Simulation modeling to increase production capacity from prototype to production: A case study of rocket motor parts manufacturing plant

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ABSTRACT: In manufacturing industry, a newly developed product shall go from a stage of research and development to preliminary design, detailed design and prototyping in order to reach a final goal of mass production. In general, during designing and prototyping phase, the product is produced in a small amount only for test and verification. Once the design is approved and all manufacturing processes are verified, only then will the product be produced in a large quantity to deliver to customers. For this reason, a production line for prototyping and mass manufacturing is normally set up differently with regard to a number of parts produced. In this study, a simulation modeling by ARENA simulation software is used to investigate and analyze the required resources in order to increase production capacity from prototyping phase to production phase of a rocket motor parts manufacturing plant.

1 INTRODUCTION

Product development is the process of designing, creating and marketing either a newly designed product or improving an existing one to satisfy the customer requirements. In modern industries, manufacturers have to compete in an extremely demanding market and new products shall be developed consistently to satisfy the needs of customers. Different techniques are used in order to analyze and optimize production capacity, such as, the use of design of experiments. However, with a complex production system, using design of experiments alone can be costly and time consuming. Thus, many engineers are turning towards system modeling and simulation software in order to find an optimal scenario suitable for their production requirement. Pisuchpen (2010) stated some advantages of using process simulation software; for example 1) an ability to evaluate many potential alternatives and determine the best approach to the problem with less time and cost than conventional method 2) an ability to evaluate various system performance index such as cost, production time, resource utilization, etc. simultaneously 3) an ability to run a "What if" scenario to evaluate proposed changes, and finally, 4) reduce the risk of inappropriate expenditure by running vigorous system simulations to verify all important managerial aspects before spending company capital. Many engineers successfully used simulation modeling to solve their production problems. Abed (2008) used a simulation study to increase the production capacity of rusk production line. He thoroughly studied and analyzed several bottlenecks in his production system. After that, simulation experiments with seven different scenarios were developed in order to find the best approach. He found that by adding two new machines, replacing three old machines, modifying two other machines and decrease the time in one process, the system performance could be improved by 50% in production with a decrease of 11.4% total production time. Hasgul (2006) used simulation models to evaluate the bottlenecks in a mixed model production line in a refrigerator company. He found that by rearranging the vacuum station and changing AGV's cell selection rule, the cycle time of the system was reduced and the bottleneck problem at vacuum station was solved. Ramis et al. (2001) used simulation modeling to evaluate different alternatives for process improvement of an ambulatory surgery center. They used statistical data taken from a clinical hospital where patients would enter and leave within the same day. From their study, it was found that by using two beds for patient preparation and five beds for post operation recovery, the maximum throughput of ten daily surgeries could be achieved. In this study, a simulation model using ARENA simulation software is developed to analyze and increase the production capacity of rocket parts manufacturing plant in order to enhance the production line from prototyping to mass productioning.