Improved Utilization of New Composites Technologies in Manufacturing

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Topics of Discussion – Technology in Composites Manufacturing

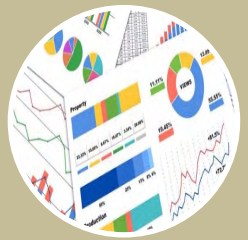
Bringing design, laboratory and engineering technology to the manufacturing plant.

Opportunities and challenges of the skills gap in the United States.

Better manufacturing, new processes- control over proprietary information.

Examples of implementation - technology in current composites manufacturing processes.

Industrial Internet Of Things- challenges to meet the dream.



Best Practice and manufacturing improvement opportunities in a changing landscape.

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Composites and the Manufacturing Process

Two of the areas brought forward in the American Composites Manufacturers Association 2018 State of the Industry Report included:

1. Need for Innovative Manufacturing Technologies in Composites

2. Better Simulation and Prediction techniques for composites parts manufacturing
    - Design for manufacturing
    - Involve plant floor leaders into the design and engineering plan

2018 ACMA State of the Composites Industry Report

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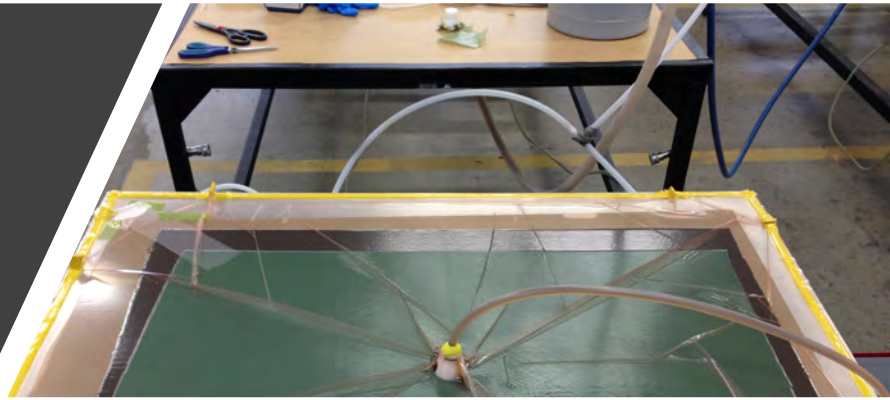
Meeting the Demand for Composites Technology

- Successful production of new process and materials is challenging.
- Transitioning and training personnel along with utilizing new equipment or processes requires planning and execution.
- Process challenges often arise as production scales up – especially in composites with a need for balanced chemical processes when speed and volume are increased.



Leadership commitment and company buy in to new processes.

Executive leadership and/or shareholders committed to long term process improvement (more than a quarter). Workforce challenges and new skills required at all levels in new economy.

Real costs need to be well planned and realized before start of new process or product (finances make or break any business).

Manufacturing leadership and employee buy in on process is critical. More than technology is needed to meet production volume and cost margins.

Staffing manufacturing is not getting easier

- 2019 has United States unemployment rate at below 4%.
- Engineers, managers, technology and thought leaders are difficult to find, hire and retain.
- Work conditions, pay, benefits and training must be competitive.
- Experienced manufacturing managers and supervisors are retiring.
- Production workers with experience in composites manufacturing operations are in short supply.
- Even the best technology needs to be understood, implemented and practical to improve manufacturing results.

Technology Implementation in 2019 and Beyond

- **Process change, computing and new material handling technologies provide both opportunities and risk.**

  "The real competitive advantage for todays manufacturers lies in speeding up information flow at every stage of the process." **(Garnick)**

  "By avoiding the need for high statistical expertise, many more people such as process, asset and field experts can start contributing to continuous improvement projects." **(Van Dijk)**

  "Entrepreneurial spirit is supported by a philosophy that is focused on developing and exploiting tactical and operational opportunity" **(USMC Operating Concepts)**

Technology Implementation in 2019 and Beyond

- Developing products, improving production, moving faster and more efficiently comes with risks to traditional structures, institutions, positions and individuals.
- Risks to proprietary information and processes are real and importance of every employee becomes more significant.
- Without fast development and manufacturing integration technologies can be irrelevant before they ever become products.

