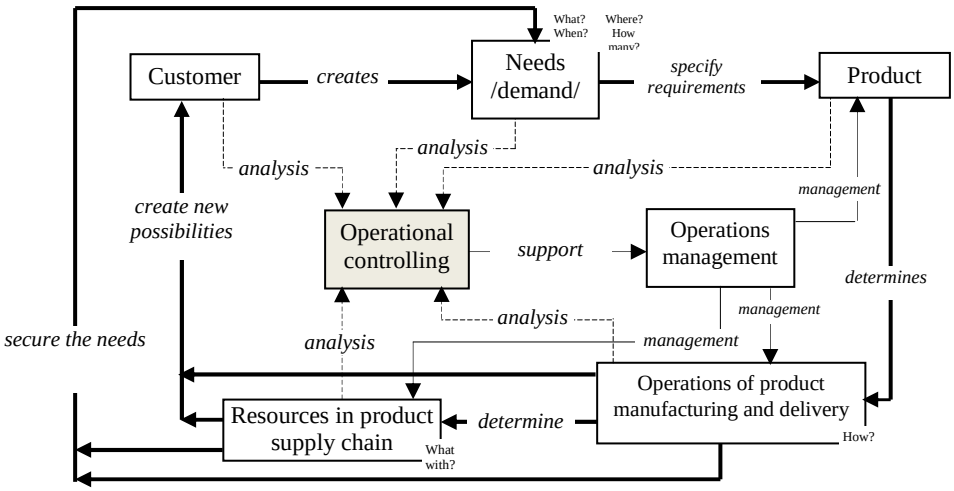
Week	Sales and delivery plan /pcs/	Production plan /pcs/	Total planned labour consumption in supply chain /manhours/	Needed number of employees	Production and delivery costs	Sales revenues
1	2000	2000	10000	50	64000	82000
2	2800	2800	14000	70	89600	114800
3	3100	3400	17000	85	108800	127100
4	3900	3600	18000	90	115200	159900
5	2700	2700	13500	68	86400	110700
6	1900	2600	13000	65	83200	77900
7	2300	2800	14000	70	89600	94300
8	1900	2800	14000	70	89600	77900
9	2800	3600	18000	90	115200	114800
10	3900	3600	18000	90	115200	159900
11	4600	3600	18000	90	115200	188600
12	5200	3600	18000	90	115200	213200
Total	**37100**	**37100**	-	-	**1 187 200**	**1 521 100**

Source: own study [Results of the research done by the Poznan School of Logistics under the research project KILiI 2/07: Analysis of the mechanisms of mapping the corporate strategy and the product competitive factors onto the supply chain processes]

Fig. 5. An example of supporting the controlling function in preparing the quarterly plan for drain pipes sales and production, including the analysis of production capacity, labour consumption, human resources, maintaining the stock level as well as realigned costs and sales revenues.
Rys. 5. Przykład wsparcia kontrolingu w opracowaniu kwartalnego planu sprzedaży i produkcji rur kanalizacyjnych z uwzględnieniem analizy zdolności produkcyjnej, pracochłonności, zasobów ludzkich, utrzymania zapasu oraz kosztów i urealnionych przychodów ze sprzedaży

THE REFERENCE MODEL OF OPERATIONAL CONTROLLING OF THE SUPPLY CHAIN IN VALUE MANAGEMENT

Successful product management resulting in customer satisfaction requires some support for the functions of planning, organising and controlling the activities in the supply chain [Marciniak 2008]. The need to aggregate the numerous, dispersed areas of operating and financial data and their systemic analysis focused on the integrated support of the product value management (presented in Fig. 6) have ensured the function of operational controlling a prominent position among the many decision support tools applied in business management.



