

Capacity Base Production Plan can Balancing the Resources and Control Manufacturing System as Efficient as Possible in Apparel Industry

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Abstract Capacity is the maximum level of output that a company can able to produce and capacity based work and workloads arranging, controlling and optimizing process is capacity planning. This article elucidate a critical role that capacity plan determine what appropriate man, machine and time required to produce current customer demand. So that we can easily execute the future forecast demand and also can balancing available resources (man, machine, materials) that improves productivity, efficiency and reduce production cost. Capacity plan remove overload works so it makes easy production plan and schedule that provide a guide of the future development and growth. If there has not major obstacles of supply chain than hope capacity utilization system will be success approximately. The research analysis those elements to achieve better capacity plan that are number of workers, ability of workers, number of machine, maintenance support, supply chain support, quality control system etc. A case study Jeans 2000 Ltd demonstrates how strategic capacity plan can significantly enhance productivity, efficiency and reduce production cost. The findings underscore the necessity of robust capacity plan in driving productivity, cost savings and sustainable business growth in apparel industry.

Keywords Capacity plan, Production plan, Balancing resources (man, machine, materials)

1. Introduction

In apparel industry production plan is very important for on time shipment and growth business. [1] Here capacity plan balancing the resources and arranging, controlling, optimizing all allocated orders so that on time delivery will be easy. [2] According to the product differentiation capacity plan determine the maximum level of output capability and calculate the time which required to produce current forecast demand. [3] If we invest time for any operation process than capacity plan helps to calculate the right target and remove overload works. [4] So it helps to control overtime than production cost will be controlled. [5] Capacity plan ensure how an organization can meet customer demand based on the amount of resources available. [6] Production plan is the act of a guide for design and produce of a product. [7] It coordinates and integrates the manufacturing activities in a production system. [8] Production plan ensure all preproduction steps so bulk production can run smoothly. [9] Capacity based production plan helps the optimum

utilization of production capacity and increase productivity. [10] It also reduces idle time by proper scheduling the machine items so that execute on time delivery and reduce wastage. [11]

2. Objectives

1. Determine what appropriate man, machine and time required to produce current customer demand.
2. Balancing the resources (man, machine, materials) and remove overload works.
3. Control overtime and reduce production cost.
4. Increase productivity and efficiency.
5. Determine the maximum level of output capability based on resource available.
6. Calculate the right target and arranging, controlling and optimizing all work and workloads.
7. Execute the future forecast demand and control organizations as efficient as possible.

3. Methodology

Here a basic jeans pants and its sewing SMV 18.25 min. Its mean per pcs jeans pant production time required 18.25 min.

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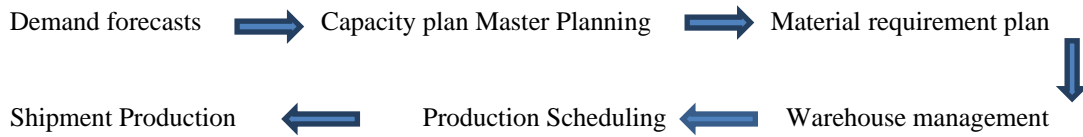


