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Throughput Accounting in Strategic Cost Management: An Application

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The theoretical part of this article developed from the study, "KIRLI, Mustafa and KAYALI, Nilgün (2010), ***Stratejik Maliyet Yönetimi ve Kısıtlar Teorisi: Bir Uygulama,*** *Celal Bayar Üniversitesi S. B. E. Dergisi, Volume: 8, Issue: 2, p. 93-114.", published in Turkish. The application part of this article including data and calculations is completely different and the original.*

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ABSTRACT

Strategic cost management considers costs as a factor that has to be managed for gaining competitive advantage. Theory of Constraints is an alternative approach which aims to eliminate the inadequacies of the traditional cost and management accounting techniques in the face of advanced production systems. Theory of Constraints argues that constraints in the production process negatively affect the performance and the profitability of company; because of this constraints have to be managed efficiently. Theory of Constraints bases on management of constraints in the continuous improvement process. Identifying the constraints and managing them efficiently increase the profitability of companies significantly. In this sense, with a hypothetic example in the last section of the study, the effect of efficiently management of a capacity constraint, a kind of constraint, to the profitability of company examined comparatively by Theory of Constraints and traditional contribution margin approaches

1. Introduction

The basic function of the traditional cost accounting is to form the necessary cost data for financial statements. In this sense, the traditional cost accounting approaches costs as an output to which endurance is compulsory. On the other hand, the concept of "Cost Management" bears wider and different meanings when compared to the concept of "Traditional Cost Accounting". Cost management doesn't consider costs as an output; instead, it considers costs as inputs which have to be managed in the process of production, and includes planning, management and reduction of costs. In the development process of business organizations, although it is a big achievement to have been transferred from traditional cost accounting to cost management, transferring to strategic cost management which adopts the approach of the usage of cost data to develop superior strategies with the aim of gaining advantages depending on constant and intense competition of cost management is a more significant step. The developments and changes which lead businesses from traditional cost accounting to cost management and to strategic cost management policies and applications in their historical development process are as follows (Kırlı and Kayalı, 2010:94; Öker, 2003:17; Atmaca and Terzi, 2007:294; Arzova, 2002: 1-2; Haldane, 1998:64):

- Shortening of product life cycle,
- Changes in cost structures: whereas the weight of direct expenses reduces, the weight of the general production expenses increases,
- The advances in manufacturing technology,
- Increasing international competitiveness brought by globalization,
- Increased research and development expenses,
- Changed market conditions and the settlement of a consumer-oriented understanding in the market,
- Increase in the weight of assets in the asset structures of the companies,
- Improvements in computer technologies,
- Improvements in communication and transportation.

Traditional cost accounting's being insufficient against these improvements and changes in terms of many issues and the cost pressure emerging as a consequence of intense competition forced businesses to analyze the background reasons of formation of the costs and to affect these costs inside their sources before their formation; and thus, the cost management approach came to the light (Yüzbaşıoğlu, 2004:390). The

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necessity of the cost management to carry out the plans in the frame of desirable results that the businesses want to achieve in the long run urged businesses toward the sense of strategic cost management.

2. Strategic Cost Management

Strategic Cost Management is defined as the application of cost management techniques for businesses in order to improve their strategic positions constantly and to reduce their costs (Cooper and Slagmulder, 2003:23). According to another definition, Strategic Cost Management is explained as the total effort of planning, organizing, managing, coordinating and supervising cost management and cost management systems that will produce the information of cost data required by the mission, aim and strategies of a business (Erden, 2004:255). According to another definition, Strategic Cost Management is to approach the conditions in a broad sense and in the long-run required by global competition arena in terms of decision making and to integrate strategic cost analysis intensively into the concept of this plan when the stressed alternatives are compared in strategic planning (Karcıoğlu, 2000:72). If the efforts of cost management displayed in the sense of an integrated system by providing coordination among the functions in a business such as, management, production, supply, research-development, engineering and finance (Yükçü, 2007:376) are revealed in the frame of plans and strategies which will lead a business to the desired results in the long run, a strategic cost management will come into question. Strategic Cost Management is expected to perform the following functions (Yüzbaşıoğlu, 2004:394, quoting from Delman and Franz):

- Predicting, using and affecting the effects of strategic decision on cost,
- Predicting and analyzing the extents of effect related to strategic cost position; finding and defining costs depending on activities,
- Determining, planning and analyzing costs intended for competition in the value chain analyses,
- Determining, planning and analyzing the completeness of life cycle costs.