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Composites Technology in Manufacturing Case Study 1

Simulation for real time planning, estimation, training and processing composites.

Compares real process for post production review of first and each subsequent article

Technology – Simulation Software, camera, video and basic documentation during processing.

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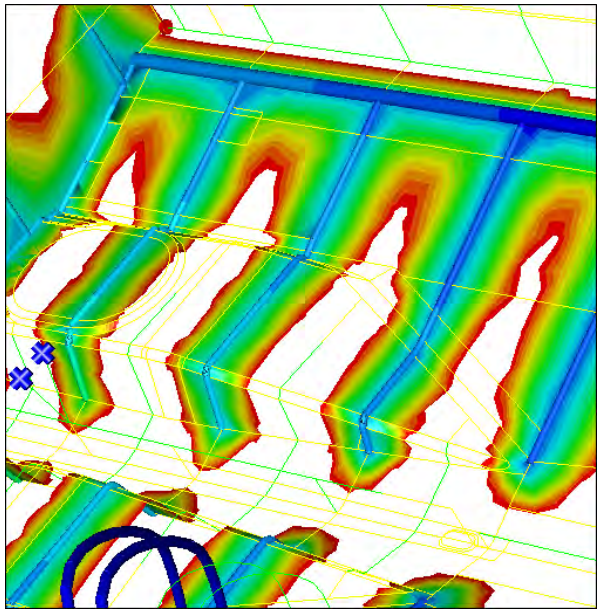
Simulation to Manufacturing

Polyworx flow simulation software



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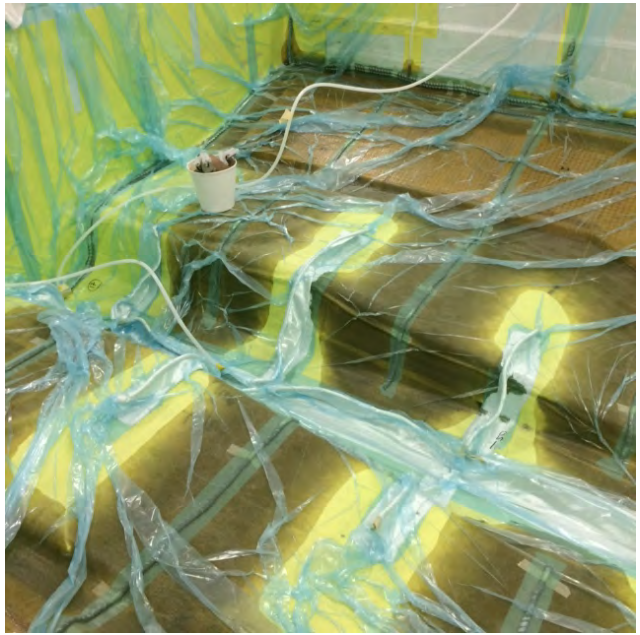
Simulation software used to predict, plan, train and inform production personnel. Run using simulation of composite layup, resin and engineering planning prior to starting Vacuum Infusion Process on new product.