Figure 1. Flow chart of production planning & control

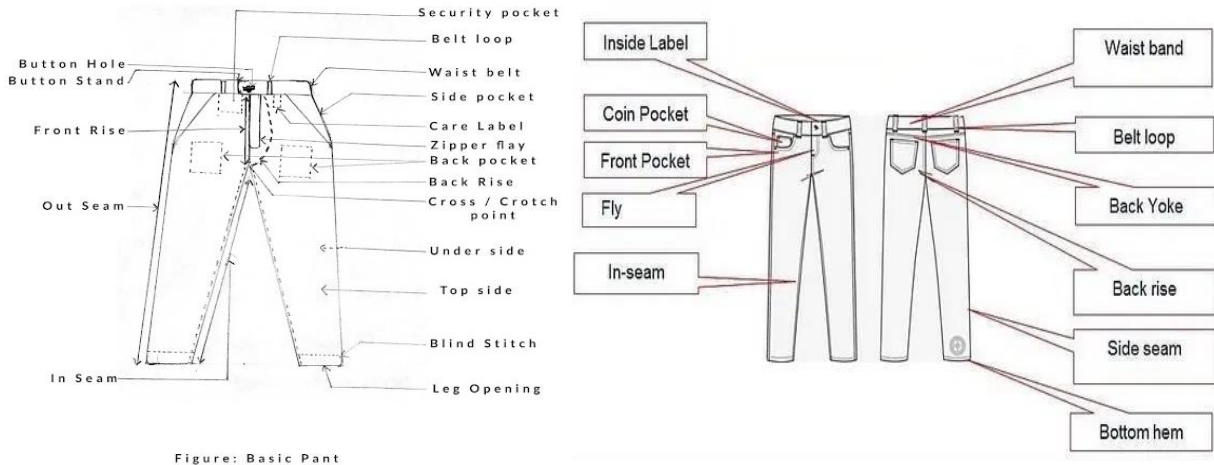


Figure 2. Basic jeans pant different parts

Table 1. Basic jeans pant operation bulleting

Jeans 2000 Ltd, CEPZ						
Buyer: C&A		TGT / HUR: 190 pcs		Total Manpower:72		
Style:502503		Plan effi%:80%		SMV:18.25		
NO.	OPERATIONS	Machine	SMV	Target	Manpower	Total Machine
Front part						
1	Front rise	4T O/L	0.25	240	1	1
2	S/fly & D/fly O/L	4T O/L	0.3	200	1	1
3	Mark & J-stitch 1/4	DNLS	0.3	200	1	1
4	Fly button hole	Eye	0.3	200	1	1
5	D/fly join& D/fly tack	SNLS	0.3	200	1	1
6	D/fly top stitch	SNLS	0.25	240	1	1
7	Coin pkt rolling	SNCS	0.25	240	1	1
8	Coin pkt, facing & waist & side mark	Helper	0.5	120	2	0
9	Iron coin pkt & facing	Ironer	0.5	120	2	0
10	Coin pkt attach	DNLS	0.25	240	1	1
11	Facing attach with pking	F/L	0.25	240	1	1
12	Front pkt bag O/L	3T O/L	0.25	240	1	1
13	Front pkt bag 1/4 top stitch	SNLS	0.25	240	1	1
14	Front pkt join	SNLS	0.25	240	1	1
15	Front pkt mouth rolling	DNCS	0.5	120	2	2
16	Side & waist tack	SNLS	0.5	120	2	2
17	Front part side O/L	4T O/L	0.5	120	2	2
18	Wash tack	SNLS	0.25	240	1	1
19	Label poly & preparation	Helper	0.25	240	1	0
20	Label join	SNLS	0.25	240	1	1
Back part						
21	Back yoke join	FOA-2	0.3	200	1	1

Master Plan:

Master plan is along termplanning documents and schedule that provide a guide of the future development and growth. [14] In garments industry master plan is very important for improve supply chain, production, efficiency and on time delivery. [15] It arranging, controlling and optimizing all work and activities for future allocated orders. [16] Master plan depends on factory capacity and product SMV. [17] So, it is very important to calculate actual capacity of a company otherwise we can't execute a proper production plan. [18] Capacity plan helps to keep a sequence of production orders, estimating production as per line wise capacity, achieving targeted production and on-time production and delivery to the customers. [19]

Here an example of Jeans 2000 Ltd, CEPZ monthly production plan.

Capacity utilization of the plan:

Jeans 2000 Ltd, CEPZ a RMG base company has total sewing unit workers 1250

January-2025 allocated orders average SMV = 21.6 min

Plan working hour/day = 10 hours

Plan working day = 27 day

Target efficiency = 80%

Now January 2025,

factory capacity

$$= \frac{\text{monthly total working minute}}{\text{Avg SMV}} * \text{taget effi\%}$$

$$= \frac{1250*27*10*60}{21.6} * .8$$

$$= 750000 \text{ pcs}$$

January 2025 monthly production plan = 720000 pcs

$$\text{Then load} = \frac{\text{monthly Plan}}{\text{monthly capacity}} * 100$$

$$= \frac{720000}{750000} * 100$$

$$= 96$$

##January 2025, possible to execute plan up to 750000 pcs. Here load is less than its capacity so it is possible to execute this plan. If company has not any supply chain problems than we hope it will be achieved approximately.

