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THE USE OF LINEAR PROGRAMMING IN DETERMINING THE OPTIMALITY OF PRODUCTION MIX THAT MAXIMIZED PROFITABILITY IN LIGHT OF THE THEORY OF CONSTRAINTS: A CASE STUDY

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ABSTRACT
While companies produce several products, the range of constraints and bottleneck might be multiple, thus requiring the need to manage such constraints efficiently and effectively and guide the company's resources towards producing production mix that maximizes profits. In this case the linear programming model considered one of the main models used in achieving the optimum production mix that maximizes profits and therefore considered one of the tools of the theory of constraints.

Keywords: Linear Programming, Theory of Constraints, Furniture industry

INTRODUCTION

(Mehra, 2005) determines the Theory of Constraints (TOC) as a prominent approach among methodologies to improve manufacturing, which earned considerable attention in recent years, as a philosophy that relies on logical thinking. (Holmes, 2005) clarifies on Eliyahu M. Goldratt who presented the (TOC) last 1986 as a management style for controlling a manufacturing plant and implementing a significant improvement in management through focusing on a constraint that prevents a system from achieving a higher level of performance (Goldratt, E.M., 1986). This system known as Drum-Buffer-Rope (DBR) (Rahman, S., 1998). Gradually Goldratt focuses on the concept that moved from the production floor to encompass all aspects of business, and by 1987 the overall concept became known as the Theory of Constraints (TOC). Goldratt in his book titled "The Goal" focuses on the nature of constraints in limiting the performance of an organization, where as a constraint is defined as any factor that limits the process or the system from doing more of what it was planned to a accomplish. Constraints can be time constraint, labor constraint, market constraint, ..etc. as it reducees throughput, however the key to this theory is to consider that any system can be presented as the form of events, or diagrams (Rahman,1998) (Mabin and Balderstone, 2003). Therefore the theory of constraints deals with finding bottlenecks in production lines and to address them to balance the energies at the level of production lines, and this leads to improving the efficiency of internal processes, thus

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maximizing the return on internal processes throughput that affect eventually in the increase of profitability. And to achieve the interests of stockholders and other parties and supports it through the existence of a set of instructions and rolls that stem from the application of this theory that governs relationship between the constraints. (Holmes and Hendricks, April,2005)

THEORY OF CONSTRAINTS CONCEPT AND THE UNDERLYING ASSUMPTIONS

The theory of constraint was developed to assist management in improving the speed of manufacturing processes, reducing cycle time and operating costs. (Pegels and Watrous, 2005) Taking into consideration that management use to allocate most of their time as an effort to improve the efficiency and accelerate the manufacturing processes as a whole, rather than focusing on the attention of the activities which are considered to be constraints and/or bottleneck areas in the process as a whole. By focusing on the efficiency of activities which are not considered as constraints that might lead to disruption or delay in the production process, due to the accumulation of production stocks under operation in the activities that considered to be constraint activities. (Mackey, Jim and Mike Thomas,1995) (Stein, 1996) (Rezaee and Elmore, 1997) (Ray et al., 2010) (Robbins, 2011) (Tulasi & Rao, 2012). Therefore the Theory of Constraints TOC can be defined as a strategic tool to effectively help companies improve an important factor for success, namely: the cycle time, which turns raw materials into final products by identifying and deleting places of bottlenecks where semi-finished products accumulate while waiting for the completion of its role in the production process.(Gupta et al., 2010).

THEORY OF CONSTRAINTS ASSUMPTIONS

There are certain assumptions underlying the theory of constraints, these assumptions are: (Kim et al., 2008) (Spector, 2011 Y.) (Ur Rahman, 1998).

