



A Manufacturing Readiness Assessment with Mennie Machine Co.

Intro

Docent is a software program designed to guide the user through the Manufacturing Readiness Assessment process, using the Manufacturing Readiness Level (MRL) criteria defined by the MRL Working Group which is composed of experts in manufacturing from the Department of Defense, industry, and academia. The MRL criteria are designed to identify areas of risk in the manufacturing process, and are tailored to the different stages of manufacturing, from research and development to full rate production.

Mennie Machine Company (MMC) is a woman-owned ISO/TS 16949:2009 Certified manufacturing company in Mark, IL. They work in the automotive, defense, and commercial industries. They were chosen because of the diversity in products they manufacture and industries they serve. Docent was utilized to perform a manufacturing readiness assessment of a Spline Shaft. At the time of the assessment, the part was at the prototype stage, and was to be produced using an existing production line that has been used for similar parts.



Preparation

Preparation for a Manufacturing Readiness Assessment begins weeks or months ahead of the actual assessment. A single assessor should take ownership of the process. The assessor should be someone who has a deep understanding of manufacturing best practices, is familiar with the Manufacturing Readiness Levels (MRL) criteria, and has reviewed the MRL Deskbook. This person can identify the

necessary team members, and co-ordinate between them to find a date when everyone can be on site to perform the assessment. An ideal team might include the lead engineer, quality manager, and production manager. It can be tempting to make the assessment team too large; try to limit the team to 6-8 members. This helps the team be able to reach consensus faster. If expertise beyond this team is needed, an individual can be consulted before starting the assessment. Being on location is an important part of doing the assessment. To ensure that the criteria are being met, it is important to meet the workers, see the manufacturing line in person, and become familiar with the facility.

For the MMC assessment, a single assessor was chosen from outside the company to lead the assessment, and the team consisted of the quality manager, assessor, and a team leader. A pre-assessment meeting was held to plan for the assessment, as well as to familiarize the group with Manufacturing Readiness Assessments, Docent, and the MRL Criteria to be used during the assessment.

Factory Tour

On the day of the assessment, the team should tour the factory floor (or lab if the process is still in the research and development), inspecting the relevant manufacturing cells. Familiarity with the criteria will be essential for making the best use of this tour. Pay attention to small details, and check that any written work instructions, policies and procedures are being adhered to by the employees.

For MMC, the group gathered onsite, and then went on to tour the existing manufacturing line, while the quality manager explained the process being used. Since there was an existing production line, we were able to view it in action, making a similar part. The process includes receiving the forgings from an outside company which then goes to the production lathe and through the spline roller. A heat treat is added, the part is ground, coated, packaged and shipped.



Define the scope

Defining the scope of the assessment is an important part of the process. As you progress through the assessment, the team will have questions regarding what is included or not included in the assessment. Clearly defining the scope up front will help to minimize confusion later.

After touring the shop floor, we went to a conference room to complete the assessment. We first defined the scope, which was to assess the readiness for manufacturing the driveline component.

Choose a target level

The next step is to choose a target level for the assessment. Docent will adjust to the correct level by asking questions above or below the chosen target. However, the user can save time by choosing the correct MRL from the start. A brief explanation of each of the MRL's is available under the Docent help page under the heading "What should my target level be?" For full documentation and a thorough understanding of the Manufacturing Readiness Assessment process, review the latest version of the MRL Deskbook, found at <http://www.dodmrl.com/>. It is important not to choose a level that is too high, as that will generate too many questions, or too low, as that will not be helpful. The MRL criteria are designed in a way that if you choose the correct MRL for the current stage of manufacturing, they will ensure that you are making the correct choices for long term success and addressing any potential issues needed at this stage. There is no need to choose a level 10 when you are in the research and

development stage, choose instead a level 1, 2, or 3 and the criteria will ensure that you are taking the initial precautions required to setup for long term success.

For the spline shaft we chose a MRL 6, which corresponds to “Capability to produce a prototype system or subsystem in a production representative environment” (MRL Deskbook v2016). While the production line to be used was operating at full rate production for similar parts, the part being assessed was only at the prototype stage.

The screenshot shows the DOCENT web application interface. The top navigation bar includes the DOCENT logo, a Help dropdown menu, and an Assessment dropdown menu. The main content area is split into two columns. The left column is titled "Start New Assessment" and contains the following fields and controls:

- Start New Assessment**: Use this option to start a new assessment.
- Add Team Members:** A section with two rows of buttons. The first row has a plus icon, a "Team Member" button, and a "QC Manager" button. The second row has a minus icon, a "Team Member" button, and a "Project Manag" button.
- Scope:** A text input field containing "Assess readiness for driveline component".
- Target MRL:** A dropdown menu with "6" selected.
- Date to achieve Target MRL:** A date input field containing "03/23/2017".
- Location:** A text input field containing "Mennie Machine Co."
- Deskbook Version:** A dropdown menu with "2016" selected.
- Continue**: A dark blue button at the bottom of the form.

