

Maximizing Machine Capacity by Improving Efficiency using Linear Programming Model

P. Sivasankaran, B. Radjaram, K. Karthigayan

Abstract: In the global manufacturing system, machine performance is considered to be one of the vital role in organization wellbeing. In specific analysing the capacity utilization of machines in each shift is a big challenging job in industrial organization. The primary importance is keeping the machines in uptime condition at the same time loading the jobs in machines decides the capacity usage of machines to do the useful jobs. In this paper focus is made on the capacity planning of machines in production shift. capacity utilization measures the actual capacity of machine with respect to the potential output within a specific period. In real situations if the demand for the product increases the production capacity also increases but at the same time if the demand falls capacity will also become very low. Hence in this work attempt has been made to develop a mathematical model for machine capacity planning using linear programming model solved by using LINDO software.

Keywords: Capacity utilization, uptime, LINDO, Linear Programming

I.INTRODUCTION

In the rapid changing environment organization faces several kinds of pressures to fix the production capacity in optimum level. The enterprise must use some scientific methods to survive healthier in global competition. While deciding the capacity of production by the manufacturing system managers must decide about the internal capacity of shop floor such as production target, number of labours, machineries and inventories etc. In this work internal capacities are number of production units and annual outputs produced the manufacturing enterprise. In this paper attempt has been made to develop mathematical model using LP model for measuring the capacity planning of production by textile manufacturing industries considered as case study for detailed illustration. Using quantitative model one can define the optimum capacity of production for each shifts.

1.1. Capacity planning:

Capacity is defined as the concept of defining the potential output produced by the manufacturing enterprise. Measuring the quantity of producing based on the given resources within the organization set up. Capacity planning involves set of decisions as given below:

1. Identifying the current level of production.
2. Identifying the future production
3. Analyse the factors which influences the capacity

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4. Evaluation of capacity alternatives by financial, technological aspects
5. Fixing the optimal capacity that best fits the enterprise.

Both capacity management and demand management are said to be the integrated measure for the shop floor system. Demand management concerned with variation in production quantity, price etc. In capacity management involves changes in production capacity, machine compatibility are some of the important measures. Accurate capacity planning and management involves effective usage of machines for optimum production. The level of demand and lot size determines the size of capacity in production planning and control systems. The simultaneous availability of machines and batch size ensures the performance of production system.

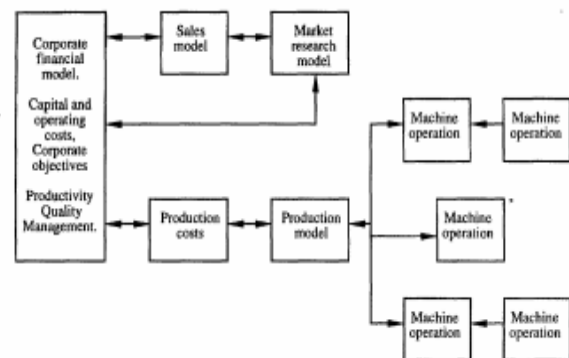


Fig 1. Corporate model of production system

1.2 Capacity selection

Capacity should be considered based on the variations in the current and future capacity of shop floor. Decisions based on the capacity selection is based on the following rules

- a. To find out the hike in economic capacity
- b. To find out the number of economic shifts
- c. Identifying the production capacity based on the seasonal demand
- d. To quantify the amounts of inputs like semi-finished products, operating supplies etc. to be purchased from other enterprises
- e. Estimation of a capacity plan in compliance with the technological developments and unexpected situations.

1.3 Classification of Capacity Planning

The production machine design planning considers input requirements, conversion manner and output. After thinking about the forecast and long-term making plans corporation need to undertake ability planning. Capacity is defined as the ability to achieve, keep or produce.



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For an organization, ability might be the potential of a given machine to produce output within the specific time period. In operations, management capacity is referred as an quantity of the input resources available to produce relative output over duration of time. In general, terms capacity is referred as most production capability, which may be attained inside an ordinary running schedule. Capacity planning is crucial to be determining optimal utilization of use fulresource and plays a crucial role decision making process, for example, extension of present operations, modification to product lines, beginning new products, etc.

