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After completing this training module, participants should be aware of key updates, understand key concepts, and use the Capacity Analysis Report (CAR) to:

- Conduct Capacity Planning
- Perform Capacity Analysis
- Achieve Capacity Verification
- Update the Ford Capacity Planning Systems
- Respond to Capacity Studies & Shortages
- Complete Supplier Certification

**Objective:** Enhance training participants awareness and understanding of the Ford Capacity Analysis Process.
CAPACITY ANALYSIS TRAINING

Agenda

- Case for Change
- What’s New
- Goal of Capacity Analysis
- Understanding Overall Equipment Effectiveness, OEE
- Required OEE
- Demonstrated OEE
- Capacity Risk and Gap Closure
- Capacity Shortage Resolution
- Capacity Studies
- Supplier Certification Process
- Capacity Analysis Training Key Takeaways
- Student Assessment
The industry has changed, affecting **HOW**
capacity should be analyzed...

- **New Model Launches**
  - Increased Frequency, Accelerated Timing, Incremental Volume Increases for Cross-Platform Utilization

- **Capacity Uplift Studies**
  - Capacity uplift studies – including successive studies impacting multiple vehicle lines and global platform applications – require a proven method of assessing capacity risk, and accurate capacity status reporting.

- **Supply Base Consolidation**
  - Resourcing Actions (Launches with Compressed Timing), Site Locations with Larger & More Complex Programs and Increased Business Volume

- **Increase in Shared Capacity**
  - Greater Equipment Utilization, Reduction of Capital Investment, Utilization of Flexible Manufacturing Cells, Non-Robust Planning of Total Allocation on Shared Equipment

- **Unproven Supply Location**
  - New Facilities Lack Historical Efficiency Data for Capacity Verification
Case for Change

GPDS 2.4 Alignment & Capacity Analysis Timing

Supplier Sourcing Begins
Priority Suppliers Selected
Cross-Functional Teams Formed
Team Kick-Off Meetings Begin

\[ \rightarrow \rightarrow \text{CAPACITY ASSESSMENTS} \rightarrow \rightarrow \]

Resolve Open Issues

\[ \text{Decision to Proceed to Run-At-Rate} \]

On Site Evaluation #1 \rightarrow On Site Evaluation #2 \rightarrow On Site Evaluation #3 \rightarrow On Site Evaluation #4

Supplier APQP/PPAP Readiness Assessment (Schedule A)

POST LAUNCH CAPACITY ANALYSIS (AFTER MP2) INCLUDES CAPACITY STUDIES, SREAS, RESOURCING ETC
### Case for Change

GPDS 2.4 Alignment & Capacity Analysis Timing (continued)

#### GPDS Global Phased PPAP Achievement by Vehicle Build Milestone

<table>
<thead>
<tr>
<th>PPAP Phase</th>
<th>Not later than (Milestone):</th>
<th>Not later than (MBJ1)</th>
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<tbody>
<tr>
<td>Capacity Planning</td>
<td>&lt;FDJ&gt;</td>
<td>17 MBJ1</td>
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<tr>
<td>Phase 0 Run-at-Rate</td>
<td>Timing must support Phase 1 at TT IPD</td>
<td></td>
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<tr>
<td>Phase 1 PPAP (minimum 1 production stream)</td>
<td>Body TT IPD, Trim and Chassis TT IPD</td>
<td>Body 6 MBJ1, Trim and Chassis 5.5 MBJ1</td>
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<tr>
<td>Phase 2 PPAP (all production streams)</td>
<td>Body PP IPD, Trim and Chassis PP IPD</td>
<td>Body 3.25 MBJ1, Trim and Chassis 3 MBJ</td>
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<tr>
<td>Phase 3 PPAP</td>
<td>MP2 IPD</td>
<td>-1 MBJ1 (1 month after Job 1)</td>
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#### GPDS Global Phased PPAP Achievement by Powertrain Build Milestone

<table>
<thead>
<tr>
<th>PPAP Phase</th>
<th>Not later than (Milestone):</th>
<th>Not later than (MBJ1)</th>
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</thead>
<tbody>
<tr>
<td>Capacity Planning</td>
<td>&lt;Unit DC &gt; -3</td>
<td>23 MBJ1</td>
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<tr>
<td>Phase 0 Run-at-Rate</td>
<td>Timing must support Phase 1 for Rough and Finished Parts</td>
<td></td>
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<tr>
<td>Phase 1 PPAP rough parts (minimum 1 production stream)</td>
<td>Rough Parts Unit TT MRD</td>
<td>12 MBJ1</td>
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<tr>
<td>Phase 1 PPAP finished parts (minimum 1 production stream)</td>
<td>Finished Parts Unit TT MRD</td>
<td>8 MBJ1</td>
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<tr>
<td>Phase 2 PPAP rough parts (all production streams)</td>
<td>Rough parts Unit PP MRD</td>
<td>6 MBJ1</td>
</tr>
<tr>
<td>Phase 2 PPAP finished parts (all production streams)</td>
<td>Finished Parts Unit PP MRD</td>
<td>5 MBJ1</td>
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<tr>
<td>Phase 3 PPAP rough parts</td>
<td>Rough parts Unit J1 MRD</td>
<td>2.75 MBJ1</td>
</tr>
<tr>
<td>Phase 3 PPAP finished parts</td>
<td>Finished Parts Unit J1 MRD</td>
<td>2.5 MBJ1</td>
</tr>
</tbody>
</table>
Capacity Analysis Robustness

Supplier Capacity Reporting Verification Observations

Communication
- Suppliers do not cascade capacity study requirements & commitments to their affected plants.
- Suppliers are misinterpreting new study as superseding prior study.

Capacity Reporting Data Discrepancy
- Suppliers overstate capacity reported in Ford GCP/MCPV system - data are not aligned with Phase 3 Capacity Analysis Reports.
- Reported Volumes exceed Supplier Actual Capacity - Not aligned to capacity from manufacturing location.

Supplier Capacity Uplift Execution
- Suppliers delay tooling investment until uplift volumes are cascaded in Ford releases.
- Supplier process / location changes to support Capacity Uplifts is not communicated to Ford via SREA.
Capacity Analysis Robustness

Supplier Capacity Reporting Verification Observations

PPAP Compliance

- Self-Certifying Suppliers are not aware of Capacity Analysis Reporting requirement for Phase 3 PPAP.
- Capacity Analysis Reports are submitted without actual capacity implementation completed.
- Capacity Analysis Reports meet APW/MPW requirement but actual Production Output does not meet demonstrated APW/MPW.
- Sub-tier supplier capacity were not verified prior to Phase 3 PPAP Capacity Verification submission.

Capacity Analysis Reporting Common Concerns

- Capacity is over committed on shared lines and not reflected in Capacity Analysis Reports.
- Quality, Equipment Efficiency & Availability assumptions are overstated.
- Changeover times on shared lines are not accounted for in Capacity Analysis Reports.
What’s New
Updated CAR Form & Enhanced Learning Tools

To improve upon the existing Capacity Training, here is What’s New......

- **Incorporated Lessons Learned**
  - Added information on Capacity Planning
  - Strengthen linkage between Capacity analysis and Capacity reporting in the Ford Capacity Systems
  - Emphasizing the importance of:
    - Sub-supplier capacity verification
    - Robust Shared Loading analysis

- **New CAR Form**
  - Eliminated all macros and corrected formatting errors;
  - Added Declarations page to indicate completion of sub-supplier capacity analysis
  - Setup CAR form to allow Tier 1 Supplier to use CAR for sub-suppliers
  - Restructured shared loading plan for each process, identified changeover time and added indicator when shared loading analysis is required
  - Re-characterized surrogate data sheet for both historical data collection usage and surrogate data
  - Updated Predicted Good Parts per Week to indicate the Supplier’s Purchased Part Commitment (PPC) values
To improve upon the existing Capacity Training, here is What’s New......

- **Supplier Certification**
  - Implementing Supplier Capacity Analysis Reporting (CAR) Training Certification to ensure that only trained supplier representatives complete the Capacity Analysis Reports based on actual plant output.
  - Register certified supplier personnel as “Capacity Planner” in Ford Global Capacity Planning (GCP/MCPV) systems and Track completion of Supplier CAR Training Certifications

**What’s New**

Updated CAR Form & Enhanced Learning Tools
Meeting Capacity Requirements

- The Supplier is to manage its tooling, equipment and facilities such that, during a 7 calendar day week:
  - Average Production Weekly (APW) capacity requirements are to be met by operating the tooling, equipment and facilities based on a 5 day work week.
  - Maximum Production Weekly (MPW) capacity requirements are to be met by operating the tooling, equipment and facilities based on a 6 day work week.
- The remaining time during the week is reserved for completing the required tooling, equipment and facility maintenance.
- If the Supplier is unable to meet the Average Production Weekly based on a 5 day work week, or the Maximum Production Weekly based on a 6 day work week, the Supplier must contact their Ford Buyer to develop a resolution plan to meet the capacity requirements.
- Any exceptions to these requirements must be requested by the Supplier and concurred in writing by Ford.
The following module provides an overview of Capacity Analysis Requirements. Material discussed in module are:

- Goal of Capacity Analysis
- Capacity Planning
- Demonstrating Capacity:
  - Phase 0 PPAP – Run at Rate
  - Phase 3 PPAP – Capacity Verification
  - Capacity Studies

**Objective:** Build awareness of the Ford Capacity Analysis requirements
Goal of Capacity Analysis
Different Approach to Capacity Assessment

**GOAL** of **CAPACITY ANALYSIS**: Use data to confirm a supplier can produce the required **VOLUME** of **QUALITY PARTS** in the planned **OPERATING PATTERN** at the planned **PRODUCTION RATE**.

**Utilize The CAR Process:**
- **Capacity Planning**
- **Phase 0 – Run at Rate**
- **Phase 3 - Capacity Verification**
- **Capacity Studies**
- **Capacity Shortages**

- Process starts with planning. Are the planned manufacturing equipment & processes projected to be capable of producing the required volume during planned operation patterns?
- Next step is verification. Do the demonstrated Phase 0 and 3 PPAP results validate that the equipment and process can produce the required volume at the appropriate efficiency?
- Managing growth and shortages. Can the equipment and process supply additional volume or what can be done to increase production and efficiency?
To validate a supplier’s capacity plan, the Capacity Analysis Report (CAR) form should be utilized to make comparison between the Supplier’s Planned Manufacturing Plan (Required Overall Equipment Effectiveness, OEE, for Planned Volumes) and their Historical Manufacturing Performance.

The relevant tabs within the CAR workbook during Capacity Planning are:

- Capacity Planning
- Historical Manufacturing Performance
- Shared Loading Plan
- Supplier Declarations including sub-tier suppliers

The integrity of each tab is critical in completing a proper analysis – the selection of appropriate processes and parts for Historical Manufacturing Performance, and the inclusion of appropriate changeover times (if applicable) is required.

The intent of the Capacity Planning Analysis is to provide validation of the Supplier’s Capacity Plan – does the supplier plan has an appropriate work pattern, with appropriate equipment cycle times, to meet the expected program volume adjusted for their historical manufacturing efficiency?

Note: if historical data is not available, surrogate production data from a similar manufacturing process may be used.
Environments for CAR Use
Planning, Phase 0, Phase 3, Capacity Studies, Capacity Shortages

Production Part Approval Process
PPAP Phases

Phase 0
- Initial Run at Rate
  - Parts produced from a production stream (from a minimum of one production tool / line / process stream) at production feeds and speeds.
  - Provides an early indicator if supplier can make future timing

Phase 1
- Quality Verification
  - Parts are produced from a minimum of one production stream (tool, line, facilities, etc.)
  - Dimensional, lab and engineering specification (ES) testing complete for this production stream (less appearance approvals)

Phase 2
- Production Verification
  - The complete actual production stream (tooling, equipment, facilities, personnel, etc.) intended for this specific program / launch is in place and operational
  - Dimensional, lab and ES testing complete from all tools, cavities, molds, production streams (including all appearance approvals)
  - Supplier submits part submission warrant (PSW)

Phase 3
- Capacity Verification
  - Parts are produced from the complete actual production stream (tooling, equipment, facilities, personnel)
  - Capacity verification is demonstrated by yielding quality parts to meet a minimum of one day of Ford production (Daily Planning Volume - DPV)

Equipment At Home Line
Capacity Planning
In conjunction with the requirement to satisfy the <TT> or <uTT> requirements for producing parts at designed cycle times and achieving print specification requirements, a CAR form is required at Phase 0 to validate the Supplier’s ability to achieve Run at Rate requirements.

The relevant tabs within the CAR workbook during Phase 0 PPAP are:
- Phase 0 PPAP (Run @ Rate)
- Shared Loading Plan
- Supplier Declarations including sub-tier suppliers

As the Phase 0 Run at Rate event typically utilizes a short duration of production (~300 pieces), it is also strongly recommended that a Capacity Planning document with Historical Manufacturing Performance data also be reviewed – if it has not previously been completed.

