INTERNATIONAL RESEARCH JOURNAL OF ENGINEERING & APPLIED SCIENCES
ISSN: 2322-0821(O) VOLUME 10 ISSUE 1
ISSN: 2394-9910(P) Jan 2022 - Mar 2022
www.irjeas.org

ENHANCEMENT OF PRODUCTION BY LEAN MANUFACTURING METHOD

Vivek Vishnu[1], Vineet Kumar Dwivedi[2]

[1]Research Scholar, Department of Mechanical Engineering, SAM College of Engineering & Technology, Bhopal, India
[2] Asst. Professor, Department of Mechanical Engineering, SAM College of Engineering & Technology, Bhopal, India

*Corresponding author – vvishnu4799@gmail.com

Abstract - The thesis proposes a method for introducing lean manufacturing using string diagram in an operating CNG high pressure storage tank manufacturing job shop at Jayfe Cylinder Ltd. Haryana. By applying lean manufacturing using process layout diagram to produce part families with similar manufacturing processes and stable demand, plants expect to reduce costs and lead-times and improve quality and delivery performance. The thesis outlines a method for assessing, designing, and implementing lean manufacturing using process layout diagram, and illustrates this process with an example. A manufacturing cell that produces high pressure steel tank container for commercial & automobile customers is implemented at cylinder tank Machining Centers. The conclusion of the thesis highlights the key lessons learned from this process.

Keywords – CNG, Lean manufacturing method, High pressure tanks

Manuscript Received: 18 December 2021, Received in Revised form: 03 January 2022, Accepted: 06 January 2022
DOI – 10.55083/irjeas.2022.v10i1001

1. Introduction

The environment in Jayfe cylinder limited Haryana, is a bit changed and different from the one in which it has succeed in the past. The turn down in auto parts spending has increased the significance of cost in a decision process which before emphasized the incorporation of state-of-the-art technology into new Automobile products.

Linking Jayfe Cylinder Group Business and Manufacturing Strategies

Jayfe cylinder Group is the leading suppliers to Maruti, Tata motors. The Jayfe cylinder manufacturing mission incorporates the planned purpose of the group as a whole:

And with that, Manufacturing's strategy mainly focuses on to fulfil consumer need, growth and best practices. And using finest practices, Manufacturing can also provide best customer satisfaction at a low cost, producing improved business from its current customers and attracting new ones.

An interesting expression of this strategy is the way in which major functions and interaction of manufacturing centres made.

While JPM Group has created manufacturing business units in their all-manufacturing centres that is each and every centre by having functions report to the management of the business unit, Jayfe cylinder has maintain functions, operating at a Zonal level, and supporting the manufacturing centres through their representatives.

With that, Jayfe cylinder has made a matrix approach with the intent of not just holding functional knowledge, but also to eliminate the additional costs of duplicating responsibilities or management within their each and every manufacturing centre.

Understanding the nature of the product life cycle is very useful in determining the appropriate production strategy. This chapter discusses this concept in greater length by introducing the product-process matrix.

Then, it looks after the plus points and limitations of the diverse process's structures, making it simpler to show the advantages of fine manufacturing and the conditions in which its accomplishment is enviable. Then, it tells the reasons that justify the design and moving of a manufacturing cell in the Machining Center. Finally, the procedure used to introduce the cell is made.

Product-Process Matrix

The product-process matrix joins the product and process life-cycle with the intention of providing a means whether or not a firm has correctly matched its production course to the product structure.

Since conventionally the manufacturing industry has considered itself a small producer, until recently the most of its operations had choose for a supple process layout, to allow them to manage little quantities of a large variety of products. As a result, machines are divided by function to minimize machine rest time and maximize machine use in what is often called a job shop blue print.

International Research Journal of Engineering & Applied Sciences, IRJEAS
www.irjeas.org, ISSN(O): 2322-0821, ISSN(P): 2394-9910, Volume 10 Issue 1, Jan-Mar 2022, Page 01-04 DOI – 10.55083/irjeas.2022.v10i1001

2. Functional and Product Flow Layouts: Benefits and Limitations

The flow and detached line flow of the product-process matrix communicates to what is often known as a functional layout or job shop. In a functional layout tool with the same function is present with each other, providing flexibility; so a wide variety of products can be manufactured at a low volume. It also allows for easy training of workers as they have the opportunity to learn from each other when they are placed side by side.