February 2025 capacity planning:

Let, February 2025 allocated orders average SMV= 20 min

Plan working hour/day = 10 hours

Plan working day = 24 day

Target efficiency = 80%

Now February 2025,

factory capacity

$$= \frac{\text{monthly total working minute}}{\text{Avg SMV}} * \text{taget effi\%}$$

$$= \frac{1250*24*10*60}{20} * .8$$

$$= 720000 \text{ pcs}$$

February 2025 monthly production plan = 750000 pcs

$$\text{Than load} = \frac{\text{monthly Plan}}{\text{monthly capacity}} * 100$$

$$= \frac{750000}{720000} * 100$$

$$= 104\%$$

$$\text{So plan working hour} = \frac{\text{Load*SMV}}{1250*24*60*.8}$$

$$= \frac{750000*20}{1250*24*60*.8}$$

$$= 10.41$$

Table 2. January-2025 sewing plan

Jeans 2000 Ltd, CEPZ monthly sewing load jan-2025							
Buyer	PO	Style	Color	Order Qty (pcs)	Plan hour	Target Effi%	Sewing SMV
C&A	502503	Basic 5 pkt jeans pant	Black	50000	10	80%	18.25
C&A	502505	Basic 5 pkt jeans pant	Black	60000	10	80%	18.3
C&A	502507	Basic 5 pkt jeans pant	Blue	40000	10	80%	18.4
C&A	502508	Basic 5 pkt jeans pant	Blue	35000	10	80%	17.6
C&A	502517	Basic chino pant	Black	35000	10	80%	22.6
H&M	706505	Basic 5 pkt jeans pant	Black	60000	10	80%	17.2
H&M	706507	Basic 5 pkt jeans pant	Black	50000	10	80%	17.2
H&M	706502	Basic 5 pkt jeans pant	Blue	40000	10	80%	18.25
H&M	706503	Basic 5 pkt jeans pant	Blue	50000	10	80%	18.5
H&M	706509	Basic 5 pkt jeans pant	Black	50000	10	80%	17.4
H&M	706511	Basic 5 pkt jeans pant	Black	30000	10	80%	16.4
G-STAR	102520	Basic combat jacket	Black	30000	10	80%	38.4
G-STAR	102518	Basic combat jacket	Black	20000	10	80%	37.5
G-STAR	102505	Basic 5 pkt jeans pant	Blue	40000	10	80%	16.2
G-STAR	102504	Basic 5 pkt jeans pant	Blue	45000	10	80%	18.4
G-STAR	102531	Basic cargo pant	Black	45000	10	80%	28.5
G-STAR	102532	Basic cargo pant	Black	40000	10	80%	27.2
Grand Total				720000	Avg. SMV		21.6

Table 3. Jeans 2000 Ltd, CEPZ master load & capacity status 2025@ efficiency 80%

Month	Load Qty (pcs)	Capacity (pcs)	Balance (pcs)	Load%	Avg. Plan hour	Avg. SMV	Load Days	Production Req/day
January 2025	720,000	750,000	30000	96%	10	21.6	27	26667
February 2025	750,000	720,000	-30000	104%	10.41	20	24	31250
March 2025	650,000	662,727	12727	98%	9	22	27	24075
Grand Total	2120,000	2132,727	12727	99.33%	9.8	21.2	78	27180

##February 2025, possible to execute plan up to 720000 pcs. Here load is higher than its capacity so if we want to achieve monthly production plan than we must need to increase plan working hour and efficiency otherwise we can't achieve this plan.