The Phase 0 PPAP (Run @ Rate) tab also allows for the analysis of additional production streams as required for completion of Phase 2 PPAP. By adjusting the Planned Net Ideal Cycle Time [Line AF on the CAR] to account for additional production streams, the overall capacity can be analyzed in support of Phase 2 requirements.
In conjunction with the requirement to satisfy the <MP2> or <PTJ1> requirements for producing parts at designed cycle times and achieving print specification requirements, a CAR form is required at Phase 3 to validate the Supplier’s ability to contain total program capacity.

The relevant tabs within the CAR workbook during Phase 3 PPAP are:
- Phase 3 PPAP (Cap Ver)
- Shared Loading Plan
- Supplier Declarations including sub-tier suppliers

Again, as the Phase 3 Run-at-Rate event continues to be a relatively short duration of production (~24 hours), it is also **strongly recommended** that a Capacity Planning document with Historical Manufacturing Performance data also be reviewed – if it has not previously been completed.

The Phase 3 Capacity Verification tab assumes all production equipment, tooling, personnel and gauging are in place and that all production streams are capable of achieving the required production rate.
Capacity Studies are regularly conducted to get confirmation of supplier capacity to support New Model Launch & Manufacturing Plan Changes:

- New model confirm capacity studies are conducted at 2 wks post Final Data Judgment <FDJ> Milestone at 17 Months Before Job 1 (MBJ1)
- Pre-Launch Readiness capacity studies are also conducted at 7.5 MBJ1 for new model programs. This aligns with <TT> build milestone.
- Capacity studies are conducted for planned Capacity Uplifts both within the New Model launch timeline and post launch.
- Capacity studies are also conducted to evaluate alternative product offerings to Customers (mix rate changes).
- There is no difference in Supplier response expectations for both “What If” and Confirm Studies.
Early Communication with Ford Manufacturing Planning & Logistics through our Receiving Plant MP&L Analysts is crucial to mitigating supply risks to our plants.

Potential Supply Risks that are communicated at least 6-8 weeks prior to impact date have higher likelihood of being averted.

Escalate issues impacting supply to your Buyer, STA & MP&L contacts as soon as possible.
The following module provides an **understanding** of Overall Equipment Effectiveness (OEE). Material discussed in module are:

- Components of OEE
- Understanding OEE
- Required OEE versus Demonstrated OEE

**Objective**: Develop an understanding of Overall Equipment Effectiveness
GOAL of CAPACITY ANALYSIS:

Use data to confirm a supplier can produce the required VOLUME of QUALITY PARTS in the planned OPERATING PATTERN at the planned PRODUCTION RATE.

3 Components of OEE:

- **AVAILABILITY**
  Includes Operating Pattern, Downtime, Allocation Percentage

- **PERFORMANCE EFFICIENCY**
  Rate at which parts are produced compared to ideal rate

- **QUALITY RATE**
  “Comparison of good parts to all parts produced”

The relationship between these three components produces the minimum level of efficiency required to meet Ford volume requirements, or **Required OEE**.

Using OEE as the unit of measure also allows assessment of a supplier’s capacity for future production using current production performance data, Surrogate OEE, or Historical Manufacturing Performance.

Comparing **Required OEE** and **Demonstrated OEE** determines the supplier’s capacity risk.
Understanding OEE
Components of OEE & Linkage to Capacity Goal

**Overall Equipment Effectiveness (OEE)**
Combines key manufacturing metrics to state the overall health of the production process. It can be communicated as a Minimum Required OEE, or an Effective or Demonstrated OEE. The relationship between these two determine the feasibility of the manufacturing process to meet Ford volume requirements.

**(Minimum) Required OEE**
The minimum OEE a supplier must achieve to support the Ford volume requirements.

**Demonstrated OEE**
The OEE a supplier demonstrates – through a Phased PPAP event, or through historical / surrogate analysis.
Understanding OEE

Components of OEE & Linkage to Capacity Goal

**Availability**
- Operating Time / Net Available Time

**Performance Efficiency**
- \( \frac{(\text{Total Parts Run}) \times (\text{Net Ideal Cycle Time})}{\text{Operating Time}} \)

**Quality Rate**
- \( \frac{(\text{Total Parts Run}) - (\text{Total Defects})}{\text{Total Parts Run}} \)

From the standard OEE Form, the three components that are needed in an algebraically simplified formula are:

- Net Ideal Cycle Time
- Total Good Parts Produced
- Net Available Time

*Note: These are the same inputs used on the Historical Manufacturing Performance sheet.*
Understanding OEE
Components of OEE & Linkage to Capacity Goal

Is Demonstrated (or Historical) OEE ≥ Required OEE?
This relationship is used to determine the capacity risk, at all three GPDS deliverables.

Demonstrated OEE is based on:
- Historical Data in Capacity Planning;
- Actual Run Data during Phase 0 and Phase 3

Required OEE is the minimum level of efficiency required to meet customer demand, based on:
- Ford Volumes;
- Supplier’s Manufacturing Plan
## Capacity Analysis Deliverables

### GPDS Capacity-Related Deliverables

<table>
<thead>
<tr>
<th>Schedule A Deliverable</th>
<th>Supplier Engagement Visit</th>
<th>Phase</th>
<th>GPDS Text</th>
<th>Capacity Planning Toolset</th>
</tr>
</thead>
<tbody>
<tr>
<td>#25</td>
<td>#1</td>
<td>Planning</td>
<td>Verify Supplier’s Demonstrated OEE (Historical) ≥ Required OEE.</td>
<td>Capacity Planning</td>
</tr>
<tr>
<td>#19</td>
<td>#3</td>
<td>PPAP Phase 0</td>
<td>Verify Supplier’s Demonstrated OEE (Run @ Rate) ≥ Required OEE.</td>
<td>Phase 0 (R@R)</td>
</tr>
<tr>
<td>#30</td>
<td>#4</td>
<td>PPAP Phase 3</td>
<td>Verify Supplier’s Demonstrated OEE (Capacity Verification) ≥ Required OEE.</td>
<td>Phase 3 (CapVer)</td>
</tr>
</tbody>
</table>

### Is Demonstrated OEE ≥ Required OEE?

- Ford uses a tool based on Overall Equipment Effectiveness (OEE) to determine the effectiveness of a capacity plan. Supplier’s collection and use of the OEE metric is part of the Q1 Manufacturing Site Assessment (Q1MSA) requirements.
- Production rate and production quantity, along with shared capacity analysis, are also available within the capacity analysis toolset.
Capacity Analysis Deliverables

The Capacity Analysis Workbook

- Capacity Planning
- Phase 0 PPAP (Run @ Rate)
- Phase 3 PPAP (Cap Ver)
- Historical Mfg Performance
- Supplier Declarations
- Shared Loading Plan (up to 8)
Capacity Analysis Deliverables
The Capacity Analysis Workbook

Sample of the “Supplier Declarations and Notes” tab.

- Confirmation that sub-supplier Capacity has been verified
- Method used to verify sub-supplier capacity
- Date of Certification
- Name of Certified Capacity Planner
- Email of Capacity Planner

- Notifications of potential errors and recommendations to address them
Understanding OEE

Demonstrated OEE vs. Required OEE

- GPDS Deliverables #25, #19, and #30 require comparisons be made between the Required OEE to support customer requirements and a Demonstrated OEE.
- Additionally, a predicted good part estimate – correlated to the Demonstrated OEE and planned operating parameters – is required for input and verification as the supplier’s PPC (APPC and MPPC) into GPC or MCPV.
- **Demonstrated OEE (Parts) ≥ Required OEE (Parts)**
Understanding OEE
GPDS 2.4 Volume Communication

Capacity Requirement Communication Tools
- Supplier On Board Agreement (SOBA)
- SOBA / Long Lead Tool Orders
- Tool Orders
- GCP for Vehicle Parts
  - MCPV for Powertrain Parts

NTEI Part Level Data VEHICLE
- FPV, APW, MPW
  - APW, MPW
  - APW, MPW

NTEI Part Level Data POWERTRAIN
- FPV, APW, MPW
  - APW, MPW
  - APW, MPW

Capacity Study
- POST LAUNCH CAPACITY ANALYSIS (AFTER MP2) INCLUDES CAPACITY STUDIES, SREAS, RESOURCING ETC.

Volume Sources
- Buyer / Purchasing CPAT
- GCP / MCPV Systems

Carry Over Part Level Data
- Vehicle (APW, MPW)
- Powertrain (APW, MPW)

Capacity Planning Deliverable #25
- Phase 0 PPAP Deliverable #19
- Phase 3 PPAP Deliverable #30
The following module provides a deeper **understanding** of Required OEE and how to **use** the Capacity Analysis Report to determine it. Material discussed in module are:

- Setting up the Analysis – Understanding the Value Stream
- Using section A of the CAR to determine the Required OEE
- Required OEE calculations
- Required OEE examples

**Objective**: Provide a deeper understanding of Required OEE and demonstrate how to use Section A of the CAR to determine it.

This Module Provides An Understanding Of Required OEE And How It Is Determined
Understanding the CAR File
Capacity Analysis – Form Architecture

SECTION A: REQUIRED OEE
Manufacturing Assumptions
Calculating Required OEE
Operating Plans for Containing APW, MPW
Demand Calculation Accounting for Scrap Loss

SECTION B: DEMONSTRATED OEE
Historical Performance
GPDS Deliverable #25: Historical (“Capacity Planning”)
GPDS Deliverable #19: Phase 0 (“Phase 0 Run @ Rate”)
GPDS Deliverable #30: Phase 3 (“Phase 3 Cap. Ver.”)

SECTION C: PICTORAL GAP ANALYSIS
Required OEE vs. Demonstrated OEE
Closing Gaps between Required & Demonstrated OEE
Improve Required OEE (Section A) and / or
Improve Demonstrated OEE (Section B)
All value streams are required to be assessed for capacity risk. That is, all processes that are utilized for production require assessment for risk. As illustrated on the following slides, this may require the use of more than one document, and is consistent with PPAP requirements.

For end item part numbers that have multiple value streams, the Capacity Planning Analysis (CAR) must begin by looking at a single value stream. This is due to considerations made to individual process scrap losses, which have impact on the individual process Required OEEs.

The Capacity Analysis Toolset is generally set-up on a part-specific basis. However, depending on the part and manufacturing process, it may be appropriate to group families of parts, or to group several manufacturing lines.
Required OEE
Setting the Analysis

VALUE STREAM IDENTIFICATION:

The value stream for the above process is detailed below. Note that this single value stream considers the progressive, sequential, operations from incoming material to shipment. If there were multiple value streams that contributed to the overall part production, each value stream would require separate analysis.
Consider the following product flow diagram, showing multiple value streams in a process:

- Cam
  - Incoming Material
  - Machining
  - Drilling
  - Inspection
  - Cam & Bearing Installation to Shaft
- Shaft
  - Incoming Material
  - Turning
  - Cut-Off
  - Inspection
  - Installation of Pin
- Bearing
  - Grinding (OD / ID)
  - Grading
  - Receipt & Inspection
  - Installation of Lever (Press Fit)
- Lever
  - Casting
  - Machining
  - Welding
  - Outsourced E-Coat
  - Testing & Inspection
  - Shipment

How would you set it up for analyzing capacity?
ALL Value Streams need to be assessed for capacity.

Asking additional questions may simplify the value streams, or identify value streams that are sub-Tier processes. For example, if Bearings are purchased parts, the Tier 1 should ensure that the bearing supplier completes capacity analysis demonstrating sufficient bearing supply.
Required OEE
Setting up the Analysis

- Section A1 includes general supplier and part information for the analysis.
- Section A2 provides the volume requirement inputs that the entire analysis uses to determine feasibility.
- Section A3 offers key contacts for the program.

### A1) Supplier & Part Information

<table>
<thead>
<tr>
<th>Supplier Name</th>
<th>Location/Site Code</th>
<th>Part Number</th>
<th>Revised Requirements</th>
<th>APW</th>
<th>MPW</th>
<th>Select for Analysis</th>
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</thead>
<tbody>
<tr>
<td>ABC Part Company</td>
<td>Lexington, KY / A123B</td>
<td>1234-56789-AA</td>
<td>SOBA (Supplier On Board Agreement)</td>
<td>2500</td>
<td>2900</td>
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### A2) Capacity Requirements

<table>
<thead>
<tr>
<th>Program Code</th>
<th>Model Year</th>
<th>Revised Requirements</th>
<th>Source of Capacity Requirements</th>
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<tbody>
<tr>
<td>PXXX</td>
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<td>SOBA (Supplier On Board Agreement)</td>
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</table>

### A3) Key Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone #</th>
<th>Email</th>
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<tr>
<td>Bill Smith</td>
<td>313-555-1234</td>
<td><a href="mailto:bsmith@fordexample.com">bsmith@fordexample.com</a></td>
</tr>
<tr>
<td>Penny Pintcher</td>
<td>313-555-9876</td>
<td><a href="mailto:ppintcher@fordexample.com">ppintcher@fordexample.com</a></td>
</tr>
</tbody>
</table>

**NOTE:**
It is important to note the source of the volume requirements used – in this example, the APW and MPW requirements were determined by SOBA.
Required OEE
Setting up the Analysis

- Although all value streams must be assessed for capacity risk, the remainder of the training will focus on the value stream below. Subsequent analyses (for the Cam and Shaft) would take place on separate documents.