There are three main factors in the concept of strategic cost management (Su, 2006:42):

- Value Chain Analysis
- Strategic Positioning Analysis
- Cost Drivers Analysis

For a business, value chain is the total of the activities which add value to the business within the duration starting from raw material procurement from suppliers until distributing the product to the ultimate consumer (Shank and Govindarajan, 1993:13). Value chain analysis doesn't restrict the analysis with a business's own value chain; it also includes in the value chains of the sector in which the business acts and of the other opponent businesses in the sector, as well. The aim of this is to search for the ways to supply the business with cost saving by analyzing both internal and external value chains of a business, and thus; to obtain advantage in competition (Su 2006:42). In this context, value chain analysis is an instrument of analysis which helps explaining how the business can raise its customer value and how the business can reduce its costs; and helps understanding suppliers, customers and the relations with other businesses in the sector and the advantage of competition of the business; this analysis covers all the activities required so as to provide customer with competitive goods and services (Blocher et.al., 2002:44).

Strategic positioning analysis is the analysis of situation of the business that it will undertake while competing. Strategic positioning analysis includes two different strategies for the businesses to improve their advantage of competition: *Cost leadership strategies* and *diversification strategies* (Su, 2006:42). The focus of cost leadership strategies is to achieve lesser cost when compared to one's opponents. Cost leadership strategies can be achieved through cost minimization approaches in scale economies in production, learning-curve theory, strict cost control, and in the fields such as service, sales, marketing and Research & Development (Shank and Govindarajan, 1993:95). The focus of diversification strategies is that a business produces its goods or services so that it is recognized as unique in the sector. Diversification strategies can be achieved through applications such as brand loyalty, maximum services for the customers, sales via network systems, new goods design, goods technology and features of goods (Shank and Govindarajan, 1993:95).

The third main factor of strategic cost management is cost driver analysis. In cost driver analysis, cost drivers are separated into two groups:

These are structural cost drivers and executional cost drivers (Yalçın, 2006:30; quoting from Riley). Structural cost drivers are related to the economic structure of the business; scale, context, technological investments and experience can be shown as examples for structural cost drivers (Şakrak, 1997:112). On the other hand executional cost drivers are closely related to the performance of a business; the participation of workforce in the aim of continuous improvement, total quality management, capacity utilization, goods design and plant layout efficiency can be shown as examples for executional cost drivers (Şakrak, 1997:112).

3. Theory of Constraints

3.1. Conceptual Essentials of Theory of Constraints

In the late 1970s, Dr. Eliyahu Goldratt developed the software that he named Optimized Production Technology so as to solve the problem which had alleged that production managers made mistakes in terms

of programming and supervising their sources and stocks. In 1984, Goldratt started to introduce the focus of Optimized Production Technology under the name of Simultaneous Production; and in 1987 he used the concept of Theory of Constraints. His book "The Goal" located the logic and fundamental principles of Optimized Production Technology in the literature under the name of Theory of Constraints (Kırlı and Kayalı, 2010:97; Blocher et.al., 2002:162; Üreten, 1998:281).

The main thesis of Theory of Constraints is that constraints determine the performance of a business and that each system has at least one constraint (Küçüksavaş et.al, 2006:19; quoting from Ruhl and Tollington). The Theory of Constraints is the notion of management laying emphasis on the restrictive effects of the constraints on a business's performance and arguing that these constraints have to be managed with the aim of removing their negative effects on the business's performance (Kaygusuz, 2005:134). In the management notion brought by Theory of Constraints, these constraints needs focusing in order to increase productivity and profitability of the organization with reference to the fact that each system has at least one constraint and that the performance of system is managed by this constraint (Akman and Karakoç, 2005:106). The difference of Theory of Constraints from other approaches is that it argues on the necessity to focus on constraints rather than focusing on costs (Blackstone, 2001:1053).