Source: own study

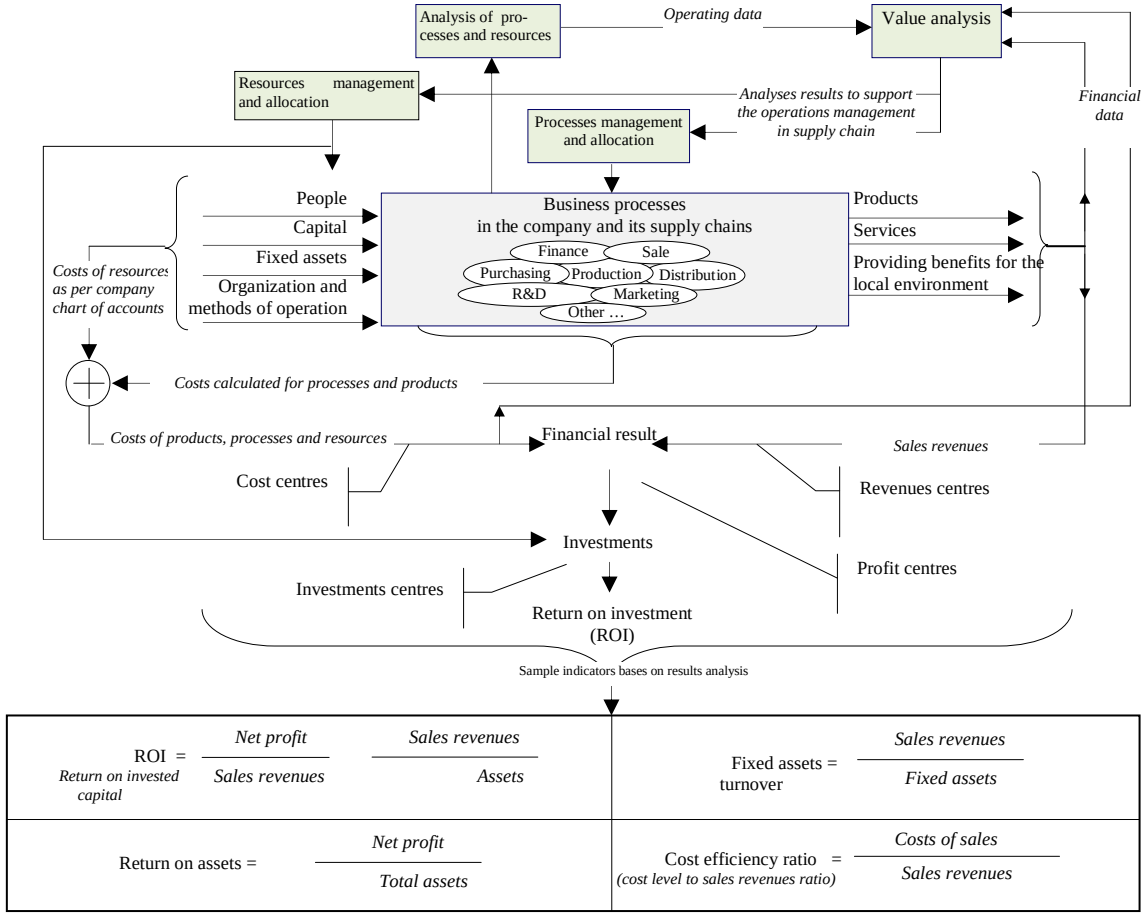
Fig. 6. The function of operational controlling in the process of supporting operations management in the supply chain.
Rys. 6. Funkcja kontrolingu operacyjnego w procesie wspomagania zarządzania operacyjnego w łańcuchu dostaw

The analysed changeability of the market environment, the intensity of the competitors' activities, many constraints in terms of time, assets and capital as well as the results of the dynamic reaction from the suppliers and cooperating entities result in a complex impact on managing the production and delivery operations in the supply chain, and consequently on the customer value and the company's financial result. The obtained research results confirm the systemic interconnections and feedbacks (positive, negative and stabilizing) in supply chain processes management, which puts a constraint on the possibility of applying the cause and effect analysis on a wider scale.

Controlling is a management support system which by means of coordinating the processes of planning, organizing and control, as well as information gathering and processing, ensures effective business management to achieve the planned objectives. The systemic approach of the controlling function to support the operations management as presented in Fig. 7 results from the need for a complex analysis of the business and operating results of the product supply chain (ex post analysis - feedback) and for influencing (ex ante analysis - feedforward) the operations management factors - products, processes and resources that determine the achieved result. The operating data ordered in accordance with the value chain make it possible for the managing staff to see the cohesion between the customer satisfaction and the sales result, and the control measures of individual operating processes in the supply chain (e.g. reliability, flexibility, reaction time) responsible for product value.

