Employee Productivity Improvement and Skill Enhancement in Pharmaceutical Industry

Manan Hingorani
Industrial Engineering Department,
Pandit Deendayal Petroleum University
Gandhinagar, Gujarat, India
mananhingorani@gmail.com

Nitesh Jaiswal
XYZ Pharmaceutical Industry
Ahmedabad, Gujarat, India
nitesh28770@gmail.com

Abstract

Productivity is not just about doing more, it is about creating more impact with less resources, and it can be achieved only by intelligent planning and sustained hard work. Employee productivity play a vital role in any organization, it is biggest challenge to sustain with low operating cost and manpower cost with high profit margin in such competitive environment. This paper illustrate the journey to improve employee productivity and resource optimization approach in a pharmaceutical industry. The entire exercise consists study of existing process and manpower deployment pattern, identify the redundancy and bottlenecks in the current system, manpower benchmarking and comparison exercise and proposed standard manpower with skill enhancement framework. Industrial engineering tools and techniques being applied in the data collection and process mapping exercise. Study has been conducted in the pharmaceutical processes like- Granulation, Compression and Coating and packaging. This paper also includes a skill enhancement framework to make the operatives' multi skilled, thereby allowing them to work in different departments flawlessly.

Keywords
Manpower mapping, Manpower optimization, Skill enhancement, Skill mapping, Work study.

1. Introduction

In the journey to improve employee productivity, it is important to have a robust structure of manpower planning which should ensure adequate supply, proper quality and quantity as well as effective utilization. It is the process by which management determines how an organization should move from its current manpower position to its desired manpower positions with the objective of less resources with high productivity Manpower planning helps the organisation to tap talents efficiently which will help to achieve both the individual and organisational goal. This will consequently minimise some of the problems associated with absenteeism and labour turn- over. Moreover, the process of manpower planning includes analysis of skill level in the organisation (skill inventory), analysis of expected and current vacancies due to discharges, transfers, promotions; sick leaves, absence on other reasons.

This manpower planning exercise is divided into two parts:-

(a) Standard manpower mapping Exercise:

- Identify the current manpower (operatives) numbers in each area like-Granulation, Compression, Coating in Plant-1.
- Study the current occupancy of the machines and workload.
- Benchmarking and comparison of manpower against the equipment capacity with other units and industries.
- Identify the gaps in current manpower deployment and conduct a Time and motion study, DILO study (Day in a life of officer/operator/ helper) and Man M/c study, SMED to identify the current utilization of manpower.
- Identify the redundancy in the current system by segregating non value added activities and value added activities.

- Apply ECRS methodology (eliminate, combine, re-arrange, simplify) and identify the proposed best way to conduct the current practice.
- Propose standard manpower structure with future occupancy of resources and future workload.

(b) Skill enhancement or Multiskilling framework:

- Map the current activities in each area and Identify the skill required against the respective activities
- Label the current skills sets in the scale of 0 to 1, 2, 3, 4 (Beginner level, Basic level, Intermediate level, Advance level, and Expert Level.).
- Propose the desire skill set required for the respective based on standard manpower or skill mapping exercise as mentioned above.
- Propose a upskilling and multiskilling frame work for skill enhancement and career progression for existing workforce or skill set
- Propose a training plan to track the progress.

Material flow in the plant:

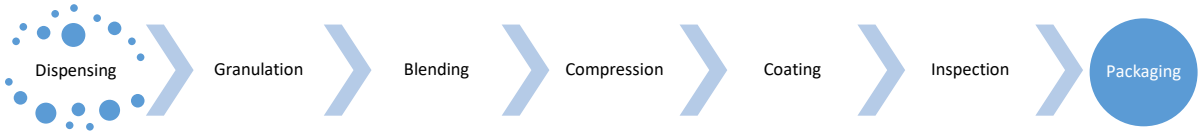

Figure 1. Material flow process

As shown in the Figure 1, the raw material starts off at dispensing then goes to the Granulation department where mixing, shifting, wet granulation, drying, etc. activities are performed then blending processes are done, after that the material is moved to the compression process where the powdered raw material is compressed in a form of tablet.

2. Manpower mapping

Figure 2 shows the manpower quantity in each department such as Granulation, Compression and Coating.

