



Users' Manual

MIRAT

Manufacturing Readiness Assessment Tool

Public Release Case #88ABW-2008-1197

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01. Introduction

Manufacturing Readiness Assessment Tool (MRAT)

The MRAT was developed to help structure and efficiently complete a Manufacturing Readiness Assessment (MRA) to determine the Manufacturing Readiness Level (MRL) of a chosen product or technology. MRAT helps standardize the process and reporting of the product's or processes current MRL (1-10).

Most importantly, the tool drives the interested parties / evaluators to consensus of not only the current readiness level but also those areas requiring improvement or further development. Consensus on improvement areas is important to efficiently achieve the milestones or technology transition target levels.

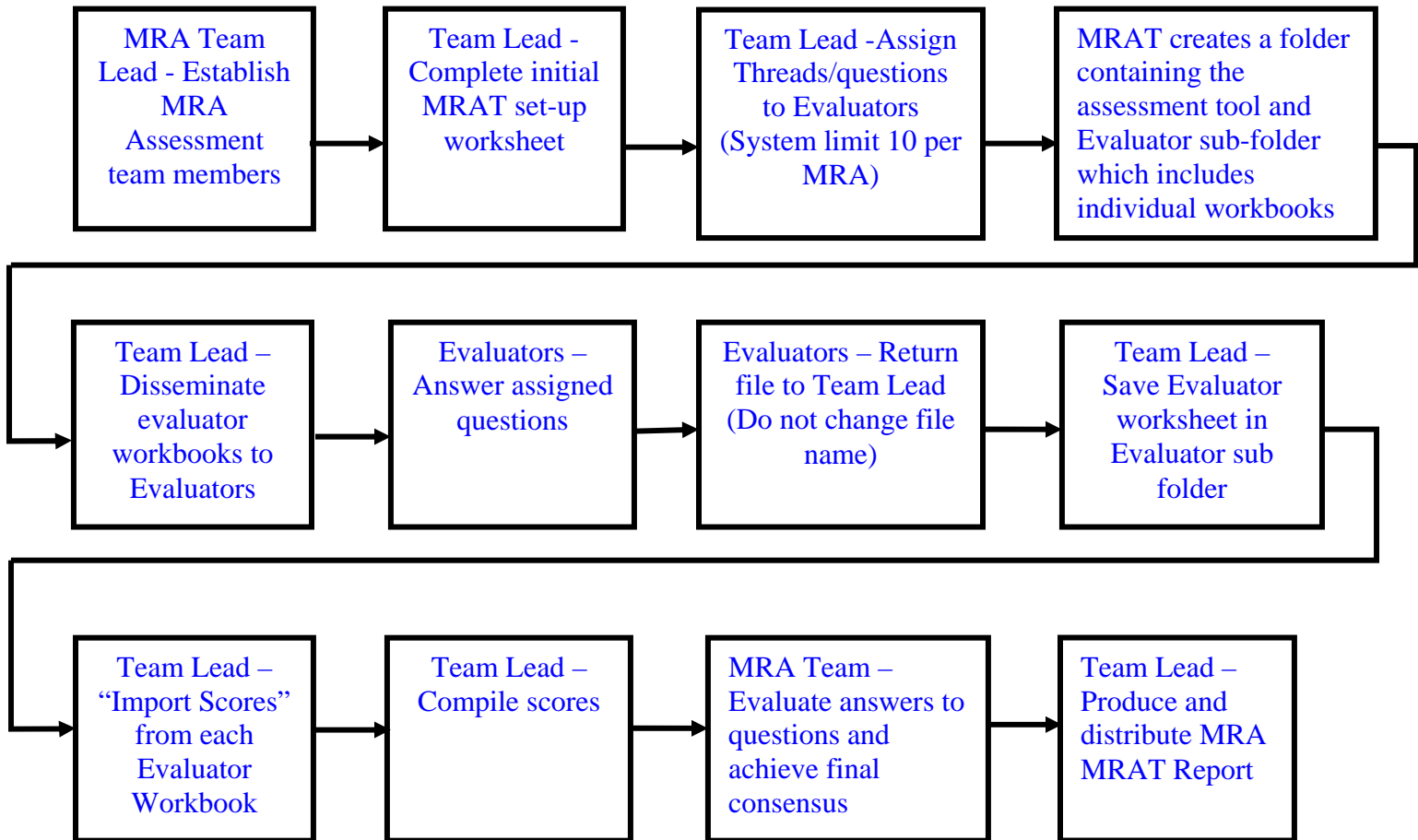
MRAT produces a report which indicates areas where the program or product falls short of the target MRL. This report coupled with cost and schedules become the basis for a final report which includes a comprehensive risk management plan and a meaningful manufacturing maturation plan.

This learning guide is designed to act as an instructional guide during your training and a reference resource in your workplace.

Note: The MRAT is designed to be used with Microsoft Excel™ 2003 and 2007 software. Developers of the MRAT make no guarantees with respect to the operation of this tool if it is used with any other than a licensed version of Microsoft Office software. (Please refer to the MRAT Software Compatibility Chart, Figure 21.)

02. Process Flow

The following MRAT flow diagram will provide a process overview of the tool.



03. File Management

1. Upon receiving the MRA Tool, it is recommended to create a folder under a directory that is supported by a back-up file system such as “My Documents”, and save the MRA tool in that directory. The MRA tool will operate from and create working folders within the “My Documents” directory.

The tool will create folders and sub-folders within the directory that the tool is operated from, so it is important to save the Master MRA tool in the “My Documents” directory.
(Refer to Figure 1)