The presented controlling model shows the interconnection of the set of process analysis instruments, the value analysis and value mapping in the supply chain, which makes it possible to influence the processes and supply chain resources on the basis of the analysis of the financial result - revenues, costs, profitability and assets turnover as well as return on the capital invested in the company. The objectives of the value analysis include:

- improving the customer satisfaction, product quality and its competitiveness, resulting in progressive increase in sales value,
- price reduction resulting from various measures taken to reduce the product costs in the supply chain, e.g. the increase in efficiency of activities, material flow, and effective utilization of resources,
- increasing the profitability of individual products and product groups, customers, markets and distribution channels.



Source: own study

Fig. 7. The functional model of the operational controlling in product value management
Rys. 7. Model funkcjonalny kontrolingu operacyjnego w zarządzaniu wartością produktu

Miles Lawrence D., who is considered to be the founder of the Value Analysis concept, is the author of the book Techniques of Value Analysis and Engineering which was published in 4 editions (the first of which dated 1961) and translated into 12 languages. The author describes a sequence of interconnected stages of value analysis, value management appraisal and value improvement, which constitute a point of reference for further methods of value analysis. The aim of the value analysis is determining such a multifunctional relation product - customer that will make it possible to satisfactorily provide, at the relatively lowest cost, all the functions required by the customer. The value analysis method evolved over the years, which led to developing derivatives of this method such as Purchasing Analysis [Miller 1955] or Value Engineering [Kuhn 1971].

Analytical tracking of the ways of processes implementation and resources utilization and of their interconnections enables elimination of ineffective methods of operations and resources utilization that do not add any value. This includes researching the systems of purchasing, production and co-production, distribution and operations implementation conditions in all the processes of the supply chain that are responsible for creating value of the final product. An important operating objective is improvement of the flow efficiency in the supply chain and effectiveness in resources utilization through elimination of bottlenecks, queues and downtimes.

As a result of process mapping in the supply chain, it is possible to identify the activities and resources as well as to analyse their impact on the value constituents. Creating a detailed plan of the process, including the output, input as well as the sequence of activities and tasks requires a division of the process into sequential steps which reflect the actual path followed by a product in the process. The analysis will make it possible to specify the interrelations - e.g. the product availability is

dependent on the resources allocation, timeliness and completeness of deliveries. The other elements that are simultaneously analysed in the controlling model include the impact of the resources allocation on the operating costs and the working capital turnover cycle, as well as the impact of the product availability on the product sale. Operating interrelationships of the resources allocation variants (e.g. maintaining stocks or lack of stocks in the final link of the supply chain) lead to the situation where delivery timeliness and completeness may have a smaller or greater impact on the product availability for the customer. The vital role in shaping the supply chain processes and resources focused on the product value is played by the interdependencies features resulting from the research carried out by the author:

- the interdependence between the product value and the value development process is usually mutual, i.e. the processes influence the product value, while the product requirements, its market maturity and competitive environment influence the operating processes in the supply chain,
- the degree and direction of interdependencies between the product value and the process are subject to change over time, the changes in the direction may be observed in the transition from the customer market to the producer market,
- the interdependence between the product value and the value creating processes and resources in the chain do not have to be balanced - an example of this situation may be dumping or monopoly policies applied by companies; however, over a long-term period these relations strive to reach the balance as a result of fulfilment or weakening,
- a consequence of the aforementioned relations may be dependence of the processes and resources from the customer value of a product, as the customer value is a basic precondition for the processes implementation in the product supply chain.

Companies which develop the product value in accordance with the customers' preferences, simultaneously affect their own financial situation:

- shortening the order cycle time results in decreasing the costs of frozen capital in the company's turnover cycle,
- a bigger number of turnover cycles results in accumulating more profits in the company's (e.g. annual) reporting period,
- a shorter turnover cycle results in decreasing the required amount of capital, and thus in decreasing the costs of capital (e.g. credit costs),
- more turnover in the reporting period results in a higher level of resources utilization,
- greater profits for the given value of assets (investment level) results in increased assets profitability ratios.