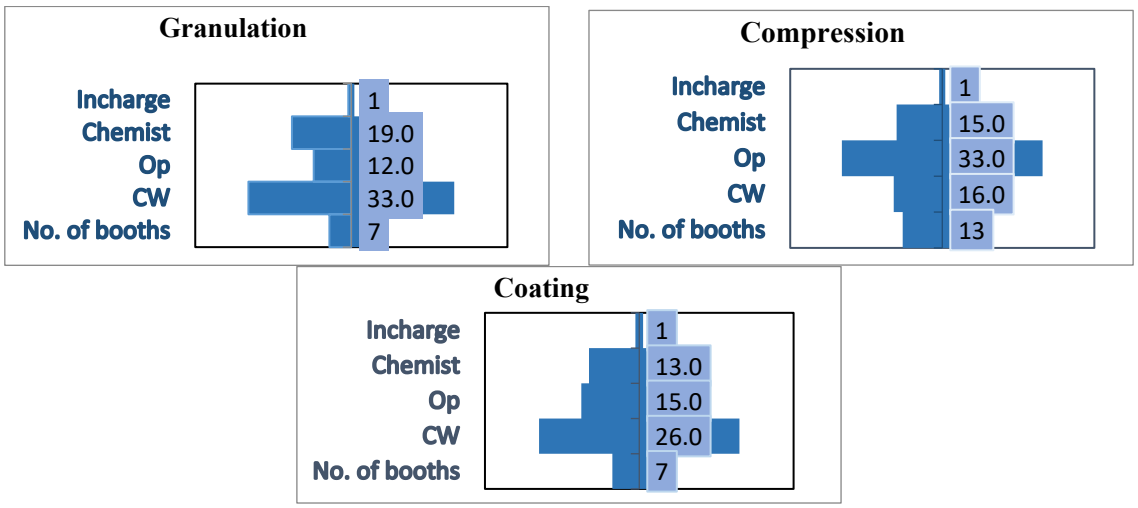

Figure 2. Manpower mapping

3. Gap analysis

By conducting Time-Motion Study and DILO analysis of the operatives and officers following occupancy was found: (Sample Given)

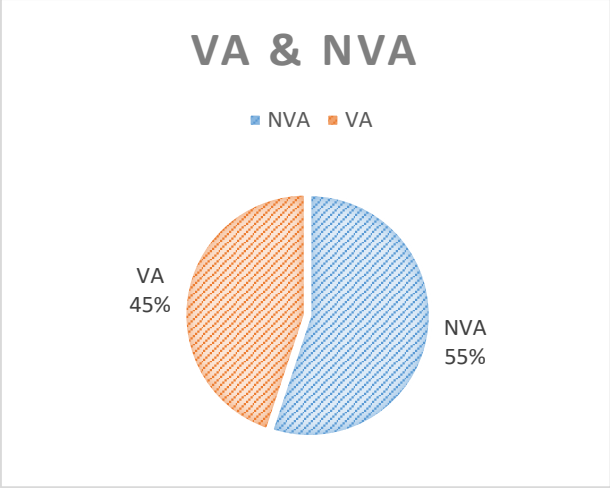

Figure 3. DILO analysis result

Figure 3 shows the result of the DILO analysis, 55% time Officer (Granulation) was engaged in such an activity which can be done by either operatives or it can be rearrange for better utilized. There is lot of scope of improvement in for Officer's current responsibility and job deployment- an officer can supervise two area for productivity improvement.

3.1. Manpower allocation in other Units

To benchmark the required manpower numbers, we share the other unit manpower deployment along with capacities. (FTE= Fixed Term Employees, CW= Contract Workers).

