Multi-functional Teams
A different approach towards the "made to order" production systems

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Abstract: It is very important for any organization to create and build a mindset of its manufacturing system in order to develop good culture and create identity for itself. Designing apt layout of the manufacturing facility has immense impact on not only the target achieving but also on the delivered quality, overall efficiency of the system and culture building. Many times it so happens especially in start-ups and small scale industries that during the growth of one organization some systems take shape unknowingly. These systems though having started with a good idea are not meticulously monitored and analyzed. Making some changes in these established systems sometimes is vital for the growth of organization.

In the organizations which have "made to order" manufacturing it becomes difficult to set up a layout and process for manufacturing in order to optimize some areas. In this report we take a look at one such production layout that is being used by a Mumbai (India) based signage industry. This report sheds light on the short comings of its production system and also suggests an alternate approach to tackle these short comings. The suggested system has been experimentally verified in another manufacturing facility owned by the same company located in Delhi, India. Results of the experiment give us a judgment as to how much increase in efficiency can be achieved by this alternate solution by comparing the results of the existing production system and alternate production system

***IndexTerms* – manufacturing system, made to order.**

1. INTRODUCTION

1.1 Problem Definition:

The present scenario in the production system is that though we are able to deliver on the targets in time, we are not able to streamline the workflow. It has become very difficult to keep track of the work output by individual subsystems or by associates which is leading to irresponsibility on the shop floor among employees. In general there are several areas where we can improve upon collectively. These areas are as follows.

1. Quality of the work output
2. Tracking the material movement
3. Disputes in the workers pertaining to the responsibility regarding the work allocation
4. Scheduling of the jobs is more man dependant.
5. Performance evaluation of the workers is difficult because there is no centralized data system which would capture the data for meeting the target or fault analysis for workers in the day to day activity.

2. Existing Production Layout

Current production system is structured in a way that it has been divided into different subsystems with specific responsibilities assigned to them. For every subsystem one key person is assigned (team leader) to lead the subsystem.

2.1 Interdepartmental exchanges:

These subsystems receive the information from the production in-charge all at the same time. We can show this information transfer model by the following diagram. It is very important to note that there is only one point of contact for all the departments where the information exchange takes place.

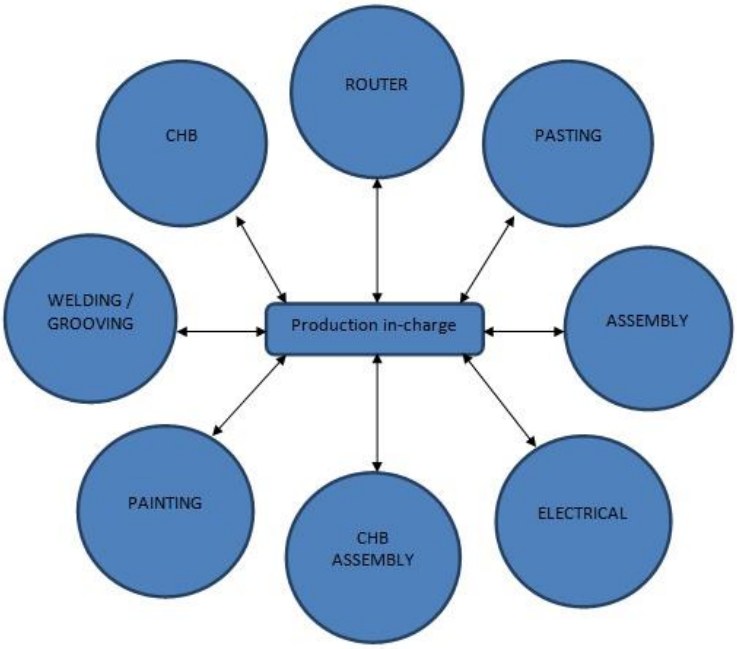

Figure 1: Information Transfer

Though this looks neat and sorted on paper, in actual scenario it becomes very difficult for one person to be responsible for the information transfer. Further it also has high chances of errors taking place due to poor communication or some miscommunication with one or more of the departments. Thus first challenge is to minimize these subsystems in order to make the communication easy.