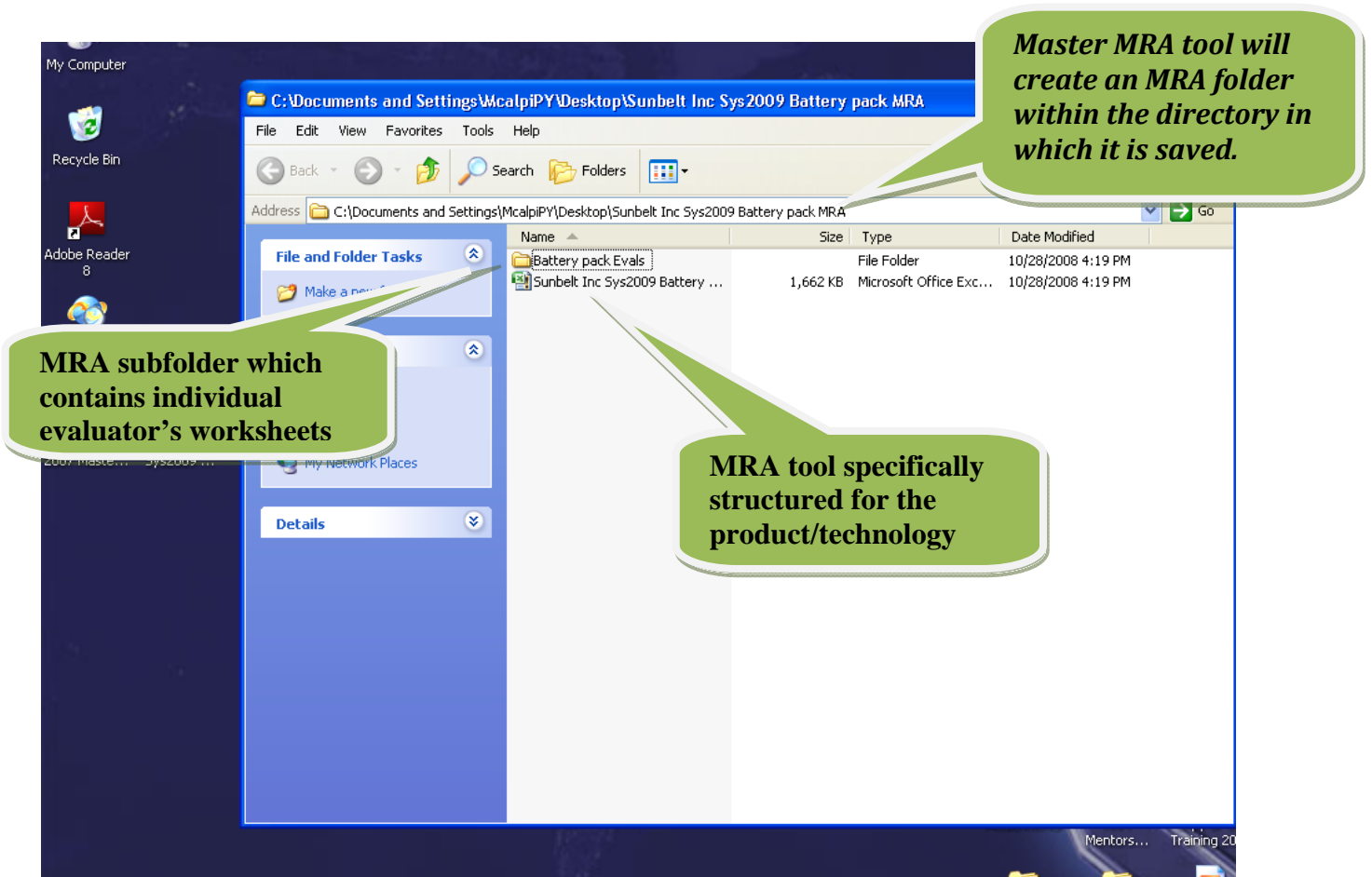


Figure 1

04. Security Warning – Enable Macros

2. From the designated location open the Master MRA Tool Excel™ file
3. Read and follow the instructions on the Security Warning screen
4. The **Security Warning** will display on the information line below the tool bar, indicating that **“Some active content has been disabled”**
5. Click the **“Options”** button adjacent to the Security Warning
6. The **Security Alert – Macros & ActiveX** window will appear
7. Click the **“Enable this content”** button
8. Click the **“OK”** button
9. Click the **“Run”** button

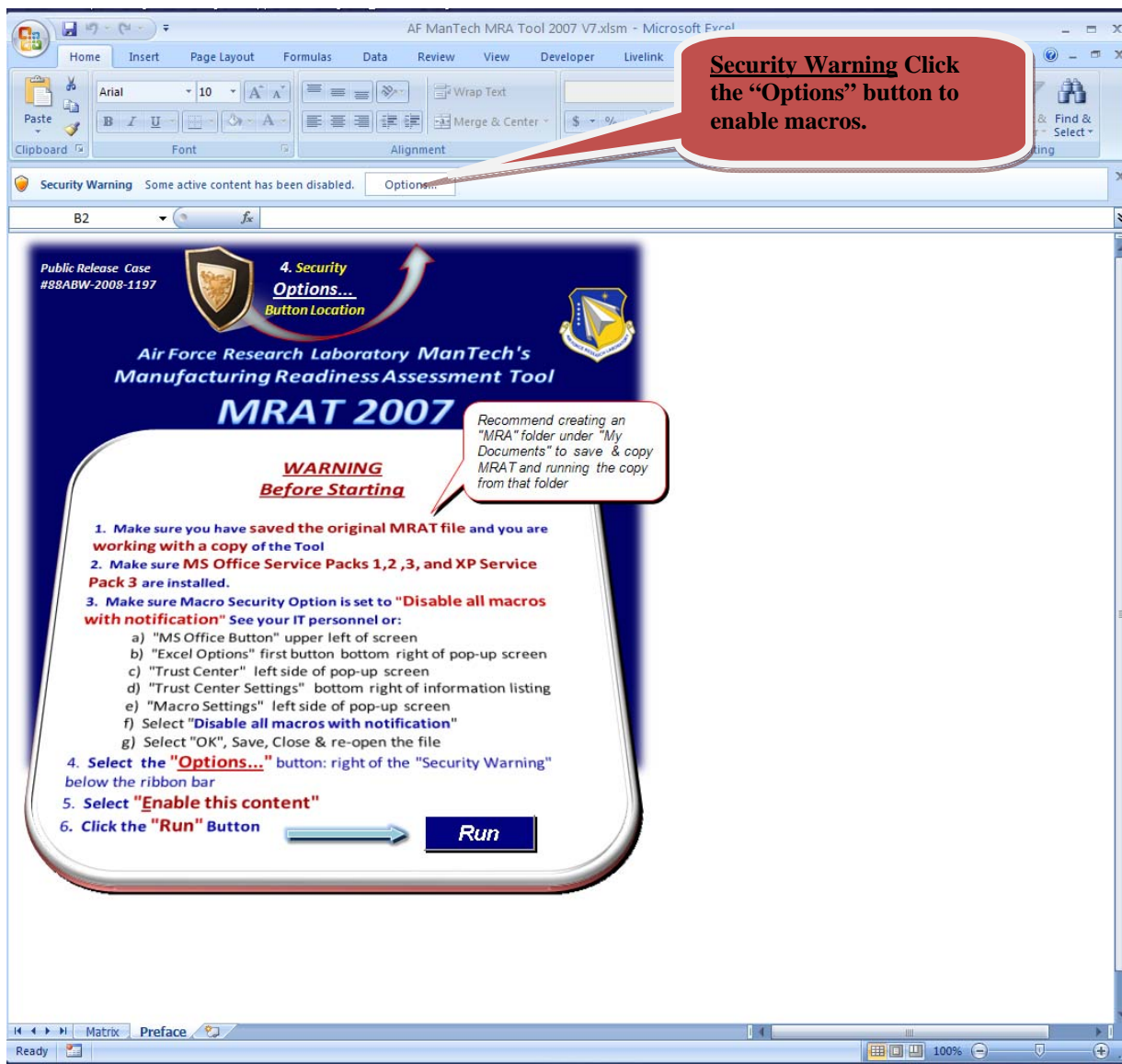


Figure 2

05. MRAT Setup and Work Instructions

10. The screenshot below represents the set-up view for inputting required assessment information
11. Complete the required fields listed below (Refer to Figure 3)
12. All required fields are **marked with an asterisk and highlighted in red**.
(Color changes from red to blue when fields are complete)

(1) Input Required* Information (2) Click Start

Company Name:	Sunbelt		Start Date	End Date
System Name:	Sys-2011	* Assessment Dates:		
Product/Technology:	Battery Pack	Production Dates:	14-Jan-09	23-Jan-09
Number of Units:	500 ~ 1,667 / mth	Milestone Date:		Use Calendar
MRL Target:	6	Technology Development leading to a Milestone B decision. <i>Capability to produce a prototype system or subsystem in a production relevant env...</i>		

“Use Calendar” button to utilize pop-up calendar and select desired dates.