Table 1. Manpower allocation in different Units

	Manpower Per shift															
	Sites	**Unit 1**			**Unit 4**			**Unit 5**			**Unit 2**			**Unit 3**		
Area	**Equipment capacity**	**Officer**	**OP**	**FTE/ CW**	**Officer**	**OP**	**FTE/ CW**	**Officer**	**OP**	**FTE/ CW**	**Officer**	**OP**	**FTE/ CW**	**Officer**	**OP**	**FTE/ CW**
Granulation	20 Kg										1 for 2-3 area	1		1 for 2-3 area	1	
	50 / 60 Kg	1	1								1 for 2-3 area	1				
	100 Kg	1	1	1							1 for 2-3 area	1	1 for 2-3 area	1 for 2-3 area	1	1 for 2-3 area
	150 Kg				1	2	1	1	1	1						
	300 Kg	1	1	1	1	2	1	1	2	1	1 for 2-3 area	1	1 for 3-4 area	1 for 2-3 area	1	1 for 3-4 area
	500 Kg	1	1	2							1 for 2-3 area	1	1 for 3-4 area	1 for 2-3 area	1	1 for 3-4 area
Blender	650 L	Shared by Granulation		1			1			1			1			
	100/50/15 L			1			1						1			
	1500 L			1												
	3000 L			1												
	4000 L			2												
Coating	65 - 120 Kg	1 for 3 areas	1	if required	1 for 2 areas	1	1 for 2 areas				1 for 3 areas	1	1 for 3 areas			
	100 - 300 Kg		1			1					1 for 3 areas	1	1 for 3 areas	1 for 3 areas	1	1 for 3 areas
	250 - 450 Kg		1								1 for 3 areas	1	1 for 3 areas			
	350 - 850 Kg		1											1 for 3 areas	1	1 for 3 areas
Compression	26 stn	1 for 3-4 area	1					1 for 2 areas	1	1 for 2 areas	1 for 3-4 area	1	1 for 3-4 area			
	30 stn								1							
	32 stn	1 for 3-4 area	1			1					1 for 3-4 area	1	1 for 3-4 area			
	37 stn										1 for 3-4 area	1	1 for 3-4 area			
	40 stn	1 for 3-4 area	1													
	42 stn										1 for 3-4 area	1	1 for 3-4 area			

45 stn	1 for 3-4 area	1	1	1 for 3-4 area	1	1 for 3-4 area							1 for 2-3 area	1	1 for 2-3 area
49 stn	1 for 3-4 area	1	1							1 for 3-4 area	1	1 for 3-4 area	1 for 2-3 area	1	1 for 2-3 area
55 stn													1 for 2-3 area	1	1 for 2-3 area
61 stn	1 for 3-4 area	1	1										1 for 2-3 area	1	1 for 2-3 area
73 stn													1 for 2-3 area	1	1 for 2-3 area
75 stn										1 for 3-4 area	1	1 for 3-4 area			

By comparing the manpower with other plants as shown in the Table 1, we can see that there is an opportunity as the other units utilize lesser manpower than Unit 1, for similar capacity of the following areas such as granulation, coating and compression. There is opportunity of productivity improvement as we are reducing the input resources, keeping the output intact.

3.2. Allocation Index

Graphs show the manpower allocation index in the Figure 4, Figure 5 and Figure 6 for Granulation, Compression and coating respectively. As we can see that the operatives assigned per suite in unit 1 is more compared to other Units and No. of Suites under one superviser (officer) are less.

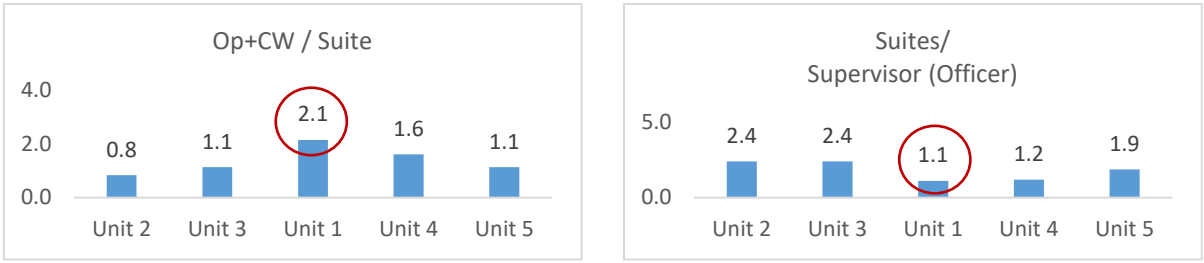

Figure 4. Manpower Index (Granulation)

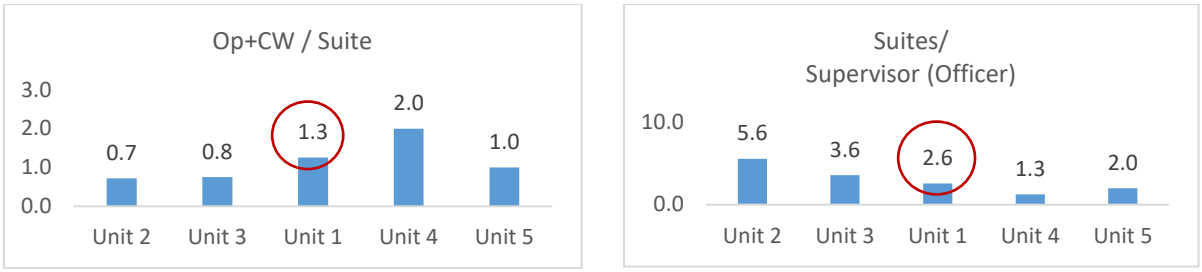

Figure 5. Manpower Index (Compression)