Through the management of constraints and simultaneous production, the main hypotheses that Theory of Constraints, which is characterized as a management philosophy contributing to the continuous development of a business (Blackstone, 2001:1053) is based on the following (Kaygusuz, 2006:160-161; quoting from Tollington and Huang):

* In the Theory of Constraints, all expenses including direct labor expenses are accepted as operating expenses except for direct raw materials and supplies expenses.

* The primary aim of the business is to earn money today and in the future, to reap profit and to grow profit.

* According to the Theory of Constraints, there is at least one constraint for each good. All constraints either inside or outside the business preventing business from reaping profit have to be managed with methods such as linear programming.

* The planning of the flow of goods in a business is obligatory; and while planning, constraints must be defined and it shouldn't be forgotten that there can be differentiations in goods and product mix. Uniformity in product mix and its being in a constant state do not reflect a real-time situation.

Constraint is defined as everything that restricts performance related to the aim of a system (Atwater and Gagne, 1997:6). There are different approaches about the classification of constraints in the literature. In the approach which relates constraints to the internal and external environment of business organization, constraints are separated into two as internal and external constraints (Küçüksavaş et.al, 2006:19; quoting from Louderback and Patterson). The examples of internal constraints can be management policies, production capacity and the behaviors of employees whereas the examples of external constraints can be the factors such as market demand with which the business is not able to interfere, and legal acts. The most commonly accepted approach in terms of classification of constraints in literature is the approach of Atwater and Gagne's approach which discusses constraints in five subjects. According to this approach, five constraints and their brief definitions are shown in the following table:

Table-1: Constraint Types

Type of Constraint	Definition
Market Constraints	The constraint in the business capacity caused by disparity emerging in market demand.
Source Constraints	The constraint emerging as a result of insufficient business sources in meeting market demand.
Politic Constraints	The constraint emerging from the managers who utilize the opportunities that they have. The improvident attitudes of managers cause this situation.
Raw Material Constraints	The constraint caused by raw material shortage which is an external source.
Logistic Constraints	The constraint emerging as a result of restricted business activities by the procedures applied in business organization.

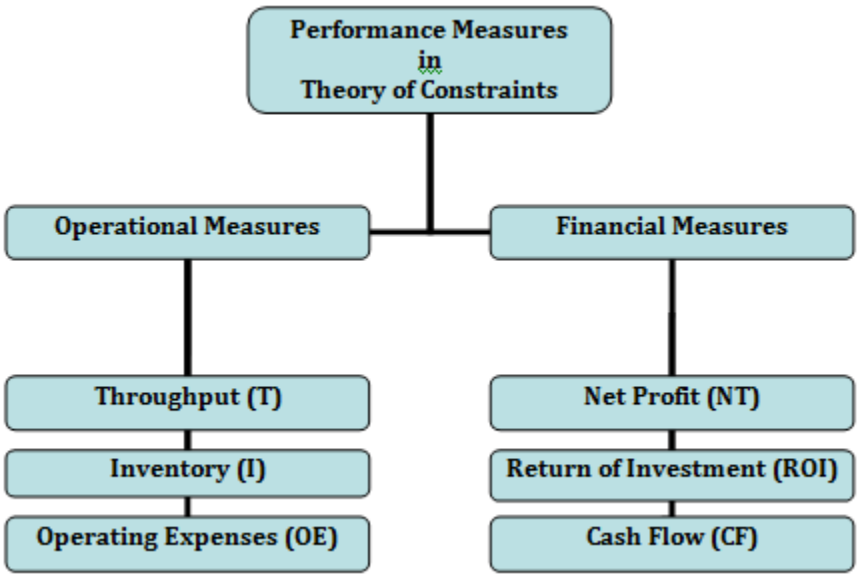
Source: Derived from (Atwater and Gagne,1997:7)

