MWES MANUFACTURING AUTOMATION

Whitepaper

Bridging the Gap Between Design & Manufacturing:

A Guide to Process Development

The Future of Automation

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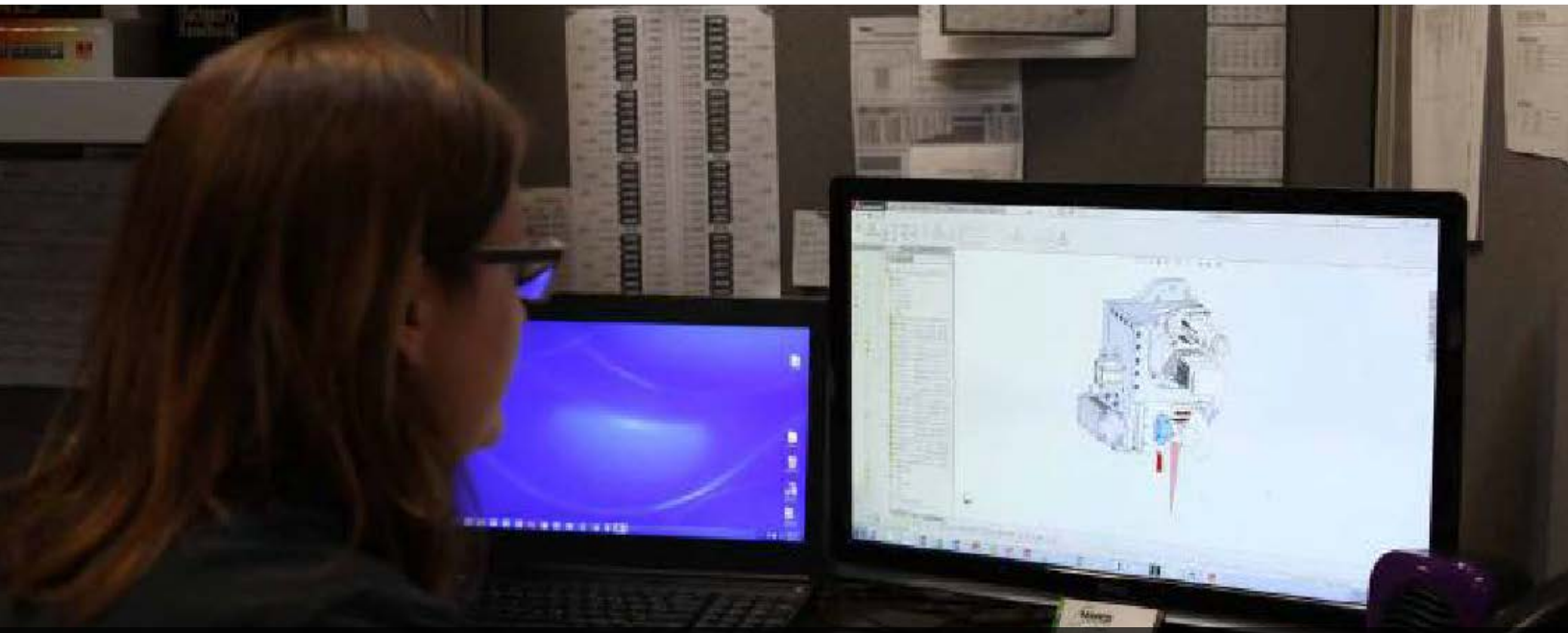


Process development is necessary to transition prototype parts to full-scale manufacturing.

When you only have one shot to make your product launch a success, you need to ensure that quality control and process capability are engineered into your production line. Good process development is necessary to transition prototype parts to full-scale manufacturing.

As engineers, we are always challenged to bridge the gap between design and manufacturing in the most effective way. As manufacturers, you produce new parts from a prototype design, but also struggle to select the best process for long-term production.

The secret to success is actually quite simple: create a robust process that creates quality parts that meet the needs of the end customer (or your own) standards on time and within budget. When it's written out in just a sentence, it sounds simple! But the reality is that most manufacturers of new parts experience bumps in the road to production, whether it is due to errors in part design, high-risk thresholds, or high throughput rates.