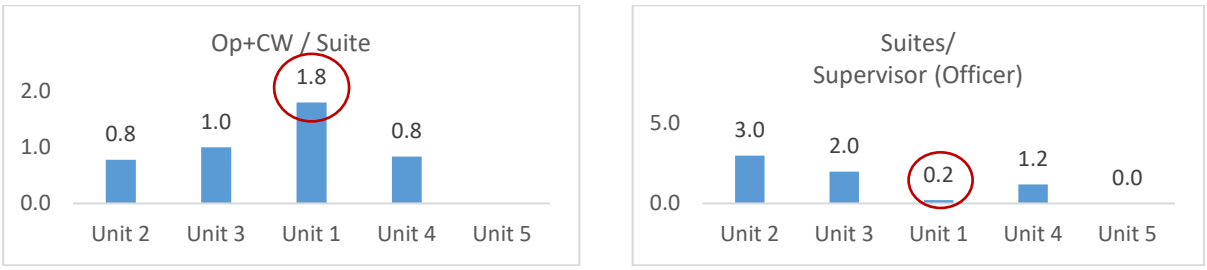

Figure 6. Manpower Index (Coating)

4. Data collection- Time & Motion Study

Following Data was collected for the study conducted at Unit 1:

- Current manpower mapping based on current shift schedule of the different departments,

- Skill mapping of the following mapped manpower,
- Hierarchy of the position,
- Current job role of the mapped manpower,
- Occupancy data collected from planning team,
- On field data collection (Man-Machine Charts, DILO study, Gemba Walk)

5. Span of control analysis- Scientific Approach for Officers of Granulation, Compression and Coating

Total Sum of the Supervisor Index is 27, calculated from Table 2. Which we have to compare in Table 3.

Table 2. Span of control analysis

Element	Degree of Supervision and Points Allocated				
Similarity of functions	Identical (1)	Essentially alike (2)	Similar (3)	Inherently different (4)	Fundamentally distinct (5)
Geographical contiguity	All together (1)	All in one building (2)	Separate building & one plant location (3)	Separate locations, one geographic area (4)	Dispersed geographic areas (5)
Complexity of functions	Simple repetitive (2)	Routine (4)	Some complexity (6)	Complex varied (8)	Lightly complex varied (10)
Direction & control required	Minimum supervision & training (3)	Limited supervision (6)	Moderate periodic supervision (9)	Frequency continuing supervision (12)	Constant close supervision (15)
Co-ordination required	Minimum relationship with others (2)	Relationship limited to defined courses (4)	Moderate relationship easily controlled (6)	Considerable close Relationship (8)	Extensive mutual non-recurring relationship (10)
Planning required	Minimum scope & complexity (2)	Limited scope & complexity (4)	Moderate scope & complexity (6)	Considerable effort required guided only by policies (8)	Extensive effort required areas & policies not charted (10)

Table 3. Supervisory Index vs Spans Of Control

Supervisory Index	Spans Of Control
Over 40	4 - 5
37- 39	4 - 6
34-36	4 - 7
31-33	5 - 8
28-30	6 - 9
25-27	7 - 10
22-24	8 - 11
Under 22	12 - 20

The above approach is based on degree of supervision with higher to lower complex environment, processes, geography, decision making, coordination and supervision required. It is clear from the above exercise that, an officer can supervise more than 2 or 3 line with 7 to 8 no of persons below on his span.

6. Existing skill mapping

Figure 7 shows how the skill promotions are followed, each level has specific activities to be performed, and an operative can progress further in the skill levels by experience or training. Skill enhancement framework is suggested as a solution/result of the study.

6.1. Skill levels

Table 4 shows the current number of the manpower having particular skill level in Granulation, similarly Table 5 and Table 6 shows the present number of manpower in the following skill levels for compression and coating respectively.