Evaluators	Tech & IB	Design	Materials	Process	Cost & Funds	Quality	Personnel	Facilities	Mfg Mgmt
Art Temmesfeld	X	X	X	X	X	X	X	X	X
Bernard Wilson	X	X	X						
Beth Carter			X	X	X				
Patricia McAlpine		X	X	X		X	X	X	X
Tony Bumbalough	X	X	X	X	X	X	X	X	X

MRAT
Manufacturing Readiness Assessment Tool

Assessment Team Leader

* Name:

* Phone:

Email:

Address

Materials and Manufacturing Directorate
AFRL/RXMT
2977 Hobson Way, bldg 653 Room 215
Wright-Patterson AFB, OH 45433-7739

Questions & Definitions Based on: v7.0 Oct 2008 Threads

Figure 3

NOTE: The folders referred to in the File management section (Master MRA folder, MRA Tool and Sub-folders of this document will be created using the information specified on this set-up screen. The company names, systems name, and product/Technology specified on this set-up screen.
(Refer to Figure 1)

- A. Company Name
- B. System Name
- C. Product/Technology
- D. Number of Units

E. Target MRL :

- i. Enter MRL by clicking on the arrow at the bottom right hand corner of MRL box
- ii. Choose desired MRL from drop down menu.
- iii. The MRL number and a matching description appears in the box next to the number as verification

NOTE: Enter dates by either typing in the date or by clicking on the “Use Calendar” button to utilize the pop up calendar and select the desired dates.

F. Assessment Dates:

G. Production Dates:

H. Milestone Date: (if applicable)

I. Assessment Team Leader, Phone, Email, and Address

(1) Input Required* Information (2) Click Start

Company Name: Sunbelt Start Date: 19-Jan-09 End Date: 20-
 System Name: Sys-2011 Assessment Dates: 19-Jan-09 20-
 Product/Technology: Battery Pack Production Dates: 14-Jan-09 23-
 Number of Units: 500 ~ 1,667 / mth Milestone Date:
 MRL Target: 6

Technology Development leading to a Milestone B decision.
Capability to produce a prototype system or subsystem in a production relevant environment.

Select Activities for Tony Bumbalough	Tech & IB	Design	Materials	Process	Cost & Funds	Quality	Personnel	Facilities	Mfg Mgmt
Art Temmesfeld	X	X	X	X	X	X	X	X	X
Bernard Wilson	X	X	X						
Beth Carter				X	X	X			
Patricia McAlpine		X	X	X	X	X	X	X	X
Tony Bumbalough									

START
 Manufacturing Readiness Assessment Tool
MRAT

Assessment Team Leader
 Name: Tony Bumbalough
 Phone: 937-904-4594
 Email: Anthony.Bumbalough@wpafb.af.mil
 Address: Materials and Manufacturing Directorate
 AFRL/RXMT
 2977 Hobson Way, bldg 653 Room 215
 Wright-Patterson AFB, OH 45433-7739

Questions & Definitions Based on: v7.0 Oct 2008 Threads

Evaluate Threads

- Tech & IB
- Design
- Materials
- Process
- Cost & Funds
- Quality
- Mfg Personnel
- Facilities
- Mfg Mgmt

Select All OK

Figure 4

06. Evaluation Team: Assigning Threads to Evaluators

J. Evaluators

- i. Input an Evaluator’s name and press “Enter” on the keyboard (The user must input at least one evaluator name with assigned threads for the system to operate properly) (Refer to Figure 4)

- ii. The Assessment Team Leader should be included as an evaluator
- iii. The system is limited to 10 evaluator names
- iv. Evaluator names may not contain any slashes, periods, commas, or colons.
- v. The “Evaluate Threads” screen will display which allows the user to select activities (assign Threads) for each Evaluator
- vi. Click “**OK**” when complete
- vii. At this point in the process you may change the evaluator and thread assignment by clicking on the evaluator’s name. An information box will appear with the option to “**Remove Evaluator**” or “**Change the Threads**”. Select the appropriate option.

NOTE: The system will allow you to remove the evaluators and change thread assignments only during the initial assignment process.

The “Start” button will only appear on the screen after the required fields are completed. After clicking the “Start” button, the user will not be able to make any changes to the set-up information. A warning screen will display to confirm that you want to continue with this action. (Refer to Figures 5 - 7)

13. Press “**START**” button when complete

(1) Input Required* Information (2) Click Start

Company Name: Sunbelt
System Name: Sys-2011
Product/Technology: Battery Pack
Number of Units: 500 ~ 1,667 / mth
MRL Target: 6

Assessment Dates: 19-Jan-09 20-Jan-09
Production Dates: 14-Jan-09 23-Jan-09
Milestone Date:

Technology Development leading to a Milestone B decision.
Capability to produce a prototype system or subsystem in a production relevant environment.

Evaluators	Tech & IB	Design	Materials	Process	Cost & Funds	Quality	Personnel	Facilities	Mfg Mgmt
Art Temmesfeld	X	X	X	X	X	X	X	X	X
Bernard Wilson	X	X	X						
Beth Carter				X	X	X			
Patricia McAlpine		X	X	X	X	X	X	X	X
Tony Bumbalough	X	X	X	X	X	X	X	X	X

START
Manufacturing Readiness Assessment Tool
MRAT

Assessment Team Leader
Name: Tony Bumbalough
Phone: 937-904-4594
Email: Anthony.Bumbalough@wpafb.af.mil
Address: Materials and Manufacturing Directorate
AFRL/RXMT
2977 Hobson Way, bldg 653 Room 215
Wright-Patterson AFB, OH 45433-7739

Questions & Definitions Based on: v7.0 Oct 2008 Threads

Figure 5

07. Creating Additional MRAs

14. An information box will appear and ask to “Set up additional MRAs?”

Note: Additional MRAs could include multiple technologies for a system, multiple subsystems for a system, or multiple companies producing the same technology.

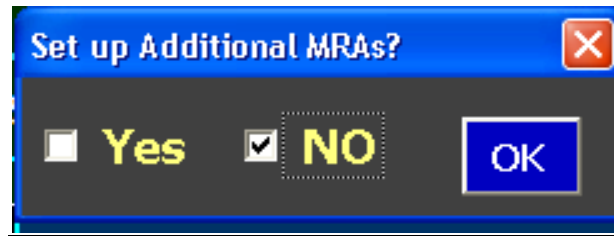


Figure 6

**NOTE: If selecting “YES”, go to step 15a and skip step 15b
If selecting “NO”, go to step 15b.**

15. Select the appropriate answer and click the “OK” button

- a. **If you have answered “Yes”,** (that you want to set up additional MRAs):
 - i. A new screen will appear which will ask if you are “Ready to create MRA folders and assessment files”?
 - ii. Read verification and warning information
 - iii. Click “OK”
 - iv. The MRAT will begin creating a master file with sub-files and individual worksheets for evaluators for the first product/technology

