ISSN No:-2456-2165

A Study on the Investigation of Production Loss in a Plating shop using Fuzzy Cognitive Maps

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Abstract:- The main aim of the study is to determine the various sources which contribute loss in the production routine of the plating shops in an industry. Here we use the concept of Fuzzy Cognitive maps to determine the Major Factor which contributes to the Production Loss. Fuzzy Cognitive Map (FCM) is an efficient method which analyses the data by directed graphs and connection matrices.

Keywords:- *Connection Matrices; Directed Graphs; Fuzzy Cognitive Maps; Producion Loss.*

I. INTRODUCTION

Nowadays, industry is facing rising material and energy prices, which creates an urgent need to avoid any losses in production process. The difference between the input and output of a working system is considered as a loss. Losses can be incurred by the use of all factors of production. Production loss can impact small and large scale industries and they usually result from various problems arising in the production process. Unplanned stops, planned stops, small stops, slow cycles, production rejects and startup rejects are the recommended six big losses. Equipment failure, setup and adjustments, idling and minor stops, reduced speed, process defects and reduced yield are the traditional six big losses. Hence Overall Equipment Effectiveness depends on availability loss, performance loss and quality loss.

Analysis, monitoring and control of the various factors involved in the production process helps in determining the exact location or process where the loss occurs. Time is one of the important factors which helps in determining the production loss. Considering the valuable resources and their time, the loss events that have high impact on the production volumes can be found out. Hence for the efficient production determination of the major loss is an essential one.

To explore the issue of passenger transportation, W.B. Vasantha Kandhasamy and V. Indira created the matrix theory in the year 1998. To investigate this issue, we employ the same matrix theory. There are four parts to this Study. “The second portion is where we talk about how to use the FCM connection matrix. The most frequent causes of production loss in the plating business are discussed in section three. Section 4 discusses how to use an FCM connection matrix to identify the key factors that lead to production loss in the plating shop. We address our research-based findings in the last part.

II. FUZZY COGNITIVE MAPS(FCM)

An FCM [4] is a directed graph with concepts as nodes and causalities as edges. It represents causal relationship between concepts. When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes. FCMs with edge weights or causalities from the set {–1, 0, 1} are called simple FCMs. Let C1, C2, …, Cn be the nodes of an FCM. Suppose the directed graph is drawn using edge weight eij∈ {0, 1, -1}. The matrix E is defined by E = (eij) where eij is the weight of the directed edge CiCj . E is called the adjacency matrix of the FCM, also known as the connection matrix of the FCM. Let C1C2, C2C3 , C3C4 ,…, CiCj be the edges of the FCM (i≠ j). Then the edges form a directed cycle. An FCM is said to be cyclic if it possesses a directed cycle. An FCM is said to be acyclic if it does not possess any directed cycle. An FCM with cycles is said to have a feedback.

If A = (a1, a2, …, an) where ai∈ {0, 1}, then A is called the instantaneous state vector and it denotes the on-off position of the node at an instant.

ai = 0 if ai is off and ai = 1 if ai is on for i = 1, 2, …, n.

If the FCM settles down with a state vector repeating in the form.A1 → A2 → … → Ai → A1 then this equilibrium is called a limit cycle. A = (a1, … , an) is a vector which is passed into a dynamical system E. Then AE = (a'1, … ,a'n) after thresholding and updating the vector suppose we get (b1, … , bn) we denote that by (a'1, a'2, … , a'n) (b1, b2, … , bn). Thus the symbol ‘→’ means the resultant vector has been thresholded and updated. The edges eij take values in the fuzzy causal interval [–1,1]. eij = 0 indicates no causality, eij> 0 indicates causal increase i.e. Cj increases as Ci increases (or Cj decreases as Ci decreases). eij< 0 indicates causal decrease or negative causality i.e. Cj decreases as Ci increases (or Cj increases as Ci decreases). Simple FCMs have edge values in {–1, 0, 1}. Then if causality occurs, it occurs to a maximal positive or negative degree.

III. METHODOLOGY

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with the branch of knowledge. Hence the methods describes actions to be taken to investigate a problem and the rationale for the application of specific procedures and analyze information applied to understanding the problem, thereby, allowing to critically

ISSN No:-2456-2165

evaluating the study. Hence it is necessary to design a methodology to solve the problems.

Both small and large businesses may have production losses, which are typically caused by unforeseen issues that crop up during what ought to be a standard manufacturing process. Due to problems with equipment, supplier shortages, human error, weather, and other factors that businesses may or may not be able to control, the process takes longer or less things are produced than expected. However, with careful preparation, steps may be done to reduce losses and their financial effect.

Let us discuss about Five Major factors individually, which contribute to the Production Loss in a Plating shop. Then the FCM concept can be applied to find the major factor that contribute to the production loss.