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Simulation to Manufacturing

Polyworx

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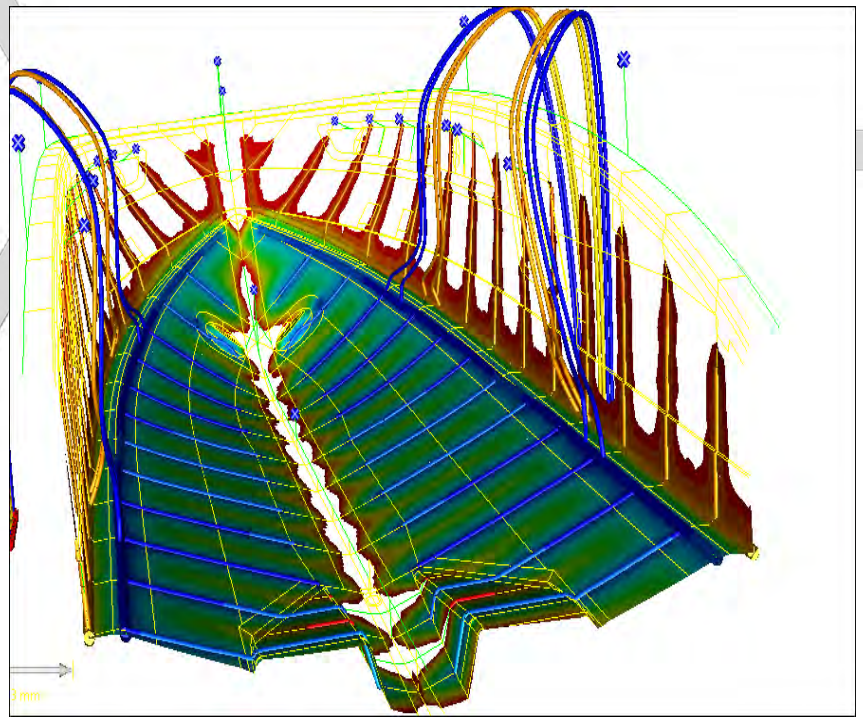

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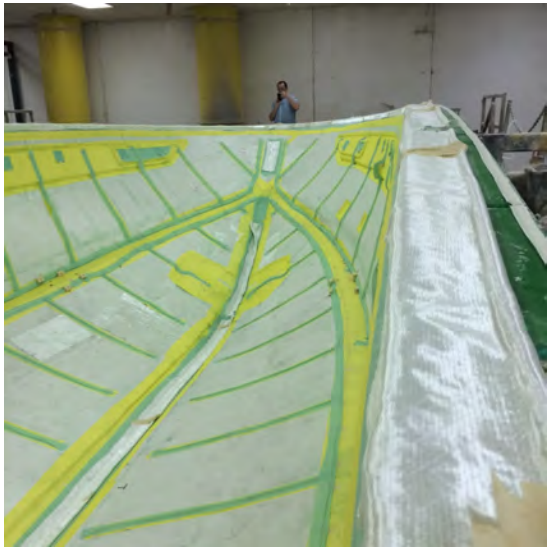
Simulation to Manufacturing



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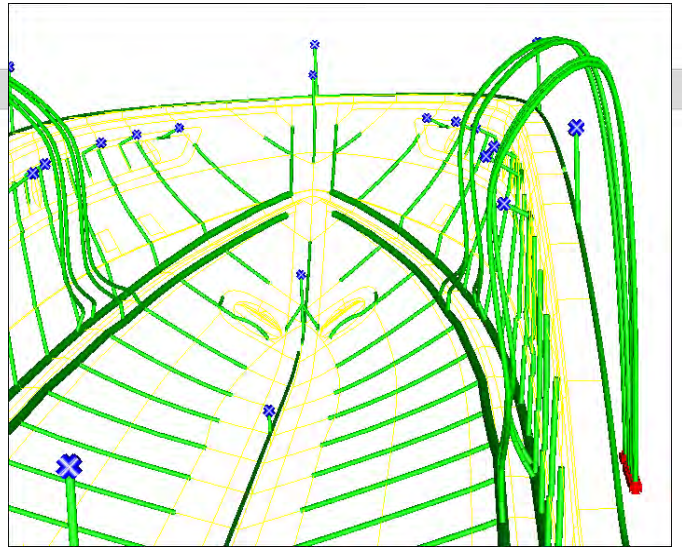
Used for set up of new model production. Subsequent use for comparison training and benchmarking to actual production process.

Key for new production associates, quality team leaders and engineering personnel as they can go to shop floor and follow process setup and execution.



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Composites Technology in Manufacturing Case Study 2

Simulation for real time non destructive testing of corrosion control FRP products on manufacturing line and after installation.