3.2. Performance Measurement and Throughput Accounting

One of the basic hypotheses of Theory of Constraints is that the present and future aims of the businesses are to earn money and to reap profit (Kaygusuz, 2006:160; quoting from Tollington and Huang). In order to achieve this aim, the measurements developed intended for measuring the performance of business are classified in two groups (Kırlı and Kayalı, 2010:101): Operational Measures and Financial

Measures. Operational measures are Throughput, Inventory and Operating Expenses (Corbett, 2000:38). On the other hand Financial Measures are Net Profit, Return on Investment and Cash Flow (IMA, 1999:38; Rahman, 1998:342). In Figure-1 Performance Measures used in Theory of Constraints are shown schematically (Kırlı and Kayalı, 2010:101):

Figure-1: Performance Measures in Theory of Constraints



Throughput (T) which is defined as the earning rate of the system through the sales of products and/or services (IMA, 1999:34) is calculated by taking Direct Material Costs (DMC) out of Sales Revenue (IMA, 1999:34):

$T = Sales\ Revenue - DRMS$ (1)

In calculating Throughput, it is grounded on the circle in which the transformation of direct raw material and material costs endured by the business transform into product, and product transforms into money by getting sold and this transformation process contributes to the business financially. Although Throughput resembles to the "Contribution Margin" in the traditional cost accounting approaches, there are differences between them. Throughput accepts direct raw material and material costs as the sole variable cost; and accepts direct labor expenses and general production expenses as totally fixed. On the other hand, while Contribution Margin is calculated, the variable costs of direct labor expenses and general production expenses are also taken into consideration along with direct raw material and material expenses in the calculation. As a result, Throughput is separated from Contribution Margin from this aspect. As it is understood from the equation (1), whereas the Throughput is increased by the increase in sales revenue and the decrease in direct raw material and material expenses, the decrease in sales revenue and the increase in direct raw material and material expenses decrease Throughput (Kırlı and Kayalı, 2010:102).

All the investments used in production made by the business in order to realize their sales are defined by Inventory measure. Unlike traditional cost accounting, Theory of Constraints defines inventories not only as direct raw material and supply, and semi-product and product inventories but also as the assets involving machine, building, facility and transportation in a general context (Bayazıtlı et.al, 2005:199; Gupta, 2003:650).

Operational expenses involve all the expenses which are spent by the business in order to obtain Throughput from inventories (IMA, 1999:35). In the Theory of Constraints, there are production costs such as direct labor expenses and general production expenses which are apart from direct raw material and material expenses in the operational expenses concept; also there are marketing, sales and distribution expenses and general management expenses in this concept (Kaygusuz:2005:163). While the Theory of Constraints measures the performance of the system, it takes only direct raw material and material expenses into consideration as the expense which changes due to sales; and all the other expenses are accepted as fixed (Kırlı and Kayalı, 2010:102-103).

The financial performance measure used by Theory of Constraints during the measurement of the performance of a business; Net Profit (NP), is the difference between Throughput (T) and Operational Expenses (OE) (Ricketts, 2008:56):

$NP = T - OE$ (2)

As it can be understood from the equation (2), according to Theory of Constraints, the increase in Throughput in a business and the decrease in operational expenses increase the net profit; the decrease in Throughput and the increase in operational expenses decrease the net profit.

Another financial measure used by Theory of Constraints in performance measurement, Return of Investment (ROI), is calculated by Net Profits' going into Inventories (I) (IMA, 1999:38):

ROI = **Error!** (3)

If you write the equation (2) to its place in the equation (3), we obtain equation (4) below (Kırlı and Kayalı, 2010:103):

ROI = **Error!** (4)

As it can be understood from the equations (3) and (4), the factors increasing net profit, also increase investment return. On the other hand the decrease in the amount of investment of the business on inventories, with its broad sense in Theory of Constraints, increases the return of investment. In case the business reaches to the zero inventory cost, the return of investment approaches to the maximum level.