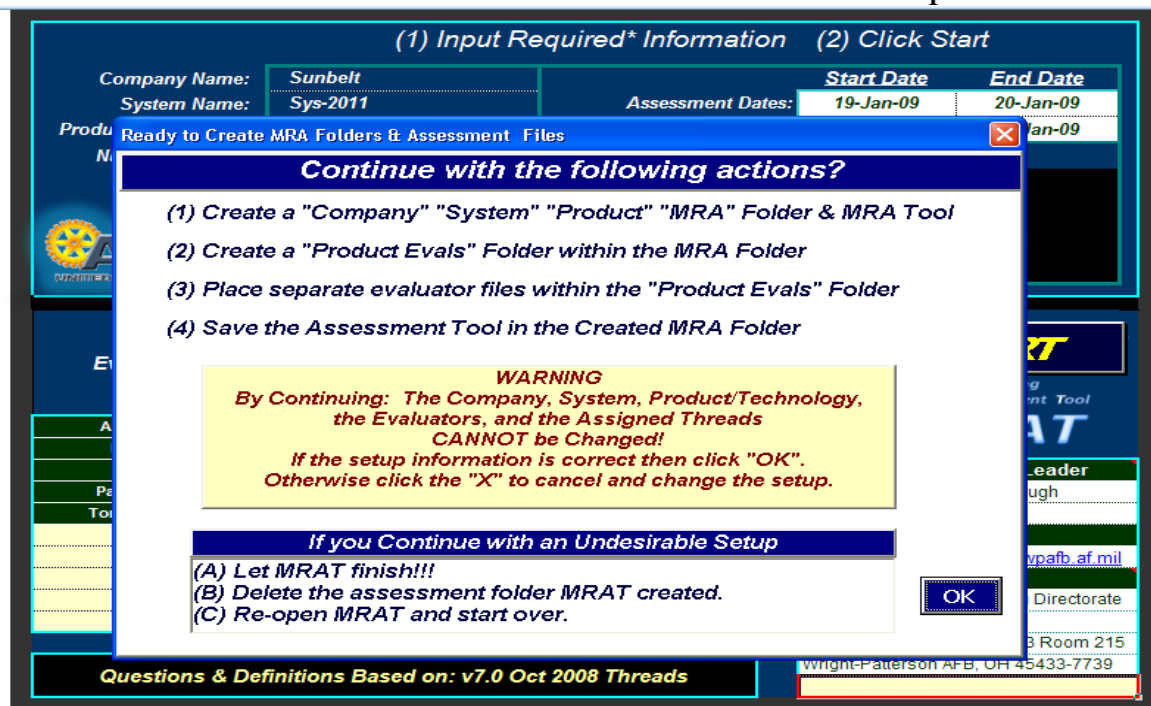


Figure 7

The MRAT will begin creating files, sub-files and individual worksheets (refer to Figure 1) for each evaluator of the first product/technology.

This process takes approximately 3-5 min. Excel™ will close and you will need to locate the Master MRA Tool within the directory where the MRA Tool originated (i.e. “My Documents”).

- v. Locate the MRA Tool within the “My Document” directory
 - vi. Click on the MRA Tool to re-open
 - vii. A second Setup screen will appear and will have only two required fields highlighted:
 1. Product/Technology
 2. Assessment Dates
 - viii. Input any required changes, making sure to fill in the required fields and click “Start”
 - ix. If there are additional MRAs that you would like to set up at this time, repeat step 15a as many times as necessary to set up additional MRAs. It will continue making folders that are labeled with the company name, the system name, and the product you want to evaluate.
- b. If you have answered “No”, (that you do not want to set up additional MRAs): (Refer to Figures 6 & 7)**
- i. A screen will appear which will ask if you are “Ready to create MRA folders and assessment files?”
 - ii. Read verification and warning information
 - iii. Click “OK”
 - iv. The MRAT will begin creating a master file with sub-files and individual worksheets for evaluators for the second product/technology

The MRAT will begin creating files, sub-files and individual worksheets (refer to Figure 1) for each evaluator of the first product/technology.

This process takes approximately 3-5 min. Excel™ will close and you will need to locate the Master folder created within the directory where the MRA Tool originated (i.e. “My Documents”). The master folder will contain the original tool and a subfolder with individual evaluator worksheets.

08. Assessment Team Leader Evaluation MRA Tool

16. Open the folder with the company name, system name, and product/technology name
17. Open the Product/Technology MRA Tool (Excel™ file)
18. Refer to steps 3-9 to enable macros
19. The MRAT Setup screen will appear with the information as entered (Refer to Figure 8).
20. In addition to the set-up sheet, the workbook also contains the evaluators' worksheets and a consensus sheet

(1) Input Required* Information (2) Click Start

Company Name:	Sunbelt	Start Date	19-Jan-09
System Name:	Sys-2011	End Date	20-Jan-09
Product/Technology:	Battery Pack	Production Dates:	14-Jan-09 23-Jan-09
Number of Units:	500 ~ 1,667 / mth	Milestone Date:	
MRL Target:	6	Technology Development leading to a Milestone B decision.	

Capability to produce a prototype system or subsystem in a production relevant environment.

Evaluators	Tech & IB	Design	Materials	Process	Cost & Funds	Quality	Personnel	Facilities	Mfg Mgmt
Art Temmesfeld	X	X	X	X	X	X	X	X	X
Bernard Wilson	X	X	X						
Beth Carter				X	X	X			
Patricia McAlpine		X	X	X		X	X	X	X
Tony Bumbalough	X	X	X	X	X	X	X	X	X

Assessment Team Leader

Name: Tony Bumbalough

Phone: 937-904-4594

Email:
Anthony_Bumbalough@wpafb.af.mil

Address
 Materials and Manufacturing Directorate
 AFRL/RXMT
 2977 Hobson Way, bldg 653 Room 215
 Wright-Patterson AFB, OH 45433-7739

Questions & Definitions Based on: v7.0 Oct 2008 Threads

SETUP / Tony_Bumba / Patricia_McAlp / Beth_Carte / Bernard_Wilso / Art_Temme / CONSENSUS

Figure 8

CAUTION: It is highly recommended you access the individual evaluator worksheets by using one of the options listed in steps 21a, 21b, or 21c. It is recommended to complete the individual worksheets contained within the evaluator sub-folder and save the completed worksheet under the same original file name. **Do not change the name of the file.**

If you ignore this caution and use steps 31-39 to complete the worksheet on this screen, **DO NOT** use the “Import Scores” button. The “Import Scores” button will replace the data on the screen with the data contained in the product/technology Evaluator sub-folder for each evaluator. Any information entered on this screen will be permanently deleted.

It is recommended to select one of the methods described in step 21a, 21b, or 21c, to complete the individual evaluator’s worksheet.

09. Evaluator Worksheets

21. Evaluators may access the individually assigned worksheets from one of three options:

a. Common computer

- i. Locate the master folder in the directory where the original tool was saved. The folder will be labeled with the company, system, and product name
- ii. Click on the sub-folder labeled with the product/technology “Evals”
- iii. Open individual worksheets labeled with the evaluator’s name or team name
- iv. Refer to steps 22-28 to enable macros (**Refer to Figure 9**)
- v. Follow steps 31-39 to complete MRAT worksheet
- vi. Upon completing the worksheet, save your inputs
- vii. Do not change the name of the file**

b. Email

- i. Locate the master folder in the directory where the original tool was saved. The folder will be labeled with the company, system, and product name
- ii. Click on the sub-folder labeled with the product/technology “Evals”
- iii. Attach the worksheet to an email and send to the evaluator
- iv. Do not change the name of the file
- v. Upon receiving the email, save the attachment to the desktop
- vi. Refer to steps 22-28 to enable macros (**Refer to Figure 9**)
- vii. Follow steps 31- 39 to complete the MRAT worksheet
- viii. Upon completing the worksheet, save your inputs
- ix. Do not change the name of the file**
- x. Email the worksheet back to the Assessment Team Leader
- xi. Assessment Team Leader will save document to MRAT evaluation sub-folder
- xii. Do not change the name of the file**

c. Thumb Drive/Memory Stick (if unrestricted)

- i. Insert thumb drive into USB port
- ii. Locate the master folder in the directory where the original tool was saved. The folder will be labeled with the company, system and product name
- iii. Click on the sub-folder labeled with the product/technology “Evals”
- iv. Save the worksheet to the thumb drive/memory stick
- v. Open worksheet
- vi. Refer to steps 22-28 to enable macros (**Refer to Figure 9**)
- vii. Follow steps 31- 39 to complete MRAT worksheet
- viii. Upon completing the worksheet, save your inputs to the thumb drive/memory stick
- ix. Do not change the name of the file**
- x. Provide to Assessment Team Leader
- xi. Assessment Team Leader will save document to MRAT evaluation sub-folder
- xii. Do not change the name of the file**

