MES-OP

Test Operation Integration with MES

ELECOMP Capstone Design Project 2022-2023

Sponsoring Company:

Cambridge Technology
125 Middlesex Turnpike
Bedford, MA 01730
http://www.cambridgetechnology.com/

Company Overview:

Cambridge Technology designs, develops, and manufactures leading-edge laser beam steering solutions including galvanometer and polygon optical scanning components, 2-axis and 3-axis scan heads, scanning subsystems, high power scanning heads, and controlling hardware and software. Our company partners with OEM customers to deliver scanning solutions that support advanced industrial processes, electronics, and laser-based medical applications. As the inventor of galvanometer-based optical scanning technology, we make it our mission to drive innovations in photonics by delivering unprecedented technical capabilities through the critical lens of collaboration, quality, and customer service. We dedicate ourselves to excel at:

- Collaboration with our partners to ensure our goals and pathways align
- Innovative engineering bringing tomorrow's solutions to life today
- Manufacturing excellence through DFMA and continuous process improvements
- Delivery from the largest engineering solution to the smallest component

Technical Director(s):

Jonathan O'Hare
Sr. Program Manager
Jonathan.ohare@novanta.com

Shaan Mitra
Test & Manufacturing Engineering Manager
Dialog
shaan.mitra@novanta.com

Project Motivation:

High performance galvanometers involve complex assemblies having numerous operations, many of which are manually implemented with detailed procedures in order to obtain a quality product meeting all specifications. As the latest products push the limits of performance and become more advanced in their design, so too must their manufacturing methods. Integral to the advancement of manufacturing is the collection of better data. Better data about the manufacturing process means having better ways to measure or observe the product at each successive operation. This includes observing both quality and performance metrics while at the same time making that data traceable to the final product. Implementation involves hardware in the form of digital test and measurement instrumentation, software interfaces for that instrumentation and MES software to tie it all together into a controlled and monitored process.

In this project the emphasis will be on implementing one or more test instruments into their respective operations and integrating that data within an electronic traveler using an MES system under evaluation. One of the instruments is a new laser measuring instrument to characterize thermal bending effects of a subassembly. The goal is to be able to make the instrument operator friendly including a UI and work instructions in the MES interface as well as having the measured data uploaded to the electronic traveler. This will serve as a proof-of-concept for a new manufacturing line being developed for a new product.

Anticipated Best Outcome:

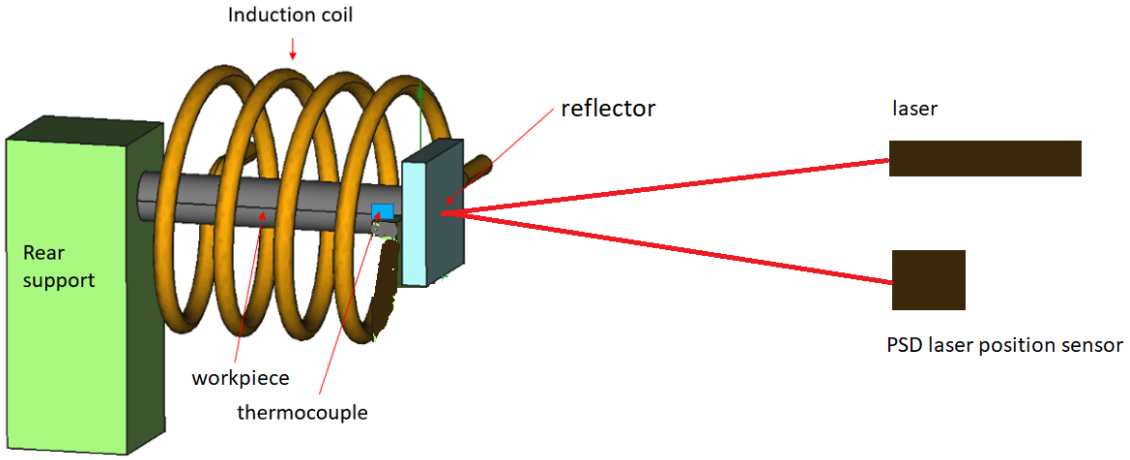
At least two manufacturing operations implemented having the test measurement device described and its associated assembly operation integrated into MES system so that the data is automatically uploaded into an electronic traveler. The best outcome would be to have the measurement devices robust enough for use in a Production environment having their HMIs (human machine interfaces) accessible through the MES UI environment supported with work instructions and contextual help so that it could be operated with minimal user training.