Cash Flow (CF) financial measurement, discussed by Theory of Constraints in performance measurement, which is not as commonly used as the other two is calculated by adding the negative or positive changes in inventories to the net profit of the business which are in the same period (IMA, 1999:38):

$CF = (T - OE) + \Delta I$ (5)

The applications related to accounting of the approach of Theory of Constraints which grounds importance on Throughput is named as Throughput Accounting. Throughput Accounting can be defined as a strategy which tries to maximize the profit by removing financial bottleneck or making it work more efficiently and by determining optimal product mixes (Utku and Ersoy, 2008:1630). Throughput Accounting focuses on Throughput in the business and takes only direct raw material and material expenses into consideration. Whereas Throughput Accounting centers the method of product expenses calculating, which predict the removal of production restrictions in the system in order to increase the profit level; it also concentrates on the performance measurements related to decision making (Beyazıtlı et.al, 2005:196).

A comparison of the priorities of Throughput Accounting and traditional cost accounting reveals that while Throughput Accounting primarily attaches importance to increasing Throughput, traditional approach primarily attaches importance to reducing operational expenses. Throughput Accounting's second priority is reducing inventories and its third priority is reducing operational expenses; on the other hand traditional approach's second priority is increasing sales and its third priority is focusing on inventories (Beyazıtlı et.al, 2005:202; quoting from Ruhl). Whereas traditional cost accounting allocates general production expenses to goods, it uses allocation keys, which are directly proportional with production values, such as direct labor hours, machine work-time and production amount. Nonetheless, in case general production expenses don't increase due to production volume, traditional cost accounting miscalculates product costs because of allocation keys. As for Throughput Accounting, while it allocates general production expenses to produced goods, it allocates general production expenses based upon used and consumed time in the process of production of goods as distinguished from traditional approach (Utku and Ersoy, 2008:1631). Thus, the negativity of traditional approach, which occur in case general production expenses don't increase due to production volume and results in miscalculation of product costs, is removed; thus, Throughput Accounting contributes positively to the profitability and competitive capacity of the business (Kırlı and Kayalı, 2010:104).

Throughput Accounting presents a way to provide with the measurement of the business's productive efficiency by managing restrictions in production process in a good way (Atmaca and Terzi, 2007:293). Throughput Accounting benefits from the following measurements in measuring productive efficiency (Ricketts, 2008:56):

Productivity (PR): *PR* = **Error!** (6)

Inventory Turns (IT): *I T* = **Error!** (7)

Productivity (PR) is calculated by dividing Throughput to Operational Expenses (OE); Inventory Turns (IT) is calculated by diving Throughput (T) to inventories. The increase in these two measurements is defined as the increase in productivity efficiency (IMA, 1999:38). According to Throughput, whereas the optimum decision or a better decision when compared to the previous one increases Throughput (T), it reduces inventories (I) and Operational Expenses (OE) and it increases the Net Profit (NP), Revenue of Income (ROI), Productivity (PR) and Inventory Turns (IT) (Ricketts, 2008:56).

4. Application

In this part of the study, Throughput Accounting application will be practiced in calculating Optimal Product Mix which is an important decision area of Strategic Cost Management. ABC Manufacturing Company, which is subject to the application, and its cost, production and market data are hypothetical and are designed by myself. The information given in the tables are as follows: Market Data of ABC Manufacturing Company in Table-2, Cost Data of ABC Manufacturing Company in Table-3, Process Times Required by Product-A, Product-B and Product-C in the Production Departments of ABC Manufacturing in Table-4:

Table-2: ABC MANUFACTURING COMPANY MARKET DATA

PRODUCTS / MARKET DATA	PRODUCT-A	PRODUCT-B	PRODUCT-C
Demand Quantities (units) (2 Monthly Demand)	7,500	5,000	6,000
Selling Prices (€ per unit)	5.20	6.25	8.40

Table-3: ABC MANUFACTURING COMPANY COST DATA

	PRODUCT-A	PRODUCT-B	PRODUCT-C
DIRECT MATERIAL COSTS (€ PER UNIT)	2.40	3.25	4.30
Direct Material-P	1.30	0.90	1.60
Direct Material-Q	0.70	1.00	1.90
Direct Material-R	0.40	1.35	0.80
DIRECT LABOUR COSTS(€ PER UNIT)	0.25	0.30	0.95
MANUFACTURING OVERHEAD COSTS (VARIABLE) (€ PER UNIT)	0.15	0.20	0.85
MANUFACTURING OVERHEAD COSTS (FIXED) (€) €13,450	3,750	2,500	7,200