Even for the material exchange between the departments it becomes a bit messy due to the different processes involved during assembly and the repeated involvement of the departments. This can be seen from the following diagram (for aluminium channel letters and stainless steel channel letters different colored arrows are used. For alu-black arrow; for SS- brown arrow)

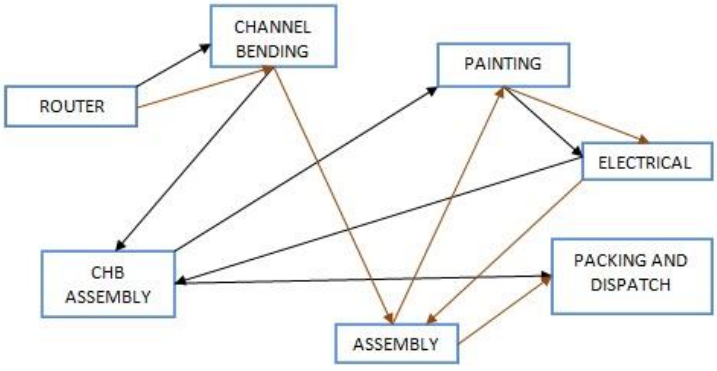

Figure 2 : Material movement during production

2.2 Job scheduling:

For scheduling of the jobs individual subsystems are considered. A list is made for every subsystem for the pending jobs in hand. For every subsystem the criteria for measurement of work output is different thus every subsystem contains its own timeline for the completion of jobs. For every timeline the plan B i.e. the backup plan for the target completion is to be made. Then before assigning the target date for the jobs these timelines are to be matched in order to achieve the correct sequence of the jobs. This entire process is man dependant as there are large no of variables involved and it largely depends on the experience and skill of the person in control of the processes.

2.3 Job evaluation and scheduling:

This is a crucial point in maintaining the quality of output. In present scenario there is no fault recording technique also it becomes very difficult to trace back the responsible person for any particular activity as the activities are not contained or restricted to one particular group of associates and are often spread out throughout the shop floor. Because there is no traceability for the individual activities which in turn result in assembling of the final product, there is lack of responsibility among the associates performing these activities. It is very important that this sense of responsibility be built among the associates in order to keep the good quality of work along with the increased production. Also in order to maintain the quality of work and increase the performance of the production system it is also important to have a good performance evaluation system in place for every single associate. As far as various activities in the production processes are concerned the responsibilities are not clearly defined for every individual or even for the group of associates. This creates problems while evaluating the performances of associates.

3. Proposed Production System

3.1 Brief overview

Taking into consideration the major drawbacks of the existing production layout, new layout or model has been designed in order to cover majority of these drawback and achieve balance between theoretical excellence and practical feasibility. Thus the new model works on crashing the variables in the existing models wherever possible and converting them into either constants or similar constraints which can be handled in same fashion thereby making it easier for the in-charge to take care of them.

In the new model basically assembly and sub-assembly departments have been merged to form a multifunctional team. Each team consists of the associates from variety of departments for e.g. every team will have the combination of members from electrical, CHB assembly, pasting, assembly etc. let us take a look at how the multifunctional teams would be formed, what would be the structure of each team and how they would work and also the factors by which the teams would be graded. Each team will have one skilled person from CHB assembly department, assembly department and electric department. In addition to this it will have 3 helpers. i.e. we need a team which would have 6 members in one team.

