Cycle time study of wing spar assembly on aircraft factory

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Abstract

Aircraft manufacturing processes require a high amount of time to carry out them owing to the large volume of various operations and the high utilization of manual labor. This paper focuses on cycle time study of aircraft assembly using a wing spar as a case of study. Through lean philosophy has been studied the current process and have been analyzed the obtained results. The overall goal was to find potential areas for productivity improvement and propose new solutions that would reduce significantly the cycle time. Results showed a 20% reduction in cycle time through application of lean philosophy, achieving 67% final saving if automation being applied. The study gives significant contribution to the overall goal, showing that, is possible and necessary to bet for new techniques and technologies for manufacturing processes in aeronautical industry.

1. Introduction

Manufacturing processes in aerospace require a high amount of time to carry out them owing to the large volume of work and the high utilization of manual labor. That is why an accurate estimation and analysis of aircraft assembly times is important for process planning, cost control, reducing product development lead times and ultimately commercial success. Thus the implementation of effective methodologies allowing analyze processes time fast and accurately, is a significant challenge for manufacturers hoping to build and maintain a competitive advantage.

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Assemble an aircraft needs for around one third of total manufacturing cost [3]. Thus, Cycle Time Reduction (CTR) will be one of the major factors affecting the future of the civil aerospace industry [7] to successfully compete in the market, minimizing costs and passing a portion of those savings to customers.

Cycle time is an important aspect of process efficiency, defined as the total time it takes to complete a specific task from start to finish. Therefore, cycle time involves different elements that play a key role on it, see Fig 1. These elements, the relationship between them and the implications of these relationships, give clear vision of the subjects to be addressed and help to determine the methods and technologies applied as well as the terminology used to contextualize the field of study.

![Fig. 1. Venn diagram for cycle time.](image)

As can see in Fig. 1, cycle time involves different elements and actions for its development. For example: standardization and process optimization, development teams, time reductions, acceleration techniques, project complexity, information process, time to market, explicit goals, product design, launch and change philosophy, continuous improvement and manufacturing techniques. [8]. These concepts are intimately linked with the following concepts [9]:

- Product strategy
- Development process
- Team structure
- Supply chain

Although the literature cites many product development acceleration techniques, not many examples provide why and how these techniques are successful. Thus is key, look for management methods and new techniques that provide and improve manufacturing processes. One major cost driver is the manufacturing cost, in which assembly cycle time carries a big portion and provides necessary data for production planning and control [6]. Hence, an effective method to accurately estimate assembly cycle time is required to allow a better analysis of the process.

There are different approaches available nowadays to improve process performance. Lean philosophy offers a unique method that helps identify possible improvement areas on a production line [4]. The concept of lean is commonly known as a measure to reduce inventory and the number of hands involved in any process. It is also associated with continuous improvement, but the main theme in the lean concept is waste reduction. Lean is a useful tool that helps in reducing waste of time, material, effort and resources in an industry. The core approach of lean manufacturing is to produce a product in the shortest possible cycle time and streamline the flow of processes offering value to the customer through an ideal value added process that has zero waste [1].

Given the increase in demand in aeronautical sector, manufacturers are pushed to look for new concepts to stay in business amidst strong competition. Thus, the integration of lean philosophy and tools like Cause-Effect diagrams (Ishikawa diagram), histograms (Pareto diagram), Value Stream Maps (VSM) [10,11], brainstorming’s or the Deming cycle (Plan, Do, Check, Act; PDCA) maximizes shareholder value by achieving the fastest rate of improvement in customer satisfaction, cost, quality, process speed and invested capital [6].
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