1.4 Measurement of Capacity Planning:

Capacity planning is to be completed remembering future development and extension plans, showcase patterns, deals determining, and so forth. It is a straightforward assignment to design the limit if there should arise an occurrence of stable interest. Yet, by and by the interest will be only here and there stable. The vacillation of interest makes issues with respect to the obtainment of assets to fulfil the client need. Limit choices are vital in nature. Limit is the pace of profitable ability of an office. Limit is generally communicated as volume of yield per timeframe. Creation supervisors are increasingly worried about the limit with respect to the accompanying reasons:

- Adequate limit is required to satisfy the clients need in time.
- Limit influences the cost productivity of tasks.
- Limit influences the booking framework.
- Limit creation requires a speculation.

Capacity Measurement in Operations Management

Estimation of Capacity Planning

The limit of the assembling unit can be communicated in number of units of yield per period. In certain circumstances estimating limit is increasingly confounded when they make various items. In such circumstances, the limit is communicated as worker hours or machine hours. The connection among limit and yield.

Design Capacity:

Structured limit of an office is the arranged or built pace of yield of merchandise or administrations under ordinary or full-scale working conditions. For instance, the structured limit of the concrete plant is 100 TPD (Tons every day). Limit of the sugar industrial facility is 150 tons of sugarcane smashing every day.

System capacity:

System capacity is the most extreme yield of the particular item or item blend the arrangement of laborers and machines is fit for delivering as a coordinated entirety. Framework limit is not as much as plan limit or at the most equivalent, on account of the confinement of item blend, quality detail, breakdowns. The genuine is even less in view of numerous elements influencing the yield, for example, real interest, vacation because of machine/hardware disappointment, unapproved non-appearance.

II.LITERATURE REVIEW:

To furnish perusers with a review about tasks investigate models and applications Volling et al. (2013) distinguished ebb and flow and future research issues dependent on the audit of 49 works. To overcome any issues between applied takes a shot at the one hand and quantitative commitments on the other, they gave a system to the organizing of arranging assignments. For information assortment, a bibliographic database of research and the pertinent articles were evaluated. Among the works that they considered have been 26 from the German talking network and this gives proof that ways to deal with creation the board in the car business are especially very much evolved right now

Fulemová , Bicova (2014), exhibits a proficiency expanding of the watching exercises in the assembling workshop research facility at the college , where is required the operational scope organization of machines the executives and guaranteeing satisfactory number of a HR as per ISO 9001 prerequisites . They demonstrated that booking with the assistance of MS Project programming will be tackled distinctly for the outer lab (VTP) ,which is progressively utilized by accomplices and there isn't so hard to plan the agreements for a specific period .

Georgiadis, Athanasion (2013), managed long haul demand driven scope quantification in the opposite channel of shut circle supply chains (CLSCs) with remanufacturing, under high limit procurement cost combined with vulnerability in genuine interest , deals designs , quality and timing of end-of-utilization item returns . They utilized the joining technique Euler and the reconciliation time-step was equivalent to multi week (equivalent to or shorter than the most brief time consistent in the model). The model is fathomed by utilizing the Powersim 2.5c re-enactment programming bundle. The investigation likewise uncovered that adaptable approaches can successfully adapt to overinvestment wonders in remanufacturing offices, identified in close ideal strategies .

Huang et al. (2012) , built up an interim parameter chance constrained dynamic programming (ICDP) technique for the scope organization of an incorporated metropolitan strong waste (MSW) the executives framework under vulnerability. They utilized information envelopment examination (DEA) procedure to distinguish the ideal limit extension plot under various framework expenses and requirement infringement levels. This examination is the primary endeavor for arranging waste administration framework through coordinating the ICDP and DEA strategies, the outcomes recommend that the created strategy is a compelling apparatus for leaders for the long haul scope quantification .

Demeulemeester , Ma (2013) introduced a staggered integrative solution way to deal with an emergency clinic case blend and capacity planning issue based on scientific programming what's more, recreation examination that comprises of three stages, each of which contains its own significance and capacities.