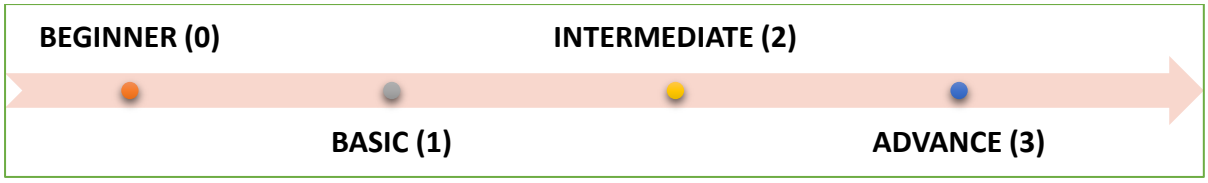

Figure 7. Skill levels

Table 4.

Granulation	L0	L1	L2	L3	NA	Left	Grand Total
Fix Term Employee	16	10	2			1	29
Worker Moraiy 41		1					1
Plant Operator		3	5				8
Senior Plant Operator				2			2
Technical Assistant				1			1
Total	**16**	**14**	**7**	**3**		**1**	**41**

Table 5.

Compression	L0	L1	L2	L3	NA	Left	Grand Total
Fix Term Associate	4	3	3				**10**
Fix Term Employee	13	3	4				**20**
Worker Moraiy 41		1	1				**2**
Plant Operator		4	6	1			**11**
Senior Plant Operator			2	2			**4**
Technical Assistant			1	2			**3**
Total	**17**	**11**	**17**	**5**			**50**

Table 6.

Coating	L0	L1	L2	L3	NA	Left	Grand Total
Fix Term Associate	1		1				2
Fix Term Employee	13	4	2				19
Worker Moraiy 41			1				1
Plant Operator			1				1
Senior Plant Operator			4				4
Technical Assistant			2				2
Total	**14**	**4**	**11**				**29**

6.2. Skill verification: On job skill evaluation

A complete shift study has been conducted, to analyze the current skill level of manpower, working in Granulation, Compression and Coating, and based on the activity perform by operatives we are suggesting the current skill level of manpower are as follows. Table 7 shows what are the existing skill levels of the following operatives and what should be the desired skill level at particular areas.

Table 7

	OP			FTE	
	Existing Skills	**Proposed Skills After Evaluation**		**Existing Skills**	**Proposed Skills After Evaluation**
Granulation	1	2		0	1
Compression	1	2		1	2
Coating	2	3			

7. Standard manpower and skill sets required

Table 8 shows what should be the standard manpower numbers and the desired skill level at particular areas, according to the conducted study.

Table 8

	Equipment capacity	OP (Nos)	Skill Level	FTE (Nos)	Skill Level
Granulation	50 / 60 kg	1	2		
	100 kg	1	2	1	1 to 2
	300 kg	1	3	1	1 to 2
	500 kg	1	2 or 3	1	1 or 2
	Roll compactor	1	2 or 3	2	2 or 3
Blender	650L	Manpower shared by Granulation team	1 to 2	Manpower shared by Granulation team	1 to 2
	1500L		1 to 2		2 or 3
	3000L		1 to 2		1 to 2
	4000L		1 to 2		1 to 2
Compression	26 Station	1	2		
	32 Station	1	2 or 3		
	40 Station	1	2 or 3		
	45 Station	1	2 or 3	1	1 or 2
	49 Station	1	2 or 3	1	1 or 2
	61 Station	1	2 or 3	1	1 or 2
Coating	65 - 120 Kg	1	2	1 for 2 area	1 or 2
	100 - 300 Kg	1	2		
	250 - 450 Kg	1	2		
	350 - 850 kg	1	2 or 3		

7.1. Activities to be performed in each area are as follows:

Table 9 shows the activities to be performed by the operatives of respective skill levels (Note: Following level can perform all the activities done by previous all levels.(e.g. L2 can also perform activities of L0 & L1.))

Table 9. Activities for skill level

Area	Skill Level	Activities
Granulation and Blending	0	• Can perform manual activities like, material movement and feeding, basic cleaning, weighing of material (packed material), movement of vessels. • Can Read, Write & understand English • Understanding of Number & Basic Maths
	1	• Monitoring, Recording, Verification of weighing Balance, Material Handling • Cleaning of Area & Machine • Labelling procedure of product & area, basic documentation. • Machine start & stop, printing the specs. List.
	2	• Preparation of Binder solution, Operation of filter bag machine, • To set critical parameters, Operation of Machine, In process test, supervision of lower level operatives • Alarm Identification and Alarm Management for respective machine, Trouble shooting of respective machine • To fill BMR & Area Log Book
	3	• Alarm Management for all machines, Operation and trouble shooting of all machines • To fill BMR & Area Log Book of all machines. • Conduct Training related to machine operation
Compression	0	• Can perform manual activities like, material movement and feeding, basic cleaning, weighing of material (packed material), movement of vessels. • Can Read, Write & understand English • Understanding of Number & Basic Maths
	1	• Monitoring, Recording, Verification of weighing Balance, Material Handling • Cleaning of Area & Machine • Labelling procedure of product & area, basic documentation. • Machine start & stop, printing the specs. List.

