With manufacturing in wind energy ramping-up, it is imperative to control lead-times and cost through the management of production bottle-necks, material utilization, and labor. In short, the value stream must be managed and optimized within a given firm.

One of the key means for enhancing the value stream is through automation in the manufacturing process. In wind energy related composites manufacturing, automation takes place through sophisticated nesting software systems, material processing systems, and laser projection lay-up and ply validation.

This poster presentation will explore the features and quantifiable benefits of such systems, including an analysis of different types, and how they can enhance the value stream in composites manufacturing for wind energy.

A value stream is defined as the flow of materials and information required for bringing a product to market. Enhancing the value stream involves the analysis and execution of the elimination of waste and the enhancement of cycle times. Most often, a value stream is optimized through automation, through streamlined and lean processes.

For wind energy related applications, specifically wind blade manufacturing, what is the best means for automation and what is its quantifiable value to manufacturing?

This poster presentation will explore the features and tangible benefits of such automated systems throughout the wind blade manufacturing value stream, including nesting, material processing, and laser projection assembly lay-up and ply validation. Further, the presentation will determine which are the best systems for providing automation and the ultimate enhancement of the manufacturing value stream in wind energy.

The automated Wind blade manufacturing value stream consists of the following elements, downstream from blade design. These elements have been tested and compared to results of manufacturing that involves manual processes as well as processes that include high-ply (bristle bed) systems.

• Composites Ply Nesting: Using sophisticated algorithms, composites specific nesting applications will create ply cutting files that maximize composite material utilization while maintaining fiber orientation central to design and quality.
  • Benefits over Manual Nesting and General Nesting Applications:
    • Greater material utilization: composites nesting engines will provide maximum material utilization while allowing for control of ply placement
    • Maximized throughput: nesting times will be enhanced greatly utilizing a composites specific engine versus nesting manually
  • Example of composites nesting software product is “ComposiNest” by Gerber Technology,

• Low-ply Material Processing: Material processing consists of automated, multi-roll feeding and rewinding systems combined with low-ply cutting and annotation systems.
  • Benefits Over High-ply (bristle bed) systems:
    • Greater productivity: optimizes throughput through faster feeding/cutting/rewinding speeds as well as by maximizing system “up” time
    • Lower cost of ownership: not only eliminates labor, but utilizes lower power and consumable usage to create greater return on investment
  • Example of a material processing system is the “DCS3600L” cutting system with (3) roll automated feeder and rewinder.

• Laser Projection Assembly Lay-up and Ply Validation: Using sophisticated software and lasers that work in conjunction with upstream CAD data, 3D-laser ply alignment has revolutionized the layup of composite plies.
  • Benefits over Manual Operations:
    • Increased Productivity: increased throughput utilizing true multi-tasking to build multiple blades in parallel, maintain consistent accuracies and repeatability, and reduce time from CAD model to finished production
    • Enhanced Quality: through controlled ply sequence of events, accurately projected images correct for equipment motion, minimizing skill level and eliminating costly human errors resulting in less scrap
    • Error Reduction: by recording of date and time of each operation, downstream traceability allows for the execution of corrective action.
  • Example of Laser projection is the Virtex LaserEdge®6/5 “LPS-7H” projectors, networked in a series.

Methods

Through industry experience and customer testing using the products of Gerber Technology, the results of using a composites specific ply nesting system, a low-ply material processing system, and laser projection assembly lay-up and ply validation are as follows:

• Composites Ply Nesting: Using ComposiNest, a firm can expect up to a 33% greater material utilization than nesting manually and a 4% greater material utilization than that from a competing product. Further, a nest can be created using ComposiNest in 5% of the time of creating the nest manually.

• Low-ply Material Processing: Using a DCS3600L with (3) roll automated feeder and rewinder (and processing three layers at once), a firm can expect a dramatic productivity gain over both a high-ply (bristle-bed) system (processing six layers at once) with a similar configuration and a fully manual process (processing six layers at once). For example, when examining the cycle times required for processing the material for (6) 45m long wind blades, testing indicated that manual processing requires a 335% percent longer cycle time than low-ply processing, while high-ply (bristle-bed) processing requires a 25% percent longer cycle time than low-ply processing, even when the high-ply system is processing six layers at once versus three for the low –ply system.

• Low-ply material processing also provides a lower cost of ownership than high-ply (bristle-bed) systems; for example, when producing (6) blades 45m long, the yearly cost of ownership of low-ply systems is approximately 54% percent lower than that of a high-ply system. Therefore, the Return on Investment (ROI) is much greater with the low-ply system.

• Laser Projection Lay-up and Ply Validation: Using a Virtex LaserEdge®6/5 “LPS-7H” a firm can expect higher throughput, improved quality, and reduced costs over a manual process. For example, cycle time reduction of up to 5-10% and setup time reduction by as much as 50% equates to a Return on Investment (ROI) of less than one year or a yearly productivity gain of (10) blades.

Furthermore, patented technology in a field-replaceable laser module maximizes system uptime, 99.9% uptime to be exact, and substantially lowers the cost of ownership of the LaserEdge system.

Conclusions

With demand for composites in wind energy growing daily, it is imperative that the value stream must be managed and optimized within a given firm through automation. However, there are many options when deciding upon the correct form of automation.

Key factors in determining the best value stream for manufacturing exist around the lean concepts of waste and increasing productivity. When reducing waste in wind energy – specifically wind blade production, a firm should look at those products that provide maximum cost control, reduction in labor, and error reduction. From the standpoint of increasing productivity, a firm should look at those products that reduce cycle times – not just shift bottle necks in manufacturing.

From the research conducted by Gerber Technology, it is clear that the most efficient value stream will be created using composites specific ply nesting software, low-ply material processing systems, and laser projection assembly lay-up and ply validation systems.