10. Evaluator Worksheet Security Warning



Figure 9

22. Read and follow the instructions on the Security Warning screen
(Refer to Figure 9)
23. The **Security Warning** will display on the information line below the tool bar, indicating that **“Some active content has been disabled”**
24. Click the **“Options”** button adjacent to the Security Warning
25. The **Security Alert – Macros & ActiveX** window will appear
26. Click the **“Enable this content”** button
27. Click the **“OK”** button
28. Click on the evaluator’s name on the bottom of the screen to begin

The Evaluator workbook contains a reference MRA Tool Matrix
(Refer to Figure 20) and the Evaluator worksheet

11. Evaluator Screen Orientation

The screenshot shows the Evaluator Screen Orientation with the following components:

- Line 1:** Hide info button and Definitions dropdown menu.
- Line 2:** Assessment start date of MRA, Company name, System name, Product/Technology name, and Unit name.
- Line 3:** Number of units, Production Dates, Target MRL, and Milestone Date.
- Line 4:** Evaluator name, Current overall MRL Rating, and a brief description of the current MRL.
- Line 5:** MRL and definition – Commonly used definitions and terms.

Filter	All Threads	MRL <=6	Status	0 of 133 Questions Answered	0 Yes, 0 No, 0 N/A, 133 Un-Answered	AMS	Thread	Std	M/RL	Comments
1	Have emerging technologies been assessed to determine if underlying manufacturing research is required to develop characteristics, specifications, standards, etc.?						Tech & IB	Dev.	3	

Figure 10

29. Figure 10 represents the individual evaluator’s worksheets

- Line 1** Hide information button- For a better view of the questions; Definition drop down menu- Helpful definitions & descriptions (Refer to Figure 11) (Double click the pop-up box with the definition to close the box)
- Line 2** Assessment start date of MRA, Company name, System name, Product/Technology name, and Unit name
- Line 3** Number of units, Production Dates, Target MRL, and Milestone Date.
- Line 4** Evaluator name, Current overall MRL Rating, and a brief description of the current MRL
- Line 5** MRL and definition – Commonly used definitions and terms

The screenshot shows the Evaluator Screen Orientation with a dropdown menu open for Six Sigma definitions. The menu items are:

- Six Sigma
- Special Tooling/Special Test Equipment
- Supply chain
- Systems Engineering Plan
- Technology Development Strategy
- Three Sigma
- Value Stream Mapping
- Yield and Rates
- TRL 1
- TRL 2
- TRL 3
- TRL 4
- TRL 5
- TRL 6
- TRL 7

The main content area shows the current MRL definition: "MRL(6): Initial mfg approach developed. Majority of manufacturing processes have been defined and characterized, but there are still significant engineering/design changes. Preliminary design of critical components completed. Producibility assessments of key technologies complete. Prototype materials, tooling and test equipment, as well as personnel skills have been demonstrated on subsystems/ systems in a production relevant environment. Detailed cost analysis include design trades. Cost targets allocated. Producibility considerations shape system development plans. Long lead and key supply chain elements identified. Industrial Capabilities Assessment (ICA) for MS B completed."

Filter	All Threads	MRL <=6	Status	133 of 133 Questions Answered	132 Yes, 1 No, 0 N/A, 0 Un-Answered	AMS	Thread	Std	M/RL	Comments
	Have emerging technologies been assessed to determine if						Te	Mi		Have emerging technologies been assessed to

Figure 11

Hide info		Definitions	
19-Jan-09 MRA of: Sunbelt Inc / Sys-2011 / Battery Pack			
500 Units @ a Rate of: ~ 1,667 / mth From Jan-2009 To: Jan-2009 with a Target MRL of 6 By 00-Jan-1900			
Evaluator: Tony Bumbalough		Current Overall MRL Rating: 0	<i>Not all questions at or below the target are answered!</i>
MRL(6): Initial mfg approach developed. Majority of manufacturing processes have been defined and characterized, but there are still significant engineering/design changes. Preliminary design of critical components completed. Producibility assessments of key technologies complete. Prototype materials, tooling and test equipment, as well as personnel skills have been demonstrated on subsystems/ systems in a production relevant environment. Detailed cost analysis include design trades. Cost targets allocated. Producibility considerations shape system development plans. Long lead and key supply chain elements identified. Industrial Capabilities Assessment (ICA) for MS B completed.			
Tech & IB		Design	Materials
Process		Cost & Funds	Quality
Personnel		Facilities	Mfg Mgmt
6		All Threads	Set MRL Clear MRL
Filter	All Threads MRL<=6 Status : 0 of 133 Questions Answered 0 Yes, 0 No, 0 N/A, 133 Un-Answered		Comments
1	Have emerging technologies been assessed to determine if underlying manufacturing research is required to develop characteristics, specifications, standards, etc.?	Tech & IB	3
2	Have pertinent Manufacturing Science & Advanced Manufacturing Technology requirements been identified?	Tech & IB	4

Figure 12

The colors of this line change according to the responses to the questions as each question relates to the selected MRL

- Yellow – Not all questions have been answered
- Green – At or greater than the selected MRL
- Red – Below the selected MRL

Line 6 Status for each MRL thread (Refer to Figure 12)

1. MRL Box (Defaults to the set target level);
2. “All Threads” drop down list – displays the status of the questions answered for the number displayed in the MRL box
3. “Set MRL” will preset default “Yes” answers for number displayed in the MRL box and the “All Threads” or the selected thread

Use “Set MRL” default only when the product or technology MRL has been pre-assessed at a certain level

4. “Clear MRL- will clear all answered questions for the selected thread in the drop down list

Line 7 Identifies tool function options and information status

1. “Filter” button-filter the questions/answers for easier viewing
2. Follow steps 33-37

Line 8 MRA questions (281 total questions for MRL 10) based on the threads selected during the initial setup for the evaluator

12. Completing Evaluator Assessments

The screenshot shows an evaluator assessment interface for 'Sunbelt Inc / Sys-2014'. The evaluator is Tony Bumbalough, and the current overall MRL rating is 0. The interface displays a list of 133 questions, with 0 answered. The questions are filtered by MRL <= 6. The table below shows the first six questions, their threads, sub-threads, and MRL values.

Filter	All Threads	MRL <= 6	Status	0 of 133 Questions Answered	ANS	Thread	Sub	MRL	Comments
1	Have emerging technologies been assessed to determine if underlying manufacturing research is required to develop characteristics, specifications, standards, etc.?					Tech & IB	Man'tech Dev.	3	
2	Have pertinent Manufacturing Science & Advanced Manufacturing Technology requirements been identified?					Tech & IB	Man'tech Dev.	4	
3	Are the required manufacturing science and manufacturing technology development efforts initiated?					Tech & IB	Man'tech Dev.	5	
4	Are the necessary manufacturing technology development efforts continuing?					Tech & IB	Man'tech Dev.	6	
5	Are the required manufacturing science and technology development solutions being demonstrated in a production relevant environment?					Tech & IB	Man'tech Dev.	6	
6	Are the required manufacturing science and manufacturing technology development solutions demonstrated in a production representative environment?					Tech & IB	Man'tech Dev.	7	

Figure 13

30. The evaluator's assigned questions are displayed
31. Begin answering questions by selecting "Yes", "No" or "N/A" from the drop down menu in the "Ans" column
32. The questions may be filtered by text, answer, thread, sub-thread, MRL, and comments for better clarity (Refer to Figure 14)