Table-4: ABC MANUFACTURING COMPANY PROCESSING TIMES (MINUTE PER UNIT)

PRODUCTS	COST CENTERS			
	PRODUCTION DEPARTMENT-I	PRODUCTION DEPARTMENT-II	PRODUCTION DEPARTMENT-III	PRODUCTION DEPARTMENT-IV
PRODUCT-A	1.40	2.40	1.80	5.00
PRODUCT-B	1.80	3.20	2.40	3.60
PRODUCT-C	1.30	3.50	3.50	1.75

In calculating Potential Capacity, "Two-Month Operating Period", "Two Shifts a Day", "Eight Hours Operating Time in One Shift" are taken as the basis:

Potential Capacity = (2 Months) x (30 Days) x (2 Shifts) x (8 Hours) x (60 Minutes) = 57,600 minute

In Table-5, Actual Capacity, Potential Capacity and Capacity Utilization Rate calculations based on the data obtained from Table-2, Table-3 and Table-4 take place. As it can be seen from the Table-5, there is a "Capacity Constraint" due to the "Missing Capacity" in Production Department-IV:

Table-5: ABC MANUFACTURING COMPANY
ACTUAL CAPACITIES FOR EACH PRODUCTION DEPARTMENT (MINUTE)

	COST CENTERS			
	PRODUCTION DEPARTMENT-I	PRODUCTION DEPARTMENT-II	PRODUCTION DEPARTMENT-III	PRODUCTION DEPARTMENT-IV
PRODUCT-A	7,500*1.40=10,500	7,500*2.40=18,000	7,500*1.80=13,500	***7,500*5.00=37,500***
PRODUCT-B	5,000*1.80=9,000	5,000*3.20=16,000	5,000*2.40=12,000	***5,000*3.60=18,000***
PRODUCT-C	6,000*1.30=7,800	6,000*3.50=21,000	6,000*3.50=21,000	***6,000*1.75=10,500***
ACTUAL CAPACITY	27,300	55,000	46,500	***66,000***
POTENTIAL CAPACITY	57,600	57,600	57,600	***57,600***
CAPACITY UTILIZATION RATE	47.40%	95.49%	80.73%	***114.58%***
MISSING CAPACITY				***8,400***
				CONSTRAINT

In Table-6, "Production Priorities" are calculated in ABC Manufacturing Company according to the Theory of Constraints Approach:

Table-6: ABC MANUFACTURING COMPANY
PRODUCTION PRIORITIES ACCORDING TO THE THEORY OF CONSTRAINTS APPROACH

	SELLING PRICE (€ PER UNIT)	DIRECT MATERIAL COST (€ PER UNIT)	THROUGHPUT VALUE (€ PER UNIT)	TIME ON CONSTRAINT (MIN. PER UNIT)	THROUGHPUT VALUE / TIME ON CONSTRAINT	PRODUCTION PRIORITY
PRODUCT-A	5.20	2.40	2.80	5.00	0.56	3
PRODUCT-B	6.25	3.25	3.00	3.60	0.83	2
PRODUCT-C	8.40	4.30	4.10	1.75	2.34	1

In Table-7, "Production Priorities" are calculated in ABC Manufacturing Company according to the Contribution Margin Approach:

Table-7: ABC MANUFACTURING COMPANY
PRODUCTION PRIORITIES ACCORDING TO THE CONTRIBUTION MARGIN APPROACH

	SELLING PRICE (€ PER UNIT)	DIRECT MATERIAL COST (€ PER UNIT)	DIRECT LABOUR COSTS (€ PER UNIT)	MANUFACTURING OVERHEAD COSTS (VARIABLE) (€ PER UNIT)	TOTAL UNIT VARIABLE COSTS (€ PER UNIT)	UNIT CONTRIBUTION MARGIN (€ PER UNIT)	PRODUCTION PRIORITY
PRODUCT-A	5.20	2.40	0.25	0.15	2.80	2.40	2
PRODUCT-B	6.25	3.25	0.30	0.20	3.75	2.50	1
PRODUCT-C	8.40	4.30	0.95	0.85	6.10	2.30	3