First: Maximizing firms' profitability, as the main objective of the firms is to capitalize on their funds to achieve the greatest possible achievements leading to maximize profitability, the improvement of quality, satisfy customers needs, the speed of product delivery, adopt to technological development and make progress more quickly than competitors, therefore contribute to the achievement and increase profitability. Secondly; the presence of one or more constraints that hinders the ability to achieve firms' entity of the desired level of performance, which could lead to the minimization achievements of the overall firms' entity. According to the Theory of Constraints, it could be the limitations on the manufacturing processes as an external constraints (such as market demand, or the availability of raw materials, or might be internal constraints (such as energy resources, that limit the possibility of producing the required quantity

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of the market). The third assumption: is the use of throughputs as a way to measure margin achievement which is measured as the difference between sales revenue and the cost of direct materials. In addition the Interrelationship of Resources, as TOC focuses on achieving a balanced flow of production through the system to increase the margin of achievement by minimizing the points of bottlenecks, taking into consideration the required division of resources in terms of the level of constraints. (Goldratt, 1994) and this has been supported by applied researches by (Rahman, S. (2013) Noreen, E.–Smith, D.–Mackey, J. (1995): (Dettmer,1997) (Scheinkopf,1999) Cox & Schleier (Eds.) (2010) Cox, Boyd, Sullivan, Reid & Cartier (2012).

THE IMPLEMENTATION STEPS OF TOC

Using the Theory of Constraints in identifying and managing constraints and bottlenecks that could possibly occur in the production process in order to speedup the flow of products and improve production processes which requires a series of steps that can be determined as the following: Scheinkopf (2010) mentioned as copied from (Goldratt, E. M. (1990)

- Identifying the constraints and bottlenecks in the system: constraints could be defined as anything that limits the company's ability to generate more output, and the process of identifying constraints require the performance of some functions such as; putting production flowchart and diagrams showing the succession of operations and the amount of time required for each operation and determine the number of times for machines to be maintained and prepared for the performance of tasks in a single day. Thus noting several weak processes which represent production process constraints through identifying the relative importance of the constraints and their impact in achieving outputs. This process leads to identifying the constraints which represent the most influential constraints among other constraints and activities, which can be the focus point of attention in the improvement processes. Dettmer, H. W., (1997) Lepore, D., and Cohen, O., (1999)
- Determining the most profitable products combination in light of specific constraints: in this step, the process requirements and solutions that address the constraints is identified, as it have been pre-defined for the optimization use of the machine and determining the optimal product mix to be processed for the purpose of increasing the company profit. The most profitable production mix is an integration products that maximize company's total profitability. This is determined depending on the profitability of each product and the time required for each product on the constraints. Whereas in case of single product, the search will be focused on the way that maximizes production through the constraints. At this stage such constraints will be managed in an appropriate way for the purpose of

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using it in producing and selling profitable products only, or products with biggest value, in this case one of the constraint that will be generated through producing a product that creates a higher value or the completion of each unit of constraint capacity. However in the case of multiple constraints and bottlenecks, the matter requires the use of quantitative methods such as linear programming. Hall, R., N. P. Galambos, and M. Karlsson. 1997

- Maximizing the production flow through the constraints: In this step the firm will be looking for a way to accelerate the flow through the constraints by streamlining processes, improving product design, reducing setup time, reducing the activities of none added value, such as: screening, taking into consideration that there is an important tool for managing product flow, which is called a Drum-Buffer-Rope system (DBR) which serve as a system for balancing the production flow through the constraint, in a way that prevents the accumulation of materials or production under operation at different stages. However the Drum represents the speed in which the constraints operate. Whereas the Buffer represents the inventory as strategically determined to protect the output from deviations which may occur in the system. While the Rope represent the balanced time between the speed of resource constraints and the inventory which can be achieved through control of critical points. Sproull, B. 2009
- Adding energy to constraints: management have to act in such a way to ease the constraints and improve the cycle time in the long run by adding energy to the constraints, as this could be done by adding a new machine or upgrading old machine or even adding new workers. Hall, R., N. P. Galambos, and M. Karlsson. 1997
- Treatment and improving activity constraints of The first step: According to the concept of continuous improvement process within the concept of the Theory of Constraints, when overcoming the constraints or removing its effects on the system, this will show other constraints but it does not have the same effect as the former constraints. Therefore we should go back to the first step to find out the underlying causes for this constraints and processing it as to improve the system, taking into consideration that the policy adopted by the company to ease a specific constraints may not be suitable for other constraints or entries in the sense that there is no policy could be applicable for all times. The second step: to determining the most profitable product mix in light of the specific constraints using linear programming taking into consideration the Theory of Constraints. (Goldratt, 1990)
- The most profitable product mix according to the traditional entrance is based on the highest contribution earned by a product among different products, in the sense of the