- The first step is completing Section A.

---

### A. New Model Required OEE (Overall Equipment Effectiveness) - ABC Part Company 2017

**PXXX 1234-56789-AA**

#### A1) Supplier & Part Information

- **ABC Part Company**
- **Lexington, KY / A123B**
- **Car Part**
- **1234-56789-AA**

#### A2) Capacity Requirements

- Supplier & Part Information
- Capacity Requirements
- Key Contacts

**Capacity Requirements**

- **Supplier to demonstrate APW of** 2500 parts per week operating no more than 5 days per week
- **Supplier to demonstrate MPW of** 2900 parts per week operating no more than 6 days per week

#### A3) Key Contacts

- STA Site Engineer: Penny Pintcher
- Supplier Lead: Jane Brown
- Ford Buyer: Bill Smith

### A4) Planned Departmental Operating Pattern & Net Available Time

#### A4.1) Shared Load Required

<table>
<thead>
<tr>
<th>Process</th>
<th>APW Plan</th>
<th>MPW Plan</th>
<th>APW Plan</th>
<th>MPW Plan</th>
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<td>50</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### A5) Required Good Parts / Week

#### A5.1) Required Incoming Parts for Casting

<table>
<thead>
<tr>
<th>Part Name</th>
<th>APW</th>
<th>MPW</th>
<th>APW</th>
<th>MPW</th>
<th>APW</th>
<th>MPW</th>
<th>APW</th>
<th>MPW</th>
<th>APW</th>
<th>MPW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casting</td>
<td>2846</td>
<td>3302</td>
<td>2760</td>
<td>3202</td>
<td>2539</td>
<td>2945</td>
<td>2526</td>
<td>2930</td>
<td>2500</td>
<td>2900</td>
</tr>
</tbody>
</table>

#### A5.2) Percent of parts scrapped

- **Percent of parts scrapped**: 1.5% APW, 3.0% MPW

#### A5.3) Required Good Parts / Week

- **369** parts per week operating no more than 5 days per week

---

**NOTE:**
As TESTING is an outcome of the INSTALLATION process, processes have been merged.
Required OEE
Scrap Loss Considerations

- The CAR Toolset adjusts part requirements (APW/MPW) for each process based on downstream scrap loss assumptions. To determine a Required OEE, the volume of parts to support the next process is required.

- Each process’s scrap loss affects the upstream process, compounding through the overall manufacturing operation. The individual process Required OEEs are calculated based on these unique value stream volume requirements. Within-process scrap & rework losses will be analyzed separately.
Once net ideal cycle times are calculated, the CAR will begin identifying potential capacity risks.

The reasons why processes have been identified as risks may be obvious, as is the case with Machining & Installation where Required OEEs exceed 100%.

However, as the processes are compared against their surrogate, additional risks may be identified.

Next, we’ll explore the reason for exposing Welding as a capacity risk.
Required OEE

Required OEE Calculation – Throughput Analysis

Remember, Required OEE is the **minimum level of efficiency** that is required to support the demand, based on the defined operating pattern, allocation percentage, and operating parameters. Once all potential losses are assessed, a process may not be feasible, even if the Required OEE < 100%.

Required OEE is directly proportional to Required Good Parts. However, if consideration of other losses (Scrap, Rework, Changeover, etc.) exceed the Maximum Possible Parts, the manufacturing plan is not feasible. This condition can occur even when the Required OEE appears reasonable.
Welding, despite having a Required OEE < 100%, shows a risk because the CAR identified the process would be unable to contain its own loss assumptions (changeover, scrap, and rework).

The maximum possible parts / week is 2,931. The required good parts (demand) is 2,539 parts / week.

- Accounting for Scrap Losses = 221 parts \((2,539 \div 0.92) - 2,539\)
- Accounting for Rework = 381 parts \(2,539 \times 0.15\)

Without accounting for any other availability or performance efficiency losses, the process is already 7.2% “over capacity.”
The CAR allows you to toggle between inputs to make the Required OEE plan realistic and feasible. Consider the following:

- **CASTING:** A plan to cover MPW by simply running more efficiently is not acceptable.
- **MACHINING:** To reduce Required OEE, 2 years ahead of Job 1, it may be possible to reduce NICT.
- **WELDING:** A plan for 8% scrap rate and 15% rework probably has room for improvement.
- **ASSEMBLY:** Explore options to reduce Required OEE. 2 – 10hr shifts, 3 – 8hr shifts, NICT reductions, etc.

### A4) Planned Departmental Operating Pattern & Net Available Time

| A | Process description (in value stream order) |
| B | Days / Week |
| C | Shifts / Day |
| D | Total Hours / Shift |
| E | Contractual Planned Downtime - lunch, breaks, etc. (minutes/shift) |
| F | Allocation Percent (enter 100 for dedicated) |
| G | Net Available Time (hours / week) | \[ B \times C \times (D - (E/60)) \times F \] |
| G1 | Net Ideal Cycle Time (sec/part) | \[ K / (L \times M) \] |
| G2 | Required OEE |

### A5) Required Good Parts / Week

| H | Percent of parts scrapped |
| J | Req'd Good Parts / Week to Support Next Process | [Process 1 Req'd Parts = Process 2 Req'd Parts / (100% - Process 2 Scrap%)] |

### A6) Required OEE (Overall Equipment Effectiveness)

| K | Ideal Cycle Time per Tool or Machine (sec/cycle) |
| L | # of Tools or Machines in parallel |
| M | # of identical parts produced per Tool or Machine Cycle |
| N | Net Ideal Cycle time (sec/part) | [K / (L x M)] |
| P | Theoretical Parts per week at 100% OEE | [G x 3600 / N] |
| Q | Required OEE | [J / P] |
| R | Percent of parts reworked (re-run through process) |
| S | Can process contain its changeover, scrap & rework assumptions? | [J / (100% - H) + (J x R) + (G1 x 60 x G2 / N) <= P] |
| T | % Remaining for Availability & Performance Efficiency losses | [P - (J / (100% - H) + (J x R) + (G1 x 60 x G2 / N))] / P |

Enter any other assumptions for clarification
Here is the same file, with adjustments made to the parameters, as discussed on the previous slide.

CASTING: To cover MPW, the plan has been adjusted to operate 6 days.

MACHINING: Cycle time has been reduced from 77 seconds to 60 seconds.

WELDING: Plans have been developed to reduce scrap rate from 8% to 4%, and rework from 15% to 7%.

ASSEMBLY: Plan has been adjusted from 8 hour shifts to 10 hour shifts.

### A4) Planned Departmental Operating Pattern & Net Available Time

<table>
<thead>
<tr>
<th>Days / Week</th>
<th>Shifts / Day</th>
<th>Planned Minutes per Changeover (into this part #)</th>
<th>Total Hours / Shift</th>
<th>Contractual Planned Downtime - lunch, breaks, etc. (minutes/shift)</th>
<th>Allocation Percent (enter 100 for dedicated)</th>
<th>Net Available Time (hours / week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>5</td>
<td>C</td>
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<td>2</td>
<td>120.00</td>
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<td>8</td>
<td>120.00</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>8</td>
<td>E</td>
<td>8</td>
<td>8</td>
<td>120.00</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>8</td>
<td>F</td>
<td>8</td>
<td>8</td>
<td>120.00</td>
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<tr>
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<td>2</td>
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<td>2</td>
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<td>2</td>
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<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Q</td>
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<tr>
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<td>2</td>
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<tr>
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<td>2</td>
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<td>2</td>
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<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>T</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

### A5) Required Good Parts / Week

| Req'd Good Parts / Week | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan |
|------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|                        | 1.5%     | 3.0%     | 4.0%     | 0.5%     | 1.0%     |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| Total Good Parts / Week | 2727     | 3163     | 2645     | 3068     | 2539     | 2945     | 2526     | 2930     | 2500     | 2900     |          |          |          |          |          |          |          |          |          |

### A6) Required OEE (Overall Equipment Effectiveness)

| Required OEE (J / P) | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan | APW Plan | MPW Plan |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Percent of parts scrapped | 50.5% | 48.8% | 76.9% | 74.3% | 86.6% | 83.7% | 84.1% | 81.3% | 83.3% | 80.6% | 0.0% | 0.0% | 7.0% | 5.0% | 2.0% |          |          |          |          |

Enter any other assumptions for clarification

---

CASTING department has 20 machines total. 3 of which are dedicated to Ford.

100 total carriers in the e-coat system. 10 are allocated for APW. 12 for MPW. Each P552 carrier has 2 racks.
Batch processes need to be carefully understood when setting up Required OEE Section.

**Background Information:**
Supplier has a conveyor paint line for top-coating mirror shells. The line runs at a constant speed and has hangers for 200 total racks. The line cycles 9 times every 10 hours. The APW and MPW volumes are 4,200 and 5,160 respectively. The supplier has dedicated 14 racks of the paint line for this specific Ford part, each with a part density of 12-parts / rack.

**Considerations:**
There are two ways of documenting this process – using allocation percent (LINE F) as the main variable. Both options are correct.

**OPTION A:**
- LINE F: Percent allocation at 7.0% (14 dedicated racks / 200 total)
- LINE K: Ideal Cycle Time at 20 seconds / rack - Every 10 hours (36,000 seconds), 9 cycles are completed (1,800 racks)
- LINE L: Number of racks available (1)
- LINE M: Number of pieces per rack (12)

**OPTION B:**
- LINE F: Percent allocation at 100% (considering the 14 dedicated)
- LINE K: Ideal Cycle Time at 4000 seconds – Every 10 hours (36,000 seconds), 9 cycles are completed.
- LINE L: Number of racks available (14)
- LINE M: Number of pieces per rack (12)
### Required OEE

**Required OEE Calculation – Shared Process Example (Casting)**

- Each Shared Process requires completion of a Shared Loading Plan worksheet.

#### A4) Planned Departmental Operating Pattern & Net Available Time

<table>
<thead>
<tr>
<th>Process</th>
<th>APW Plan</th>
<th>MPW Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casting</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>NICT</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Background Information:
Supplier has 25 casting cells within their casting department. The supplier plans to allocate 22% of their casting department for this Ford part, at the documents operating patterns, to contain APW and MPW volumes of 3,723 and 4,086 parts per week.

#### Shared Loading Plan
The Shared Loading Plan calculates the minimum allocation percent required to produce the APW and MPW volumes, adjusted for the most recent Demonstrated OEE (in this case, 88.9%).

#### A5) Required Good Parts / Week

<table>
<thead>
<tr>
<th>Process 1</th>
<th>APW Plan</th>
<th>MPW Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Weekly</td>
<td>3723</td>
<td>4086</td>
</tr>
<tr>
<td>Max Weekly</td>
<td>4330</td>
<td>4752</td>
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</tbody>
</table>

#### A6) Required OEE (Overall Equipment Effectiveness)

<table>
<thead>
<tr>
<th>Process 1</th>
<th>APW Plan</th>
<th>MPW Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal Cycle Time</td>
<td>540</td>
<td>550</td>
</tr>
<tr>
<td>Calculating Tools in parallel</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Ideal Cycle Time per Tool or Machine (sec/cycle)</td>
<td>21.6</td>
<td>22</td>
</tr>
<tr>
<td>Theoretical Parts per Week at 100% OEE</td>
<td>4400</td>
<td>5100</td>
</tr>
<tr>
<td>Required OEE</td>
<td>84.6%</td>
<td>78.8%</td>
</tr>
</tbody>
</table>

#### Demonstrated OEE (Overall Equipment Effectiveness):
Enter average OEE from most recent production performance data; Historical Mfg Performance may be used for this calculation

<table>
<thead>
<tr>
<th>Part</th>
<th>Ford Part # or &quot;Non-Ford&quot;</th>
<th>Req'd Good Parts / Week</th>
<th>NICT</th>
<th>Time Req'd @ Demonstrated OEE (hrs/week)</th>
<th>Tool Changeover Time (min/week)</th>
<th>% Allocation Minimum Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>U387</td>
<td>3723</td>
<td>25.1</td>
<td>25.1</td>
<td>20.9%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>U251</td>
<td>4000</td>
<td>27.0</td>
<td>27.0</td>
<td>22.5%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>P221</td>
<td>6500</td>
<td>43.9</td>
<td>43.9</td>
<td>36.6%</td>
<td></td>
</tr>
</tbody>
</table>
Each Shared Process requires completion of a Shared Loading Plan worksheet.