The right column is titled "Continue Existing Assessment" and contains the following:

- Continue Existing Assessment**: Use this option to start working on an existing assessment.
- Help** and **Open Assessment**: Two dark blue buttons at the bottom of the section.

Complete the assessment questions

After completing the appropriate fields on the Docent start page, click the Continue button to begin working through the assessment. Each question has further explanation that can be found by clicking on the Explain link. Answer a question by selecting Yes, No, or Not Applicable from the dropdown box. It

is recommended (although not required) to fill in all fields for each question. To get the most value from the assessment process, it is important to document the discussions and decision making involved in answering each question. Some questions may not be applicable or in scope of the current assessment. The questions will work through the threads, and move up or down a level based on your answers. The level of the current question is located in the upper right hand corner of the page, and the thread (or criteria category) that the question came from is located in the upper left hand corner. After answering the question, click the Next button to work through the rest of the assessment. When all questions have been answered, you will be shown the Dashboard which will display your results.

Review the assessment

To check the progress of the assessment, navigate to a different thread, or review the current progress, select the Assessment drop down menu, and choose the appropriate option. To get back to the assessment questions, choose Continue from the Assessment drop down menu.

Create a Manufacturing Maturation Plan

The outcome of a Manufacturing Readiness Assessment is the Manufacturing Maturation Plan. This consists of all necessary action items required to reach the desired Manufacturing Readiness Level. The plan should be created by the assessor and used as a final deliverable of the assessment process.

After completing all questions for the MMC assessment, the dashboard was displayed as shown below. For threads where the criteria was not met, a red X is shown, and the planned completion date of the action plan(s) for that thread is shown. In some cases, the criteria were met at a level higher than the target MRL, and these are indicated in blue.

Thread	Sub Thread	1	2	3	4	5	6	7	8	9	10	Completion Date
Technology Maturity	Technology Maturity	✓	✓	✓	✓	✓	✓					
Technology & Industrial Base	Industrial Base						✗					2017-03-31
Technology & Industrial Base	Manufacturing Technology Development	✓	✓	✓	✓	✓	✓	-				
Design	Producibility Program	✓	✓	✓	✓	✓	✓					
Design	Design Maturity	✓	✓	✓	✓	✓	✓					
Cost & Funding	Production Cost Knowledge (Cost modeling)	✓	✓	✓	✓	✓	✓	-				
Cost & Funding	Cost Analysis	✓	✓	✓	✓	✓	✓					
Cost & Funding	Manufacturing Investment Budget	✓	✓	✓	✓	✓	✓					
Materials	Maturity	✓	✓	✓	✓	✓	✓					
Materials	Availability	✓	✓	✓	✓	✓	✓					
Materials	Supply Chain Management	✓	✓	✓	✓	✓	✓	-				
Materials	Special Handling	✓	✓	✓	✓	✓	✓					
Process Capability & Control	Modeling & Simulation	✓	✓	✓	✓	✓	✓					
Process Capability & Control	Manufacturing Process Maturity	✓	✓	✓	✓	✓	✓					
Process Capability & Control	Process Yields and Rates	✓	✓	✓	✓	✓	✓					
Quality Management	Quality Management including Supplier Quality	✓	✓	✓	✓	✓	✓	-				
Quality Management	Product Quality	✓	✓	✓	✓	✓	✓					
Quality Management	Supplier Quality Management	✓	✓	✓	✓	✓	✓					
Manufacturing Workforce	Manufacturing Workforce	✓	✓	✓	✓	✓	✓					
Facilities	Tooling/ Special Test and Inspection Equipment (STE/SIE)	✓	✓	✓	✓	✓	✓					
Facilities	Facilities	✓	✓	✓	✓	✓	✓					
Manufacturing Management	Mfg Planning & Scheduling	✓	✓	✓	✓	✓	✓					
Manufacturing Management	Materials Planning	✓	✓	✓	✓	✓	✓					

By choosing Assessment->Action Items, all information that was entered during the assessment for action plans is displayed. Clicking the Export button will export this data to an Excel spreadsheet if desired. Use this as a basis to create the Manufacturing Maturation Plan. By following through with the plan, you can rest assured mitigating risk and are on track to manufacturing success.