13. Filtering

33. To view questions by text, answer, thread, sub-thread, MRL, and comments:
- Click on the “Filter” button (Refer to Figure 13)

The screenshot shows a software interface with a top navigation bar containing tabs for 'Hide info', 'Definitions', and a dropdown menu. Below this is a header section with the text '19-Jan-09 MRA of: Sunbelt Inc / Sys2009 / Battery pack' and '500 Units @ a Rate of: ~ 3,750 / mth From Jan-2009 To: Jan-2009 with a Target MRL of 7 By 00-Jan-1900'. A yellow status bar displays 'Evaluator: Tony Bumbalough', 'Current Overall MRL Rating: 0', and a warning message: 'Not all questions at or below the target are answered!'. Below the status bar is a detailed MRL(7) description. A function key bar at the bottom contains tabs for 'Tech & IB', 'Design', 'Materials', 'Process', 'Cost & Funds', 'Quality', 'Personnel', 'Facilities', and 'Mfg Mgmt', with 'Tech & IB' selected and a dropdown menu showing '7'. A table below the function key bar has columns for 'Un Filter', 'Tech & IB', 'MRL<=7 Status', 'ANS', 'Thread', 'Sub', and 'MRL'. The 'Un Filter' button is circled in red. A callout box points to the 'Sub' column header, stating: 'An indication that the filter is activated on the function key line is that the arrows appear on the bottom right hand corner of the function keys'. The table contains four rows of questions related to Technology Readiness (TRL 3, 4, 5, 6 or greater).

Figure 14

It is recommended to filter by sub-thread (“Sub”).

34. To filter questions by sub-thread: (Refer to Figure 14)
- Click on the “Sub” arrow on the function line
 - A drop down list of sub-threads will appear
 - Select a sub-thread and click “OK”
 - Only the questions relating to the filtered sub-thread will display
 - If you would like to see all the questions again, click “Un-filter”

35. Begin answering questions by selecting “Yes”, “No” or “N/A” from the drop down menu in the “Ans” column
- For each question, click in the “Ans” column and an arrow will appear
 - Click the arrow and a drop-down menu will appear
 - Select “Yes”, “No”, or “N/A” for each question
36. To preset all answers to “Yes” for a certain MRL:

Use “Set MRL” default **only** when the product or technology MRL has been pre-assessed at a certain level

- Click on the number displayed in the MRL box and select the desired MRL from the drop down list
(The number in the MRL box defaults to the set target MRL)
- Click on “All Threads” drop down list
- Select desired thread
- Click “Set MRL” to set all answers to “Yes” or
- Click “Clear MRL” to clear all answers

Caution - Selecting the “Clear MRL” button will permanently clear all responses and comments if “All Threads” is selected. Otherwise, it will clear all responses and comments for the selected thread.

Colors indicate the status of each thread according to the number selected in the MRL box. **(Refer to Figure 15)**

- Yellow – Not all questions have been answered
- Green – At or greater than the selected MRL
- Red – Below the selected MRL

37. All “No” and “N/A” answers should include a specific comment in the “comments” block

Hide info Definitions

04-Nov-08 MRA of: Sunbelt Inc / Sys-2012 / Battery Pack 2

700 Units @ a Rate of: ~ 5,250 / mth From Jan-2009 To: Jan-2009 with a Target MRL of 7 By 00-Jan-1900

Evaluator: Tony Bumbalough Current Overall MRL Rating: 0

MRL(7): Detailed design is underway. Material specifications are approved. Materials available to meet planned pilot line build schedule. Manufacturing processes and procedures demonstrated in a production representative environment. Detailed producibility trade studies and risk assessments underway. Cost models updated with detailed designs, rolled up to system level and tracked against targets. Unit cost reduction efforts underway. Supply chain and supplier QA assessed. Long lead procurement plans in place. Production tooling and test equipment design & development initiated.

Tech & IB Design Materials Process Cost & Funds Quality Personnel Facilities Mfg Mgmt 7 Quality Set MRL Clear MRL

Un Filter	Quality MRL<=7 Status : 7 of 7 Questions Answered 5 Yes, 2 No, 0 N/A, 0 Un-Answered	ANS	Threat	Sub	MRL	Comments
34	Does the technology development strategy include a quality strategy?	No	Quality	Quality Mgmt	4	Does the technology development strategy include a quality strategy? No; Quality strategy is scheduled for completion on 06/09.
35	Is there a refined quality strategy in the System Engineering Plan?	No	Quality	Quality Mgmt	5	Is there a refined quality strategy in the System Engineering Plan?
36	Are Key Characteristics being identified during technology demonstrations?	Yes	Quality	Quality Mgmt	5	Default Opinion
37	Have quality risks and adequate metrics been identified?	Yes	Quality	Quality Mgmt	6	Default Opinion

All "No" and "N/A" answers should include a comment in the comment block!

Figure 15

38. Answer each question, then repeat steps 35 -36 until all assigned questions are answered
39. Answer all questions under the assigned threads
40. Save the worksheet to the MRAT evaluation sub-folder
41. Do not change the file name
42. Open the folder with the company name, system name, and product/technology name
43. Open the Product/Technology MRA Tool (Excel™file)
44. Refer to steps 3 – 9 to enable macros
45. The MRAT Setup screen will appear with the information as entered (Refer to Figure 16)

(1) Input Required* Information (2) Click Start

Company Name:	Sunbelt	Start Date	End Date
System Name:	Sys-2011	Assessment Dates:	19-Jan-09 20-Jan-09
Product/Technology:	Battery Pack	Production Dates:	14-Jan-09 23-Jan-09
Number of Units:	500 ~ 1,667 / mth	Milestone Date:	
MRL Target:	6	<p style="color: green; font-weight: bold;">Technology Development leading to a Milestone B decision.</p> <p style="color: yellow; font-weight: bold;">Capability to produce a prototype system or subsystem in a production relevant environment.</p>	

Evaluators	Tech & IB	Design	Materials	Process	Cost & Funds	Quality	Personnel	Facilities	Mfg Mgmt
Art Temmesfeld	X	X	X	X	X	X	X	X	X
Bernard Wilson	X	X	X						
Beth Carter				X	X	X			
Patricia McAlpine		X	X	X		X	X	X	X
Tony Bumbalough	X	X	X	X	X	X	X	X	X

Air Force Research Laboratory
ManTech's
Manufacturing
Readiness Assessment Tool

MRAT

Assessment Team Leader

Name: Tony Bumbalough
Phone: 937-904-4594
Email: Anthony_Bumbalough@wpafb.af.mil
Address: Materials and Manufacturing Directorate
AFRL/RXMT
2977 Hobson Way, bldg 653 Room 215
Wright-Patterson AFB, OH 45433-7739

Questions & Definitions Based on: v7.0 Oct 2008 Threads

SETUP Tony_Bumba Patricia_McAlp Beth_Carte Bernard_Wilso Art_Temme CONSENSUS

Figure 16

46. To display the individual evaluator's worksheets, click on the tabs labeled with the evaluator's name at the bottom of the screen
47. Select an evaluator tab, and the evaluator's worksheet will be displayed
(Refer to Figure 16)
48. Click the "Import Scores" button on each evaluator's worksheet
 - a. A warning window will display, asking for confirmation to continue
(Refer to Figure 17)
 - b. Read and confirm; click "OK"
 - c. All the answers completed on the individual worksheet will be copied to this worksheet

Continue Importing Evaluator: Tony Bumbalough's Answers & Comments from Tony_Bumba worksheet in the Battery Pac... ✖

WARNING: Answers & comments on this sheet will be replaced with content from the Tony_Bumba worksheet in the Battery Pack Evals folder!