March 2025 capacity planning:

Let, march 2025 allocated orders average SMV = 22 min
 Plan working hour/day = 10 hours
 Plan working day = 27 day
 Target efficiency = 80%
 Now march 2025,
 factory capacity

$$= \frac{\text{monthly total working minute}}{\text{Avg SMV}} * \text{target effi\%}$$

$$= \frac{1250*27*10*60}{22} * .8$$

$$= 736364 \text{ pcs}$$

March 2025 monthly production plan = 650000 pcs

$$\text{Then load} = \frac{\text{monthly Plan}}{\text{monthly capacity}} * 100$$

$$= \frac{650000}{736364} * 100$$

$$= 88.2\%$$

Here march 2025 possible to run factory = plan working day * load%
 = (27*0.882)
 = 23.81
 = 24 days

So, Factory will be ideat
 march 2025 = (27-24) days
 = 3 days

March 2025, possible to execute plan up to 736364 pcs. Here load is 11.8% less than its capacity so it has apossibility that factory will be idle 3 days at march 2025. Due to less allocated orders we can't run this factory full month. In this situation we need to reduce plan working hour otherwise production cost will be high.

Now if, plan working hour/day = 9hours
 Then march 2025,
 factory capacity

$$= \frac{\text{monthly total working minute}}{\text{Avg SMV}} * \text{target effi\%}$$

$$= \frac{1250*27*9*60}{22} * .8$$

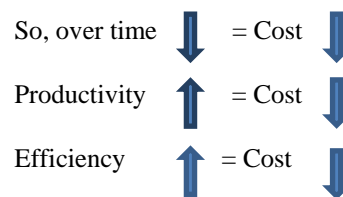
$$= 662727 \text{ pcs}$$

$$\text{Then load} = \frac{\text{monthly Plan}}{\text{monthly capacity}} * 100$$

$$= \frac{650000}{662727} * 100$$

$$= 98\%$$

If reduce excess working hours and increase productivity then production cost will be low and efficiency will be high.



4. Result and Discussion

1. Without capacity plan a company can't determine what appropriate man, machine and time required to produce current customer demand. So it's not possible to balance the resources (man, machine, materials). Without capacity plan if allocate 1800,000 pcs orders for 3 month master load.

$$\text{Then productivity} = \frac{\text{output}}{\text{input}}$$

$$= \frac{\text{Production load} * \text{Avg.SMV}}{\text{total working minute}}$$

$$= \frac{1800000*21.2}{1250*78*10*60}$$

$$= 0.66$$

$$\text{CM (cost of making)} = \frac{\text{CPM} * \text{SMV}}{\text{productivity}}$$

$$= \frac{x*21.2}{0.66}$$

$$= 32.1 \times \$$$

(Here, CPM = x dollar)

Here without capacity plan if allocate more order quantity than its capacity for master load. It will not outcomes a good result due to absence of right target, achievement and capacity base plan. Preparation to balance resources—man, machine, and materials—remains lacking, leading to an inability to determine the required amount of each. As a result, overall productivity, efficiency, and cost-effectiveness suffer significantly.

2. With capacity plan table 3, shows that average SMV 21.2 so Jeans 2000 Ltd 3 month sewing capacity 2132,727 pcs and here considered 80% efficiency and 9.8 average working hours. Here load is 99.33% and allocated orders is 2120,000 pcs.

Table 4. Jeans 2000 Ltd, CEPZ achievement forecast based on capacity plan

S.L no	Method	Capacity 3 month (pcs)	Load 3 month (pcs)	Plan working hour/day	Productivity	Efficiency %	CM (cost of making)\$	Outcomes
1.	Without capacity plan	Not possible to estimate	1800,000	10	0.66	66%	32.1 x \$	High cost & low achievement
2.	With capacity plan	2132,727	2120,000	9.8	0.8	80%	26.5 x \$	Low cost & high achievement

$$\begin{aligned} \text{So productivity} &= \frac{\text{output}}{\text{input}} \\ &= \frac{\text{Production load} * \text{Avg.SMV}}{\text{total working minute}} \\ &= \frac{2120000 * 21.2}{1250 * 78 * 9.8 * 60} \\ &= 0.8 \end{aligned}$$

If average annual CPM (cost per minute) = x dollar).