Background Information:
Supplier has a fully-automated assembly line, with 42 operations in single-piece flow. The APW and MPW volumes are 7,500 and 8,250, respectively.

Selecting an Ideal Cycle Time
Due to the nature of the single-piece flow assembly operation, the entire assembly process can be grouped as a single process with the constraint operation cycle time used in LINE K.

Note the operating pattern exceeds the Capacity Planning Web Guide.
With all Required OEEs < 100%, and all potential losses considered, Section A is complete. Below, all Required OEEs are stated, based on the planned operating patterns and process parameters.

Do we know if any of the processes are capacity risks?

<table>
<thead>
<tr>
<th>Process</th>
<th>Required OEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casting</td>
<td>50.5%</td>
</tr>
<tr>
<td>Machining</td>
<td>48.8%</td>
</tr>
<tr>
<td>Welding</td>
<td>76.9%</td>
</tr>
<tr>
<td>Outsourced E-Coat</td>
<td>74.3%</td>
</tr>
<tr>
<td>Assembly</td>
<td>86.6%</td>
</tr>
<tr>
<td>E-Coat</td>
<td>83.7%</td>
</tr>
<tr>
<td>Assembly</td>
<td>84.1%</td>
</tr>
<tr>
<td>Assembly</td>
<td>81.3%</td>
</tr>
<tr>
<td>Assembly</td>
<td>83.3%</td>
</tr>
<tr>
<td>Assembly</td>
<td>80.6%</td>
</tr>
</tbody>
</table>

Capacity risk is identified by comparing the Required OEEs from Section A against the Demonstrated OEEs from Section B. In Capacity Planning, Demonstrated OEE is populated by the use of **surrogate processes**.
### Required OEE

#### Section A Exercise

#### A4) Planned Departmental Operating Pattern & Not Available Time

<table>
<thead>
<tr>
<th></th>
<th>Process 1</th>
<th>Process 2</th>
<th>Process 3</th>
<th>Process 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Unpack</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Milling &amp; Drilling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
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<tr>
<td></td>
<td>18.0%</td>
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<td>18.0%</td>
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</tr>
<tr>
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<td>32.25</td>
<td>38.70</td>
<td>19.35</td>
<td>23.22</td>
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<td></td>
<td>0.00</td>
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</tbody>
</table>

#### A5) Required Good Parts / Week

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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Reqd' Good Parts / Week to Support Next Process</td>
<td>3093</td>
<td>4124</td>
<td>3093</td>
<td>4124</td>
<td>3000</td>
<td>4000</td>
<td>3000</td>
<td>4000</td>
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</tbody>
</table>

#### A6) Required OEE

<table>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Ideal Cycle Time per Tool or Machine (sec/cycle)</td>
<td>50</td>
<td>50</td>
<td>60</td>
<td>60</td>
<td>147</td>
<td>137</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td># of Tools or Machines in parallel</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of identical parts produced per Tool or Machine Cycle</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Possible Parts / Week (G x 3600 / N)</td>
<td>4644</td>
<td>5572</td>
<td>3483</td>
<td>4179</td>
<td>3132</td>
<td>4206</td>
<td>7740</td>
<td>9288</td>
<td></td>
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</tr>
<tr>
<td>Required OEE</td>
<td>66.6%</td>
<td>74.0%</td>
<td>88.8%</td>
<td>98.7%</td>
<td>95.8%</td>
<td>95.1%</td>
<td>38.8%</td>
<td>43.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of parts scrapped (re-run through process)</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>5.0%</td>
<td>5.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can process contain its own changeover, scrap &amp; rework assumptions?</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>% Remaining for Availability &amp; Performance Efficiency losses (P = [(J/(100% - H)) + (JxR) + (Gx160xG2/N)]) / P</td>
<td>33.4%</td>
<td>26.0%</td>
<td>11.2%</td>
<td>13.3%</td>
<td>13.3%</td>
<td>2.0%</td>
<td>59.3%</td>
<td>54.8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Enter any other assumptions for clarification.
### Section A Exercise

**Milling & Drilling Plan Appears To Exceed Global Terms & Conditions**

- Receiving & Unpack probably do not belong on CAR

**0% Scrap Rate in Assembly Suspect**

**Required OEE Probably Too High for Milling & Drilling**

**“All Ford Parts” implies a Family of Parts are Considered**

**Bonus: 5, 8-hour Shifts / Day in Receiving Impossible**

---

**A4) Planned Departmental Operating Pattern & Not Available Time**

<table>
<thead>
<tr>
<th>Process</th>
<th>Process 1</th>
<th>Process 2</th>
<th>Process 3</th>
<th>Process 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days / Week</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Shifts / Day</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total Hours / Shift</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Contractual Planned Downtime - lunch, breaks, etc. / (minute/shift)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Not Available Time (hours / week)</td>
<td>18.0%</td>
<td>18.0%</td>
<td>18.0%</td>
<td>18.0%</td>
</tr>
<tr>
<td>Planned Minutes per Changeover (into this part #)</td>
<td>32.35</td>
<td>38.70</td>
<td>19.35</td>
<td>23.22</td>
</tr>
<tr>
<td>Planned Changeover Frequency / Week (into this part #)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**A5) Required Good Parts / Week**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
<td>3093</td>
<td>4124</td>
<td>3093</td>
<td>4124</td>
<td>3000</td>
<td>4000</td>
<td>3000</td>
<td>4000</td>
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<tr>
<td>Process 2</td>
<td>3093</td>
<td>4124</td>
<td>3093</td>
<td>4124</td>
<td>3000</td>
<td>4000</td>
<td>3000</td>
<td>4000</td>
</tr>
<tr>
<td>Process 3</td>
<td>3093</td>
<td>4124</td>
<td>3093</td>
<td>4124</td>
<td>3000</td>
<td>4000</td>
<td>3000</td>
<td>4000</td>
</tr>
<tr>
<td>Process 4</td>
<td>3093</td>
<td>4124</td>
<td>3093</td>
<td>4124</td>
<td>3000</td>
<td>4000</td>
<td>3000</td>
<td>4000</td>
</tr>
</tbody>
</table>

**A6) Required OEE**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
<td>50</td>
<td>50</td>
<td>60</td>
<td>80</td>
<td>147</td>
<td>137</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Process 2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Process 3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Process 4</td>
<td>25</td>
<td>25</td>
<td>20</td>
<td>147</td>
<td>137</td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Net Actual Cycle Time (sec/part)</td>
<td>3483</td>
<td>4179</td>
<td>3132</td>
<td>4206</td>
<td>7740</td>
<td>9288</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual Cycle Time (sec/part) = K / E (W)</td>
<td>66.6%</td>
<td>74.0%</td>
<td>88.8%</td>
<td>98.7%</td>
<td>95.8%</td>
<td>95.1%</td>
<td>38.8%</td>
<td>43.1%</td>
</tr>
<tr>
<td>Percentage of parts reworked (re-run through process)</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Process contains its own changeover, scrap &amp; rework</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>% Remaining for Availability &amp; Performance Efficiency</td>
<td>93.4%</td>
<td>26.0%</td>
<td>11.2%</td>
<td>1.3%</td>
<td>1.3%</td>
<td>2.0%</td>
<td>59.3%</td>
<td>54.8%</td>
</tr>
</tbody>
</table>

2 Employees Receive Parts. Ford Parts = 18% of Business.
3 Employees Unpack & Deliver to Machines. 18% of Business.
1 Machine Dedicated to This Ford Part.

2 Assembly Cells Dedicated to All Ford Parts.
Learning Model

Objective: Provide a deeper understanding of Demonstrated OEE and demonstrate how to use Section B of the CAR to determine it.

This Module Provides An Understanding Of Demonstrated OEE And How It Is Determined
At Phase 0 and Phase 3, Demonstrated OEE is generated from the performance data of the run event. There are no significant changes from the current capacity standard at Phase 0 and Phase 3 relative to the inputs required to complete the analysis.

However, by moving the initial assessment of capacity earlier to <PA>, actual performance data may not be available during capacity planning. As such, the Demonstrated OEE is generated from performance data of *surrogate* processes.
When selecting a surrogate process, the best surrogate should be aligned with the planned process for the new part. Considerations include:

- Part Complexity
- Technology Used in the Production
- Manual or Automated Process
- Greenfield or Brownfield Site
- Process Layout Comparison
- Volume, Operating Pattern, etc.
- Similar Part Size and Cycle Time
- Potential Cultural Differences

Surrogate processes selected do not necessarily need to be from a common part or time (e.g., Milling from ‘12 P415, Welding from ‘13 U38X).

**REMEMBER:** When selecting surrogate processes, it is not required that the overall parts are exact. The goal is selecting *manufacturing processes* that are similar to the new part’s *manufacturing processes.*
Obtain Historical OEE Performance Data for each process. Remember, OEE can be calculated with three known data inputs:

**Net Ideal Cycle Time (NICT)**
- NICT should be verified through observations or design, *not* engineering standards.
- NICT must *not* include any ‘baked-in’ efficiency losses.
- NICT is the best, sustainable cycle time achieved in production (steady state, not ramp up).

**Net Available Time (NAT)**
- NAT is the amount of time that the process was in production for the specific part number.
- NAT *excludes* planned downtime (lunches, breaks, etc.) but *includes* unplanned downtime.
- If the process was shut down early on Friday because requirements were met, do not include the time that the process was shut down.
- For shared processes, NAT must also include changeover time.

**Good Parts Produced (GPP)**
- GPP includes only the good parts through the process – no scrap or rework parts (first time through).
The Capacity Analysis utilizes the Average OEE from each process to compare against the Required OEE. However, attention should be paid to trending and variation – included at the bottom of the sheet.

### Demonstrated OEE

**Surrogate Selection & Analysis**

- **NOTE:** Analysis of surrogate data is critical. If volumes have been reduced, operating patterns may have changed (i.e., breaks that were originally unplanned are now being taken). Such changes should not negatively impact the OEE.

The outputs from the Surrogate Summary tab are:

1. Average OEE, which is used for comparisons on the “Capacity Planning” Tab;
2. Trends in the OEE, graphed by process, to identify the stability of the production data.
# Demonstrated OEE

## Surrogate Selection & Analysis

- Data from the Historical Manufacturing Performance tab of the Capacity Analysis is auto-loaded back to the Capacity Planning tab.

<table>
<thead>
<tr>
<th>Q</th>
<th>Required OEE [ J / P ]</th>
<th>50.5%</th>
<th>48.8%</th>
<th>76.9%</th>
<th>74.3%</th>
<th>86.6%</th>
<th>83.7%</th>
<th>84.1%</th>
<th>81.3%</th>
<th>83.3%</th>
<th>80.6%</th>
</tr>
</thead>
</table>

## B. Supplier Demonstrated OEE (Overall Equipment Effectiveness) - Historical Performance

### B1) Historical Performance (from Historical Mfg Performance Summary)

<table>
<thead>
<tr>
<th>Process Description</th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>V Supplier Name</td>
<td>ABC Part Company</td>
<td>ABC Part Company</td>
<td>ABC Part Company</td>
<td>ABC Part Company</td>
<td>ABC Part Company</td>
</tr>
<tr>
<td>W Supplier Location</td>
<td>Lexington, KY</td>
<td>Lexington, KY</td>
<td>Lexington, KY</td>
<td>Lexington, KY</td>
<td>Lexington, KY</td>
</tr>
<tr>
<td>X Site Code for Surrogate Process</td>
<td>A123B</td>
<td>A123B</td>
<td>A123B</td>
<td>A123B</td>
<td>A123B</td>
</tr>
<tr>
<td>Y Surrogate Customer &amp; Program Reference (~Ford P221)</td>
<td>P221/Casting Deck A</td>
<td>P056/Machining Cell 4</td>
<td>P221 Welding Cell D</td>
<td>Main E-Coat Line</td>
<td>P356 Assembly</td>
</tr>
<tr>
<td>Z Average Historical OEE</td>
<td>48.4%</td>
<td>78.0%</td>
<td>81.7%</td>
<td>85.9%</td>
<td>78.2%</td>
</tr>
</tbody>
</table>

- Enter any other assumptions for clarification (Part Number, Annual Volume, Operating Pattern, etc.)

### B2) Process Specific Weekly Part Estimate \[ P \times Z \]

<table>
<thead>
<tr>
<th></th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>2613</td>
<td>2613</td>
<td>2090</td>
<td>2508</td>
<td>2394</td>
<td>2874</td>
</tr>
</tbody>
</table>

**Average Demonstrated OEEs are used as inputs for the Shared Loading Plans.**
Demonstrated OEE
Shared Loading & Analysis

- Allocation Percentage (Line F) will be less than 100% for any process that is shared between Ford and/or non-Ford parts.
- G1 & G2 become available for input allocation percentages < 100%.
- G1 & G2 are main inputs for Sections S & T (previously discussed regarding whether a process is able to contain its own losses).