extent of the contribution of each product in the coverage of fixed costs without taking into account resource constraints. While under the theory of constraints, it is the most profitable production mix in the light of the extent of the contribution of one hour of an activity restriction in the contribution of the output of each product, in the sense of the extent of the contribution of each product activity hour restriction in the coverage of fixed costs. The existence of the restriction within the resources of production processes in the company makes it imperative to manage the mix of the most profitable products to achieve optimum use of resources, and in the case of multiple constraints and bottlenecks in the process, the matter becomes more complicated when the company is facing the determinant of optimal product mix, which requires the use of linear programming, which is considered as a quantitative method, as designed in finding a product mix, that maximizes profit when there are a number of restrictions or constraints. (Blackstone, 2010 J.H.) (Goldratt, 1990) Hall, R., N. P. Galambos, and M. Karlsson. 1997, Sproull, B. 2009.

THE CONCEPT OF LINEAR PROGRAMMING

Linear programming defined as a mathematical way to allocate scarce resources or constraint resources in order to achieve a particular goal, with the objective of maximization profit, while it will be possible expression and restrictions on the ability to achieve such resources in the form of mathematical equations. It is also a mathematical method to allocate scarce resources to competing activities in an optimal manner when the problem can be expressed using a linear objective function and linear inequality constraints.. Thus, linear programming can be used in the cases of: (Dantzig, 1963), (Adams, 1969), (Hiller et al., 1995)

- Addressing situations involving the allocation of limited resources among competing uses.
- The cases in which the relations between various factors relating to the phenomena in question can be represented in straight lines, or in other words where relations are linear.
- Achieving the objective sought by the company as a result of the solution to the problem resulting into maximizing profits to the maximum level, or minimizing costs to the minimum level. (Winston and Albright, 2000), (Anderson et al., 2002).

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THE LINEAR PROGRAMMING PROBLEM SPECIFICATIONS

Programming model preparation requires the need for the availability of a particular specification in the problem to be solved and these specifications are as follows: (Manley and Threadgill, 1991), (Zappe et al., 1993), Taghrid, I., & Hassan, F. (2009)

- Necessity of having one goal to be achieved, measured by the maximum profit or maximum possible value or cost, and this goal must be clear and precise.
- The problem should involve a number of decision variables which lead to choosing the optimum value for each of them to be achieved, these variables may be units of products or distribution areas or channels, or any different activities undertaken by the company.
- There should be constraints that limit the company's ability to achieve the desired goal, these restrictions may be expressed for the limited resources available in the company, as well as these constraints relate to the nature of the activities and the environment surrounding it, therefore, the decision-maker doesn't have an absolute hands in his choice of the values of the decision variables that achieve the desired goal.
- The need for all decision variables to be continuous, meaning the decision variables can take any fractional values and not necessarily integer values all the time.
- The need for a linear relationships between the variables included in the issue.
- The need for the availability of the necessary data for the preparation of the model, as these data should be known as uncertain.

ASSUMPTIONS UNDERLYING THE LINEAR PROGRAMMING

The importance of the availability of the mentioned specifications due to the nature of the programming model and assumptions, since any question of linear programming is based on a number of assumptions which can be summarized as follows: (Chopra and Meindl, 2001), (Thomas, 2002), (Stadtler, 2000), (Taghrid and Hassan, 2009), (Fagoyinbo et al., 2011)

- Linear: meaning the relationship between the problem variables should be as linear relationships, this means that the function of the objective and constraints imposed on the problem and its equation should be of the first class.
- Non-negativity: it means that all the variables that come within the linear programming model must be non-negative, (greater or equal to zero), as it cannot be said that the volume of production for example is negative in any way.