	2	• Selection of Tooling, To set critical parameters, Operation of Machine, In process test • Supervision of lower level operatives • Alarm Identification and Alarm Management for respective machine • To fill BMR & Area Log Book • Trouble shooting of respective machine
	3	• Alarm Management for all machines, Operation and trouble shooting of all machines • To fill BMR & Area Log Book of all machines. • Conduct Training related to machine operation
Coating	0	• Can perform manual activities like, material movement and feeding, basic cleaning, weighing of material (packed material), movement of vessels. • Can Read, Write & understand English • Understanding of Number & Basic Maths
	1	• Monitoring, Recording, Verification of weighing Balance, Material Handling • Cleaning of Area & Machine • Labelling procedure of product & area, basic documentation. • Machine start & stop, printing the specs. List.
	2	• Issuance and retrieval procedure • Preparation of Coating solution, To set critical parameters, Operation of Machine, In process test • Alarm Identification and Alarm Management for respective machine • To fill BMR & Area Log Book • Trouble shooting of respective machine
	3	• Alarm Management for all machines, Operation and trouble shooting of all machines • To fill BMR & Area Log Book of all machines. • Conduct Training related to machine operation.

8. Skill enhancement framework

As shown in the Figure 8, we will train a level 3 operative of one area in another area as well, for example level 3 granulation operative will be trained in compression from level 1 as most of the activities are similar, it will take shorter amount of period for the following operative to climb up the levels for another department, thereby making the manpower multi-skilled (Expert (4)). We can appoint mentors in each area to successfully execution and movement of skills set from 0 to 3. Who will and monitoring and track the progress of skill enhancement project. Once a person can reach up to level 3 he can be deployed in other area's to become master of manufacturing operations in other areas as well.

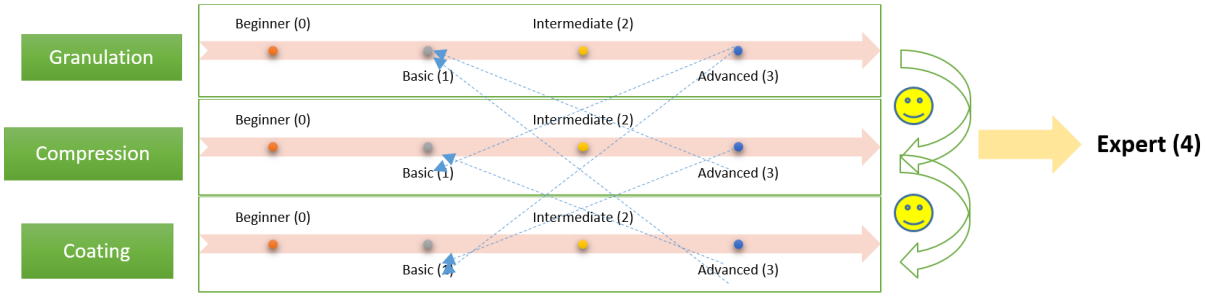

Figure 8. Skill enhancement framework

8.1.Training deployment for operatives

Since highest number of people are in L0 & L2- 17 and at any shift we can deploy 2 L0's we need at least 8 Mentors, who any way can cater to L1-11, as shown in table 11. Since highest number of people in L0- 16 and at any shift we can deploy 2 L0's we need at least 8 Mentors, who can any way cater to L1-14, and L2- 7, as shown in Table 10.