$$\begin{aligned} \text{CM (cost of making)} &= \frac{\text{CPM} * \text{SMV}}{\text{productivity}} \\ &= \frac{x * 21.2}{0.8} \\ &= 26.5 \text{ x\$} \end{aligned}$$

Here cost reduce on per pcs garments = (32.1 – 26.5)
= 5.6 x \$

$$\begin{aligned} \text{So cost reduction\%} &= \frac{5.6 \text{ x}}{32.1 \text{ x}} * 100 \\ &= 17.44 \text{ \%} \end{aligned}$$

Table 4, shows that productivity and efficiency is significantly higher and cost of making is comparatively very lower with capacity based master plan. Here capacity study and capacity plan determine style wise SMV, manpower and machine requirement to produce current customer demand. It helps to identify and remove the bottleneck areas in a bulk production line so line target and efficiency will achieve easily. It balancing the resources (man, machine, materials) and remove overload works as a result improves productivity, efficiency and reduce production cost. According to capacity plan we can easily calculate monthly, weekly and yearly production capacity of a company. It helps to do a proper master plan that arranging, controlling and optimizing a long term planning documents and schedule. By this process a company can allocate the maximum level of orders that can able to produce. If the allocated order exceeds capacity, it becomes essential to increase planned working hours; otherwise, achieving the target plan will not be possible. Again, if allocated order is too less than its capacity than need to decrease plan working hour otherwise production cost will be high. A case study Jeans 2000 Ltd demonstrates the final outcomes that proper capacity plan able to produce the maximum level of output and reduce production cost.

Descriptive Analysis: Table 4, shows that the result of productivity, efficiency and cost-effectiveness with capacity based plan.

Master load (pcs):

- Mean: (2120,000 + 1800,000) / 2 = 1960,000 pieces.
- Range: 2120,000 - 1800,000 = 320,000 pieces.

Without capacity-based master load has significantly lower and possible of 85% (1800,000/2120,000) of the capacity-based master load.

Productivity:

- Mean: (0.8 + 0.66) / 2 = 0.73
- Range: 0.8 – 0.66 = 0.14

Capacity based productivity has significantly higher and possible of 121% (0.8/0.66) of the without capacity based productivity.

Efficiency:

- Mean: (80% + 66%) / 2 = 73%
- Range: 80% – 66% = 14%

Capacity based efficiency has significantly higher and possible of 121% (80/66) of the without capacity based efficiency.

CM (cost of making)\$:

Capacity based cost of making has significantly lower and possible of 82.6% (26.5x/32.1x) of the without capacity based cost of making.

$$\begin{aligned} \text{So cost reduction\%} &= \frac{5.6 \text{ x}}{32.1 \text{ x}} * 100 \\ &= 17.44 \text{ \%} \end{aligned}$$

5. Conclusions

Capacity plan is very important for arranging, controlling and optimizing all work and workloads of a company. [20] It helps to determine how services are offered and what appropriate time and manpower required to produce current customer demand. [21] So it is the act of balancing available resources to satisfy customer demand that improves productivity, efficiency and reduce production cost. Capacity planning is the best way to invest time for any operation process that makes easy to achieve target and remove overload works. [22] Man and machine ratio totally depends on capacity plan. Here capacity plan is the best way to remove and balancing the bottleneck points in a production line. [23] In garments industry without capacity utilization we can't execute the maximum level of output. So in modern industrialization its importance is very much. [24] It helps to execute the future forecast demand and also control organizations as efficient as possible. [25]

