Improving the Manufacturing Process of Konarka Solar Panels

*Design Team*

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*Abstract*

The purpose of this project is to increase Konarka’s ability to meet customer demand for their solar panel products. Konarka is a world leader in organic photovoltaic solar panel manufacturing. Konarka has identified two problem areas that are impeding their manufacturing process. These areas are their ablation process and their labor resource allocation process. This project will focus on four main methods to help the company better meet demand. A simulation model of the current state of Konarka’s solar panel manufacturing process will be used to test and analyze various manufacturing strategies. An approach to improving their ablation process will be offered. Effective labor resource allocation for their processes will be demonstrated and a facilitators guide will be developed so that Konarka management may use the model for future process planning. The current state simulation model will be used to understand the range of capabilities of the company’s current manufacturing methods. Data collection methods are described as well as how the information will be analyzed. Alternative manufacturing approaches will be based on the current model. This will help Konarka justify any financial risks that these solutions may entail and improve the company’s ability to meet their customer’s demands. The project will use certain performance measures such as work in progress (WIP) and manufacturing lead time to compare the current process and the two proposed processes.

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The Need for the Project

Konarka cannot meet customer demand. Konarka cannot meet customer demands in their current manufacturing process. Konarka, located in New Bedford, MA, is recognized throughout the world as a leader in OPV (organic photovoltaic) solar panels. Management must reject orders knowing that the facility does not have the production capacity to meet customer requests, and cannot meet promised delivery dates on orders that are accepted. Konarka management does not have a clear understanding of their production capacity and therefore must estimate what additional jobs they can take on. Konarka’s issue with meeting promised delivery dates stems from the fact that they do not have an accurate method to determine lead time for orders, incorporating yield loss, machine failure rates, and lack of operators.

The Design Project Objectives and Requirements

A simulation model will be created to understand current production capabilities. The model will then be modified to include an in-line ablation machine and an increased number of labor resources.

Design Objectives

Konarka manufacturing management has indicated the need to understand their production capability, capture the benefits of an in-line ablation machine, and optimize the number and movement of labor resources. Their current ablation takes a substantial amount of time through operator-material handling. Their lack of human resources is causing manufacturing delays, as there are not enough employees to operate the many work stations required for flowing product through the production line. Currently, operators are moving when they are available to service each underutilized station.

Design Requirements

The current manufacturing process will be modeled using the Arena simulation package to capture Konarka’s production capabilities and confirm that ablation is the bottleneck process. The ablation process will next be altered in the simulation to model an “in-line ablation process”, in which the cutting of the panel material can be done without human material handling.
As a lack of human resources is causing production delays, the simulation will be used to determine the increase in production rate that can be obtained by adding more resources to the manufacturing process. This also will be translated into a projected profit amount to be used by Konarka to justify hiring more resources to better meet demand. Lastly, the current state simulation model will be given to Konarka management along with a facilitators guide so that they may independently determine their production capabilities given a demand profile.

**Design Concepts considered**

**Arena Standard Edition and Arena Input Analyzer were chosen for simulation and data analysis.**

Simulation software was chosen to best represent the current process and alternative solutions. Two simulation programs were considered: Arena Standard Edition by Rockwell Automation, and AnyLogic University Researcher by XJ Technologies. Arena was chosen due to previous experience using the program and the university’s financial ability to purchase the license for the software.

Statistical software was necessary for analyzing statistical distributions of collected data. Minitab and Arena’s Input Analyzer software were considered. Following some issues working with Minitab, focus was moved to Arena’s Input Analyzer. The program fed back the best-fitted distribution for the data that could be directly entered into the simulation model.

**Recommended Design Concept**

**Konarka’s current state was evaluated in the simulation. The model was adapted to improve the ablation bottleneck and understaffing issues.**

**Design Description**

To improve Konarka’s manufacturing processes, their current process performance measures needed to be determined. Data was collected and analyzed on performance measures such as time studies, yield calculations, and machine failure rates.
This information was used in the simulation model to mimic the current manufacturing process.

**Analytical Investigations**

Excel files were created to calculate the manufacturing price for each panel size. This was based on the amount of material required for each panel and the time studies performed to determine direct labor time required for each panel size. Retail prices of panels, labor rates, and overhead rates, were provided by Konarka. This information was used to determine overall manufacturing costs for various runs completed in the simulation. By using this financial data, the increased profit can be determined from an automated ablation process and optimal workforce.

**Experimental Investigations**

After meeting with Konarka’s Vice President of Manufacturing, the ablation issue and the labor resource management were identified as issues to be addressed. In the current Ablation process, an operator must grab a panel one at a time and precisely line it up to be laser cut. This is the bottleneck process due to the length of time it requires to perform this task and the number of defects caused by human handling. Konarka has considered designing and building a new machine that can automate the ablation process. Since there is no machine available on the market that can conduct the process with their specific requirements, a significant amount of financial and labor resources would have to be devoted to developing the automated ablation machine. To simulate the increased output in Arena, the current model would be modified to include an ablation process that runs at such a speed that it is no longer the bottleneck.

Konarka currently has an issue with understaffing. They do
Financial Issues

Purchasing the full version of Arena software and covering travel expenses to Konarka were vital to the success of the project. Performance measurements will be based on the difference between the current state and the modified version of the model. The model needs to be able to handle a substantial amount of entities for Konarka to see their maximum potential after the proposed improvements in the manufacturing process. Since the student version of Arena, available in the COE labs, could not accommodate this level of entities, the full version of Arena had to be purchased.

Travel costs to the manufacturing plant were an additional cost, since the manufacturing plant is situated in New Bedford, MA and all of the team members are located in Boston. Travel to Konarka was necessary to gather a sufficient amount of data to input into the Arena model. Expense reports were created to cover this travel cost.

Key Advantages of Recommended Concept

Developing a simulation program to model the current process was used to both understand the current process performance measures and provide Konarka with an accurate and dynamic method for determining lead times for incoming orders.
Recommended Improvements

Konarka’s new barcoding system often proves problematic. The scope of the project was clear after visits to Konarka’s manufacturing facility. An additional for improvement is the barcoding system that was recently implemented. It is used to track the amount of panels that are completed, and the yields that are associated with each process. These barcodes will eventually connect to a database system automatically. Sometimes, however, the scanner was not able to read the printed barcode because it was either tilted or printed improperly on the panel surface. After a certain amount of runs, the roll would have to be re-aligned. One of the operators would re-align the lamination machine, but did not know to re-align the printer. A potential improvement is an alarm system to alert the operators immediately after a problematic barcode is printed.