<table>
<thead>
<tr>
<th></th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F</strong> Allocation Percent (enter 100 for dedicated)</td>
<td>100%</td>
<td>100%</td>
<td>40.0%</td>
<td>40.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>G</strong> Net Available Time (hours / week)</td>
<td>120.00</td>
<td>144.00</td>
<td>28.67</td>
<td>34.40</td>
<td>71.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86.00</td>
</tr>
<tr>
<td><strong>G1</strong> Planned Minutes per Changeover (into this part #)</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>G2</strong> Planned Changeover Frequency / Week (into this part #)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
</tbody>
</table>

- The shared analysis must be completed for each shared process and each shared analysis must be refreshed (with updated volume information, loading plan, and historical/surrogate OEE) at all three phases of capacity analysis.
Only Machining and Outsourced E-Coat need to be assessed for total allocation.

To complete a “Shared – Loading Plan” for a process, the following information is needed:

- APW & MPW Volume Information adjusted for downstream scrap losses, along with the NICT for all parts that are planned for production on the specific process;
- Average Demonstrated OEE from most recent production performance data.

The “Shared – Loading Plan” validates:

- The accuracy of the planned allocation percentage for the process, adjusted for the Demonstrated OEE (not available until after Section B is completed).
- That the equipment / process is not oversold considering the total book of business of the process.
## Demonstrated OEE
### Shared Loading & Analysis

### Shared Loading Plan for PROCESS 4 Outsourced E-Coat

<table>
<thead>
<tr>
<th>Study Phase</th>
<th>Departmental Operating Pattern for Average Weekly</th>
<th>Departmental Operating Pattern for Max Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days / Week</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Shifts / Day</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total Hours / Shift</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Contractual Planned Downtime (lunch, breaks, etc.)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**NICT (Net Ideal Cycle Time) =** 120.00 min/shift

**Demonstrated OEE (Overall Equipment Effectiveness):** 85.9%

**Net Available Time (NAT) =** 120.00 hrs/week

**Net Available Time (NAT) =** 144.00 hrs/week

### Loading Plan to meet Average Weekly

<table>
<thead>
<tr>
<th>Part</th>
<th>Ford Part # or “Non-Ford”</th>
<th>Req'd Good Parts / Week</th>
<th>NICT</th>
<th>Time Req'd @ Demonstrated OEE / Week</th>
<th>Tool Changeover Time (min/week)</th>
<th>% Allocation</th>
<th>% Allocation Minimum Required</th>
<th>Req'd Good Parts / Week</th>
<th>NICT</th>
<th>Time Req'd @ Demonstrated OEE / Week</th>
<th>Tool Changeover Time (min/week)</th>
<th>% Allocation</th>
<th>% Allocation Minimum Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>x</td>
<td>1234-56789-AA</td>
<td>2536</td>
<td>14.4</td>
<td>11.7</td>
<td>15.0</td>
<td>9.8%</td>
<td>2390</td>
<td>14.4</td>
<td>11.1</td>
<td>15.0</td>
<td>7.7%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1234-56789-BA</td>
<td>3000</td>
<td>14.4</td>
<td>13.9</td>
<td>20.0</td>
<td>15.0</td>
<td>11.6%</td>
<td>4000</td>
<td>14.4</td>
<td>18.6</td>
<td>20.0</td>
<td>12.9%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Non-Ford Part 1</td>
<td>500</td>
<td>16.3</td>
<td>2.6</td>
<td>15.0</td>
<td>2.2%</td>
<td></td>
<td>200</td>
<td>16.3</td>
<td>3.7</td>
<td>15.0</td>
<td>2.6%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Non-Ford Part 2</td>
<td>200</td>
<td>16.3</td>
<td>1.1</td>
<td>15.0</td>
<td>0.9%</td>
<td></td>
<td>300</td>
<td>16.3</td>
<td>1.6</td>
<td>15.0</td>
<td>1.1%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Non-Ford Part 3</td>
<td>1800</td>
<td>16.3</td>
<td>9.5</td>
<td>15.0</td>
<td>7.9%</td>
<td></td>
<td>2200</td>
<td>16.3</td>
<td>11.6</td>
<td>15.0</td>
<td>8.0%</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Non-Ford Part 4</td>
<td>17750</td>
<td>16.3</td>
<td>93.4</td>
<td>15.0</td>
<td>77.8%</td>
<td></td>
<td>20440</td>
<td>16.3</td>
<td>107.5</td>
<td>15.0</td>
<td>74.7%</td>
<td></td>
</tr>
</tbody>
</table>

### Loading Plan to meet Max Weekly

<table>
<thead>
<tr>
<th>Part</th>
<th>Ford Part # or “Non-Ford”</th>
<th>Req'd Good Parts / Week</th>
<th>NICT</th>
<th>Time Req'd @ Demonstrated OEE / Week</th>
<th>Tool Changeover Time (min/week)</th>
<th>% Allocation</th>
<th>% Allocation Minimum Required</th>
<th>Req'd Good Parts / Week</th>
<th>NICT</th>
<th>Time Req'd @ Demonstrated OEE / Week</th>
<th>Tool Changeover Time (min/week)</th>
<th>% Allocation</th>
<th>% Allocation Minimum Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>x</td>
<td>1234-56789-AA</td>
<td>2536</td>
<td>14.4</td>
<td>11.7</td>
<td>15.0</td>
<td>9.8%</td>
<td>2390</td>
<td>14.4</td>
<td>11.1</td>
<td>15.0</td>
<td>7.7%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1234-56789-BA</td>
<td>3000</td>
<td>14.4</td>
<td>13.9</td>
<td>20.0</td>
<td>15.0</td>
<td>11.6%</td>
<td>4000</td>
<td>14.4</td>
<td>18.6</td>
<td>20.0</td>
<td>12.9%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Non-Ford Part 1</td>
<td>500</td>
<td>16.3</td>
<td>2.6</td>
<td>15.0</td>
<td>2.2%</td>
<td></td>
<td>200</td>
<td>16.3</td>
<td>3.7</td>
<td>15.0</td>
<td>2.6%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Non-Ford Part 2</td>
<td>200</td>
<td>16.3</td>
<td>1.1</td>
<td>15.0</td>
<td>0.9%</td>
<td></td>
<td>300</td>
<td>16.3</td>
<td>1.6</td>
<td>15.0</td>
<td>1.1%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Non-Ford Part 3</td>
<td>1800</td>
<td>16.3</td>
<td>9.5</td>
<td>15.0</td>
<td>7.9%</td>
<td></td>
<td>2200</td>
<td>16.3</td>
<td>11.6</td>
<td>15.0</td>
<td>8.0%</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Non-Ford Part 4</td>
<td>17750</td>
<td>16.3</td>
<td>93.4</td>
<td>15.0</td>
<td>77.8%</td>
<td></td>
<td>20440</td>
<td>16.3</td>
<td>107.5</td>
<td>15.0</td>
<td>74.7%</td>
<td></td>
</tr>
</tbody>
</table>

### Total % Allocation

| Total % Allocation | 132.2 | 110.2% | 300.0 | 154.1 | 107.0% |

If Total % Allocation > 100%, loading plan exceeds capacity.

### Oversold Conditions

Oversold conditions may be addressed in same ways as Gap Analysis.

**NEW** – Tool Changeover Time is input for reference. Changeover time is already factored in OEE.

**Ford Part Number(s), or “non-Ford” planned to be produced at Job 1 for studied part.**

% Allocation – Min. Req’d Used to validate the % Allocation planned. If different than plan, raise discussion with Buyer & Cross Functional Team.
The total allocation percentage from “Shared – Loading Plan” tab is shown on the “Capacity Planning” tab (and after each subsequent analysis).

For Machining, the Total % Allocation is 54.2% for both APW & MPW. This means that, adjusted for the supplier’s demonstrated OEE, the operation can contain all business (Ford and non-Ford) without exceeding the acceptable operating patterns.

However, for Outsourced E-Coat, the Total % Allocation is greater than 100%. As such, the process is oversold – capacity is at risk (follow-up with action plan).

The Total % Allocation can be addressed in the same ways that gaps are addressed between Required OEE and Demonstrated OEE – by utilizing capacity gap closure to improve Demonstrated OEE, by reducing Required OEE (and thus, the part-specific allocation percentage), or by off-loading some of the business.
Phase 0 & Phase 3
Continuing the Analysis

- At Phase 0, inputs are the same as the previous standard, translated to OEE values.
- Highlighted cells reflect deviations from the plan.

### B. Supplier Demonstrated OEE - Phase 0 PPAP (Run @ Rate)

**B1) Equipment Availability**

<table>
<thead>
<tr>
<th></th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Available Time (ACTUAL changeover NOT included for Shared) (minutes)</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>120</td>
<td>180</td>
</tr>
<tr>
<td>Planned Downtime - lunches/breaks/meetings (minutes)</td>
<td>0</td>
<td>15</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Net Available Time (minutes) [V - W]</td>
<td>180</td>
<td>165</td>
<td>165</td>
<td>120</td>
<td>165</td>
</tr>
<tr>
<td>Shared Equip Changeover Time ACTUAL (minutes)</td>
<td>NOT REQUIRED</td>
<td>NOT REQUIRED</td>
<td>NOT REQUIRED</td>
<td>NOT REQUIRED</td>
<td>NOT REQUIRED</td>
</tr>
<tr>
<td>Shared Equip Changeover Time Weekly Scaled (minutes) [(G1 * G2 * X) / (60 * G1 * G2)]</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net Available Time with Scaled Changeover (minutes) [X + Z]</td>
<td>180</td>
<td>171</td>
<td>165</td>
<td>120</td>
<td>185</td>
</tr>
<tr>
<td>Observed Unplanned Downtime (minutes)</td>
<td>17</td>
<td>13</td>
<td>12</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>Operating Time (minutes) [AA - Z - AB]</td>
<td>163</td>
<td>152</td>
<td>153</td>
<td>116</td>
<td>142</td>
</tr>
<tr>
<td>Equipment Availability (AC / AA * 100)</td>
<td>90.6%</td>
<td>88.9%</td>
<td>92.7%</td>
<td>96.7%</td>
<td>86.1%</td>
</tr>
</tbody>
</table>

**B2) Performance Efficiency**

<table>
<thead>
<tr>
<th></th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned Parts Run (Good, Scraped, Reworked)</td>
<td>100</td>
<td>200</td>
<td>85</td>
<td>400</td>
<td>70</td>
</tr>
<tr>
<td>Performance Efficiency (AE * AF / AC)</td>
<td>81.8%</td>
<td>84.4%</td>
<td>88.0%</td>
<td>14.4%</td>
<td>110.0</td>
</tr>
</tbody>
</table>

**B3) Quality Rate**

<table>
<thead>
<tr>
<th></th>
<th>#</th>
<th>%</th>
<th>#</th>
<th>%</th>
<th>#</th>
<th>%</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Scrapped</td>
<td>1</td>
<td>1.0%</td>
<td>7</td>
<td>3.5%</td>
<td>12</td>
<td>4.4%</td>
<td>2</td>
<td>4.4%</td>
</tr>
<tr>
<td>Parts Reworked</td>
<td>3</td>
<td>3.0%</td>
<td>0</td>
<td>0%</td>
<td>2</td>
<td>2%</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Quality Rate [(AE - AJ - AK) / AE]</td>
<td><strong>96.0%</strong></td>
<td>96.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B4) Overall Equipment Effectiveness (OEE)**

<table>
<thead>
<tr>
<th></th>
<th>AD * AG * AL</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 0 OEE</td>
<td>71.1%</td>
<td>72.4%</td>
<td>73.8%</td>
<td>74.2%</td>
<td>74.6%</td>
<td>75.0%</td>
<td>75.4%</td>
</tr>
</tbody>
</table>

**B5) Predicted Good Parts / Week [P * AM]**

<table>
<thead>
<tr>
<th></th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted Good Parts / Week [P * AM]</td>
<td>3839</td>
<td>3839</td>
<td>1940</td>
<td>2328</td>
<td>2057</td>
</tr>
</tbody>
</table>

**B6) Observed Average Cycle Time (sec/cycle)**

Also shows a predicted part count per week, to validate correct rate was met, and has cells available for documenting observed rates.
Phase 0 & Phase 3
Continuing the Analysis

- At Phase 0, the **planned** changeover time is scaled against the weekly plan.
- At Phase 3, the **observed** changeover time is scaled against the weekly plan.