The obtained research results confirm the network interconnections and feedbacks (positive, negative and stabilizing) in supply chain processes management, which makes it impossible to apply the cause and effect analysis on a wider scale. The analysed functions of interdependence networks f show different values and correlation directions and they vary over time. The operations within the chain as well as resources availability may be interrelated, which at this stage of analysis makes it difficult to determine the resulting function of the product value sensitivity to the constituent operations [Luenberger 1974, Mielcarek 2006] which is based on the analysis of how changes in the constituent factors influence the result (here: the operations and the chain resources on the product value). The main task of the sensitivity analysis is calculation of the turning point, i.e. the maximum value in given conditions (it may be the local maximum). The sensitivity analysis does not require determining the precise likelihood that a given value of a given factor will occur. A certain inconvenience in applying the sensitivity analysis for the purposes of operations analyses is treating the factors as independent variables. The research results also show the interdependence between the customer value of a product and the market maturity of the product (product life cycle phases) as well as the number and market maturity of competitive products.

Obtaining a complete set of variants that develop the processes focused on value is not usually possible, and the interrelations between the processes and resources constitute a different frame of reference for each assumed product value. However, the quality of the analysis increases when a greater number of solutions is considered. On the other hand, the variant analysis of a great number of operating solutions within a supply chain (e.g. delivery execution, resources allocation, production plans) is costly and time-consuming, which often counteracts the main objective of the operational controlling - supporting the achievement of a company's objectives over a short time horizon. Research conclusions lead to developing such a number of operating solution variants in the practical management of material, information and financial flows that would make it possible to conduct a comprehensive analysis at the accepted level of costs and execution time. The author treats the set of permissible variants as complete, and the individual variants as pareto optimal.

The need for systemic analysis of the company's financial result, accounting for the impact of the market environment operating factors on the operations within the supply chain, has resulted in development of tools and instruments applied in operational controlling. To support decision-making on the strategic and operating level of operations management, the following methods are applied:

- strategic analysis - including the Key Success Factors analysis, value chain model, product life cycle model, portfolio methods, SWOT analysis, complex qualification of company operations (strategic balance sheet),
- (balanced) Scorecard and techniques of cascading strategic objectives with regard to individual functional areas of operations management,
- Ishikawa Diagram (fishbone diagram / cause-and-effect diagram) and deviation analysis,
- financial ratio analysis and operating (non-cash) ratio analysis,
- Make or Buy analysis along with the decision tree to assess the possibility to apply outsourcing,
- investment project efficiency analysis in the supply chain,
- methods of cost calculation and accounting (including e.g. the variable costs and operation costs accounting, cost calculation with regard to: products, customers, sales regions, processes, distribution channels),
- working capital cycle analysis in the supply chain,
- methods of developing the material and financial plans (operating budgets),
- analysis of the costs of sales and customer service level in connection with the sales revenues in the context of break-even point and product life cycle,
- ABC analysis of: products on the basis of sales value or unit profit with regard to the customers, materials on the basis of purchase costs in connection with suppliers classification, cost groups in the supply chain,
- XYZ analysis of the stability of material flows, demand, wear and tear, and needs,
- analysis of bottlenecks in material flow (including downtimes and queues in service systems),
- process analyses using the PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method) methods,
- scenarios of balancing the resources and loads, variant-based construction of schedules and planograms using Gantt charts,
- operating analysis of: productivity, performance, utilization level, capacity, lead times, customer service level, delivery reliability in a supply chain,
- time series analysis and short- and long-term forecasting method,
- operations planning rationalization method e.g.: order, batch, delivery and transport route sizes.

SUMMARY

Adapting the operations management system to the changes that take place within the company and in its surrounding environment requires an adjustment of the decision supporting instruments, including the controlling system. Both controllers and managers agree that there is no universal and optimal model of a controlling system, as adjusting the management support function should account for many individually analysed factors that determine the management system, inter alia the type and scope of the company's business activity, the market environment, products, implemented business processes and resources as well as the organisation structure. Therefore the presented controlling model has the qualities of a reference model which constitutes a frame of reference for organising and functioning solutions as well as methodology to support the operations management in the supply chain. (The reference modelling means referring to the model, proved methods, measures repositories and organising solutions in the controlling actions cycle and implemented steps (e.g. analysis, measurement, appraisal and interpretation, simulation, selection and adjustment etc.) [Kasprzak 2005]). As for the principles of functioning and controlling the supply chain processes, a function similar to the reference model is played by the SCOR model. The presented area of operational controlling is focused on the product value and may be applied universally. It may be applied with regard to achieving the final product value delivered to the customer as well as to the products of each of the processes in the internal and external supply chain.