Project Details:

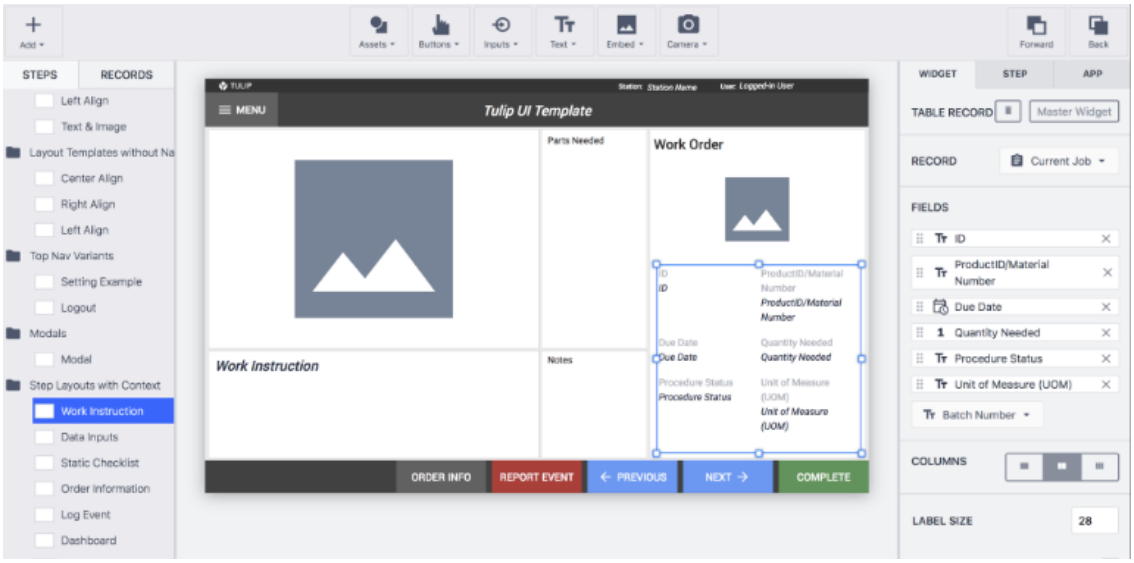
Overall system concept:

The system will comprise a test fixture device in the form of a workpiece heating system with a deflection laser measurement sensor and at least one other input device such as a barcode reader or camera used to assist an operator during an assembly process. These devices will serve as examples of different types of input devices that can be integrated with an MES system together with visual work instructions and operator inputs for the creation of a detailed electronic manufacturing traveler.