Strength and Stiffness data collection from 10+ years of destructive testing used to do predictive ultrasonic testing of product.

Technology – FRP database , software, ultrasonic testing equipment and technician trained in its use.

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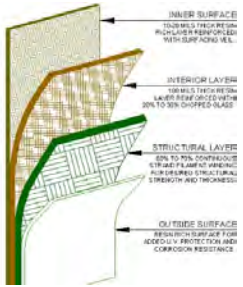
UT Comp Manufacturing NDT Inspection

- UltraAnalytix System
  - Utilizes data from over 800 inspections and multi year data taken from FRP from factory to 48 years in service.
  - Comparison of non destructive test results against flexural testing.
  - Data driven conservative but non destructive analysis.
  - Saves testing cost and time.

Non Destructive Testing Process

1. Create Systematic Inspection Plans
2. Utilize FRP data (10 plus years of inspection data)
3. Inspect:
    a. Ultrasonic readings for condition assessment of FRP.
    b. Visual External for production problems or installation problems.
4. Analysis and Report results as compared to specifications.
5. When manufactured, installed in field, during service life data comparisons.



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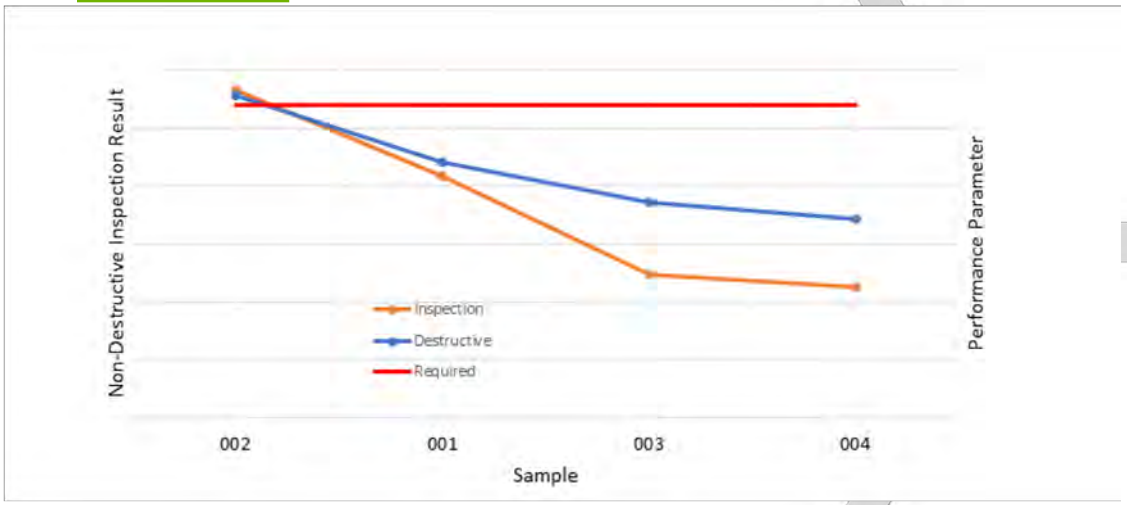
Testing done automated on production line or in field.



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FRP Codes & Standards for corrosion applications

ASME RTP-1 and other ASME process and piping standards.