OK
Cancel

Figure 17

14. Consensus Worksheet

The purpose of the consensus worksheet is to come to consensus on the responses from each evaluator.

49. To proceed to the consensus worksheet, click on the “Consensus” tab at the bottom of the worksheet (Refer t Figure 18)

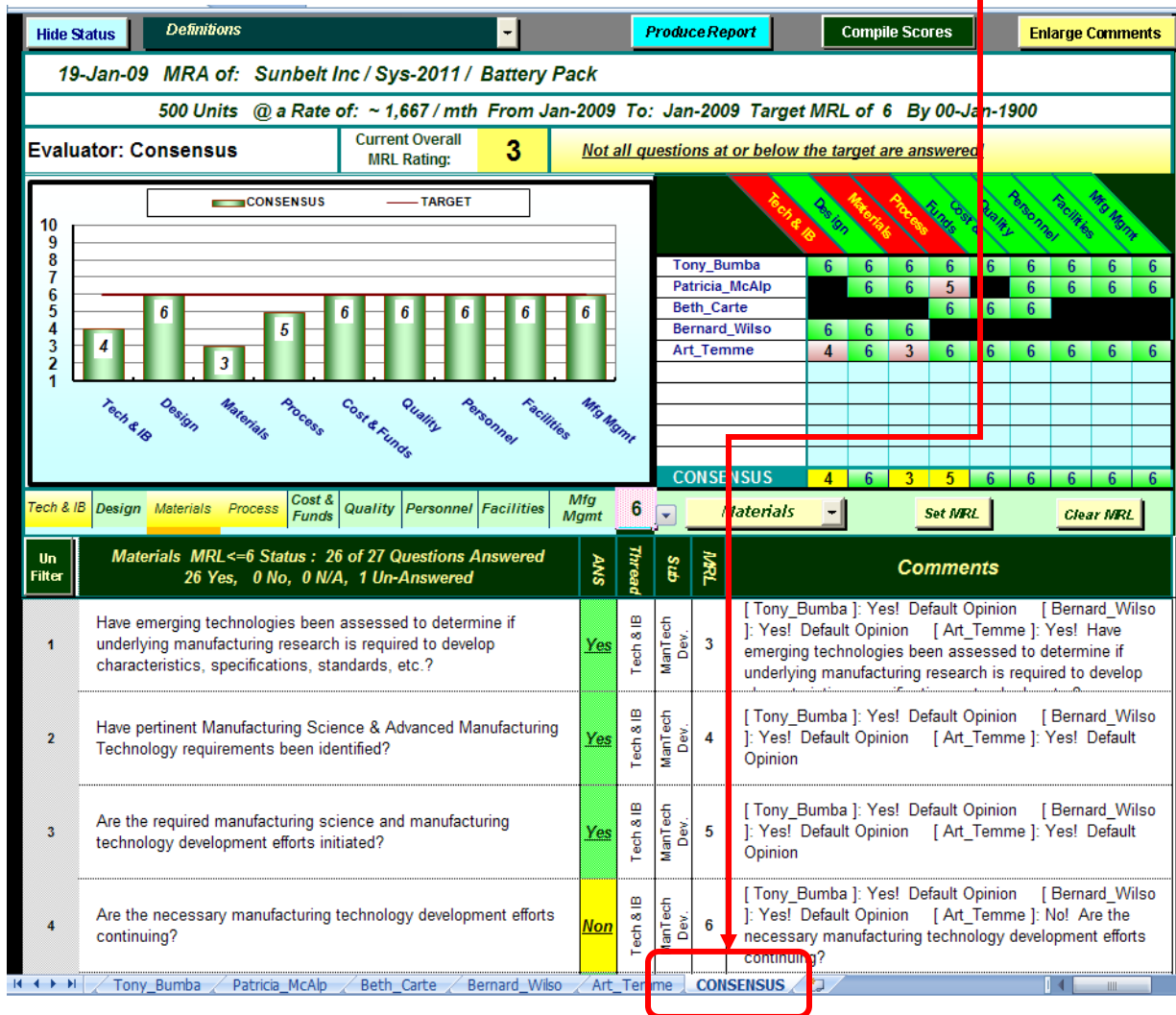


Figure 18

15. Compile Scores

50. Click on the “**Compile Scores**” button at the top of the screen
51. The consensus worksheet will display the following information:
 - a) A graph comparing the evaluators’ answers
 - b) A bar chart that highlights the status of the MRL by threads in comparison to the target MRL
 - c) Inconsistent answers between evaluators that are marked with “Non” in the “ANS” column
 - d) Areas that need improvement to obtain the target MRL
52. The report will display those questions that require further review in order to reach consensus
53. To filter the questions, click on the “**Filter**” key
54. Click on “**ANS**” key and select “**Non**” from the drop down menu
55. Evaluate each question that consensus was not met (“Non”) and come to consensus by answering “Yes”, “No”, or “N/A” agreement
56. In the comment section, explain the consensus decision
57. Make sure comments for all inconsistent answers contain an explanation about how consensus was met

Select the “Comments” box for a question, and click the “Enlarge Comments” button. A box will pop up making it easier to read and enter comments. Click “OK” when finished.

Click the “Hide Status” button to display more questions on the screen and the consensus status.

16. MRL Report

58. To proceed to the report worksheet, click on the “**Report**” tab at the bottom of the worksheet
59. Click the “**Produce Report**” button
60. The final report will highlight areas that are less than the target MRL. These areas are considered the manufacturing risk areas and should be further reviewed by the MRA team