Specifically, the proposed arrangement system incorporates three phases: i.e., the case blend arranging stage, the ace medical procedure scheduling (MSS) stage and the operational presentation evaluation phase. They demonstrated that the arranging issue can be stretched out over a medical clinic organize in a specific region, and the tactical case blend and scope quantification can be joined with the operational patient planning to shape a proficient human services

S.Pimental et al. (2013), introduced the Stochastic Capacity Planning and Dynamic Network Design Problem, which incorporates office area, arrange structure and scope quantification choices under interest vulnerability. An application to the Global Mining Supply Chain filled in as a foundation for the analysis of the highlights and multifaceted nature of the model. In order to manage such intricacy, they proposed a Lagrangian Heuristic. Surveying the double data gave by the Lagrangian multipliers could furnish us with some indications as to choose beginning limits, as examined above, or significantly other inventory network basic features [14]. To clarify the hole between the training and the scholarly models of creation arranging, Tenhiälä (2011), employed the contingency hypothesis of associations. Contentions on the possibility impacts of procedure multifaceted nature prompted a theory that expects straightforward scope organization techniques to be best in certain creation forms. The strategy for meetings and polls were utilized to gather information. The consequences of this study give speculative help for a possibility hypothesis of limit planning [15]. To consider the stochastic components' effects on scope quantification choice, Renqian (2007) assembled a stochastic limit extension model. For explaining this model, the limitations of dubious interest are changed into equal deterministic limitations and a heuristic calculation that joins the Genetic Algorithm (GA) and the Primal-Dual calculation of Nonlinear Programming, is delivered. Considering the stochastic and dynamic variables is critical to consider uncertainty in the future, which likewise assists with building up a total creation plan that needs the least change [16]. To break down the exhibition of sight and sound assistance systems, which have problematic assets, and to evaluate the limit necessity of the frameworks, Kim, Park (2002) built up a scope quantification model utilizing an open queueing system. By securing of use, line length of the assets and bundle postponement, and dependability of the frameworks, they inferred the administration limit of the frameworks alongside the appearance paces of customers and the disappointment paces of the resources. They exhibited that huge scope interactive media administration frameworks with criticism are untrustworthy operation.

Hwang et al. (2010), considered the interest and limit the board issue in an eatery framework. Markov procedures and (blockage) subordinate interest rate work were considered. A queueing based improvement model with basic semi birth-and-demise procedure and state-subordinate capacities created to address the dynamic and nonlinearity troubles. They demonstrated that neither one of the strategies is perfect for most easygoing cafés with the objective of benefit augmentation. Rather, a joint system that adjusts

both promoting and activities viewpoints ought to be embraced.

Martnez-Costa et al. (2014), offered a modern audit on vital scope organization in assembling organizations, with two fundamental destinations: (1) to depict and examine the key scope quantification issues; and (2) to survey the numerical programming models proposed in the writing for managing these issues. The principle search was directed in the Web of Science utilizing basic catchphrases and was supplemented by utilizing other web indexes. They reasoned that choices, for example, asset distribution and creation booking have been considered generally in the literature.

A.Duffie, Kim (2005), portrayed a model that speaks to the elements of a multi-workstation creation framework that fuses shut circle creation arranging and control. They utilized strategies for control building to make the examination tractable, just as improve comprehension and control of complex unique conduct and the recurrence reaction strategy was utilized to discover the cutoff points for stable reaction. They indicated that the apparatuses of control designing can be viably applied in the examination of multiworkstation systems.

Spicar (2014), depicted how framework elements assume a significant job in scope quantification and what issues happen when fail to represent, and developed easygoing circle graphs furthermore, stock and stream graphs for the models and the systems are reenacted utilizing the Vensim PLE programming. The outcomes affirmed that lacking limit may make the whole creation framework uncontrollably and capriciously vacillate despite the fact that all information parameters are held constant [21].