Calculation of Optimal Product Mix According to The Theory of Constraints Approach

Production Priority 1 : Product-C
Required Capacity for Product-C in Production Department-IV
=(Demand Quantity of Product-C) x (Required Processing Time for Product-C in Production Department-IV)

Required Capacity for Product-C in Production Department-IV
= **6,000 units** x 1.75 minute per unit = 10,500 minutes

Remaining Capacity in Production Department-IV After Manufacturing of Product-C
= 57,600 – 10,500 = 47,100 minutes

Production Priority 2 : Product-B
Required Capacity for Product-B in Production Department-IV
= (Demand Quantity of Product-B) x (Required Processing Time for Product-B in Production Department-IV)

Required Capacity for Product-B in Production Department-IV
= **5,000 units** x 3.60 minute per unit = 18,000 minutes

Remaining Capacity in Production Department-IV After Manufacturing of Product-B
= 47,100 – 18,000 = 29,100 minutes

Production Priority 3 : Product-A
Manufacturable Quantity of Product-A with Remaining Capacity in Production Department-IV
= 29,100 minutes ÷ 5.00 minute per unit = **5,820 units**

OPTIMAL PRODUCT MIX (According to The Theory of Constraints Approach)
Product-A 5,820 units
Product-B 5,000 units
Product-C 6,000 units

After calculation of Optimal Product Mix according to the Theory of Constraints, Throughput Value Format Income Statement related to ABC Manufacturing Company's two-month operating period is prepared in Table-8:

Table-8: ABC MANUFACTURING COMPANY – 2 MONTHLY OPERATING PERIOD
THROUGHPUT VALUE FORMAT INCOME STATEMENT (€)
(ACCORDING TO THE THEORY OF CONSTRAINTS APPROACH)

SALES REVENUE		**111,914**
Product-A ..... 5,820 X 5.20	30,264	
Product-B ..... 5,000 X 6.25	31,250	
Product-C ..... 6,000 X 8.40	50,400	

(-)DIRECT MATERIAL COSTS		**(-)56,018**
Product-A ..... 5,820 X 2.40	13,968	
Product-B ..... 5,000 X 3.25	16,250	
Product-C ..... 6,000 X 4.30	25,800	
THROUGHPUT		**55,896**
(-)DIRECT LABOUR COSTS		**(-)8,655**
Product-A ..... 5,820 X 0.25	1,455	
Product-B ..... 5,000 X 0.30	1,500	
Product-C ..... 6,000 X 0.95	5,700	
(-)MANUFACTURING OVERHEAD COSTS (VARIABLE)		**(-)6,973**
Product-A ..... 5,820 X 0.15	873	
Product-B ..... 5,000 X 0.20	1,000	
Product-C ..... 6,000 X 0.85	5,100	
(-)MANUFACTURING OVERHEAD COSTS (FIXED)		**(-)13,450**
Product-A	3,750	
Product-B	2,500	
Product-C	7,200	
OPERATING PROFIT		**26,818**

Calculation of Optimal Product Mix According to The Contribution Margin Approach

Production Priority 1 : Product-B
Required Capacity for Product-B in Production Department-IV
= (Demand Quantity of Product-B) x (Required Processing Time for Product-B in Production Department-IV)

Required Capacity for Product-B in Production Department-IV
= **5,000 units** x 3.60 minute per unit = 18,000 minutes

Remaining Capacity in Production Department-IV After Manufacturing of Product-B
= 57,600 – 18,000 = 39,600 minutes

Production Priority 2 : Product-A
Required Capacity for Product-A in Production Department-IV
= (Demand Quantity of Product-A) x (Required Processing Time for Product-A in Production Department-IV)