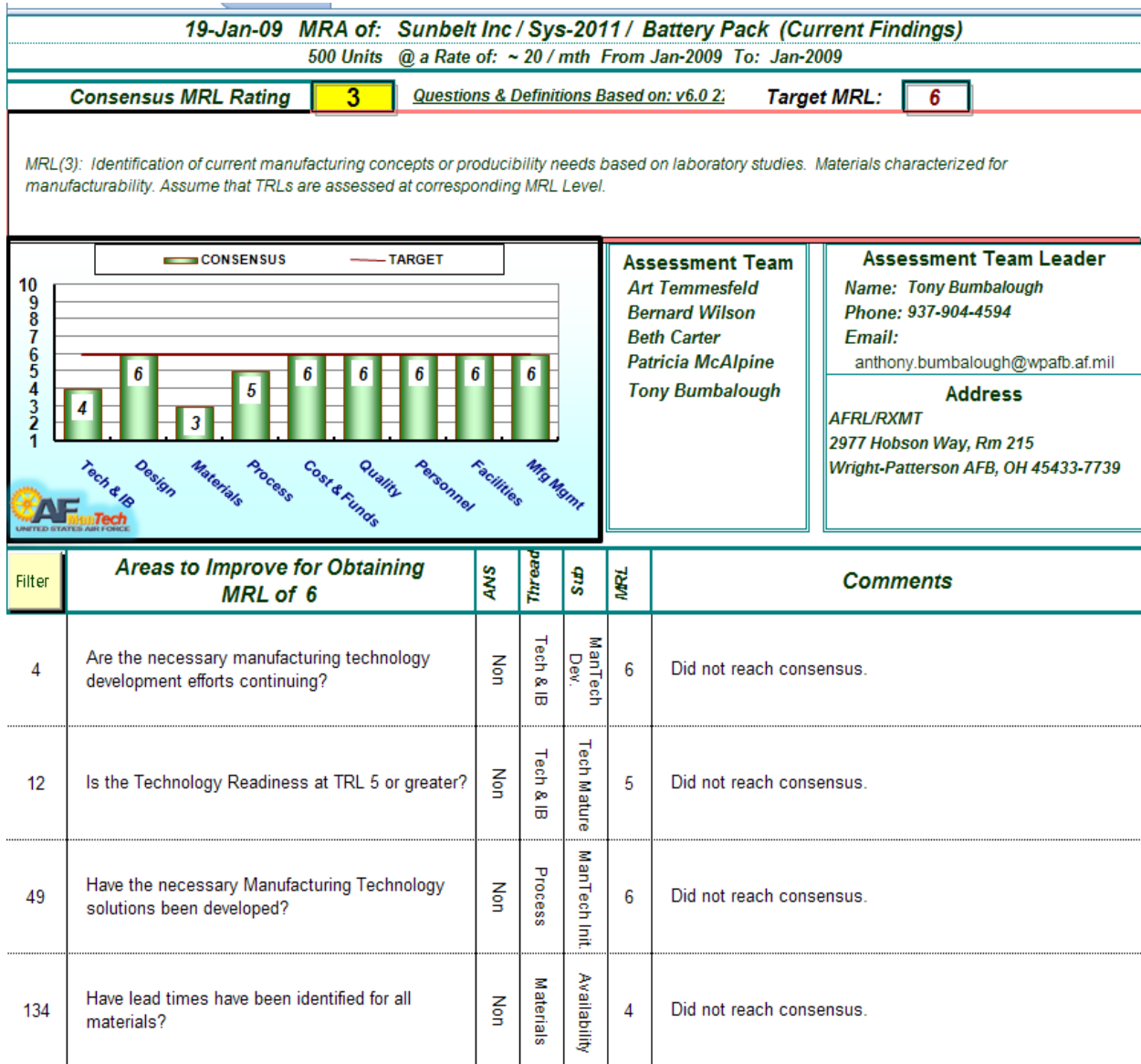


Figure 19

17. Reference: MRA Tool Matrix

- Manufacturing Readiness Level Evaluation Criteria (Refer to Figure 20)
- MRA Matrix based on nine Threads developed to help assess the current MRL
 - Technology and Industrial Base
 - Design
 - Materials
 - Cost and Funding
 - Process Capability and Control
 - Quality Management
 - Manufacturing Personnel
 - Facilities
 - Manufacturing Management

Acq Phase		Pre CR	Pre CR	Pre CR	CR - MS A	TD	MS B	SDD	MS C	LRI
Thread	Sub-Thread	MRL 1	MRL 2	MRL 3	MRL 4	MRL 5	MRL 6	MRL 7	MRL 8	MRL 9
Design	Production Program			Relevant materials/processes evaluated for manufacturability using experimental results.	Productibility & Manufacturability assessment of design concepts completed. Results guide selection of design concepts and key components/technologies for Technology Development Strategy. Required Test Evaluation Strategy (TES) includes Design for Test during production	Productibility & Manufacturability assessments of key technologies and components initiated. Systems Engineering Plan (SEP) requires validation of design choices against manufacturing process and industrial base capability constraints. Manufacturing processes assessed for capability to test and verify in production, and influence on Operations & Support (O&S).	Productibility assessments of key technologies/components and productibility trade studies (performance vs. productibility) completed. Results used to shape System Development Strategy and plans for SUD or technology insertion programs phase	Detailed productibility trade studies using knowledge of key design characteristics and related manufacturing process capability completed. Productibility enhancement efforts (e.g. Design For Mfg Assembly) initiated.	Productibility improvements implemented on system. Known productibility issues have been resolved and pose no significant risk for LRP	Prior productibility analyzed for LRP. Product discovered in mitigated and significant risk
	Design Maturity	Manufacturing opportunities identified.	Applications defined. Broad performance goals identified that may drive manufacturing options.	Top level performance requirements defined. Trade-offs in design options assessed based on experiments. Product lifecycle and technical requirements evaluated.	Initial Systems Engineering Plan and Test and Evaluation Strategy recognize the need for the establishment/validation of manufacturing capability and management of manufacturing risk for the product lifecycle. Initial Key Performance Parameters (KPPs) identified.	Identification of enabling/critical technologies and components is complete and includes the product lifecycle. Evaluation of design Key Characteristics (KC) initiated.	Basic system design requirements defined. All enabling/critical technologies/components have been tested and validated. Product data required for prototype manufacturing released. A preliminary performance as well as focused logistics specification is in place. Key Characteristics and tolerances have been established.	Product requirements and features are well enough defined to support detailed systems design. All product data essential for manufacturing of component design demonstration released. Potential KC risk issues have been identified and mitigation plan is in place. Design change traffic may be significant.	Detailed design of product features and interfaces is complete. All product data essential for system manufacturing released. Major product design features are sufficiently stable such that key LRP manufacturing processes will be representative of those used in FRP. Design change traffic does not significantly impact LRP. Key characteristics are stable and have been demonstrated in SDD or technology insertion program.	Major product are stable and testing. Design limited to minor changes. All in production appropriate
Cost & Funding	Production Knowledge (Cost modeling)		Cost model approach defined	Technology cost models developed for new process steps and materials based on experiments.	Detailed process chart cost models driven by key characteristics and process variables. Manufacturing, material and specialized reqt. cost drivers identified.	Detailed end-to-end value stream map cost model for major system components includes materials, labor, equipment, tooling/STE, setup, yield/scrap/rework, Work In Progress (WIP), and capability/capacity constraints. Component simulations drive cost models.	Cost model inputs include design requirements, material specifications, tolerances, integrated master schedule, results of system/subsystem simulations and production relevant demonstrations.	Cost models updated with detailed designs and features, collected quality data, plant layouts and designs, and obsolescence solutions.	Engineering cost model driven by detailed design and validated with data from relevant environment.	Actual cost of FRP exceeds requirements. FRP impact continuous in
	Cost Analysis	Any manufacturing cost implications identified.	Cost elements identified	Sensitivity analysis conducted to define cost drivers and production development strategy (i.e. lab to pilot to factory)	Material, manufacturing, and specialized reqt. costs identified for design concepts. Productibility cost risks assessed	Current state analysis of cost of design choices, make/buy, capacity, process capability, sources, quality, key characteristics, yield/rate, and	Cost analysis of mfg future states, design trades, supply chain/yield/rate/SDD/technology insertion plans. Allocate cost targets. Cost reduction and	Costs rolled up to system level and tracked against targets. Detailed trade studies and engineering change requests supported by cost estimates.	Cost analysis of proposed changes to requirements or configuration	LRP cost goes beyond current

Figure 20

18. Reference: Compatibility Matrices

MRAT Software Compatibility Chart

- Users of the MRAT tool must possess or obtain a licensed copy of Microsoft Excel™ for the MRAT to function.

MRAT 2007	Vista SP 1	Vista SP X
Excel 2007 SP 1	Yes	?
Excel 2007 SP 2	?	?

MRAT 2007	XP SP 1	XP SP 2	XP SP 3	XP SP X
Excel 2007 SP 1	Yes	Yes	Yes	?
Excel 2007 SP 2	?	?	?	?

MRAT 2003	XP SP 1	XP SP 2	XP SP 3	XP SP X
Excel 2003 SP 1	Yes	Yes	Yes	?
Excel 2003 SP 2	Yes	Yes	Yes	?
Excel 2003 SP 3	Yes	Yes	Yes	?
Excel 2007 SP X	No	No	No	No

Figure 21