That's why we put together this guideline to process development from our experience with launching new part introductions (NPI) or optimizing existing processes. The technique of process development is used to:

- Investigate processes
- Acquire new knowledge
- Correct existing processes
- Improve existing processes

Design for Manufacturability

In general, products need to be designed in such a way that it is easy to manufacture or assemble at a reasonable price point. The concept of designing for manufacturability exists in almost every engineering discipline, but the implementation can be drastically different based on the level of manufacturing technology used.

70% of manufacturing costs of any product are determined by design decisions.

Understanding Manufacturing Problems- It's very important to uncover potential manufacturing problems up front in the process development process because this is the least expensive time to make modifications.

Factors that could affect part manufacturability are:

- Type of raw material used
- Dimensional tolerances
- Finishing processes needed such as material removal, polishing, painting, heat treating, etc.

Design Guidelines

The backbone of any part design for manufacturing is a set of rules that are structured to help reduce the cost and difficulty of manufacturing.

- Reduce the total number of parts in assembly.
- Develop a modular design.
- Use standard components.
- Design parts to be multi-functional/use.
- Design for ease of fabrication.
- Mistake proofing.
- Avoid separate fasteners.
- Minimize assembly directions.
- Maximize compliance.
- Minimize handling.
- And much more.

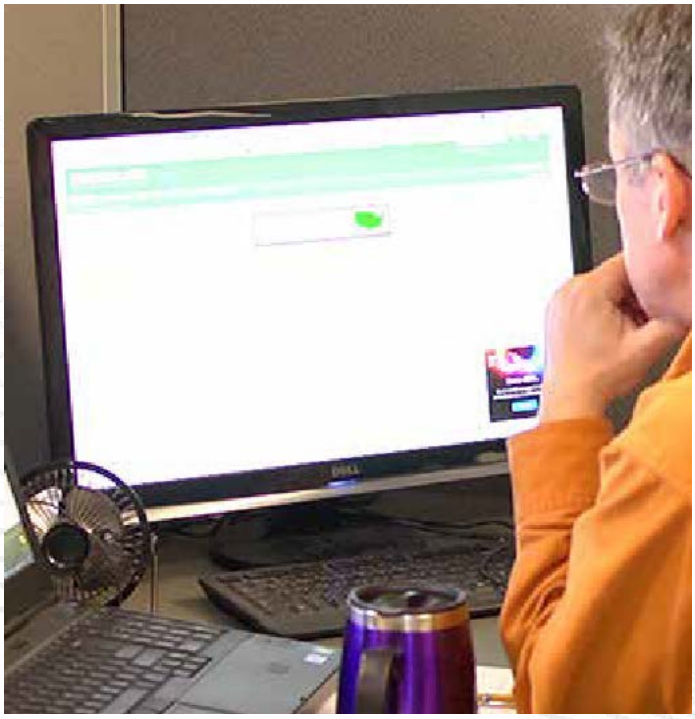
Process Development Teams

Internal Process Development

Team effectiveness is enhanced by a team's commitment to an overall goal. For teams to be able to reach high levels of performance during process development, it is essential for them to understand that roles are collaborative. Your process development team should include members from multiple disciplines, who have experience with engineering, product quality control, as well as manufacturing.

Team Members

- Engineering Personnel - Mechanical, Electrical, Controls, etc.
- Purchasing Department
- Project Managers
- Manufacturing Engineers
- Quality Control Specialists
- Safety Supervisors



External Teams and Who to Hire

Hiring a team of process development experts can be the best decision you make during a new product launch. They have a fresh perspective on your manufacturing process as well as experiences in a broad range of previous projects under their belts.

Before you hire an external team, take some of these key qualifications into consideration:

Quantitative & Analytical Skills

External teams should have strong analytical capabilities. These skills should include: designing, analysis, basic reasoning, financial / operational knowledge. These skills are all essential to executing a successful process development project.