API 12P, 15A

ASTM standards

STI ACT-100

UL 1316 GFRP

NEMA

ASME Process Piping & Repair Standards

NSF

MIL-SPEC

Many others

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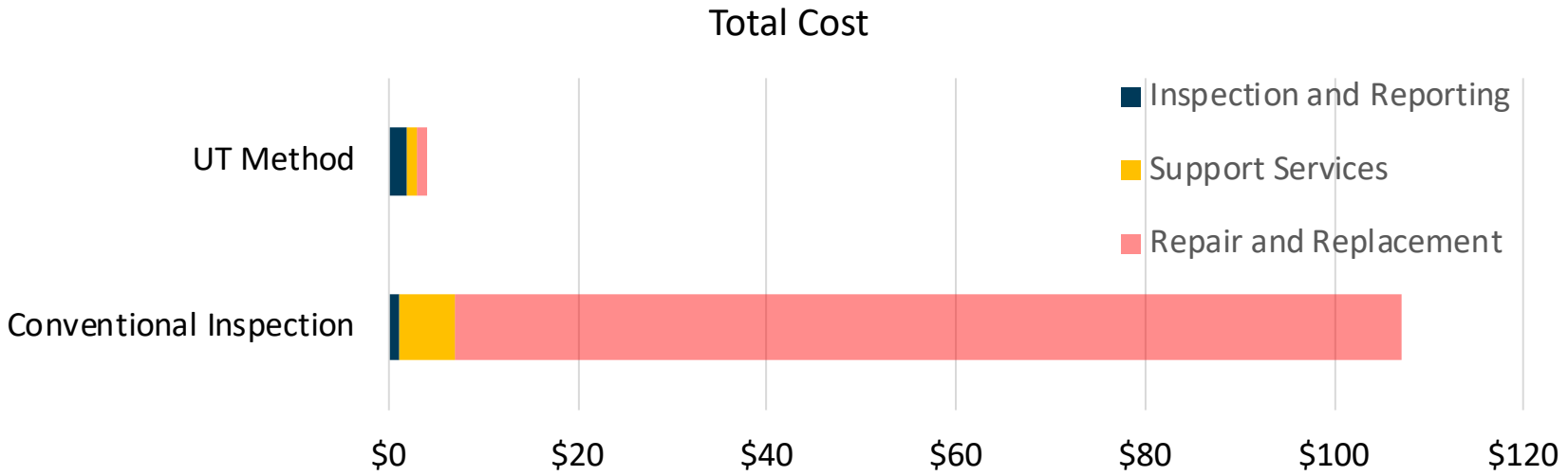
Inspection Costs by using Predictive Data Software and Non Destructive Methods

Cost savings of inspections to meet requirements. Per $1 of conventional inspection fees



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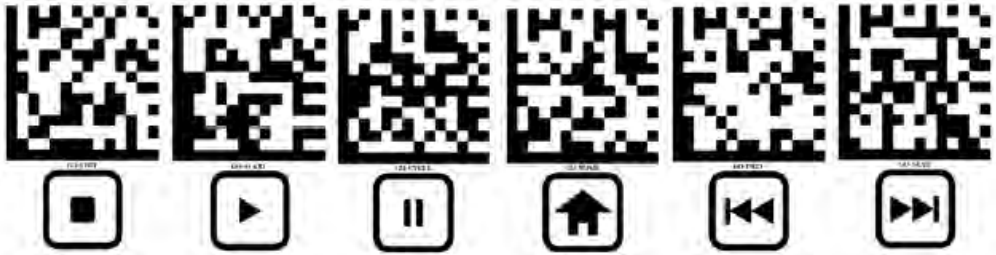
Composites Technology in Manufacturing Case Study 3

- **Material Monitoring System – cloud based FRP Manufacturing system Powered over Ethernet. Live Chopper Gun System developed by Brunswick Corporation.**
- **Monitors open molding processes in real time for use by operators in lamination bays.**
- **Monitors labor time, material and resin use by product section.**

Material Monitoring System

- **The display will consist of several 55” flat screen monitors, desks, scanners, a control box, a flow meter, material scale and a couple stand up workstations and chairs. Each Monitor weighs approximately 100lbs. Users will be able to interact with the database and “Shoot the Barcodes” with the scanners. Operated on 70 chopper guns in multiple plants and lamination bays since 2015.**