Required Capacity for Product-A in Production Department-IV
= **7,500 units** x 5.00 minute per unit = 37,500 minutes

Remaining Capacity in Production Department-IV After Manufacturing of Product-A
= 39,600 – 37,500 = 2,100 minutes

Production Priority 3 : Product-C
Manufacturable Quantity of Product-C with Remaining Capacity in Production Department-IV
= 2,100 minutes ÷ 1.75 minute per unit = **1,200 units**

OPTIMAL PRODUCT MIX (According to The Contribution Margin Approach)
Product-A 7,500 units
Product-B 5,000 units
Product-C 1,200 units

After calculation of Optimal Product Mix according to the Contribution Margin approach, Contribution Margin Format Income Statement related to ABC Manufacturing Company's two-month operating period is prepared in Table-9:

Table-9: ABC MANUFACTURING COMPANY – 2 MONTHLY OPERATING PERIOD CONTRIBUTION MARGIN FORMAT INCOME STATEMENT (€)

SALES REVENUE			**80,330**
Product-A ..... 7,500 X 5.20	39,000		
Product-B ..... 5,000 X 6.25	31,250		
Product-C ..... 1,200 X 8.40	10,080		
(-)TOTAL VARIABLE COSTS			**(-)47,070**
Direct Material Costs		**39,410**	
Product-A ..... 7,500 X 2.40	18,000		
Product-B ..... 5,000 X 3.25	16,250		
Product-C ..... 1,200 X 4.30	5,160		
Direct Labour Costs		**4,515**	
Product-A ..... 7,500 X 0.25	1,875		
Product-B ..... 5,000 X 0.30	1,500		
Product-C ..... 1,200 X 0.95	1,140		
Manufacturing Overhead Costs (Variable)		**3,145**	
Product-A ..... 7,500 X 0.15	1,125		
Product-B ..... 5,000 X 0.20	1,000		
Product-C ..... 1,200 X 0.85	1,020		
TOTAL CONTRIBUTION MARGIN			**33,260**
(-)TOTAL FIXED COSTS			**(-)13,450**
Manufacturing Overhead Costs (Fixed)		**13,450**	
Product-A	3,750		
Product-B	2,500		
Product-C	7,200		
OPERATING PROFIT			**19,810**

If the company determines Optimal Product Mix according to the Theory of Constraints, it obtains €26818 Operating Profit; however, if it determines Optimal Product Mix according to the Contribution Margin approach it only obtains €19810 Operating Profit. As is seen, Throughput Accounting provides the company with higher Operating Profit in two-month period. The solution of the Theory of Constraints for the constraint provides ABC Manufacturing Company with **"€26818 – €19810 = €7008"** more Operating Profit. Managing the constraint effectively in ABC Manufacturing Company is available through the solution brought by the Theory of Constraints. ABC Manufacturing Company should make a new capacity building investment aimed at removing capacity constraint in Production Department-IV by focusing on this solution in this phase in order to increase the performance of production system. After it removes the constraint, the company should continue to manage the new constraints which can occur during the continuous improvement process that has been mentioned before.

5. Conclusions

Theory of Constraints is a concept of management which aims to improve companies continuously and increase their performances by focusing on constraints in production process and managing the constraints effectively. The Theory of Constraints, which focuses on increase in profitability in businesses, accepts all the expenses except for direct material costs as operational costs. The Theory of Constraints lays

emphasize on Throughput in system performance measurement. Throughput is calculated by taking direct material costs out from sales revenue. The Theory of Constraints argues that the increase in businesses' performances, consequently the increase in their profits, depends on managing the constraints in their systems effectively. In managing the constraints effectively, the rate of throughput per the limited duration calculated for the subject production phase of the constraint in the production process is very significant in terms of effectiveness. In the application part of our study, the effect of a capacity constraint occurring during the production process on business profitability has been examined with the comparison of the approaches of the Theory of Constraints and traditional Contribution Margin; it is seen that the Theory of Constraints that bases "Throughput Value / Time on Constraint" in managing the constraint effectively has more successful results when it is compared to traditional approach.

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