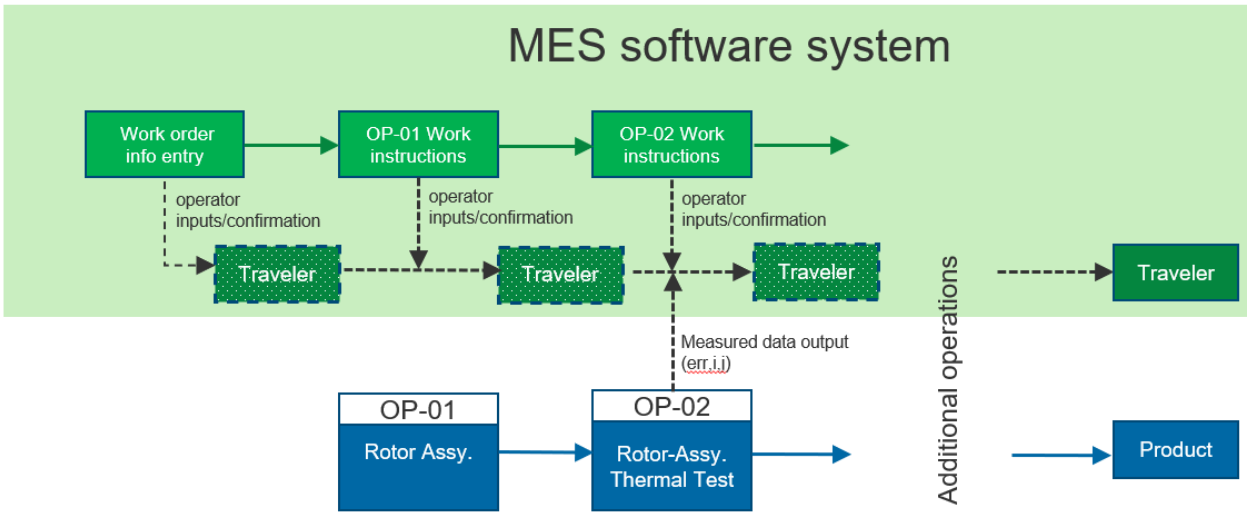
Test fixture device:



MES development environment:



Block Diagram:



Firmware/Software/Computer Tasks:

Develop a thermal test fixture for a workpiece, so that the workpiece can be loaded by an operator and temperature sensor applied so that the workpiece can be heated by a closed-loop induction heating system while thermal deflections (magnitude and direction) are measured by a laser sensor. Hardware will be provided so that development can be done at URI remotely

A second test fixture or else other operation input device will be chosen that can also be taken to URI so that work can be done remotely

Develop an integrated HMI for the test fixture and other input device so that they can be operated through the MES workflow interface GUI. This may include input controls such as buttons and or text inputs as well as images or visual models required to aid instruction. In this case the MES environment will be Tulip having a web-based development environment. Tulip's development environment has tools for displaying graphics in both 2D and 3D as well as libraries necessary for accessing input/output devices such as the described test fixture. Help and tutorials will be provided by Tulip.

The final task will be to collect test data from the final developed system for the one to two sample operations and then generate mock travelers representing a theoretical complete process with eight or more operations. A complete process map for the theoretical system will be given (TBD) but will have specific operator inputs and not exceed 5 inputs for each operation so that development time can be kept within a manageable scope.

Composition of Team:

1x Electrical Engineers & 1x Computer Engineers

Skills Required:

Electrical Engineering Skills Required:

- Ethernet networking through an edge client hub
- Data acquisition, A/D conversion
- Induction coil heater setup and integration
- Laser displacement sensors (PSDs) setup and integration
- Thermocouple setup and integration
- Control loop design (thermostat for induction heater)

Computer Engineering Skills Required:

- Experience building GUIs in workflow and widget-based development environments
- Web based UI programming (JS, HTML, CSS, etc.)
- Familiar with JSON, XML or other web-based data structures
- Familiar with using REST API calls
- General understanding of MES software system architecture

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

The developed solution will serve as a proof-of-concept for a state-of-the-art MES which will be easy to apply to one of Novanta's newest products, whose manufacturing line is about to be implemented. Value stream improvements will be easily demonstrated in the new manufacturing line since a direct relationship between the newly acquired traceable data and the finished product quality will be shown. Additionally, the value stream improvements demonstrated through this proof-of-concept will be easily transferable to other product manufacturing lines.

Broader Implications of the Best Outcome on the Company's Industry:

The ability to produce quality galvanometers in higher volumes for a variety of high demand industry applications, including additive manufacturing and via hole drilling for PCBs, will help to ensure that supplies can be met for these high demand markets. The increase in quality enabled through the acquisition of traceable operational data and improved manufacturing controls will enable our customers to also improve their own technologies, finding new applications for high accuracy laser beam steering.