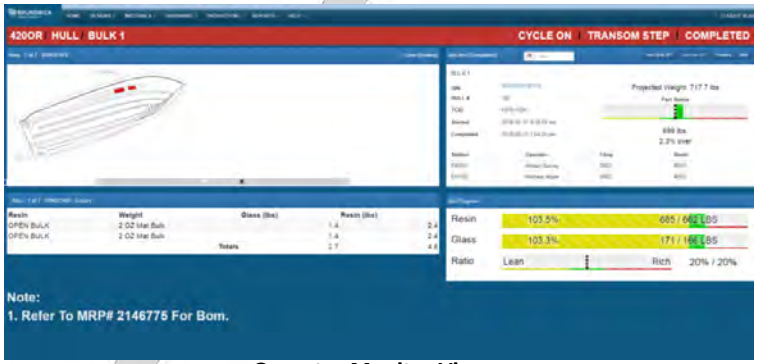


Provided by Brunswick Corporation

Material Monitoring System

Digital Dry Materials Scale and Transmitter

Manufacturing Plant Screens



Operator Monitor View

Flow Meter and Transmitter

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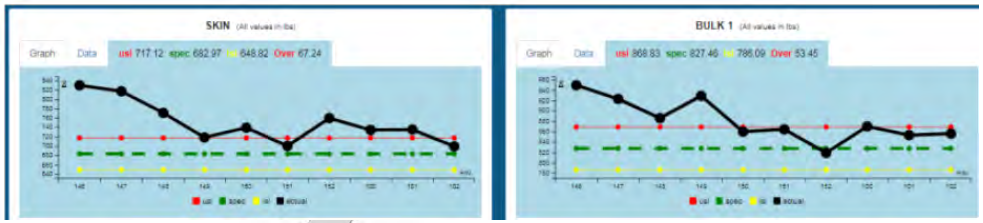
Provided by Brunswick Corporation

Material Monitoring System

- Utilizes new technology to improve accuracy, efficiency and monitoring standards for a well known, proven and economical production technology. Improves results and allows adjustments in process to be made by operators in real time based on real data.

- Practical for manufacturing open molding. No Keyboard, mouse or tablet on shop floor. Operator selections made by Bluetooth scanner and barcode activation from 10 to 50” away from monitors. Monitor scan activates page to begin production cycle and data collection.

- Breakdown of real time data for lamination process shown on monitors, in offices, at desks of engineering, production, quality team.



Monitoring Data (Remote or on production floor)

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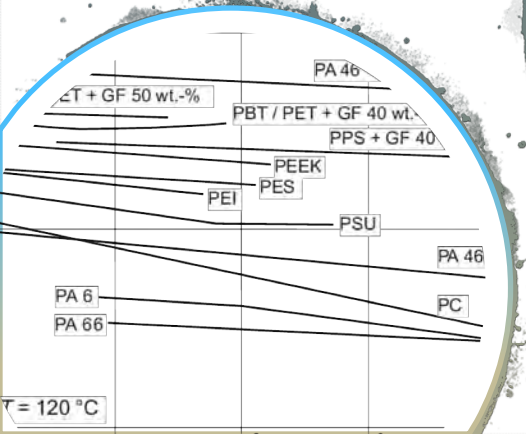
CONSISTENT AND REPEATABLE PROCESS



Correct manufacturing by trained personnel is needed for any composites technology

- Manufacturing process has to be proven and done within standard.
- Being sure material flow and reinforcement is aligned and placed as designed in produced parts is critical.

Successful use of Composites Technology requires efficient manufacturing

Manufacture with new equipment and a changing workforce.

Implement controlled processes with high labor productivity and process leadership being effective.

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Rapid technology and materials advancements challenge manufacturing leadership.

- Producing the same product for multi year production runs is becoming less and less common.
- Technology advancement in equipment and materials along with consumer demand have changed this dynamic.
- Manufacturing leaders and environments that are able to adapt quickly is critical to successfully compete.

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Manufacturing Floor Technology Advances

- **Bringing a new technology onto manufacturing floor successfully – the basics to consider.**
  - Define what is practical and can be implemented economically.
  - Measure current process and ongoing improvement.
  - Analyze if the technology is giving solutions intended.
  - Improve the process with the technology.
  - Control implementation and continued use – how much technology is reasonable for leadership and manufacturing staff to adopt at once.