However, the functional layout has several disadvantages. For example, as the no. of products and machine type's increase, difficulty increases largely. Since the products travel a lot around the factory, lead-times are higher and it becomes hard to look after the work-in-progress. Also, dividing products before they are sent to the next step in the process increases WIP and hides problems.

So defects are found late in the process and are generally takes large cost to correct, as there is a large no. of products in pipeline that have to be scrapped. Since maximizing machine use is an important to the environment, larger batches are preferred to minimize change-over and set-up costs.

This reason of increasing machine use causes an increase in supply costs, and finished goods and perpetuates long lead times and decreasing throughput. Goldratt in his book, has warned workers from using machine use as a driving metric, but in a functional layout it is hard to resist this attraction and give in to large inefficiencies for the sake of keeping all the machines busy.

Product-flow layouts communicate to the connected line flow in the product process matrix. These layouts are used when the product volumes prove to be big enough to show a dedicated line to carry a sequence of operations, that is machines located in accordance with the line of flow of the product. The advantages of this layout are the decrease of WIP as batching is removed, and no WIP is accumulated between process steps. Since waiting times are compact considerably, cycle times reduces and throughput is higher.

One of the main disadvantages of the product-flow layouts is no flexibility, as one or a small no. of products may be manufactured in one line, and accepting product changes or new products can be costly. Product-flow layouts also require high investment to purchase manufacturing and handling equipment. However, when one of the parts of equipment breaks it can cause the whole line to stop.

3. Lean Manufacturing: Benefits and Limitations

Lean Manufacturing offers an opportunity to combine the efficiency of product flow layouts with the flexibility of functional layouts. In lean manufacturing, products with similar process requirements are placed into families and manufactured in a cell consisting of functionally dissimilar machines dedicated to the production of one or more-part families. By batching similar products, the volume increases justifying the dedication of equipment.

But since this volume is justified by process and product similarity, lean manufacturing warrants much more flexibility than a pure product-flow layout. In terms of the Product-Process matrix, lean manufacturing allows movement down the vertical axis, i.e., it allows increasing the continuity of the manufacturing process flow without demanding that the products be made in large volumes.

The benefits of lean manufacturing include faster throughput times, improved product quality, lower work-in-process (WIP) levels and reduced set-up times. These gains are achieved because the batch sizes can be significantly reduced. As set-up times decrease, batch size can be reduced.

Smaller the set-up time, smaller the batch size, and as a goal a batch size of one is practical when set-up time is zero. Within a cell, small batches don't travel far as machines are placed side by side, resulting in less work-in-progress, smaller lead times and much less difficulty in production scheduling and shop floor control.

Unfortunately, in a lean layout as in the product-flow layout, a machine break down may still cause a work stoppage in the cell. A different limitation of this approach is that to make sure cell productivity and low costs, a high enough volume of products must be processed within the cell so that expense of buying the equipment to each product is low. Managers, who ignore this fact when pursuing the improvements that lean manufacturing promises, may end up with lesser benefits than expected.

Cell Design and Implementation Process

Since the goal of the internship was gaining more knowledge, it was important that the method used to would satisfy both of these objectives. In the book A New American TQM, Shiba et al. refer to 2 diverse ways to effect improvement within an organization while incorporating learning the PDCA cycle that is Plan-Do-Check-Act & the CAPD cycle.

The authors explain that the PDCA cycle is most useful in continuous improvement, where the process already exists and the PDCA cycle is run over and over again to eliminate the most important problem, and further decrease the discrepancy of the process and its results.

The CAPD cycle on the other hand, is more applicable to planning situations where the target for the next planning cycle is different from the target for the previous one. The letters are transposed to highlight the control and feedback aspects of the loop and to look upon their significance in the preparation of the development process.

4. Cell Planning Phase

The successful completion of lean manufacturing in an already established production shop depends on detailed planning, involvement of employees and management, and their staunch pledge to the change. The first three steps of the design and implementation process are incorporated in this phase: assessment, design and performance analysis. By following these steps, accurate data on the current situation is gathered and used to establish a baseline, to identify the profits from lean manufacturing, and to obtain the support of management and employees.

5. Assessment

In the assessment stage, the chief goal is to collect precise

www.irjeas.org, ISSN(O): 2322-0821, ISSN(P): 2394-9910, Volume 10 Issue 1, Jan-Mar 2022, Page 01-04 DOI – 10.55083/irjeas.2022.v10i1001

data on lead-times, costs, quality, and other important metrics to get a true image of the way in which the production environment functions. Then using analysis this data is converted intos if the cell is introduced in a new facility where the main manufacturing process/layout is not yet defined. In this case, the main point of this stage is to determine whether or not the purpose of the facility and the expected product stream go with the conditions which make lean manufacturing a helpful production method. However, this thesis will limit its scope to developing an approach to lean manufacturing in already existing production environments.