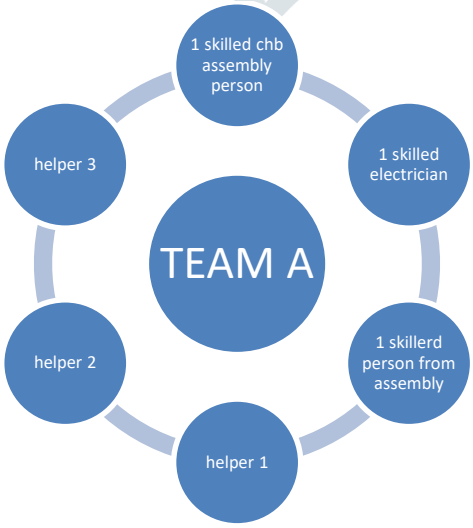

Figure 3.Team structure

Once the job has been booked the team will be assigned the job. Once the job has been assigned to the team a docket containing the details of the job such as detailed description of the job, diagrams etc will be given to the team and then it will be the responsibility of the team to take the follow up of the job, take the follow up of the material, and Highlight the issues if there are any. Team leader will then be answerable for the status of the jobs. It will be team leader's responsibility to associate with the production in-charge while scheduling the jobs of the machining departments in order to get his or her job done in accordance with the completion date assigned to the job. This can be done easily by taking a common meeting of production in-charge and team leaders. Once the job is completed and handed over to the dispatch department one copy of the essential documents would be submitted to the production in-charge with the updated designs, diagrams etc. These documents may include some or all of the following documents with signature of the concerned authority (in this case team leader.)

LED diagram (rectified as per the actual job done)

- Power supply diagram
- Packing list
- Quality check document

Based on the performance of the team; the team will be assigned a grade say A, B C etc. Based on the grade of the team priority will be given to the job of that particular team while scheduling the jobs on independent departments i.e. router, chb, painting, pasting etc

Factors to be taken under consideration while doing gradation of the team:

- Meeting the deadlines decided
- Quality checks
- Successful document completion and submission
- Reworks and rejections encountered and costs associated with it.

Now let us take a look at how challenges faced in current production system would be tackled.

3.2 interdepartmental exchanges:

The information that needs to be supplied to the machining departments would be same but apart from the machining departments there would be only one team or in exceptional cases two teams that would be working on the same project so the no of departments involved in each transactions would get drastically reduced. Every time when the job order or job sheet is raised, first the team that would handle the job would be decided depending upon the past performance (that would be assessed based on the factors such as timely deliveries, quality checks, rejections etc) and load on all the teams and then only that one particular team would be kept involved in all the transactions regarding that particular job. That means unlike the present scenario where all the 8 subsystems are involved or are needed to be considered there would be maximum 4 subsystems involved in the transactions related to one particular job. That shows that the effectiveness would be increased by two times because of reduced complexity.

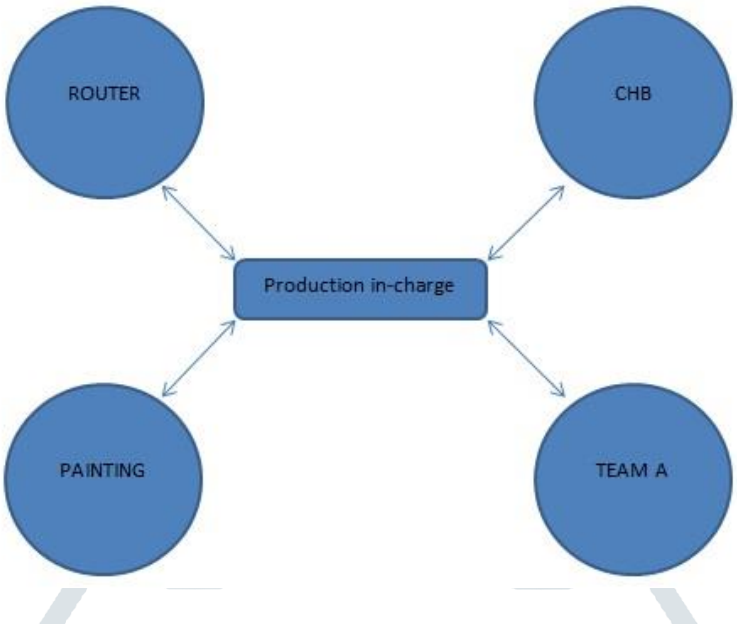

Figure 4: Interdepartmental Information exchange

Similarly the material movement from one department to another during the course of production would also get much easier to manage as instead of three different stations there would be only one team for entire assembly which would take care of that job. This makes the transactions limited and streamlines the material movement so that it can be tracked easily at any stage during the production. This material movement can be seen from the following figure.