### B. Supplier Demonstrated OEE - Phase 3 PPAP (Capacity Verification)

#### B1) Equipment Availability

<table>
<thead>
<tr>
<th>B1</th>
<th>Equipment Availability</th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Total Available Time (Include ACTUAL changeover time for Shared) (minutes)</td>
<td>1440</td>
<td>960</td>
<td>960</td>
<td>360</td>
<td>960</td>
</tr>
<tr>
<td>W</td>
<td>Planned Downtime - lunches/breaks/mtgs. (minutes)</td>
<td>0</td>
<td>15</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>X</td>
<td>Net Available Time (minutes) [V - W]</td>
<td>1440</td>
<td>945</td>
<td>945</td>
<td>360</td>
<td>945</td>
</tr>
<tr>
<td>Y</td>
<td>Shared Equip Changeover Time ACTUAL (minutes)</td>
<td>0</td>
<td>55</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Z</td>
<td>Shared Equip Changeover Time Weekly Scaled (minutes) [Y * (X / 80) / (G / G2)]</td>
<td>0</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AA</td>
<td>Net Available Time with Scaled Changeover (minutes) [X - Y + Z]</td>
<td>1440</td>
<td>920</td>
<td>945</td>
<td>360</td>
<td>945</td>
</tr>
<tr>
<td>AB</td>
<td>Observed Unplanned Downtime (minutes)</td>
<td>234</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AC</td>
<td>Operating Time (minutes) [AA - Z - AB]</td>
<td>1206</td>
<td>890</td>
<td>945</td>
<td>360</td>
<td>945</td>
</tr>
<tr>
<td>AD</td>
<td>Equipment Availability (AC / AA * 100)</td>
<td>83.8%</td>
<td>96.7%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

#### B2) Performance Efficiency

<table>
<thead>
<tr>
<th>B2</th>
<th>Performance Efficiency</th>
<th>Casting</th>
<th>Machining</th>
<th>Welding</th>
<th>Outsourced E-Coat</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE</td>
<td>Total Parts Run (Good, Scrapped, &amp; Reworked)</td>
<td>800</td>
<td>900</td>
<td>500</td>
<td>1300</td>
<td>450</td>
</tr>
<tr>
<td>AF</td>
<td>Net Ideal Cycle Time (seconds/part) [N]</td>
<td>80.0</td>
<td>38.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AG</td>
<td>Performance Efficiency (AE * AF / AC)</td>
<td>66.3%</td>
<td>64.9%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>AH</td>
<td>&quot;Availability&quot; and/or &quot;Performance Efficiency&quot; Losses Not Captured (minutes) [AC - (AE * AF)]</td>
<td>406</td>
<td>313</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### B3) Quality Rate

<table>
<thead>
<tr>
<th>B3</th>
<th>Quality Rate [(AE - AJ - AK) / AE]</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJ</td>
<td># Parts Scrapped</td>
</tr>
<tr>
<td>1</td>
<td>0.2%</td>
</tr>
<tr>
<td>3</td>
<td>0.3%</td>
</tr>
<tr>
<td>AK</td>
<td># Parts Reworked</td>
</tr>
<tr>
<td>2</td>
<td>0.3%</td>
</tr>
<tr>
<td>4</td>
<td>0.4%</td>
</tr>
<tr>
<td>AL</td>
<td>Quality Rate [(AE - AJ - AK) / AE]</td>
</tr>
<tr>
<td>99.5%</td>
<td></td>
</tr>
<tr>
<td>99.2%</td>
<td></td>
</tr>
</tbody>
</table>

#### B4) Overall Equipment Effectiveness (OEE)

<table>
<thead>
<tr>
<th>AM</th>
<th>Phase 3 OEE [AD * AG * AL]</th>
<th>55.3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>B5</td>
<td>Predicted Good Parts / Week [P * AM]</td>
<td>2986</td>
</tr>
<tr>
<td>B6</td>
<td>Observed Average Cycle Time (sec/cycle)</td>
<td></td>
</tr>
</tbody>
</table>
Phase 0 & Phase 3
Continuing the Analysis

Section C. Gap Analysis – Required OEE vs. Demonstrated OEE
Section C shows a graphic representation of the relationship between Section A (Required OEE) and Section B (Demonstrated OEE). If there are any error-states in the form, a Predicted Good Part estimate will not be calculated.

RISK
Required OEE > Demonstrated OEE

RISK
Required OEE > 100% (not feasible)

NO Predicted Good Parts / Week Estimate Generated

THIS CAPACITY ANALYSIS REPORT IS UNACCEPTABLE!
Phase 0 & Phase 3
Continuing the Analysis

Section C. Gap Analysis – Required OEE vs. Demonstrated OEE
Section C shows a graphic representation of the relationship between Section A (Required OEE) and Section B (Demonstrated OEE). All processes must show green for the Predicted Good Parts / Week estimate to be generated.

### Predicted Good Parts / Week
- **Average**: 2500
- **Maximum**: 3000

### Required Capacity
- **Phase 3**: 2650
- **Demonstrated Capacity**: 2550

### Comparison
- **Predicted OEE > Required OEE? (Is Z > Q?)**
- **OK**

### OEE %
- **Casting**: 50.5%
- **Machining**: 48.8%
- **Welding**: 51.3%
- **Outsourced E-Coat**: 49.5%
- **Assembly**: 53.9%

### Historical Demonstrated OEE
- **Casting**: 51.3%
- **Machining**: 57.7%
- **Welding**: 84.1%
- **Outsourced E-Coat**: 83.3%
- **Assembly**: 0.0%

### Car calculated PPC values
- **APPC**: 2550
- **MPPC**: 3060

### NO RISK
- For ANY Processes

### THIS CAPACITY ANALYSIS REPORT IS ACCEPTABLE!
### Phase 0 & Phase 3

Predicted Good Parts per wk

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Capacity (APW/MPW)</td>
<td>4600</td>
<td>5100</td>
</tr>
<tr>
<td>Phase 3 Demonstrated Capacity</td>
<td>4748</td>
<td>5697</td>
</tr>
<tr>
<td>Commitment (APPC/MPPC)</td>
<td>4650</td>
<td>5400</td>
</tr>
</tbody>
</table>

**Notes:** Capacity Study Number

- **Repeat of capacity requirements from section A of CAR**
- **Predicted Good Parts per week demonstrated in run**
- **Supplier commitment must match the commitment entered on the PSW warrant and be directly comparable to the required and demonstrated capacity**
Phase 0 & Phase 3
Capacity Commitment on PSW

Capacity Commitment (APPC and MPPC) recorded by the supplier on the Part Submission Warrant (PSW)
The following module provides a deeper understanding of identifying capacity risk and capacity gap closure based on the results of a capacity analysis. Material discussed in module are:

- Interpreting the Demonstrated versus Required OEE results
- Identifying the Capacity Gap
- Closing the Capacity Gap

**Objective**: Provide an understanding of OEE results, identifying capacity gaps, and gap closure.
Goal of Capacity Analysis
Demonstrated OEE vs. Required OEE

Is Demonstrated (or Surrogate) OEE ≥ Required OEE?
This relationship is used to determine the capacity risk, at all three GPDS deliverables.

Demonstrated OEE is based on:
- Surrogate Data in Capacity Planning;
- Actual Run Data during Phase 0 and Phase 3

Required OEE is the minimum level of efficiency required to meet customer demand, based on:
- Ford Capacity Requirements
- Supplier’s Manufacturing Plan
Goal of Capacity Analysis
Demonstrated OEE vs. Required OEE

Is Demonstrated (or Surrogate) OEE ≥ Required OEE?
If all processes have a favorable answer to the above question, there is no risk to capacity. Focus on continuous improvement and transferring lessons learned to new model processes.

Demonstrated OEE is based on:
- Surrogate Data in Capacity Planning;
- Actual Run Data during Phase 0 and Phase 3

Required OEE is the minimum level of efficiency required to meet customer demand, based on:
- Ford Capacity Requirements
- Supplier’s Manufacturing Plan

NO CAPACITY RISK
Demonstrated OEE ≥ Required OEE
Goal of Capacity Analysis
Demonstrated OEE vs. Required OEE

Is Demonstrated (or Surrogate) OEE ≥ Required OEE?
If ANY process has an UNFAVORABLE answer to the above question, there is risk to capacity. The capacity gap between Demonstrated OEE and Required OEE must be closed to meet Ford volume requirements.

In this example, the supplier’s Required OEE is greater than the Demonstrated OEE for the process. All gaps must be closed to eliminate capacity risk.

To close capacity gaps, suppliers can REDUCE the Required OEE, or IMPROVE the Demonstrated OEE, or a combination of both.
Goal of Capacity Analysis
Demonstrated OEE vs. Required OEE

Identifying potential capacity risks early in the GPDS cycle allows necessary time to implement improvements to minimize the risk to launch.

Regardless of *when* the capacity gap is identified, the process of resolving the capacity gap is the same. This is true even when capacity gaps are identified *after launch*. 
Goal of Capacity Analysis
Demonstrated OEE vs. Required OEE

There are two methods of closing capacity gaps:
Suppliers can Improve Demonstrated OEE (preferred) and/or Reduce Required OEE. Both methods can be used concurrently.

Improving Demonstrated OEE:
By improving surrogate processes & duplicating lessons learned, capacity gaps can be eliminated and the overall “health” of the supplier is improved.

Reducing Required OEE:
By adding operating time, reducing up-line scrap loss, or decreasing net ideal cycle time, capacity gaps can be eliminated.
Capacity Gap Closure
Improving Demonstrated OEE

DEMONSTRATED OEE:
The actual level of efficiency achieved by a supplier in historical or current production. For Capacity Planning, surrogate processes are used for Demonstrated OEE; at Phase 0 and Phase 3, actual performance data is used.

- In Capacity Planning (forward-model), the Demonstrated OEE is made of historically similar (surrogate) processes.
- At Phase 0, the Demonstrated OEE is made of actual production data. **This is true at all times after Phase 0 as well, whether before launch, or in a capacity constraint situation.**
- The approach to improving Demonstrated OEE – whether Surrogate or Actual – is the same.
Improvements must be sought for Demonstrated OEE to close the gap in this example.

Although timing may require an immediate reduction in Required OEE, the Demonstrated OEE must be improved to ensure long-term viability of the plan. To improve Demonstrated OEE, concentrate on the components of OEE.

(JPH Shown for Reference Only)
To improve Demonstrated OEE, concentrate on the components of OEE.

For Availability:
- Track & Pareto Losses to Reduce Unplanned Downtime.
- Identify Special & Common Causes.
- Analyze Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), etc.
- Utilize Rapid-Response Maintenance Teams & Hourly Count Production Boards.
- Prioritize Equipment for Maintenance Activities.

For Performance Efficiency:
- Ensure Performance to Constraint Ideal Cycle Time.
- Identify Blocked & Starved Conditions, Ensure Cycle Times Support Takt Time Requirements.
- Human Resource – Address Shortage of Operators, Imbalanced Work, or Lack of Standardization.
Capacity Gap Closure
Improving Demonstrated OEE

- For Quality Rate:
  - Track, Pareto, and Reduce Scrap & Rework Losses.
  - Install Poke Yoke / Error Proofing Devices.
  - Communicate Good vs. Bad Parts (Boundary Samples).
  - Allocate Problem Solving Resources and Process Experts to Launch.

- If the Capacity Analysis is performed early in the GPDS Process, there is time to implement OEE Enablers to improve the Demonstrated OEE.

- With each action, the Demonstrated OEE should be monitored to validate the OEE Improvement.

- Improving the Demonstrated OEE must be the first approach considered to close capacity gaps and eliminate risk.
Capacity Gap Closure
Improving Demonstrated OEE

- **Other Enablers:**
  - Install Strategic Buffers to Prevent Starve Conditions.
  - Establish Energy Room to Communicate Metrics & Progress to Plan.
  - Run Simulations with Multiple Iterations – Changing Input Variables (Cycle Times, Downtime, Quality Rate, Buffer Sizes, MTBF and MTTR, etc.) to Optimize Throughput. Analyze Results and Implement Actions.
  - Ensure Cascade of Lessons Learned from Previous Launches.
  - For Shared Equipment, Reduce Changeover Times.
  - Review Preventative Maintenance Schedules.
  - Investigate Incremental Tooling & Equipment.

- Ensure there is a method of verifying the results. Translate the results to OEE so that a common language is being used to track improvements.

- Make sure that action items are prioritized appropriately.
A complete understanding of the production data resulting in the 50.0% Demonstrated OEE is important to prioritize improvements.

**Analyze Production Data**
If no production data exists, begin logging it immediately. Focus on the following:

- **Availability (Downtime)**
  
  
  \# of downtime events, causes, durations

- **Performance Efficiency**
  
  Is the process meeting planned cycle time?