When introducing lean manufacturing in a shop like the Machining Center, which has been operating as a job shop for many years, the assessment stage not only must answer the matching question. It should explain why lean manufacturing has the prospective to yield improvements over the present manufacturing process, and create support from management to carry on with the design stage. The following list shows a short summary of the main activities to be accomplished during the assessment step:

1. Answer the match question: Is the nature of the product stream (demand and process) suited for lean manufacturing?

2. Collect accurate data on current situation: Data in every part of production is useful to know the reality of the shop and how lean manufacturing has an impact on it. Data on costs, production rates, scrap rates, lead-times, metrics, level of customer satisfaction, and culture of the organization should be incorporated, but by no means this is a complete list.

3. Make the case for lean manufacturing: Building on the two previous points, the advocate for lean manufacturing must put together a strong and honest case to justify and build enthusiasm in the management for lean manufacturing. The honesty and potency of the case for lean manufacturing must be emphasize; introducing a new method of "doing things" is risky and involves costs.

Management must have solid reasons to justify taking then risk and making the investment to support the new approach. Given the civilization of an association, the ability to move to the next step of the planning phase will depend at least to some extent on the integrity and motives powering the party advocating lean manufacturing.

If lean manufacturing is mandated by top management, production and functional personnel may comply but not commit to the change. If the idea is originated at the grassroots, i.e. from the bottom up by either production of functional workers, the advocates may not have enough access to data or trustworthiness to make an informed suggestion to get the attention of management.

If the idea is from functions sustaining production, production person may be doubtful of the motives of the function advocating the change. Obviously, the nature of the relation between the function(s) and production is very important in such case.

Lastly, if the idea comes out of the production area, it may or may not be depending upon the amount or resources required to study its validity. The evaluation step requires that the advocate has an overall, non-sponsor approach, access to data, credibility and assurance.

Regardless of who comes up with the idea for introducing lean manufacturing, it is wise for that person to decide whether or not he is the best advocate, and identify an advocate in the case that the originator is not the best choice. Otherwise, the idea may not even make it to the assessment stage.

6. Design

The aim of the design step is to find the blue print for the cell. The achievement of this step depends on involving a core of individuals who have information or have right to use information covering different parts of production and functional support. It's highly desirable that these individuals acquire authority to make decisions as representatives of their particular functions, since the cell process requires "doing things in a new way," which always impact the way in which functions and production "do business".

The cell layout can be finalized at this point unless the cell design team decides to leave layout open for the input of the implementation team. Before implementation other issues such as supervisory roles, labor contractual needs, level of support needed from functions, etc. should be discuss and documented as a guide or as an expectation for the implementation team.

While it is good to "cover all the bases", the author believes that there is a lot of value in leaving as many degrees of freedom as possible open to the input of the implementation team, who will eventually live and work within the cell. However, any issues that can be seen as potential barriers for successful implementation or requiring extra management guidance or clarification should be addressed.

7. Design at the Machining Center

The next few sections present the cell planning phase at the Machining Center. The planning phase consisted of a six-week period during which a cell vision team worked together to create the blue print of a production machining cell at the Center.

The goal of the project was twofold: learning and improvement. The author feels that these objectives have been accomplished. The cell design and implementation process proposed in this thesis was used to implement the cell at the Machining Centre, and the Machining Centre has begun to realize the benefits expected from the cell. Following are the key learning of author from internship:

1. **Do not underrate the significance of analysis: A** successful execution requires deep analysis. When introducing a cell in an already existing job shop, managers may decide to rely on their own knowledge and experience rather than on data and analysis to determine part families and cell capacity. While knowledge and experience are extremely important,

www.irjeas.org, ISSN(O): 2322-0821, ISSN(P): 2394-9910, Volume 10 Issue 1, Jan-Mar 2022, Page 01-04 DOI – 10.55083/irjeas.2022.v10i1001

without analysis it is impossible to synthesize the data into useful information to support decisions. Furthermore, analysis encourages the exploration of different scenarios, and these iterations yield a more robust design.