Koch et al. (2014), proposed a methodology that methodically builds the incomes of adaptable items when comprehending the DLP and performing limit control. They decided the function's parameters utilizing a standard reproduction based advancement strategy. Numerical examinations indicated that the advantages of the methodology are greatest when low worth interest shows up sooner than expected. To help dynamic underway arranging Peters Lanza (2012) built up a strategy by consolidating a queueing theory model with a stochastic, unique improvement approach. Thusly, they understood a Markovian Decision Process to find cost negligible arrangements as responses to unstable market requests for limiting expenses because of limit adjustments, changes in process steps, and areas. The strategy was able to respond to advertise changes by adjusting limits and changing procedure choices alluding to innovations, locations and machine types [23]. By incorporating the reenactment discipline and the criticism control hypothesis into a powerful thought of reusing systems

Georgiadis (2013), proposed a System Dynamics (SD) model for key scope quantification in the reusing business. This simulated CLRN creates the elements of the framework as endogenous outcomes of the implanted operational criticisms and gives a "test" device for arranging, testing and uncovering financially reasonable scope organization



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choices for the creation line (forward channel) and assortment focuses (switch channel). To fulfil the future need dependent on idealistic and critical financial projections Suryani et al. (2012), set up a technique for creating model to gauge air load request and situations identified with arranged limit development. The ramifications of remote direct speculation (FDI) and total national output (GDP) was utilized. From the after effects of certain analyses of 2k factorial plan, they reasoned that GDP Growth has a solid impact to air load request contrasted with others

(Becher, 2009), His objective was once to pick out the income practicable of a rule-based implementation of income administration as a approach for simultaneous ability and rate control. First, the typical conduction of this built-in technique was described primarily based on the accessible literature. Second, the barriers and constraints in the use of the underlying mannequin particularly in phrases of the applicability in exercise and the impreciseness of data have been illustrated. Third, a answer notion used to be mounted that is in position to cope with these limitations. Necessary balance and robustness of a fuzzy manipulate system was developed with the aid of a simulation device that was once in a position to performing a giant wide variety of fuzzy structures with altering parameters and analyze adjustments in the answer due to adjustments in the system. Showed that one of the most compelling motives for this variety of solution, in addition to considerable improvements in income, was once the ability to use the rule set for CPC and also for the SC.

Miglionico et al. (2014), addressed restaurant income administration from each a strategic and an operational factor of view. They proposed formulations of the so-called "Tables Mix Problem" with the aid of taking into account numerous elements of the real setting. The outcomes confirmed that all the reserving control policies, on common, perform higher than the easy First Come First-Served coverage and then the coverage bought in the case of ideal information of the demand realized. To maximize predicted revenues over a finite horizon.

Karaesmenetal. (2013), formulated a Markov Decision Process (MDP) that explicitly fashions the modern-day environment. They observed that the advantages from the environment-based model is tremendous if the prerequisites in distinctive environments are distinctively exclusive.

Ceryan, Koren (2009) formulated Optimal potential selection problem the use of blended integer programming and numerical studies carried out to furnish insights about how these choices are affected with the aid of funding costs, product revenues, demand forecasting situations and fluctuations in the planning periods. They confirmed that superior funding techniques consist of larger participation of bendy structures beneath lower flexibility funding cost, excessive product revenues as nicely as high merchandise uncertainties inside the time intervals. For multi-period an dmulti-echelon ethanol provide chains.

Giarolaetal. (2013), developed and applied a general Mixed Integer Linear Programming modelling frame works upporting strategic plan and planning selections. They addressed the supply of uncertainty thru ascenario-based

two-stage stochastic approach. Results confirmed the effectiveness of the modelling framework as a selection making-tool to steer choices and investments in the lengthy time period horizon among one of a kind ethanol gas configurations

Giarolaetal. (2012), developed a accepted blended integer linear programming modelling framework to examine the plan and planning of a multi-period and multi-echelon bioethanol upstream provide chain beneath market uncertainty and aim in gat the maximization of the economic over alperformance of the business (expected internet existing value, eNPV) and complying with environmental sustainability standards (minimum GHG emissions savings). Results confirmed the effectiveness of the mannequin as a choice making-tool to steer long-term selections and investments.