- **Quality Rate**
  
  \# of parts scrapped and reworked

**ONLY MAKE IMPROVEMENTS WHEN DATA SUPPORTS THE ACTION, and MONITOR THE IMPACT OF THE IMPROVEMENTS.**

(JPH Shown for Reference Only)
By looking at the data, we find that 17% is lost in Quality Rejects, and 32% is lost in Downtime.

Production Data should be the driver for improvement actions – the data should identify opportunities for improvement, prioritize improvement actions, and close the gap between Demonstrated and Required OEEs.
The Required OEE for each process can be identified by using Section A of the Capacity Analysis Toolset.

For each process, the Required OEE is the **TARGET** – capacity gaps can only be identified by comparing Demonstrated OEE to this target.

Are the Required OEEs for each process feasible?
Consider the inputs for Required OEE.

Although reducing Required OEE is typically associated with higher cost, reducing Required OEE may have opportunity with minimal investment.

Expand Operating Pattern

- Extra Shifts of Expanded Hours. Overtime.

Reduce Constraint Cycle Times

- Machine / Equipment Design.
- Coordination with Equipment Suppliers to Reduce Cycle Time – Faster Processes may be Possible.
- Track & Optimize Cycle Times at Ramp up.

In this example, by reducing the ideal cycle time from 276 seconds to 257 seconds (less than 7% reduction), the capacity gap was resolved.

### Capacity Gap Closure

### Reducing Required OEE

<table>
<thead>
<tr>
<th>A4) Planned Departmental Operating Pattern &amp; Net Available Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>A. Process description (in value stream order)</td>
</tr>
<tr>
<td>B. Days / Week</td>
</tr>
<tr>
<td>C. Shifts / Day</td>
</tr>
<tr>
<td>D. Total Hours / Shift</td>
</tr>
<tr>
<td>E. Contractual Planned Downtime - lunch, breaks, etc. (min/shift)</td>
</tr>
<tr>
<td>F. Allocation Percent (enter 100 for dedicated)</td>
</tr>
<tr>
<td>G. Net Available Time (hours / week)</td>
</tr>
<tr>
<td>H. Machine / Equipment Design.</td>
</tr>
<tr>
<td>I. Coordination with Equipment</td>
</tr>
<tr>
<td>J. Reduce Constraint Cycle Times</td>
</tr>
<tr>
<td>K. Max Weekly MPW Plan</td>
</tr>
<tr>
<td>L. Expand Operating Pattern</td>
</tr>
<tr>
<td>M. Extra Shifts of Expanded Hours. Overtime.</td>
</tr>
</tbody>
</table>

### Required Good Parts / Week

<table>
<thead>
<tr>
<th>A5) Required Good Parts / Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>H. Percent of parts scrapped</td>
</tr>
<tr>
<td>J. Req’d Parts / Week to Support Next Process</td>
</tr>
</tbody>
</table>

### Required OEE (Overall Equipment Effectiveness)

<table>
<thead>
<tr>
<th>A6) Required OEE (Overall Equipment Effectiveness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>K. Ideal Cycle Time per Tool or Machine (sec/cycle)</td>
</tr>
<tr>
<td>L. # of Tools or Machines in parallel</td>
</tr>
<tr>
<td>M. % of identical parts produced per Tool or Machine Cycle</td>
</tr>
<tr>
<td>N. Net Ideal Cycle Time (sec/part)</td>
</tr>
<tr>
<td>P. Theoretical Parts per week at 100% OEE (G x 3600 / N)</td>
</tr>
<tr>
<td>Q. Required OEE (J / P)</td>
</tr>
<tr>
<td>R. Percent of parts reworked (re-run through process)</td>
</tr>
<tr>
<td>S. Can process contain its changeover, scrap &amp; rework assumptions?</td>
</tr>
<tr>
<td>T. % Remaining for Availability &amp; Performance Efficiency losses</td>
</tr>
</tbody>
</table>

### Shared Process - Total Allocation Plan

<table>
<thead>
<tr>
<th>A7) Shared Process - Total Allocation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
</tr>
<tr>
<td>U. Enter Total % Allocation from &quot;Shared - Loading Plan&quot; Tab</td>
</tr>
</tbody>
</table>

### Supplier Demonstrated OEE (Overall Equipment Effectiveness)

<table>
<thead>
<tr>
<th>B1) Historical Performance (from Historical Mfg Performance Summary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Description</td>
</tr>
<tr>
<td>V. Supplier Name</td>
</tr>
<tr>
<td>W. Supplier Location</td>
</tr>
<tr>
<td>X. Site Code for Surrogate Process</td>
</tr>
<tr>
<td>Y. Surrogate Customer &amp; Program Reference (~Ford P221)</td>
</tr>
<tr>
<td>Z. Average Historical OEE</td>
</tr>
</tbody>
</table>

### Process Specific Weekly Part Estimate [P * Z]

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
</tr>
</tbody>
</table>

### Volume Requirements: 7654 APW / 8420 MPW

<table>
<thead>
<tr>
<th>Supplier Demonstrated OEE (Overall Equipment Effectiveness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier ABC</td>
</tr>
<tr>
<td>Process 1</td>
</tr>
<tr>
<td>V. Supplier Name</td>
</tr>
<tr>
<td>W. Supplier Location</td>
</tr>
<tr>
<td>X. Site Code for Surrogate Process</td>
</tr>
<tr>
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</tr>
<tr>
<td>Z. Average Historical OEE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Specific Weekly Part Estimate [P * Z]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process 1</td>
</tr>
</tbody>
</table>
Capacity Gap Closure
Using Production Data to Create GlidePath (example)

Continue to monitor production data and continuously update the improvement plan based on trends and additional information. The above illustration represents an action plan from 1 day's production data; over a longer period of time, the significance of downtime events may change – and new causes may be identified.
The following module provides an understanding of how to approach resolution of a Capacity Shortage. Material discussed in module are:

- Understand Current State Capacity
- Investigate Supply Protection Options
- Timely Communication with Customer
- Systemic Corrective Actions

**Objective:** Provide an understanding of Capacity Shortage Resolution
Sustainable Manufacturing

Capacity Analysis Reporting is a point in time measurement focusing on key manufacturing disciplines ensures sustainability.

- Trained manpower & adequate resources
- Robust preventive maintenance: Mean Time To Repair (MTTR) is less than excess capacity
- Stable OEE: Statistical monitoring

Suppliers are required to continuously maintain or exceed declared capacity in Ford capacity systems. Contact your Ford Buyer & STA as soon as there is significant changes in capacity.
Capacity Shortage
Reaction Plan Expectations

I. Assess Current Capacity and Potential Supply Impact

- Understand Maximum Possible Output
- Examine Alternate manufacturing options
- Establish output tracking of constraint operations
- Review Supply Plan based on customer release requirements as far in the future as it is available (Example Tool - Capacity Availability Worksheet)
- If there is Supply Shortage projected - Contact Ford MP&L, Buyer & STA for immediate supply mitigation.
- If there is permanent degradation in output, Contact Buyer & STA, Update CAR and GCP/MCPV APPC / MPPC accordingly

II. Communicate with Customer Immediately

- Contact respective Ford Customer plant MP&L analysts, Buyer & STA immediately
- Communicate Issue, root cause and Supply status.
- Present Supply Protection Plan
- Execute to agreed shipping plan and actions.

III. Corrective Actions

- Investigate process and system escape contributors utilizing Global 8D, 5-Why tools.
- Establish Permanent & Systemic Corrective Actions
- Update Preventive Maintenance Plans and/ or Process Control Plans with Permanent Corrective Actions as applicable
- Capture Systemic improvement actions in Q1 Manufacturing Site Assessment System
- Implement Corrective Actions per plan and Validate Results.
### Capacity Availability Work Sheet

**overlay output vs. customer demand**

**Capacity Availability Work Sheet**

```
<table>
<thead>
<tr>
<th>WEEK OF</th>
<th>PLANNED ENDS/REPAIRS AVAILABLE AT SHIP POINT</th>
<th>DEMAND BASED ON CURRENT RELEASE</th>
<th>ACTUAL PROJECTED CUMULATIVE INVENTORY STATUS AT SHIP POINT</th>
<th>SUPPLIER NOTES, CONCERNS OR ASSUMPTIONS</th>
<th>WEEK OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/10/13</td>
<td>23.8% 34,780</td>
<td>94,198</td>
<td>(4,837)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/11/13</td>
<td>23.8% 34,780</td>
<td>94,198</td>
<td>(4,837)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/12/13</td>
<td>23.8% 34,780</td>
<td>94,198</td>
<td>(4,837)</td>
<td></td>
<td></td>
</tr>
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<td>(4,837)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/14/13</td>
<td>23.8% 34,780</td>
<td>94,198</td>
<td>(4,837)</td>
<td></td>
<td></td>
</tr>
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<td>08/15/13</td>
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<td>94,198</td>
<td>(4,837)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/16/13</td>
<td>23.8% 34,780</td>
<td>94,198</td>
<td>(4,837)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

### Daily Part Position Tracking – DPP

**output / shipment plan vs. ford production**

**Daily Part Position Tracking – DPP**

```
<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Daily Output</th>
<th>Shipment Plan</th>
<th>Projected Delivery</th>
<th>Actual Delivery</th>
<th>ETA</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
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<td>08/01</td>
<td>53,000</td>
<td>100,000</td>
<td>100,000</td>
<td>100,000</td>
<td>100</td>
<td></td>
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<tr>
<td>Fri</td>
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<td>54,000</td>
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<td>105,000</td>
<td>105,000</td>
<td>105</td>
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<tr>
<td>Sat</td>
<td>08/03</td>
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<td>110,000</td>
<td>110,000</td>
<td>110,000</td>
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</tr>
<tr>
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<tr>
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<tr>
<td>Sun</td>
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<td>150,000</td>
<td>150</td>
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</tr>
<tr>
<td>Mon</td>
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</tbody>
</table>
```

### Capacity Output Tracking

**Supplier OEE / JPH Improvement Tracking**

**Capacity Output Tracking**

```
<table>
<thead>
<tr>
<th>Date</th>
<th>Daily Output (good parts avg.)</th>
<th>CT Matching %</th>
<th>SPC Matching %</th>
<th>Rejection %</th>
<th>OEE (NH)</th>
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<tbody>
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<td>15%</td>
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</tr>
<tr>
<td>08/11</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
</tr>
<tr>
<td>08/12</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
</tr>
<tr>
<td>08/13</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
</tr>
<tr>
<td>08/14</td>
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<td>10%</td>
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<td>80%</td>
</tr>
<tr>
<td>08/15</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
</tr>
<tr>
<td>08/16</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
</tr>
<tr>
<td>08/17</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
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<tr>
<td>08/18</td>
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<td>80%</td>
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<td>08/19</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
</tr>
</tbody>
</table>
```

### Blue Bar Charts

**Major Constraints Correction Action Tracking**

**Blue Bar Charts**