REFERENCES

- [1] R. P. J. G.-S. F. L. Mula, "Models for production planning under uncertainty: A review," *International of production economics*, pp. 271-285, 2006.
- [2] L. H. B. K. M. Stevenson, "A review of production planning and control: the applicability of key concepts to the make-to-order industry," *International journal of production research*, vol. 43, no. 5, pp. 869-898, 2007.
- [3] D. T. Gabriel R. Bitran, "Chapter 10 Hierarchical production planning," *Handbooks in operations research and management science*, vol. 4, pp. 523-568, 1993.
- [4] F. K. H. M. Ali Cheraghlikhani, "Aggregate production planning: A literature review and future research directions," *International journal of industrial engineering computations*, vol. 10, no. 2, pp. 309-330, 2019.
- [5] H. B. Julia C. Bendul, "The design space of production planning and control for industry 4.0," *Computers in industry*, vol. 105, pp. 260-272, 2019.
- [6] M. B. M.D Byrne, "Production planning using a hybrid simulation – analytical approach," *International journal of production economics*, vol. 59, no. 1-3, pp. 305-311, 1999.
- [7] I. K. Z. D. Z. Li Qiang, "Production planning in additive manufacturing and 3D printing," *Computers & operations research*, vol. 83, pp. 157-172, 2017.
- [8] S. K. Bokang Kim, "Extended model for a hybrid production planning approach," *International journal of production economics*, vol. 73, no. 2, pp. 165-173, 2001.
- [9] H. M. G. Zapfel, "Production Planning and Control (PPC) systems including load-oriented order release — Problems and research perspectives," *International journal of production economics*, Vols. 30-31, pp. 107-122, 1993.
- [10] J. U. R. W. G. T. G.W. Depuy, "Production planning for remanufactured products," *The management of operations*, vol. 18, no. 7, pp. 573-583, 2007.
- [11] R. P. M. P. R. C. Tommaso Rossi, "Improving production planning through finite-capacity MRP," *International journal of production research*, vol. 55, no. 2, pp. 377-391, 2016.
- [12] R. M. Douglas Jose Alem, "Production planning in furniture settings via robust optimization," *computers & operations research*, vol. 39, no. 2, pp. 139-150, 2012.
- [13] D. J. R. R. Esther Arkin, "Computational complexity of uncapacitated multi-echelon production planning problems," *Operations research letters*, vol. 8, no. 2, pp. 61-66, 1989.
- [14] L. W. L. H. A. M. E. W. Brian Kingsman, "Integrating marketing and production planning in make-to-order companies," *Internal journal or production economics*, Vols. 30-31, pp. 53-66, 1993.
- [15] A. J. M. Kerem Akartunali, "A heuristic approach for big bucket multi-level production planning problems," *European journal of operational research*, vol. 193, no. 2, pp. 396-411, 2009.
- [16] M. G. I. Nikisha K. Shah, "Integrated production planning and scheduling optimization of multisite, multiproduct process industry," *computers & chemical engineering*, vol. 37, pp. 214-226, 2012.
- [17] P. F. N. T. Mickael Comelli, "A combined financial and physical flows evaluation for logistic process and tactical production planning: Application in a company supply chain," *International journal of production economics*, vol. 112, no. 1, pp. 77-95, 2008.
- [18] C. R. Hulten, "Productivity change, capacity utilization, and the sources of efficiency growth," *Journal of econometrics*, vol. 33, no. 1-2, pp. 31-50, 1986.
- [19] M. C. Andersson, "On the complexity of using performance measures: Enhancing sustained production improvement capability by combining OEE and productivity," *Journal of manufacturing systems*, vol. 35, pp. 144-154, 2015.
- [20] E. P. Jonas Rutkauskas, "Concept of productivity in service sector," *Engineering economics*, vol. 43, no. 3, pp. 35-41, 2005.
- [21] C.-Y. Lee, "Most productive scale size versus demand fulfillment: A solution to the capacity dilemma," *European journal of operational research*, vol. 248, no. 3, pp. 954-962, 2016.
- [22] C. Anyanwu, "Productivity in the nigerian manufacturing industry," *CBN occasional papers*, vol. 19, no. 7, pp. 124-135, 2000.
- [23] R. Fishman, "Trade credit and productive efficiency in developing countries," *World development*, vol. 29, no. 2, pp. 311-321, 2001.
- [24] W.-P. W. Hsi-Mei Hsu, "Possibilistic programming in production planning of assemble-to-order environments," *Fuzzy sets and systems*, vol. 119, no. 1, pp. 59-70, 2001.
- [25] S.-F. W. Chien-Ho Ko, "GA-based decision support systems for precast production planning," *Automation in construction*, vol. 19, no. 7, pp. 907-916, 2010.