Moussawi-Haidar et al. (2010) developed a discrete-time dynamic ability manipulate mannequin for a cruise ship characterized by a couple of constraints on cabin and lifeboat capacities. They developed numerous heuristics and absolutely take a look at their performance, by simulation, towards the foremost solution, well crafted top bounds and a first-come first-served lower bound and observed that single-dimension a heuristics primarily based on decoupling the cabins and lifeboat problems operate quite well in most instances and the probability value of accepting a purchaser is now not usually uniform in time or the degree of reservation

Giarolaetal.(2012) addressed the layout of bio ethanol supply chains the place each corn grain and stover are regarded as suitable biomass. They proposed a Mixed Integer Linear Program to concurrently optimize the environmental and monetary performances with the aid of taking into account a vast range of technological options. The device boundaries have been set according to a Well-to-Tank (WTT) strategy and Modelling framework used to be formulated as a trouble MOMILP. They showed that in ordinary first era technologies, although more economically competitive, are now not a sustainable answer to the strength grant question, in particular if the present day EU law is taken into account .

Xieetal.(2014), studied a multi-channel distribution device in which a producer sells its product by means of an independent service company and a direct promoting market simultaneously. They multiplied the facts sharing difficulty for a case with three companions and multi-channel distribution. The decision making mechanism developed through the paper is tremendous in solving the manufacturing capability planning and allocation problem.

Fang, Ho(2013), raised problems associated to the session on allocation of potential for a couple of products. They used general reduced gradient technique to gain an most appropriate answer and modified it for the algorithm associated to nonlinear mannequin with constraints, that can attain the ultimate answer through randoms election of a realistic solution.



They confirmed that marginal benefit, stock preserving cost, scarcity cost, lack of surplus production and the market needs in an effort to discover the optimal allocation of ability related with number merchandise have to be viewed.

Steele et al. (2001) furnished a aid modelling shape that integrated the evaluation of product with conduct of the bodily productive sources (Embedded in the software program purposes methods) for product design, technique planning, manufacturing cost, nice control, use ful resource acquisition, planning and production scheduling and implementation of shop-floor things to do .This shape wasonce based totally on a set of manufacturing assets training that decide the shape of are source modelling database. These lessons are used for constructing object oriented software program bundle which implements quite number features of engineering diagram

Koenig, Meissner (2010) viewed the hassle of a company promoting more than one merchandise that devour a single aid over a finite time duration and analyzed the distinction between a dynamic pricing coverage and a list-price ability manipulate policy.

Mokhtari et al. (2011) introduced an built-in mannequin between a manufacturing capability planning and an operational scheduling decision making method. Based on the thinking of non delay time tabling (employed through VNS and GASA) and enhanced time tabling (adapted by using CLM), they developed an improved hybrid timetabling with the aid of enjoyable the permutation constraints and the usage of inversed problem. They carried out a two-phase genetic algorithm method for the crashing and sequencing problems. They used heuristics and two meta-heuristics (VNS and GASA) methods. Experimental consequences supported the effectiveness of counselled sequencing strategy in opposition to other methods. Therefore, in future studies, it is encouraged to consider capacity manipulate and in fact, see these two views collectively and consider potential planning and manage in a number fields and modelling in this subject as properly as enforce fashions in a large area so that the outcomes will have excessive savings and can be utilized in problems of the day and this will doubtlessly make sure the company's success in the future.

III. PROBLEM STATEMENT

In this work attempt has been to maximize the production capacity of shop floor with respect to the constraints. Hence Mathematical model is formulated by using linear programming technique. In this paper case study is illustrated by describing the operation strategy carried out in textile industries.

3.1. Case study illustration

In the textile factory, fabrics procured from domestic and foreign suppliers are stocked in warehouses and meters and fabric errors are measured by means of cloth control machines. Data obtained are conveyed to the Model unit. within the light of this information, the model unit makes the required calculations consistent with the garments within the model and notifies the cutting unit and planning departments of the obtained information. the design department calculates cutting-production losses and

informs cutting, sewing, ironing and packaging units about the output. Bar code within the number of pieces calculated is distributed to the departments. Each department swipes the Universal Product Code of the produced product by means of a Universal Product Code device and thus product tracking is performed. In line with the instructions, the warehouse delivers fabrics and consumables (interlining, lining, pocketing, felt, fiber, thread) to the cutting unit by writing batch numbers and by means of transpalets. Model unit informs the cutting unit about the mold to be used and therefore the cutting unit cuts fabrics with such mold. After the cutting process, fabric pieces are conveyed to the stitching unit to be sewed then sent to the ironing unit through a rail system. After ironing is completed, products are delivered to the packaging unit. Following the completion of packaging process, products are sorted consistent with their destination and shipped.