Since highest number of people in L0- 14 and at any shift we can deploy 2 L0's we need at least 7 Mentors, who can any way cater to L1-4, and L2-11, as shown in table 12. Critical parameters and machines were also mapped and a training plan of 3 months is prepared for the upskilling of the operatives. (Critical parameters are not mentioned due to company confidentiality). The Planned Training deployment for operatives is as follows, The L0 operatives can observe and learn the critical parameters, making their progress quicker than usual

Table 10: Granulation operatives deployment for training

Equipment capacity	100 Kg			300 Kg			500 Kg			Total
Shift	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	
Supervisor	1	1	1	3	3	3	1	1	1	**15**
L2	1	1	1	1	1	1	1			**7**
L1	1	1	1	3	3	3	1	1		**14**
L0	1	1	1	3	3	3	1	1	1	**15**
Total L0 to L2	**3**	**3**	**3**	**7**	**7**	**7**	**3**	**3**	**3**	**36**

Table 11: Compression operatives deployment for training

Equipment capacity	32 Stn			45 Stn			61 Stn			Total
Shift	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	
Supervisor	3	3	3	1	1	1	4	4	4	**24**
L2	3	3	3	1	1	1	2	2	1	**17**
L1	2	2	2	1	1	1	1	1		**11**
L0	3	3	3	1	1	1	2	2	1	**17**
Total L0 to L2	**8**	**8**	**8**	**3**	**3**	**3**	**5**	**5**	**2**	**45**

Table 12: Coating operatives deployment for training

Equipment capacity	300 Kg			450 Kg			850 Kg			Total
Shift	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	
Supervisor	1	1	1	1	1	1	1	1	1	**9**
L2	1	1	1	1	1	1	1	1	1	**9**
L1	1	1		1			1			**4**
L0	1	1	1	1	1	1	1	1	1	**9**
Total L0 to L2	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**22**

9. Conclusion

As, stated in the beginning, manpower planning is the process by which management determines how an organization should move from its current manpower position to its desired manpower positions. Which eventually help the organization to sustain in terms of optimum utilization of resources, employee productivity improvement, manpower for casting with proper recruitment plan, Skill enhancement and career progression roadmap etc. Based on the study done and proposed optimum manpower with a concrete skill enhancement framework, there has been 15% saving in the manpower numbers and 10% reduction in the cost. Moreover it helps in succession planning of existing operatives with proper road map on career progression. Training plan has been shared for all the current identified skills and implemented successfully. The best practices of this study has been shared with other pharma plants and horizontal deployment in under execution. Apparently this also helped the production planning team and human resources team to work together to plan the current and future resources at optimum level.

Acknowledgements

I would like to thank the management and office bearers of the Pharmaceutical Company, Ahmedabad, for permitting me to pursue this work. I would like to thank Mr. Kishan Fuse for giving me his guidance.

References

Kazi Arif-Uz-Zaman, Md. Rezaul Hasan Shumon, Md. Habib Hasan..Industrial Engineering Techniques and Applications- *International Conference on Mechanical, Industrial and Energy Engineering*, Khulna, Banglades, 23-24 December, 2010.

Kanawaty, George. *Introduction to Work Study*. International Labour Office, 1979.

Reid RD, Sanders NR. Operations Management, Binder Ready Version: An Integrated Approach. John Wiley & Sons; 2015 Sep 28.

M. Mahajan. *Production Planning and Control*. Dhanpat Rai & Co, 2018.

Sapna Vyas, *Organization Culture and Employee's Productivity "A Study of Pharmaceutical Industry*. January 2017, pp 15-50

Jonet, P. M. P. Process improvement in Pharmaceutical Industry through Kaizen Lean Methodology, pp 3-13, 2014

Gayane Gyurjyan, Shail Thaker, Kirsten Westhues, and CarlaZwaanstra. *Rethinking Pharma productivity*. January 2017.

"Good Manufacturing Practice (GMP) Resources." ISPE, ispe.org/initiatives/regulatory-resources/gmp.

"Good Manufacturing Practice." Wikipedia, Wikimedia Foundation, 26 Apr. 2019, en.wikipedia.org/wiki/Good_manufacturing_practice.

Biographies

Manan Hingorani is now a first year M.Tech. Data Science and Analysis Student at MIT, Pune and graduated with B.Tech. in Industrial engineering from Pandit Deendayal Petroleum University, Gandhinagar, Gujarat, India. He has experience of working at a Port, in an automotive company and a pharmaceutical company. He practiced Industrial engineering approaches in the following companies.

Nitesh Jaiswal an Industrial engineer passed out from IIT Kharagpur, presently working in as a Sr. Manager (Productivity Cell) at XYZ Pharmaceutical Industry Ahmedabad, Gujarat, India. He previously associated with Steel & Mining industry.