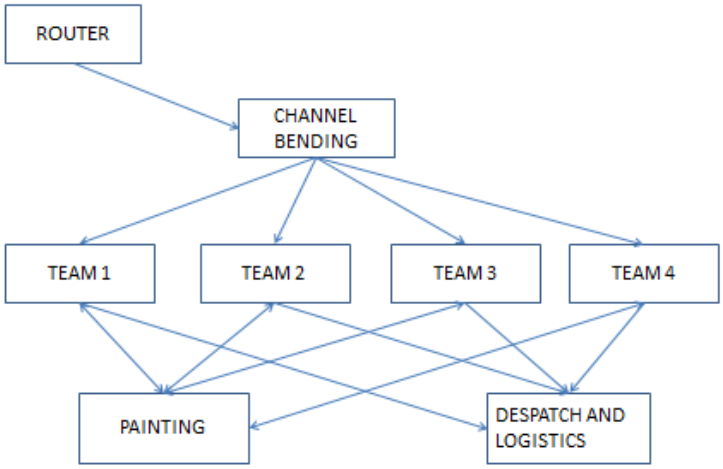

Figure 5: Interdepartmental material movement

3.3 Job scheduling:

Job scheduling is easier in a sense that the parameters governing the assigning of jobs is easier. The teams would be rated as A, B, C, D etc. depending upon their past performances and also depending upon the jobs which are into production and have already been assigned to the teams. As the teams have limited resources and are primary bottlenecks due to the labor based assembly, while scheduling of the jobs we have to work backwards. First depending upon the assembly team's capacity (which can be easily calculated by doing time study. It has to be calculated in running inches of work done per hour) jobs are to be allocated to assembly teams. Once the jobs have been assigned to the teams then calculating backwards the schedule of the machining departments viz. CHB, PAINTING is decided. Also while scheduling the jobs for the machining departments first priority is to be given for the teams which have higher grade (grades as mentioned earlier would be given based on past performance of teams

considering factors such as timely deliveries, quality of output, documentation of necessary job details etc). Unlike the current scenario where we have to take into consideration 8 subsystems now we only have to consider machining departments and one team at a time which would have expertise of three departments. Once the job cycle has been calculated depending upon the activities involved we can easily schedule the jobs for team and then schedule it for the machining departments. Further if we consider overtime and night working, in the present scenario at a time two or three departments are needed for even a single job as the activities are distributed in all the departments from assembly. But with the new model this labor hours can be crashed as we have a multi-functional team we can rely on one team only or members from the relevant team which would reduce the labor hours to be spent during the over time or night shift which would intern reduce the labor cost and add on expenses on the job.

3.4 Fault analysis and evaluation:

Unlike the present scenario where the fault traceability itself is questionable in the new mode fault traceability would become much easier. Every time when a job has been assigned to a particular team that team name will be entered in the master data base (master data will contain the data such as the job details, location, client details, completion and dispatch dates, quality status of completed jobs, rejections and rectifications involved and the team responsible for the job) against that particular job. Once a specific job has been assigned to the team that job becomes the responsibility of the team. Once this system has been put in place the grey areas pertaining to the responsibilities of the intermediate tasks or activities involved in overall production would be removed. Every team member would then realize that the job is his own responsibility and identity and thus he/she would try to give his 100% in job completion. Also their performance would be rated based on the end result delivered in terms of completion of job thus even if the intermediate processes are not directly into their area of control the habit of taking pro-active follow up would develop. As every job would have a specific team assigned for the job and it would be on record, tracing back to the job if the need comes would be much easier.