Capability Specific Experience

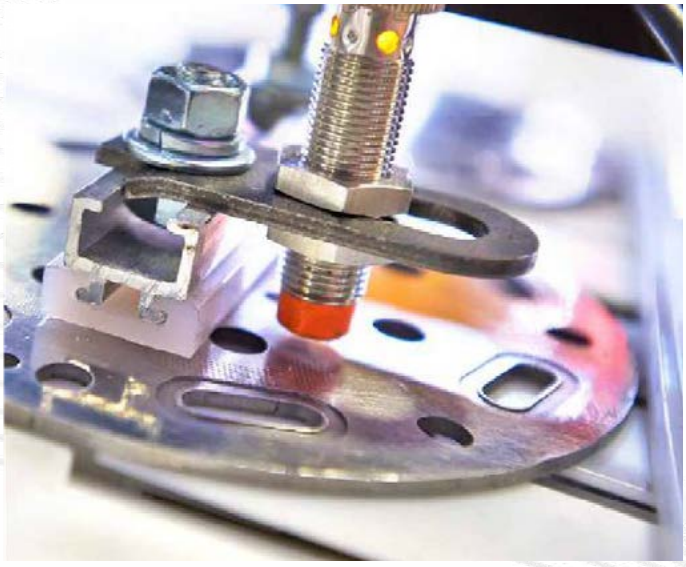
There should be a combination of people with a variety of different capability specific backgrounds.

Business Experience

Does the process development team you are going to hire have past experience executing successful process development projects? These teams should have expertise with leadership, entrepreneurial initiative, as well as showcasing a positive quantitative impact.

Technical Expertise

Technical experience is needed depending on your application such as: assembly, welding, packaging, web handling, controls, testing, business systems communication, etc.



The Process Development Flow

The overall process involves making an evaluation and setting up benchmark goals to meet. Then, a risk evaluation must be carried out to evaluate different processes to determine which testing options will provide the best parameter results.

Step 1: Evaluation

Evaluate and question the current operation or process assumptions. This is the beginning of the product process plan.

Step 2: Requirements

Production and quality requirements are determined and identified. The risk is determined and a risk threshold is established.

Step 3: Research

Areas of risk beyond threshold are identified. Research and brainstorm process methods. The outcome should result in 2-3 testing options.

Step 4: Testing

Process simulation testing is conducted on the chosen concept to ensure the desired results are met.

Step 5: Analysis

After testing is completed, report the data to analyze the production and quality capability.

Step 6: Results

The final report is an evaluation of the test performance results. This helps to determine whether to proceed to design & build or retest another concept.

The Lifecycle of TRL & MRL

Regarding developing and deploying new technologies with MWES, two key frameworks guide the process: Technology Readiness Levels (TRL) and Manufacturing Readiness Levels (MRL). Both are critical in assessing technologies' maturity and readiness for integration into a larger system or process.