Main production units in textile industry: Raw material unit :

The fabrics and consumables required for textile production are procured from Istanbul, Bursa, Gaziantep and Adana within the country and imported from Germany, China, France and Holland out of the country. Therefore, there's no limitation in terms of staple for the production. Fabrics stored within the storage unit are put through shrinkage, rubbing, wing and barré (fabric dye quality) tests. Furthermore, storage isn't considered as a constraint because the warehouses are large enough (15000m²).

Cutting unit:

Molds prepared in the model unit where the product design is made, which do not have adirect influence on production, and mold information are given to the cutting unit that has an area of 7500m². The cutting unit places the molds and lays on the fabrics delivered by the warehouse in line with work orders and customs. Plaid fabrics are cut with a hand motor by virtue of their properties. Flat fabrics are cut by means of a computed-aided cutting system. The cut fabrics are marked with a marking method, indicating the pieces to be sewed to each other. After this process, pieces to be interlined are processed in 2 interlining machines and other pieces are directly conveyed to the sewing unit by means of transpalets. Due to capacity deficiency in the sewing unit, a part of the fabrics is sent to the respective workshops for contract sewing.

Sewing unit

Textures, which are gotten through the necessary procedures in the cutting unit, are sewed on 8 groups comprising of 140 sewing machines. Catch buttonhole works are additionally performed by this unit. In the wake of experiencing all the procedures, items are taken to the pressing unit in 20-piece cases by methods for transpalets. The sewing unit has a zone of 150000m², yet the zone utilized is just 500m².

Ironing unit

The sewed items are arranged by the pressing degree as those to be pressed with hand iron and those to be pressed with press iron.



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There are 30 hand irons and 30 press presses right now. Pressing unit has a zone of 7500 m². Last checks are performed after the pressing procedure and the broken items are either sent to sewing unit or pressing unit as indicated by the wellspring of deformity. Impeccable items are sent to the bundling unit by methods for a rail framework with a suspender.

Packaging unit

Sewed and pressed items, which are fit to be utilized, are passed on to the bundling unit that is situated on a similar floor and has a territory of 7500 m². Bundling is acted in two ways: the first is suspended bundling process by methods for programmed machine and the other is hand bundling. Minstrel codes are appended to the items and they are arranged by their sizes right now. As the undertakings is occupied with trade, bundles are arranged by the nations and delivered.

3.2. Products made in the industry:

The products manufactured in the industry are listed in the table 3.3. as given below unit production times are also specified in the following table .

Products	Unit production times (Minutes)				Annual output (Pcs)	
	cutting	Sewing	Ironing	Packaging	Enterprise	Contract
Blouse (X1)	6	70	7	3	1345200	53254
Jacket (X2)	12	50	10	2	102400	69230
Dress(X3)	11	35	11	12	1245250	79046
Skirt (X4)	7	33	6	15	74000	124237
Coat (X5)	2	40	14	18	13000	40870
Pants(X6)	7	15	5	25	145430	150737
Scarf (X7)	3	50	2	11	1360	11775
Shorts (X8)	1	20	4	22	2140	16
Coveralls(X9)	8	35	15	15	3630	2099
Tunic (X10)	12	25	8	35	36	3438
Vest (X11)	3	15	4	33	134	4770

3.3 Determination of constraints:

Right-side constants: They are found by utilizing the annual average working hours of main production units. One-year average virtual working hours, which are calculated on the basis of the enterprise data, are shown below in minutes.

CUTTING	SEWING	IRONING	PACKAGING
1352000	2345600	3456200	5789000

3.4 Model formulation:

The given objective function and constraints are modelled using LINDO solver.