Performance evaluation as well would be easier in this case because for every team there would be a definite parameter governing the evaluation and it would be same for all the teams in the assembly and same for all the team members. All the faults, rectifications, reworks would be recorded in terms of monetary loss or loss of labor hours against that particular team (*this is particularly missing in the current scenario). These factors will also be taken into consideration while doing the evaluation. This evaluation can then be done on monthly or quarterly basis so that at the end of the year summing it up reviewing and then taking final appraisal calls would be much simpler and factual rather than being only intuitive and person based.

4. Real Case Feedback

4.1 Brief overview:

When this idea was initially discussed with the management it was decided that this be initiated in the Delhi unit which was then under development and wasn't functional. Thus it was decided that this model automatically would be adopted in Delhi setup. In this chapter we will take a look at how this is being currently run in Delhi unit. We will compare the "what had to be done" and "what is being done" factors. Also we will study the shortcomings of the model, record a feedback from the in-charge of the Delhi unit, and will look at how we can implement it more effectively in the time to come.

4.2 Overview of Delhi production unit:

Delhi production unit contains following man power and they are categorized as follows.(names have been changed and have only been used for representational purpose)

ROUTER	CHB	PAINTING	AVAILABLE FOR ASSEMBLY
Kamaldeep	Murari kumar	balwinder	Naresh dhadve
Jamshed		sarwan	Ravi kumar
			Satish sehgal
			Bablu
			Shaukat
			Neeraj
			Keshav
			Rumi

Table 1: Categorization of associates

As a prototype study the real time readings of the proposed and the existing model has been recorded and time study has been done in order to do the comparative study. This time study can be seen from the following tabulated data. Time required for producing standard aluminium front lit channel letters for a particular client was studied for obtaining the following observations.

Using existing production layout:

	Base assembly	Electrical	Top assembly	packing	Total cycle time in min	Total cycle time in hrs
16" letter (10 letters)	115	125	100	60	400	**6.67**
20" letter (10 letter)	156	150	125	85	516	**8.6**

Table 2: Time study for existing production layout

Using proposed production layout:

	Base assembly	Electrical	Top assembly	packing	Total cycle time in min	Total cycle time in hrs
16" letter (10 letters)	46	60	45	35	186	**3.1**
20" letter (10 letter)	50	70	68	60	248	**4.14**

Table 3: Time study for proposed production layout

Above table shows the comparative time study for the same job done by two different methods. The machining departments have been omitted from the above chart because irrespective of the method the time taken by the machine is going to be same. It can be clearly seen that there is drastic improvement in utilization of time for the same process. If for instance we take a look at 16" sample letters, it can be seen that time saved is (6.67 - 3.1) / 6.67 = 53 % which is pretty good. Now although there is large improvement possible with the new approach there are some points which are worth noting. Thus let us now take a look at the observations made by the person who is in-charge of the production in Delhi plant and who has been the driver of this whole activity of data capturing.

4.3 From the lens of production in-charge:

After a long discussion with the production in-charge of Delhi unit the above experiment was performed. On completion of this experiment some very important points and observations were recorded by the above stated associate. These observations are stated below. Along with these observations I am taking liberty to interpret these observations and suggest a rectification or modification so that the proposed system can be implemented to its full efficiency.

1. "Time required during assembly and electrical and packing is greatly reduced due to increased labor."

As we are doing one process at a time in every team, all the team members are involved in that process thus it promotes discussions and brain storming for doing that particular process faster. Further the same process is divided into the small sub processes among the team members this reduces the waiting time for sub processes and promotes parallel processing thereby reducing the time required for overall process to great extent.

2. "Due to increase in labor more number of tools (Drill machine, screw machine and heat gun) are used than regular use."