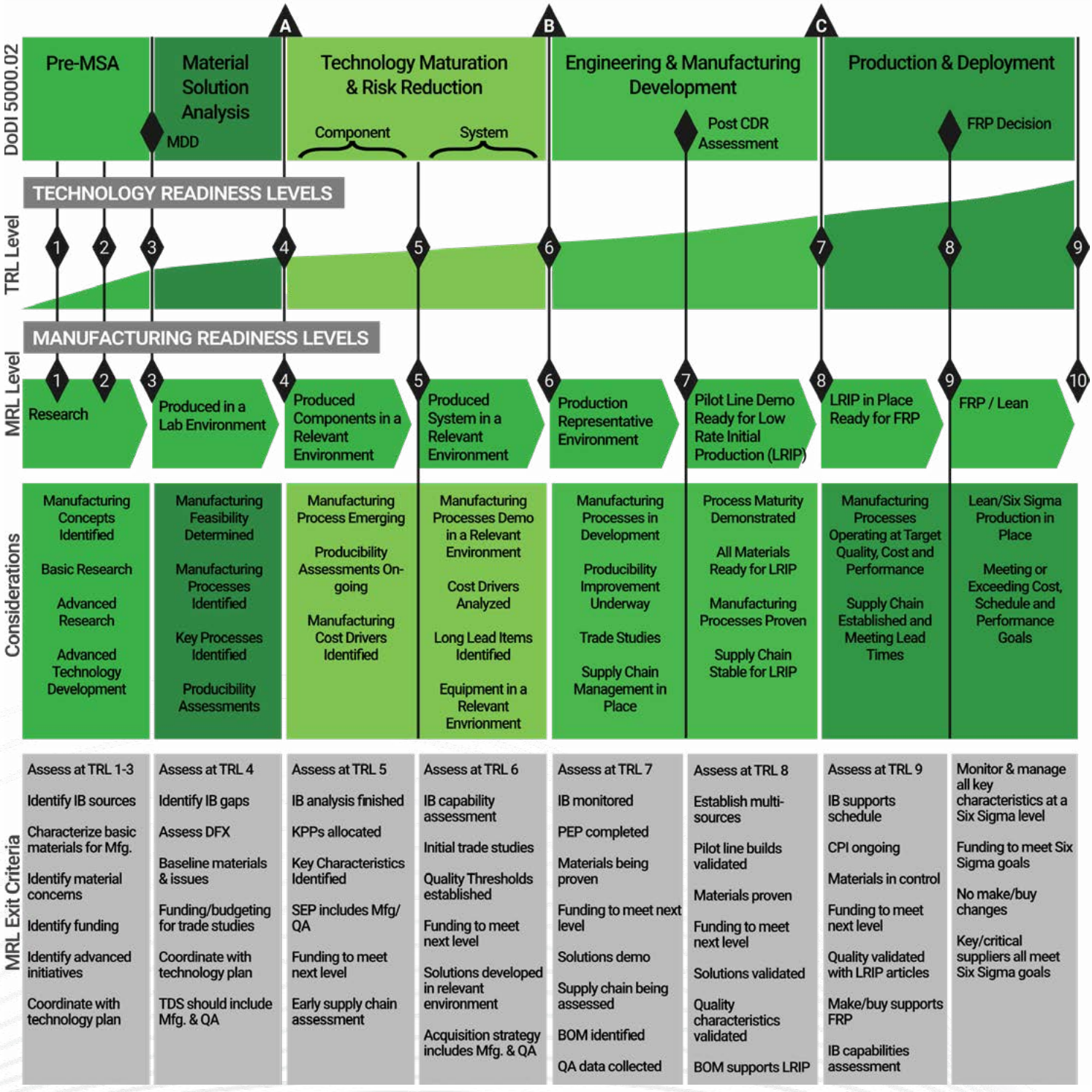
Technology Readiness Levels (TRL)

The Technology Readiness Levels process primarily concerns the maturity of technology itself, including its scientific and technical development. It answers questions about whether the technology works, if it's reliable, and if it can perform its intended function within a system. The TRL scale ranges from 1 to 9, with 1 being the lowest level of technology readiness, basic principles observed and reported, and 9 being the highest, actual system proven through successful mission operations.

Manufacturing Readiness Levels (MRL)

Manufacturing Readiness Levels, on the other hand, assess the maturity of a technology from a manufacturing perspective. They help determine if a technology can be produced reliably and cost-effectively at scale. The MRL scale also ranges from 1 to 10, with higher numbers indicating greater maturity. It considers factors such as the availability of materials, the feasibility of production processes, and the existence of a suitable manufacturing infrastructure.

LIFECYCLE TRL / MRL COMPARISON



Cost Considerations

The ease of manufacturing is just one piece of the process development puzzle. Cost and return on investment (ROI) must also be taken into consideration when launching a new product or redesigning an existing process. Here are a few key manufacturing cost considerations to take into account:

#1 - Value of Incoming Products
Break down the cost of what raw material is coming into the process. How much does each piece contribute to the overall cost of the product?

#2 - Capital Equipment Expenditure
What equipment and machines are needed to process the part at each stage of its build?