2. **People make it happen:** Analysis is necessary but not sufficient. Participation from people across the organization facilitates and enhances the design; and it is people that implement the design! Ensure that input from as many of those who will "work and live within the cell" is obtained prior to implementation; it will make the implementation process much smoother.
3. **Break down the functional barriers:** Lean manufacturing requires communication amongst and between the operators and the functional support personnel to support rapid problem solving and results. The culture of an already existing shop may not support the kinds of interactions and relationships that support lean manufacturing. Managers should be aware that the introduction of lean manufacturing can potentially require changes to the organizational culture.

REFERENCES

[1] B. Bergman and B. Klefsjö, *Kvalitetfrånbehov till användning*, 5th ed. Sweden: Studentlitteratur AB, 2012.

[2] J. P. Womack, D. T. Jones, and D. Roos, *The Machine That Changed the World*. Great Britain: Simon & Schuster UK Ltd., 2007.

[3] P. Petersson, O. Johansson, M. Broman, D. Blücher, and H. Alsterman, *Lean: Göravvikelser till framgång!* Sweden: Part Development, 2009.

[4] M.L. Emiliani and D.J. Stec, "Leaders lost in transformation," *Leadership & Organization Develop. J.* , vol. 26, no. 5, pp. 370-387, 2005.

[5] AGA Gas AB. AGA - EttavSverigesmestinnovativaföretag. [Online]. http://www.aga.se/international/web/lg/se/like35agase.nsf/docbyalias/aga_histor y

[6] J. Bicheno, *Nyverktygslådaför Lean*. Sweden: Revere, 2006.

[7] J. K. Liker, *The Toyota way - 14 management principles from the world's greatest manufacturer*. New-York, United States of America: McGraw-Hill, 2004.

[8] P. Found and R. Harvey, "Leading the lean enterprise," *Eng. Manage.*, vol. 17, no. 1, pp. 40-43, 2007.

[9] N. Modig and P. Åhlström, *Dettäer Lean - lösningenpåeffektivitetsparadoxen*. Sweden: SSE Institute for Research, 2012.

[10] P. Hines, M. Holweg, and N. Rich, "Learning to evolve - A review of contemporary lean thinking," *Int. J. of Operations and Production Manage.*, vol. 24, no. 10, pp. 994-1011, 2004.

[11] P. Petersson, O. Johansson, M. Broman, D. Blücher, and H. Alsterman, *Ledarskap: Gör Lean till framgång!* Sweden: Part Media, 2012.

[12] S. Bhasin, "An appropriate change strategy for lean success," *Manage. Decision*, vol. 50, no. 3, pp. 439-458, 2012.

[13] M. Alvesson and S. Sveningsson, *Organizationer, ledningoch processer*. Sweden: Studentlitteratur AB, 2012.

[14] K. L. Sim and J. W. Rogers, "Implementing lean production systems: barriers to change," *Manage. Research News*, vol. 32, no. 1, pp. 37-49, 2009.

[15] J. P. Kotter, "Leading Change: Why Transformation Efforts Fail," *Harvard Bus.*

i. *Review*, pp. 57-68, March-April 1995.

[16] K. Volo and S. Volo, *Engage! Your Step by Step Guide to Creating a Workplace That You, Your Co-Workers, and Your Customers Love.*: Life with a Fabulous View, Incorporated, 2013.

[17] K. Ruck and M. Welch, "Valuing internal communication; management and employee perspectives," *Public Relations Review*, vol. 38, pp. 294-302, 2012.

[18] G. Park, M. Spitzmuller, and R. P. DeShon, "Advancing Our Understanding of Team Motivation: Integrating Conceptual Approaches and Content Areas," *J. of Manage.*, vol. 39, no. 5, pp. 1339-1379, July 2013.

[19] R. Ilies and T. A. Judge, "Goal Regulation Across Time: The Effects of Feedback and Affect," *J. of Appl. Psychology*, vol. 90, no. 3, pp. 453-467, 2005.

[20] M. Kaye and R. Anderson, "Continuous improvement: the ten essential criteria," *Int. J. of Quality and Rel. Manage.*, vol. 16, no. 5, pp. 485-506, 1998.

[21] R. K. Singh, S. Kumar, A. K. Choudhury, and M. K. Tiwari, "Lean tool selection in a die casting unit: a fuzzy-based decision support heuristic," *Int. J. of Production Research*, vol. 44, no. 7, pp. 1399-1429, April 2006.

DOI – 10.55.83/irjeas.2022.v10i1001

Metadata from Crossref doi