Objective function

MAX

$$5.9x_1+6.0x_2+9.3x_3+6.1x_4+13.5x_5+8.1x_6+4.88x_7+3.7x_8+9.$$

$$5x_9+7.4x_{10}+7.6x_{11}$$

IV.CONSTRAINTS

ST

$$6x_1+12x_2+11x_3+7x_4+2x_5+7x_6+3x_7+1x_8+8x_9+12x_{10}+3x_{11}$$

$$1 \leq 1352000 \text{ - eqn 1}$$

$$70x_1+50x_2+35x_3+33x_4+40x_5+15x_6+50x_7+20x_8+35x_9+25x_{10}+15x_{11} \leq 2345600 \text{ -eqn 2}$$

$$7x_1+10x_2+11x_3+6x_4+14x_5+5x_6+2x_7+4x_8+15x_9+8x_{10}+4x_{11} \leq 3456200 \text{ -eqn 3}$$

$$3x_1+2x_2+12x_3+15x_4+18x_5+25x_6+11x_7+22x_8+15x_9+35x_{10}+33x_{11} \leq 5789000 \text{ -eqn 4}$$

$$1x_1 \leq 1345200 \text{ -eqn 5}$$

$$1x_2 \leq 102400 \text{ -eqn 6}$$

$$1x_3 \leq 1245250 \text{ - eqn 7}$$

$$1x_4 \leq 74000 \text{ -eqn 8}$$

$$1x_5 \leq 13000 \text{ -eqn 9}$$

$$1x_6 \leq 145430 \text{ -eqn 10}$$

$$1x_7 \leq 1360 \text{ -eqn 11}$$

$$1x_8 \leq 2140 \text{ -eqn 12}$$

$$1x_9 \leq 3630 \text{ -eqn 13}$$

$$1x_{10} \leq 36 \text{ -eqn 14}$$

$$1x_{11} \leq 134 \text{ -eqn 15}$$

OUTPUT:

Global optimal solution found.

Objective value: 1233724.

Infeasibilities: 0.000000

Total solver iterations: 4



Elapsed runtime seconds:	0.05
Model Class:	LP
Total variables:	11
Nonlinear variables:	0
Integer variables:	0
Total constraints:	16
Nonlinear constraints:	0
Total nonzeros:	66
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
X1	0.000000	17.72500
X2	0.000000	10.87500
X3	0.000000	2.512500
X4	0.000000	5.037500
X5	4053.500	0.000000
X6	145430.0	0.000000
X7	0.000000	11.99500
X8	0.000000	3.050000
X9	0.000000	2.312500
X10	0.000000	1.037500
X11	134.0000	0.000000

Row	Slack or Surplus	Dual Price
1	1233724.	1.000000
2	325481.0	0.000000
3	0.000000	0.3375000
4	2671765.	0.000000
5	2075865.	0.000000
6	1345200.	0.000000
7	102400.0	0.000000
8	1245250.	0.000000
9	74000.00	0.000000
10	8946.500	0.000000
11	0.000000	3.037500
12	1360.000	0.000000
13	2140.000	0.000000
14	3630.000	0.000000
15	36.00000	0.000000
16	0.000000	2.537500

Constraints 1,2,3and4 represents technical constraints similarly constraints 5,6,7,8,9,10,11,12,13,14 and 15 represents production output constraints. Based on the resources the objective function is computed which is maximizing the profit Rs.12, 33,724/-. Thus the above problem can be solved for various inputs by changing the

model description so that objective function can be calculated.

V.CONCLUSION:

In this paper production capacity planning is analysed by developing mathematical model using linear programming approach. Thus the model is solved by illustrating example from textile industry with the objective of maximizing the profit of output by improving the effectiveness of equipments. In this case study four types production units are studied in brief. From the sample illustration it is clear that we can obtain optimum solution using mathematical model techniques. Thus the problem comes np hard category so use of model is highly recommended to obtain the solution within the short span of time.

FUTURE SCOPE:

The solution obtained from mathematical model can be compared with algorithms so that we can justify the processing characteristics in getting solution using different techniques.

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Maximizing Machine Capacity by Improving Efficiency using Linear Programming Model



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