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MODEL REFERENCYJNY KONTROLINGU OPERACYJNEGO ŁAŃCUCHA DOSTAW W ZARZĄDZANIU WARTOŚCIĄ

STRESZCZENIE. Systemowe podejście kontrolingu do wspomagania zarządzania operacyjnego, wynika z jego kompleksowego badania wyników ekonomicznych i operacyjnych łańcucha dostaw oraz kształtowania czynników zarządzania operacyjnego - produktów, procesów i zasobów - determinujących osiągany wynik (przychody, koszty, rentowność i rotację majątku oraz zwrot z zainwestowanego kapitału). Wszystkie cechy produktu, stanowiące o wartości dla klienta i jego konkurencyjności, są podstawą projektowania, planowania i kontrolowania powiązanych systemowo procesów odpowiedzialnych za wytwarzanie i dostarczanie produktów. Skuteczność metod kształtowania produktów, procesów i zasobów, zależy od precyzyjnej analizy i oceny warunków operacyjnych kwalifikujących ich zastosowanie. Wsparcie zarządzania operacyjnego, ukierunkowane na wartość produktu i poprawę wyniku przedsiębiorstwa, wymaga obok analizy finansowej i techniczno-ekonomicznej przeniesienia wartości produktu na metody sterowania działaniami i kształtowanie zasobów w łańcuchu dostaw produktu już na etapie ich planowania.
W wyniku analizy wymagań wspomagających kształtowanie procesów i zasobów w łańcuchu dostaw opracowano model referencyjny kontrolingu operacyjnego w zarządzaniu wartością produktu. Wielokryterialny dobór i właściwe zastosowanie metod zarządzania przepływem materiałowym w łańcuchu dostaw jest za każdym razem poprzedzony analizą operacyjną i finansową oraz oceną warunków operacyjnych, wpływających na wybór metod sterowania.

Słowa kluczowe: kontroling, zarządzanie wartością, zarządzanie procesami, łańcuch dostaw, model referencyjny.

REFERENZMODELL DES OPERATIVEN CONTROLLING DER LIEFERKETTE IM WERTMANAGEMENT

ZUSAMMENFASSUNG. Der systembezogene Ansatz des Controlling bei dem operativen Management ergibt sich aus einer komplexen Untersuchung ökonomischer und operativer Ergebnisse der Lieferkette sowie der Gestaltung von Faktoren des operativen Management - Produkten, Prozessen und Ressourcen, die das Ergebnis (Einnahmen, Kosten, Rentabilität und Kapitalrendite) beeinflussen. Alle Produkteigenschaften, welche über den Wert für den Kunden und die Wettbewerbsfähigkeit entscheiden, bilden die Grundlagen der Gestaltung, Planung und Kontrolle der systemverbundenen Prozesse, welche für die Herstellung und Lieferung von Produkten verantwortlich sind. Die Effizienz der Methoden der Gestaltung von Produkten, Prozessen und Ressourcen ist von einer präzisen Analyse und Beurteilung der operativer Bedingungen abhängig, welche über deren Anwendung entscheiden. Die Unterstützung des operativen Management, die auf den Wert des Produktes und die Verbesserung des Unternehmensergebnisses ausgerichtet ist, erfordert - neben ´der finanziellen und technisch-ökonomischen Analyse - die Übertragung auf des Produktwertes auf die Methoden der Steuerung und Gestaltung von Ressourcen in der Lieferkette bereits auf der Etappe deren Planung.

Infolge der Analyse der Anforderungen, die die Gestaltung der Prozesse und Ressourcen in der Lieferkette unterstützen, wurde ein Referenzmodell des operativen Controlling in dem Produktwert-Management erstellt. Der multikriteriellen Wahl und einer richtigen Anwendung der Methoden des Materialfluss-Management in der Lieferkette geht die operative und finanzielle Analyse sowie Beurteilung der operativen Bedingungen, die die Wahl der Steuerungsmethoden beeinflussen, voraus..

Codewörter: Controlling, Wertmanagement, Prozessmanagement, Lieferkette, Referenzmodell.

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