- The indivisibility: meaning the problem can be scalable or the possibility of fragmentation of available resources and units produced, where it is possible to show variables with fractional values in the optimal solution of the problem.
- Proportionality: meaning that each unit of symmetric production units uses the same amount of resources available.
- Addendum: meaning that the total amount of resources used for all activities must be equal to the total resources used in each activity separately.
- Certainty: meaning that all parameters in question are confirming and stable variables, such as: the assumption of a steady sale price of a certain unit with the variable cost of the same unit. Therefore the certainty element must be provided to ensure the absence of possibilities in relations of linear programming model.

THE LINEAR PROGRAMMING MODEL

The linear programming model is a mathematical expression problem often represents allocation problems where limited resources are allocated to a number of economic activities Taghrid, I., & Hassan, F. (2009), Taha, Hamdy A., (2007), Taha, H. (1975). Therefore a linear program consists of a set of variables, a linear objective function indicating the contribution of each variable to the desired outcome, and a set of linear constraints describing the limits on the values of the variables. The answer to a linear program is a set of values for the problem variables that results in the best — largest or smallest — value of the objective function and yet is consistent with all the constraints. Formulation is the process of translating a real-world problem into a linear program. Once a problem has been formulated as a linear programming, a computer program can be used to solve the problem. However the cornerstones of any mathematical model reflects the linear programming problems, which consist of variables in the objective function and its constraints imposed to achieve the objectives of the problem, and the general formulation of the LP model is as follows:

(Max or Min) $Z = \sum_{j=1}^{n} Cj\ Xj$ …(1)

S.t

$= \sum_{j=1}^{n} a\ ij\ Xj\ (\leq,=\geq)\ bi,\ i= 1, 2, \ldots\ m$ ….(2)

$Xj \geq 0,\ j=1\ ,2 \ldots n$ …(3)

Where as:

- Equation (1) is the objective function, whether the decision maker wants to achieve the maximizing profit or minimizing the costs.

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- Equation (2) represents the constraints imposed in the production process to achieve the goal.
- Equation (3) represents the nonnegative constraints.
- Xj, represents The decision variables or (the elements of production process)
- Cj, represents the profit or cost per unit of j element.
- Bi, represents the quantity of available raw materials.
- Aij, represents the amount required by one unit from j element, of raw materials i.

THE CASE STUDY

For the purpose of clarifying the use of linear programming method in determining the products mix which will achieve the maximum profits in the light of the Theory Of Constraints (TOC), therefore the application of this method will be employed to the following case of one industrial company, namely (Nazal Furniture co.) a producer company that applies the theory of constraints in an attempt to ease the constraints and bottlenecks that limit the ability of the company to provide products needed quantity and time wised.

Therefore an appropriate solution of linear programming model with the optimal product mix, which will maximize profits using the software namely: "Quantitative System for Business" (QSB) to identify the optimal solution a company should be utilized. As this company has two production lines namely: (home furniture, and office furniture). The researcher has focused on the second line "office furniture" taking into consideration three products: the first called a meeting table (X1), the Office locker (X2), and desk table (X3). Manufacturing these products requires A range of activities namely:

- Receiving and Inspection
- Cutting
- Refining
- Installation
- Dyeing

The following data extracted from the records of the aforementioned company for one year only 2013/2014, as the researcher was given a permit for that year.

