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Process Optimization and NVA Reduction by Network Analysis and Resequencing

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ABSTRACT

The article discusses a methodology to reduce cycle times through an algorithmic, analytical framework for sequential process flows. Studying process flow flexibility for reducing bottlenecks has always continued to open new research avenues. This methodology has been formulated keeping in view of sequential manually executed assembly processes, where a single operator is involved, the process steps are entirely manual or semi-automated. The concept can also be extended to other scenarios by computing a process flexibility measure in terms of time, resources and methods. Essentially this article talks about the use of an algorithm for effective scheduling on assembly lines, computing the most optimal path that that the process flow could have taken given how the process has proceeded. Current activity scheduling methods tally the progress against a plan, which is ideal and does not account for unforeseen wait times. The output of the algorithm which is the most optimal approach as computed for a given scenario will help achieve rhythm and reduce wasted time in places where it's possible to avoid them. A standard tool to measure the exact amount of compressible wait time or Muda Type of waste is chosen, the overall equipment efficiency was adopted for gauging this approach. This discusses the generalization of the principle used and its formulation as an algorithm and a flow chart.

KEYWORDS

Algorithm, C-Code, Mapping, Network Mapping, OEE, Optimization

1. INTRODUCTION

Assembly lines across various segments face delays or wait times which turn into bottlenecks. Many methods have been devised to eliminate or reduce their effects. But a system or algorithm that can calculate the best possible sequence of operations that could have been followed is of interest to any industry. A decision to procure additional resources especially of high value requires a robust estimate of plant or machinery capacity.

Time and motion study data gives some insight to the impact of delays on the process, but a tool to evaluate whether a better choice could have been made under the same circumstances was of need. Network formulations of processes are used as tools to analyze sequence constraints.

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Keeping in view of sequence constraints and scope of delay reduction available within a process flow, a step by step approach to reduce idle times was necessary. Generalized formulations were constructed based on permitted process flow sequences, that are more optimal than the original process.

Current scheduling methods using MS project is a purely tracking tool, some intelligence is required to be built into them, by using the algorithm discussed later in this paper, we factory to progressively reach the zero delay stage.

Use of simulation for process flows can only show how these delays effect the entire assembly line flow, but an unanswered question remains could it have been better.

2. NEED FOR THE STUDY

Optimized process flows with minimum delay is the desire of any manufacturing activity. Particularly in aircraft assembly plants where most of the work is manual, the need for standardization and benchmarking is of utmost importance.

A structured approach to compute process flow time with the least delay time was always needed. This need thus evolved later to an algorithm for re-computing an optimal process flow sequence with minimum delay or wait time.

Clarity in setting reasonable benchmarks based on the environment in which the study is conducted, complete understanding of the limitations and constraints under which an activity is carried out was required. Until the constraints could be formulated as a network or mathematical formulation, generating an approach for optimization under conditions of uncertainty is impossible.

The need of this study is thus justified in the context of better decision making in typical management problems of meeting and setting deadlines, benchmarks and targets.

Unavailability of time to look at such problems in greater detail and analyzing the same makes us overlook the rationale behind troubleshooting problems, increasing the tendency to take up rash, deleterious approach.

3. JUSTIFICATION OF THE STUDY

A scientific approach or tool to compute and benchmark the best possible sequence or flow steps in an assembly line was always needed for management to take clearer decisions and formulate better improvement ideas for productivity. Thus a computer compatible approach to calculate minimum possible delay was called for.

For assembly line processes which are repetitive use of mnemonics to classify activity into compressible, incompressible types was a prerequisite.

The need to thus classify an activity correctly as avoidable, avoidable, value added or non-value added was irreplaceable.

Also, a representation of conventional time and motion study data as a network makes it easier for visualizing serial, parallel activities.

Activities that happen in the background when measured against ones in the critical path, help visualize the actual processes better.

This thus reinforced a need to conduct a study of this kind.

4. OBJECTIVES

Objective of our paper is to demonstrate the algorithm with primary focus on delay reduction for effective activity scheduling. The emphasis is on demonstrating the least possible waste d time that could have been achieved given a process flow and its constraint. Emphasis is primarily to reduce delays from the learning from unnecessary wait or wasted time, as to how it could have been replaced