A. Major Factors

- Production Loss Due to Man Power: Manufacturing needs consistent labour. The shop staff has to get knowledgeable about the manufacturing process. Both the staff and the workers are included in this. This crew would ultimately become so adept at the procedure that they would be able to create items of excellent quality. These individuals' skills would grow to be a valuable asset for the company over time. The Companies began experimenting with different methods of hiring individuals that were centred on keeping them for a little amount of time and letting them go when demand was low. Care for construction workers began to decline. Many different sorts of companies now use a sizable portion of migrant labour.
- Production Loss Due to Breakdowns: Machines are essential components of industrial systems, and when they malfunction, system performance metrics can be significantly impacted. Therefore, if the breaks are unplanned, it is a huge concern for the production planners. It is quite challenging to predict where and when a machine breakdown will occur throughout the production process. However, once important workstations for machine breakdown are identified, production planners can take preventative measures with regard to these essential workstations, enabling the production process to go uninterrupted. Workstation delays have an impact on the entire production system and cause throughput targets to be missed. The impacts of machine failure on system throughput should be identified in order to avoid significant variations in the production process.
- Production Loss Due to Delay in Material Supply: One of the most significant issues that cause production delays internationally, according to some, is the shortage and delay in the delivery of resources. The pertinent underlying causes, however, differ from nation to nation. The origin or accessibility of raw resources is the main factor in material shortages. On the other hand, a weak materials procurement and inventory management system, which includes additional underlying causes including a slow identification of the type of materials required, was shown to be the most significant contributor to material delivery delays.
- Production Loss Due to Process Time: One of the Short, sometimes frequent stops that disrupt the normal flow of manufacturing might slow down processing speed.These include component jams, misfeeds, and accidents that happen when something falls out or is positioned to obstruct a vital sensor or supply access point, for example. Typically lasting under five minutes, Industries add that these stops don't call for maintenance staff but they can pile up in terms of lost production time.
- Production Loss Due to Buffing Time: Another factor that might significantly reduce productivity is buffing time. Using a cloth wheel soaked in cutting agents or rouges, "buffing" is the technique of shining metal, wood, or composites. The compound accomplishes the cutting while the fabric buff "holds" or "carries" it. he technique that makes use of abrasive belt finishing is known in the industry as "polishing." A cut buff and a finish buff are typically the two processes needed for buffing. To prevent a loss of output, the buffing must be completed on time.

IV. MAIN RESULTS

Various factors which contribute to the production loss are determined. There are 5 attributes which contribute more in production loss, FCM is used to determine the major attribute that leads to production loss. The 5 Factors that are listed earlier are taken as nodes. i.e.,

C1- Loss due to Man power
C2- Loss due to Breakdowns
C3- Loss due to Delay in material supply
C4- Loss due to process time
C5- Loss due to buffing time

The directed graph is drawn by taking these paradoxes C1, C2, C3, C4 and C5 as nodes depicted inside the circles and the causalities among these nodes are denoted by the edges which is shown in the Fig.1.

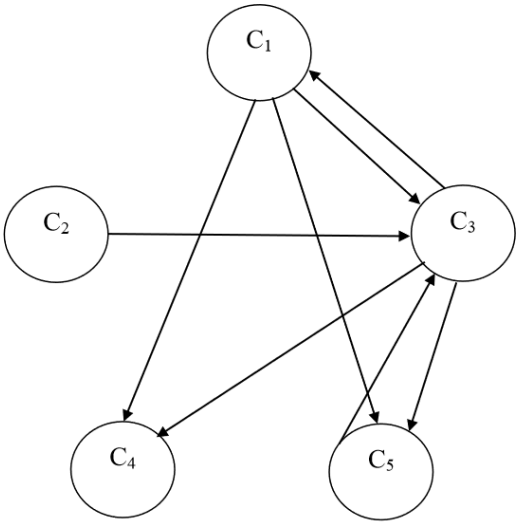

Fig. 1: Directed Graph

ISSN No:-2456-2165

FCMs, or fuzzy cognitive maps, are more useful when the initial data is unsupervised. The expertise of specialists is used by the FCMs. FCMs represent the world as a set of classes and their causal relationships. Now we give the connection matrix related with the FCM. The FCM connection matrix is represented by E. It is important to note that all matrices associated with an FCM are always square matrices with diagonal entries as zero.

$$E = \begin{bmatrix} 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

Consider the first node C1 = 1. C1 is hold on the temporal associative memories recall process. Threshold signal functions synchronously update each concept after each pass, through the connection matrix E.

The starting can be fixed as man power issues that leads to the production loss, B_1 = (1 0 0 0 0)

The arrow indicates the Threshold operation.

Now B_1 = (1 0 0 0 0)
B_1E = (0 0 1 1 1) $\rightarrow$ (0 0 1 1 1) = B_2
B_2E = (1 0 1 1 1) $\rightarrow$ (1 0 1 1 1) = B_3
B_3E = (1 0 2 2 2) $\rightarrow$ (1 0 1 1 1) = B_4 = B_3

Since (1 0 1 1 1) is a limit cycle, it is understood that losses due to man power has greater impact on other losses".

V. CONCLUSION AND FUTURE SCOPE

From the discussed fuzzy matrix, when the man power issues leads to the production loss node is switched on, it automatically influence all the other nodes except C2. Hence man power has a greater influence in the loss due to material delay, process time loss and buffing time loss. Therefore, man power issue is the most important factor which contribute to the production loss. Man power becomes the elementary factor of production. Breakdown loss does not have huge impact in production loss since it occurs occasionally. The present study made based on the production loss in industry, reveals various process involved for loss in production. Time is a dominant factor, which plays a vital role in production routine. Hence it is necessary to evaluate each and every process that is involved in production. More researches can be conducted in this field to determine various factors that contribute in production loss and preventive measures can be taken.

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