Table 1: the available energy for each activity and the required energy for each production unit in each activity

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Activity	Energy required for hours to manufacture one unit of each product			Energy available in hours for each activity
	X1	X2	X3	
Receiving and Inspection	2	1	2	3700
Cutting	1	1	2	3100
Refining	2	0	1	3350
Installation	2	2	1	3450
Dyeing	1	2	1	3950

Table 2:
Annual expected sales size, and sale price per unit of each product, with both the variable cost and fixed costs

Details	X1	X2	X3
Annual sales volume	650 units	550 units	1150 units
sale price per unit	268	243	236
Direct material per unit	18	23	36
Direct wage per unit	14	26	20
fixed costs share per unit	19	17	27

The company is facing difficulties in meeting the demand for its products in the light of the annual sales amount. Thus the company expects that there are limitations and bottlenecks in the activities required manufacturing the products, as a result, the company's application of the theory of constraints has been employed to overcome bottlenecks and constraints that limit their ability to meet consumer demands. It was found that there are a set of restrictions, and the company found that the appropriate solution in the light of this situation is through the optimal mix of products to maximize profits.

Determining the products mix to the maximum profit for this company, as it applies the theory of constraints, requires the researcher to know the activities that constitute the centers of bottleneck

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or constraints to the production process. Therefore, the solution of this problem, after identifying the most profitable product mix will be through the following steps:

- Determining the activities that constitute constraints in the production process.
- Determining the profit margin for each product in light of the theory of constraints.
- Determining the most profitable product mix in the light of the theory of constraints using the technique of linear programming

The following is an explanation of each of the above steps:

1. Identifying activities that have constraints in the production process, namely:
    a. The energy needed for manufacturing activities of the three products are identified, on the basis of:
        - The volume of expected annual sales.
        - The energy required to manufacture one unit of the product in each activity.

Table 3: illustrates the Energy needed by the activities to manufacture the products by hours

Activity	Products			Total Hours
	X1	X2	X3	
Receiving and Inspection	2*650=1300	1*550=550	2*1150=2300	4150
Cutting	1*650=650	1*550=550	2*1150=2300	3500
Refining	2*650=1300	0*550=0	1*1150=1150	2450
Installation	2*650=1300	2*550=1100	1*1150=1150	3550
Dyeing	1*650=650	2*550=1100	1*1150=1150	2900

b. Determining the activities that are considered to be constraints by comparing the energy needed for manufacturing activities products, and the energy available in each activity and table (4) after the previous calculation in Table (3) shows that calculations.

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Table 4: Activities that are considered constraints

Activities	Energy available	The energy needed by the activities for manufacturing products	Differences
Receiving and Inspection	4150	3700	-450
Cutting	3500	3100	-400
Refining	2450	3350	900
Installation	3550	3450	-100
Dyeing	2900	3950	1050

It could be noted from the previous table that "Receiving and inspection", "Cutting ", and "Installation " are activities with constraints due the shortage of energy available in each activity of the mentioned activities of the actual energy needed for manufacturing products.

2. Identifying profit margin for each production in the light of TOC based on the third assumption of TOC, where profit margin is determined by the calculation between unit selling price and the unit of direct cost for each produced product as in the following table.

The following table summarize profit margin for all products

Table 5: achievements margin for each product

Details	X1	X2	X3
Product price	268	243	236
Direct materials cost	-18	-23	-36
Profit margin	250	220	200

3. Identifying the most profitable product mix in the light of TOC

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Since there are some activities that form constraints and bottlenecks in the production process, therefore the linear programming will be used in order to determine the most profitable product mix through "QSB Software package" as follows:

a. Formulating the mathematical model for the linear programming of this study as follows:

Obj. Fun.

Max $Z = 250X1+220X2+200X3$
S.t:

$2X1+X2+2X3 \leq 3700$
$X1+X2+2X3 \leq 3100$
$2X1+2X2+X3 \leq 3450$
$X1, X2, X3 \geq 0$

b. Entering the form of the linear programming into (QSB) Quantitative System for Business for solving the model, as the following:

Figure 1: "QSB Plus" surface

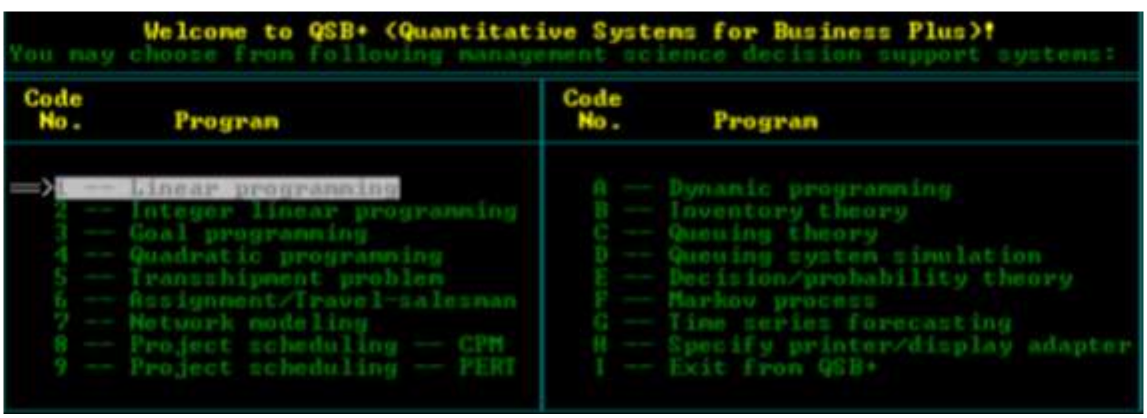

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Figure 2: entering the form

Enter the Coefficients of the LP Model

Max 250______X1 220______X2 200______X3
Subject to
(1) 2______X1 1______X2 2______X3 ≤ 3700____
(2) 1______X1 1______X2 2______X3 ≤ 3100____
(3) 2______X1 2______X2 1______X3 ≤ 3450____

Figure 3: represents the initial tabeau

		X1	X2	X3	S1	S2	S3		B(i)
Basis	C(j)	250.0	220.0	200.0	0	0	0	B(i)	A(i,j)
S1	0	2.000	1.000	2.000	1.000	0	0	3700	0
S2	0	1.000	1.000	2.000	0	1.000	0	3100	0
S3	0	2.000	2.000	1.000	0	0	1.000	3450	0
C(j)-Z(j) * Big M		250.0 0	220.0 0	200.0 0	0 0	0 0	0 0	0 0	

Figure 4: represents the first Iteration, where S3 leaves and X1 enter

		X1	X2	X3	S1	S2	S3		B(i)
Basis	C(j)	250.0	220.0	200.0	0	0	0	B(i)	A(i,j)
S1	0	2.000	1.000	2.000	1.000	0	0	3700	1850
S2	0	1.000	1.000	2.000	0	1.000	0	3100	3100
S3	0	2.000	2.000	1.000	0	0	1.000	3450	1725
C(j)-Z(j) * Big M		250.0 0	220.0 0	200.0 0	0 0	0 0	0 0	0 0	

Figure 5: represents the second Iteration, where S1 leaves and X3 enter

		X1	X2	X3	S1	S2	S3		B(i)
Basis	C(j)	250.0	220.0	200.0	0	0	0	B(i)	A(i,j)
S1	0	0	-1.00	1.000	1.000	0	-1.00	250.0	250.0
S2	0	0	0	1.500	0	1.000	-.500	1375	916.7
X1	250.0	1.000	1.000	0.500	0	0	0.500	1725	3450
C(j)-Z(j) * Big M		0 0	-30.0 0	75.00 0	0 0	0 0	-125 0	4E+05 0	

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Figure 6: represents the third Iteration, where S2 leaves and X2 enter

		X1	X2	X3	S1	S2	S3		B(i)
Basis	C(j)	250.0	220.0	200.0	0	0	0	B(i)	A(i,j)
X3	200.0	0	-1.00	1.000	1.000	0	-1.00	250.0	250.0
S2	0	0	1.500	0	-1.50	1.000	1.000	1000	666.7
X1	250.0	1.000	1.500	0	-.500	0	1.000	1600	1067
C(j)-Z(j)		0	45.00	0	-75.0	0	-50.0	5E+05	
* Big M		0	0	0	0	0	0	0	