Industrial Internet of Things (IOT) and Industry 4.0 Challenges

WHERE TO START - STANDARDS AND TESTING?

PRODUCTION SYSTEMS STILL DOS BASED IN MANY CASES.

SPREADSHEET SCHEDULES FOR MANY MANUFACTURERS.

REAL TIME DATA IS AMAZING BUT HARD TO MASSAGE.

SOLVING A PROBLEM THAT MAY NOT EXIST?? IMPLEMENT PROPERLY CREATING VALUE.

HOW MANY PROCEDURES NEED TO BE IMPLEMENTED AND FOLLOWED.

SECURITY – INTELLECTUAL PROPERTY, WIRELESS DATA.

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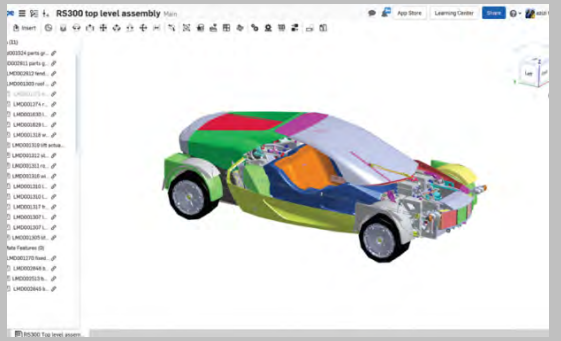
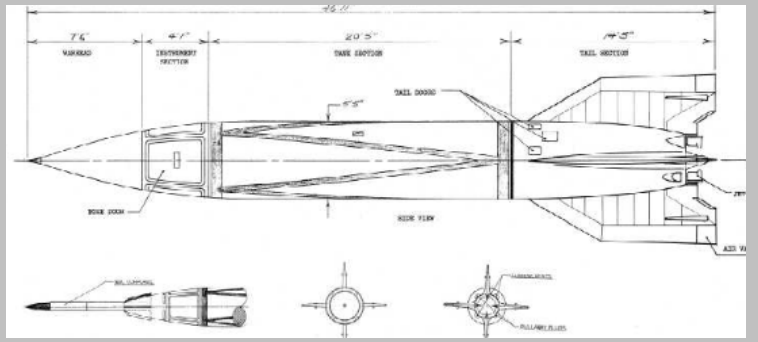
Industrial Internet of Things – Leveraging Technology

- Don’t just collect data – collect and utilize the data you can use.
- Engage employees on all levels on data driven manufacturing improvements.
- Use data relevant to composites manufacturing.
- Keep design and production platforms secure and updated.
- Simplify Integration Using Technology your team understands.
- Act upon data and production variation with clear efficient decisions and action.





References

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Sean Minogue, Advanced Manufacturing Engineer, Boston Whaler, Inc
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Timotei Centea, "Automated Carbon Composite Layups and How to Ensure Their Quality Instantly (Webinar)" Research Professor Aero and Mech Engineering, MC Gill Composites Center, Univ of Southern California.

ASME RTP 1 : 2015, Reinforced Thermoset Plastic Corrosion Resistant Equipment, Society of Mechanical Engineers, 2015.

Hon K., Li L., Hutchings I. Direct Writing Technology – Advances and Developments, Manufacturing Technology V57, pg 601.

LtCol Lew Sigmon " USMC Operating Concepts 3rd ed" DC CD&I G3/G5 Div, www.mccdc.usmc.mil/

Susan Flynn, "The Increasing Automation of the Composites Industry Stands Out at CAMX 2018" Composites Manufacturing Magazine, www.compositesmanufacturingmagazine.com October 2018.

Edwin Van Dijk, "Smart Data Collection is Required for Continuously Improving Your Production Process" Quality Magazine, www.qualitymag.com November 2018, Vol 57, No. 11.

Darren Garnick, "Five Industry Trends Disrupting the Design and Manufacturing World" Tech Briefs SAE International, www.techbriefs.com , December 2018, Vol 42, No. 12.

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Questions ??

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