```
<table>
<thead>
<tr>
<th>Date</th>
<th>Action</th>
<th>Gap 1</th>
<th>Gap 2</th>
<th>Gap 3</th>
<th>Gap 4</th>
<th>Gap 5</th>
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<tbody>
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<td>10%</td>
<td>15%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>08/11</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
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</tr>
<tr>
<td>08/12</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
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</tr>
<tr>
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<td>15%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>08/14</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>08/15</td>
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<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
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</tr>
<tr>
<td>08/16</td>
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<td>60%</td>
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<td>15%</td>
<td>80%</td>
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<tr>
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<td>80%</td>
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</tr>
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<td>15%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>08/19</td>
<td>50,000</td>
<td>60%</td>
<td>10%</td>
<td>15%</td>
<td>80%</td>
<td></td>
</tr>
</tbody>
</table>
```

### Supplier Notes

- Action Plan
- Update allocation sheet
- Hide / unhide columns
Suppliers Are Required To Review Weekly Changes To Future Releases (up to 6 mos) and Contact Ford Immediately If Releases Cannot Be Supported
# Supply Shortages – Ford Contacts

## Premium Freight Contacts

<table>
<thead>
<tr>
<th>Suppliers Shipping Premium to…</th>
<th>For Production Parts, Contact…</th>
<th>For Launch Parts, Contact…</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asia Pacific</strong></td>
<td>The APA SCM Analyst, who can be found on screen FBBW/FBBA / FCBA by inputting FAPFU in both the <strong>Plant</strong> and <strong>Location</strong> fields in CMMS system</td>
<td>The APA SCM Analyst, who can be found on screen FBBW/FBBA / FCBA by inputting FAPFU in both the <strong>Plant</strong> and <strong>Location</strong> fields in CMMS system</td>
</tr>
<tr>
<td><strong>Europe</strong></td>
<td>The responsible plant follow-up analyst to agree on the planned shipment For Constraints Management, (if production at risk) also contact: <a href="mailto:abruell@ford.com">abruell@ford.com</a> (vehicle), <a href="mailto:mbird1@ford.com">mbird1@ford.com</a> (powertrain)</td>
<td>The responsible plant follow-up analyst to agree on the planned shipment</td>
</tr>
<tr>
<td><strong>North America</strong></td>
<td>For any shipment that should not be coded as supplier expense, you must call the Ford Premium Logistics Management (PLM) hotline at 313-594-7218 to have the premium freight code changed.</td>
<td>The launch coordinator and/or the Ford Premium Logistics Management (PLM) hotline at 313-594-7218</td>
</tr>
<tr>
<td><strong>South America</strong></td>
<td>The responsible plant follow-up analyst input SAFFU in both Plant and Location fields on CMMS screen FBBW/FBBA/FCBA to find contacts) to agree on premium freight responsibility</td>
<td>The launch coordinator of each plant (input SAFFU in both Plant and Location fields on CMMS screen FBBW/FBBA/FCBA to find contacts) to agree on premium freight responsibility</td>
</tr>
</tbody>
</table>
The following module provides an overview of Capacity Studies and an understanding of Capacity Study expectations and error states. Material discussed in module are:

- When Capacity Studies occur
- Supplier Response to Capacity Studies
- Capacity Analysis and Reporting Expectations
- Common Errors

**Objective**: Build awareness and understanding of Ford’s Capacity Study expectations.
Capacity Studies
When Capacity Studies Occur

Capacity Planning Deliverable #25

Phase 0 PPAP Deliverable #19

Phase 3 PPAP Deliverable #30

PRE-LAUNCH
Capacity Planning

LAUNCH
Capacity Confirmation

CAPACITY CHANGES
Uplifts, Mix Rates & Mfg Changes

PTCC 33.5MBJ1
PTC/M1DJ 27MBJ1
M1 25MBJ1
PA 20.5MBJ1
FDJ 17MBJ1
VP 13MBJ1
PEC 8MBJ1
FEC/LR 5.5MBJ1
TT 5MBJ1
PP 2.5MBJ1
MP2 -1MBJ1

Post Launch
Capacity Studies
Responding to Capacity Studies

Suppliers respond to Studies through inputs to Ford Capacity Planning Systems:

- Vehicle Parts Suppliers enter capacity data into the Ford Global Capacity Planning (GCP) system.
- Powertrain Parts Suppliers enter capacity data into the Manufacturing Capacity Planning Volume (MCPV) system.
- GCP and MCPV information are used for Ford manufacturing planning.
- Information entered into these systems are deemed as committed capacity from the suppliers.
- Supplier communication meetings are held within 10 days after studies are kicked off to cascade study specific details and expectations.
Capacity Analysis

- Capacity verification should be based on completing Capacity Analysis Report (CAR) per Ford Phase 3 PPAP requirements
- Sub-Tier, Shared Capacity Loading and Historical OEE must be included in the analysis.

Capacity Data Input Aligned in GCP/MCPV

- Upload the Predicted Good Parts APW & MPW as APPC & MPPC data in Ford Global Capacity Planning System (GCP) / Manufacturing Capacity Planning Volumes (MCPV)
  - Predicted Good Parts/Week - Ave Purch Part Capacity (APPC) from CAR = Average Purchased Part Capacity (APPC) in GCP/MCPV
  - Predicted Good Parts/Week - Max Purch Part Capacity (MPPC) from CAR = Maximum Purchased Part Capacity (MPPC) in GCP/MCPV

Incremental Capacity Required

- If Current Capacity is less than Study Required Volumes, Ford Capacity Program Teams will be requesting for your Capacity Implementation & Support Plan, Timing, Current State & Future Capacity Planning Analysis Report (CAR).

Verified Supplier Capacity entered in GCP must be demonstrated through completion of a Ford PPAP Phase 3 PSW and Capacity Analysis Report
# Capacity Studies

## Common Reporting Errors

### Common Error

<table>
<thead>
<tr>
<th>Supplier Code</th>
<th>Supplier Name</th>
<th>Prefix</th>
<th>Base</th>
<th>Suffix</th>
<th>APW</th>
<th>MPW</th>
<th>APPC</th>
<th>MPPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCDE</td>
<td>Supplier C</td>
<td>AV61</td>
<td>Part3</td>
<td>CB</td>
<td>24210</td>
<td>25786</td>
<td>35100</td>
<td>35100</td>
</tr>
</tbody>
</table>

**Problem #1**

APPC = MPPC

### Capacity Studies

#### C. Gap Analysis - Required OEE vs. Demonstrated OEE; Predicted Good Parts per wk

<table>
<thead>
<tr>
<th>Required Capacity (APW/MPW)</th>
<th>Average</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24210</td>
<td>25786</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 3 Demonstrated Capacity</th>
<th>Average</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21835</td>
<td>23742</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Commitment (APPC/MPPC)</th>
<th>Average</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21835</td>
<td>23742</td>
</tr>
</tbody>
</table>

**NOTES**

Capacity Study Number: 83.1%
## Capacity Studies
### Common Reporting Errors

#### Common Error

** Supplier Code | Supplier Name | Prefix | Base | Suffix | APW | MPW | APPC | MPPC |
--- | --- | --- | --- | --- | --- | --- | --- | --- |
ABCDE | Supplier C | AV61 | Part3 | CB | 24210 | 25786 | 21835 | 23472 |

**Shortfall now exists, leadtime, tooling and/or capital should be added to address the shortfalls**

**AppC/MMPC updated**

**PPC matches CAR Report**

- **Required Capacity (APW/MPW)** | 24210
- **Phase 3 Demonstrated Capacity** | 21835 | 23742
- **Commitment (APPC/MMPC)** | 21835 | 23742

**NOTES**

- Capacity Study Number: [Link to data or chart]

- [Graph or chart showing OEE%: 83.1%]
Ford Capacity Reporting System Access:

- Requires Ford Supplier Portal and authorization by Supplier’s Corporate Security Administrator (CSA) to access GCP/MCPV
- Access GCP / MCPV through Covisint into Ford Supplier Portal
- Select CPV2 Capacity Planning under the Applications tab.

GCP/MCPV Help Questions:

- cpvhelp@ford.com (GCP - Vehicle)
- mcpvhelp@ford.com (MCPV - Powertrain)

GCP/MCPV Tutorials: (in GCP / MCPV system)

- [https://www.capacityplanning.ford.com/GCPWeb/reportForward.do?reportId=1.5o&categorycode=TARM_10&sub_category_code=GCPTUT_1_10](https://www.capacityplanning.ford.com/GCPWeb/reportForward.do?reportId=1.5o&categorycode=TARM_10&sub_category_code=GCPTUT_1_10) (GCP)
- [https://web.mcpv.ford.com/mcpv/homePage](https://web.mcpv.ford.com/mcpv/homePage) (MCPV- under Help Tab)
At a minimum, Suppliers are required to update their Capacity information in the Ford capacity planning systems on a Quarterly basis.

Suppliers must also update their capacity information in the Ford system as soon as there is a significant change in their operating output such that you are not able to support previously declared capacity in the Ford system.

For significant drop in capacity, please notify Ford MP&L, your Buyer and Site STA for immediate supply risk mitigation.

Besides maintaining capacity information in the Ford system, Suppliers must monitor Ford releases for the next 6-months and communicate any supply constraints to the Ford MP&L, Buyer and Site STA.
Capacity Studies
Capacity Study Response and Analysis Error States

- Confusion & Misinterpretation due to Multiple Studies
- Supplier Response Errors
- APW/MPW Operational Practices Not Consistent Across Supply Base
- No Sub-Tier Confirmation

- Missed Tool Funding due to Supplier Response Errors

- Delayed Tooling Kick-off thru Supply Chain
- Inadequate resources impacting timely execution
- Poor Sub-Tier Planning & Execution
- Does Not Believe Increased Releases are Real

- Over Committed & Overstated Capacities
- Sub-Tier Not Verified Prior to Capacity Confirmation to Ford
- Changeover Times Not Accounted in Shared Lines Planning

- Domino Effect from Lack of Quality of Event Upstream
- Lack of Ability to Recover from Non-Robust Plans
- Unplanned Downtimes due to Extended Operating Patterns (Lack of Preventive Maintenance)
The following module provides an **overview** of Supplier Certification process and an **understanding** of how supplier personnel become certified. Material discussed in module are:

- Importance of Certification
- Authorized Capacity Planner
- Certification & Registration
- Certifying Competency in Capacity Analysis

**Objective**: Build awareness of the Ford Capacity Analysis Supplier Certification Process and understand how supplier’s become certified.
Each CAR is required to be completed by an Authorized Capacity Planner who has successfully met all Ford CAR Supplier Certification Requirements.

• **Definition of Authorized Capacity Planner**
  – As defined in the Ford Motor Company Customer-Specific Requirements For Use With ISO/TS 16949 [4.10 Capacity Reporting Requirements], which states:
    • Personnel responsible for completing the Capacity Analysis Report (CAR) must be certified and registered as a Capacity Planner Role in Ford GCP/MCPV Supplier Directory
    • A review of certification to latest training material in STA training page in Ford Supplier Portal shall be conducted at least annually and updated accordingly in Ford GCP/MCPV system.

• **Training Record Compliance** [Auditable Governance]
  – TS16949 4.2.4 Control of Records – Records established to provide evidence of conformity to requirements and of the effective operation of the quality management system shall be controlled.
  – Q1 Manufacturing Site Assessment Requirement I.3.2 – Employees have a skills assessment, training plan and evidence of training. Training records of key salaried personnel are reviewed regularly for compliance.
Next Steps: Supplier Certification Process
Certifying & Registering Competency in Performing Capacity Analysis

Registration as a Certified Capacity Planner in the Ford GCP / MCPV Systems

- **Ford GCP/MCPV Supplier Directory Registration**
  - After completing training & certification, each certified representative should be registered in Ford GCP/MCPV Ford Supplier Directory as Capacity Planner Role (there can be more than one Capacity Planner for each Supplier Site)
  - This can be completed by someone with Covisint access in your company.

- **Role & Responsibilities**
  - Ensure that Capacity Volumes (Average & Maximum Purchased Part Capacity APPC/MPPC) entered in Ford GCP / MCPV Systems in response to Capacity Studies are supported by Capacity Analysis Reports (CAR) that are based on actual plant manufacturing data & compliant to latest Ford guidelines.
  - Ensure that Capacity information is refreshed per frequency requested by the GCP/MCPV system (quarterly)
  - Ensure that any reduction in capacity output from previously reported volumes in your CAR are duly updated in the Ford GCP/MCPV system and your Supplier Technical Assistance (STA) Engineer and Buyer are notified.
Capacity Planner Training

Training Access

A Supplier can access the CAR training material through the Ford Supplier Portal.

Link:


The link is also accessible through the Ford GCP/MCPV Supplier Directory Help Screen.
GCP/MCPV Capacity Planner Registration

Capacity Planner Registration

1. After a supplier authorized representative has completed training and certification, this certification must be registered in the Ford GCP/MCPV Supplier Directory by updating the Contact Maintenance External Supplier Screen.

2. This is accomplished by clicking the “Car Certified” box next to the Job Function column. The “Date Certified” will be the date the registration is entered in the GCP/MCPV system.

3. Certification must be refreshed ANNUALLY by reviewing the latest Capacity training material in the Ford Supplier Portal and updating registration in the GCP/MCPV Supplier Directory.
Key Points to Ensure Compliance to Ford Capacity Planning and Reporting Guidelines

- Training & Certification for Capacity Planner
- Register in Ford GCP/MCPV Supplier Directory
- Robust APQP Capacity Planning
- Accurate Real Time Capacity Reporting & Studies Response
- Pro-Active Supply Risk Mitigation
Effective October 2014, all supplier sites are required to use a Certified Authorized Representative to complete all Capacity Analysis Reports.

- Certified Supplier Representatives must be registered in the Global capacity Planning (GCP) or Manufacturing Capacity Planning Volume (MCPV) systems Supplier Directory as the **Capacity Planner**

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**March 2014**

Supplier Notification that Current Capacity Planners or new representatives are required to Take CAR Training

**Mar – Sep 2014**

1. Capacity Planner Training & Certification at Ford or via WebEx based course
2. Register as Capacity Planner in Ford GCP/MCPV Supplier Directory

**By Sep 30, 2014**

All Supplier designated Capacity Planners in Ford GCP/MCPV System are CAR Trained and Certified
Begin Capacity Planning early
Sub-supplier capacity verification must be complete prior to Tier 1 Capacity verification
Shared loading must be analyzed
Changeover times may not be equal for shared lines and must be understood
Suppliers must update the Ford Capacity Systems after each capacity verification event and at least once a quarter
Capacity Analysis Form has been updated to eliminate macros, include a declaration page, and allow use with sub-suppliers
Supplier Certification & Registration is implemented by October 2014

For All Questions And Known Capacity Issues – Communicate, Communicate, Communicate