As discussed in the previous point as well the new model promotes parallel processing. Thus it naturally requires multiple tools to be utilized at the same point of time. This results in the increased demand in the number of tools of same or similar type.

3. "In particular electric fitting, only two people were arranging the led and rest were doing the other work (wire twisting, soldering, silicon application)."

In every process be it electrical or assembly, the sub activities can always be divided into the two categories one involving skill and one not involving skill. When we are talking particularly about the electrical team we get to see this prominently that when only two people are assigned for doing the job those two people have to do all the sub activities by themselves even if the sub activities do not demand the skill level of person doing the job. Whereas in the proposed setup as the team is doing one process at a time different people with different skill levels are present thus the sub activities get distributed among the members as per the skill levels available. Thus this enhances the utilization of caliber of individuals on the floor.

4. "Operation with 5 people was smooth because according to me, the particular job was well known to everyone one."

As everyone is aware of the job and the process to be done automatically checks are established and better ways of doing the task are explored thereby making the process smooth.

5. "In case of non-standard jobs the electrical fitting won't be smooth as there will be only one person arranging the LEDs as backup for keshav(head of electrical department. name changed) is not fully trained."

This is a genuine obstacle which clearly highlights the need for standardization and dependency over document rather than person for doing the activity. In order to overcome this we need to setup a process by which the drawing and the necessary documents will be prepared prior to the job and this docket would then be passed on to the team doing the job so that the dependency on individual would be reduced. By doing this we would be able to delegate the task for e.g. of placing LEDs which is a task requiring skill and experience to somebody with lower skill level as well.

6. "The system got disturbed one-two times due to unloading and loading of sheets and other goods."

We need to understand that when we delegate a team a particular task or a job we are expecting them to take full responsibility of it. Also based on this performance we are eventually going to rate them and do their performance appraisal. Thus we need to

make sure that all the activities which are not related to the job are not assigned to the team. This would otherwise slow down their process thereby making our job planning less effective and would result in unnecessary delays. We need to make sure that all the resources required by the working teams are supplied to them these resources can be in form of time allotted or tools or machinery. We need to make sure that the tools and machinery being used is maintained in proper condition so that it would not create delays in the process.

7. "So in final, according to me, the proposed system will be more suitable for quantity jobs."

In the quantity jobs the processes are standardized before the production starts thus when the production starts everything is documented and SOPs are in place for doing the jobs also the raw material, tools and other resources are planned and kept ready for the production use. This is the common link in quantity jobs and the job types required for the new model. Thus if we want to use this system for the routine jobs, we have to standardize some of the elements such as electrical assemblies etc. This would make the new system feasible for the day to day production as well only thing required is that the documentation should be very strong and reliable and production should be done by referring the document rather than individual experience of the workers.

5. Conclusion

From the above report it is evident that the proposed system is of great help provided that we take good care of some factors. Above experiment shows that it is possible to even improve our efficiency by 40-50% in some cases in terms of time consumption. Although for variety of jobs this much increase in efficiency may not be obtained we can definitely aim for at least 30% increase in efficiency.

Even though we assumed that the Delhi production being newly setup would be working on the new proposed system, there are still lot of factors which are needed to be taken care of in order to implement this model and study its effectiveness. Also since we are working in urgent and important quadrant majority of the times it becomes difficult to plan and execute the jobs as per new model. This experiment and data capturing could be done because we were working in important but not so urgent quadrant and we were creating surplus production for the peak times thus we could plan the jobs properly and get the desired data by experimenting. Following areas need to be worked upon for smoothly shifting from existing production layout to the proposed production layout and avail optimum benefit from it.

- Training program for creating team leaders with hands on experience and good knowledge of CHB assembly, assembly, and electric department.
- Dependency on documents rather than verbal communication. Team should be able to refer one docket and complete the job assigned.
- Projection based production for better planning and execution.
- Sufficient trained man power to create multiple teams.