#3 - Labor Content
What people content is necessary to get the part from the raw state to a finished assembly?

Additional Cost Considerations

Cost variations in your production process and level of quality needed.

Handling Time

- How many pick and place instances are required?
- Is any grasping assistance needed?
- What is the effect of part symmetry on assembly?
- Is the part easy to align/position?

Handling Difficulty

- Size
- Thickness
- Weight
- Fragility
- Flexibility
- Slickness
- Stickiness
- Geometry

System Speed

- Cycle Time to complete 1 part

Staffing Requirements

- Workers needed to maintain the operation

Reject Rates/Failure Rates

- The rate at which the assembly process fails

Buffer Sizing/WIP

- A continuous process to ensure a consistant throughput

Common Mistakes

Complexity

One common mistake is underestimating the complexity of an operation without testing it first. You should always know the process capability for each manufacturing stage and verify that it falls within your acceptable limits. Some problems you could encounter can be high reject rates, low cycle times, and unhappy customers. We can determine high-risk areas by testing and analyzing.

Validation

A mistake we frequently experience is ill-defined Validation Plans. Specific measurables must be put into place in order to know what's considered a successful program. Define these criteria for success as early as possible.

Production

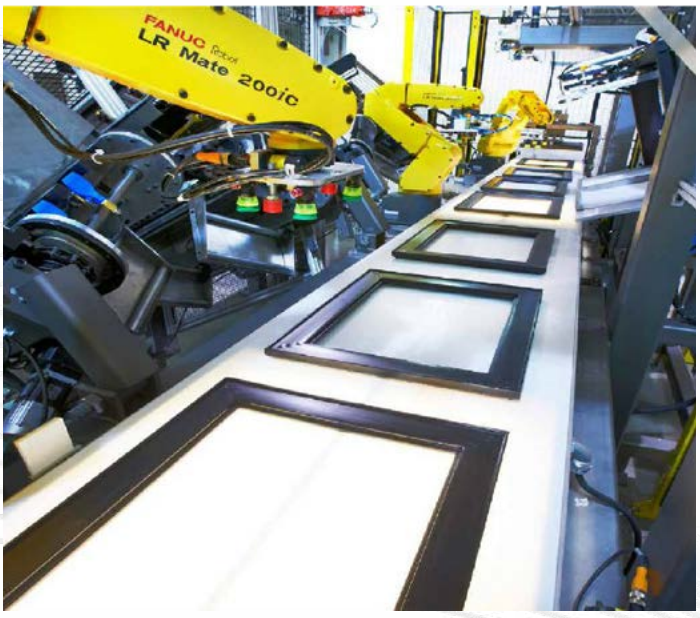
A well-defined production plan includes a universally understood and approved sales forecast for the desired product volume and part mix. The next phase includes the known cost analysis for the existing production method. This then leads to management's commitment to profitability for the current manufacturing vs. the proposed future manufacturing system, aka. ROI. Capital equipment, labor requirements, and material costs should all fall into each financial category for determination of how the proposed production plan fits into the company's business objectives. Without this production plan in place, be prepared for imminent failure.

The Outcome of Good Process Development

Proper process evaluation and testing determines where we have capability and where there is risk that requires further engineering development. When expectations for equipment performance are defined to known achievable levels, we experience LESS RISK. The result of a controlled and predictable process plan that controls risk is a manufacturing system that will meet or exceed expectations and commitments to your management for ROI and its execution timing!

Midwest Engineered Systems is here to help you with your highly technical process development or process improvement projects. We have experience with managing complex process development programs for many manufacturing operations. We will guide you through the evaluation of your current and future manufacturing risks and determine the best testing options. Not only that, but we are straightforward with you about what we believe will work and what won't. Our straightforward communication style is one of the most important aspects of working together with our customers on process development projects. In the end, you will own all the process knowledge that we develop for you and you will have an optimized process! Get in touch with a sales engineer today to discuss your project's requirements! Let's turn your design into manufacturing reality!

When you conduct process development the right way and manage the process well, you will achieve your desired results.



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