Figure 7: represents the final tableau, where x1 = 600, x2 = 666.7, and x3 = 916.7, and Z = 480000

		X1	X2	X3	S1	S2	S3		B(i)
Basis	C(j)	250.0	220.0	200.0	0	0	0	B(i)	A(i,j)
X3	200.0	1E-17	1E-17	1.000	0	0.667	-.333	916.7	0
X2	220.0	3E-17	1.000	1E-17	-1.00	0.667	0.667	666.7	0
X1	250.0	1.000	0	0	1.000	-1.00	0	600.0	0
C(j)-Z(j)		0	0	0	-30.0	-30.0	-80.0	5E+05	
* Big M		0	0	0	0	0	0	0	

Figure 7: represents the final solution summary, where x1 = 600, x2 = 666.7, and x3 = 916.7, and Z = 480000, as the follwing:

Max Z = 250x1 +220x2 + 200x3

Thus 250 * 600 + 220 * 666.7 + 200 * 916.7 = 480000 NIS

Final Solution for Prob1 Page : 1

Variable No.	Variable Names	Solution	Opportunity Cost	Variable No.	Variable Names	Solution	Opportunity Cost
1	X1	+600.00000	0	4	S1	0	+30.000000
2	X2	+666.66669	0	5	S2	0	+30.000000
3	X3	+916.66669	0	6	S3	0	+80.000000

Maximized OBJ. = 480000 Iteration = 3 Elapsed CPU second = 142.0391

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Figure 8: represents the senitivity analysis for the Obj. Coef., where x1 originally had a margin profit of “250” NIS will be in the range of 220 to 280, and x2 originally have a margen profit of “220” NIS will be in the range of 175 to 250, while x3 originally have a margen profit of “200” NIS will be in the range of 155 to 440 as the company will still be in the safe side.

Sensitivity Analysis for Objective Coefficients Page : 1

Variable	Min. C(j)	Original	Max. C(j)	Variable	Min. C(j)	Original	Max. C(j)
X1	+220.000	+250.000	+280.000	X3	+155.000	+200.000	+440.000
X2	+175.000	+220.000	+250.000				

Figure 9: represents the sensitivity analysis for the constraints, where x1 originally had the energy of “3700” will be in the range of 3100 to 4366.67, and x2 originally have the energy of “3100” will be in the range of 2100 to 3700, while x3 originally have the energy of “3100” will be in the range of 2450 to 6200 as the company will still be in the safe side.

Sensitivity Analysis for RHS Page : 1

Constrnt	Min. B(i)	Original	Max. B(i)	Constrnt	Min. B(i)	Original	Max. B(i)
1	+3100.00	+3700.00	+4366.67	3	+2450.00	+3450.00	+6200.00
2	+2100.00	+3100.00	+3700.00				

CONCLUSIONS

Based on the analysis carried out in this research and the result shown, and the importance of the Theory of Constraints for companies is considered important, since it serve as a tool that helps in the work of turning raw materials into ready goods with the most minimum possible time through the identification of constraints and bottlenecks in the production process and minimizing from these constraints in order to maximize profitability taking into account the activities that have constraints and limited resources in the problem was posted in Nazal Furniture Company, and thus working to improve performance in activities with certain constraints only. However not all of the entity's activities will take the same attention from the company especially activities that seem to be free from constraints, thus reflecting to improve and accelerate the performance of the company as a whole. While when the company has multible products will be subject to face a range of restrictions and bottlenecks, thus requiring the distribution of these resources with certain constraints to the products the company produced in a manner that achieves the optimal use of these resources by identifying product mix that maximizes profits, taking into consideration the linear programming model as an important tool

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that is used in the light of the Theory of Constraints to overcome this problem, especially in light of the multiplicity of constraints and products which are used in problems which include a set of specifications and is based on a set of assumptions and therefore it is a mathematical expression to the problem that includes a number of variables, and therefore it can be said that it is one of the important tools used in the analysis of the Theory of Constraints in achieving its objectives, especially in light of multiple constraints and the multiplicity of products.

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