Capacity Analysis Report (CAR)

ERROR States

Ford Motor Company
Supplier Technical Assistance (STA)
February 2018

Introduction

This document includes examples of error states that are commonly found in completed Capacity Analysis Reports (CAR Forms) inclusive of the process for accurately assessing capacity during Phase 3 PPAP. It is intended to supplement the Capacity Analysis Report User Guide for version 5.*6*, the Global Terms & Conditions Capacity Planning Web-Guide, Single-Point-Lessons for Volume Sources and other reference material. *Significant updates are marked in blue italics*.

Error states occurring in the areas listed below are featured, and additional error states may be added over time if determined to be significant.

Topic	Page
1. CAR Checklist *1.1 Historical Manufacturing Performance* *1.2 Shared Loading Plan* *1.3 Supplier Declarations and Notes* *1.4 Section A (All phases)* *1.5 Section B – Capacity Planning* *1.6 Section B – Phase 0* *1.7 Section B – Phase 3* *1.8 Section C (All Phases)*	3
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1. CAR CHECKLIST

The purpose of the CAR checklist is to facilitate reviewing the CAR and understanding the meaning of the colours for each field (also available in the comments of the CAR5.6).
In the Checklist, the data to be reviewed has been highlighted in light Orange with a "check" box.

Checklist split:

1.1 Historical Manufacturing Performance
1.2 Shared Loading Plan
1.3 Supplier Declarations and Notes
1.4 Section A (All phases)
1.5 Section B – Capacity Planning
1.6 Section B – Phase 0
1.7 Section B – Phase 3
1.8 Section C (All Phases)

CAR 5.6 Colour codes:

ORANGE: *cell needs data.*
YELLOW: *data to be reviewed. There is a potential capacity risk that needs to be evaluated*
RED: *cells have no proper data or there is Capacity Issue.*

Do NOT approve any CAR with ORANGE or RED.
Before approving a CAR with YELLOW, the risk has to be evaluated.

1.1 Historical Manufacturing Performance

Demonstrated Performance History (could be surrogate)		GPP = Good Parts Produced	NICT = Net Ideal Cycle Time (sec/part)	NAT = Net Available Time (hrs/wk)	OEE = Overall Equipment Effectiveness [GPP/(NAT/NICT)]											
		Ensure OEE data is available for all processes. ☐				**" Process A "** ☐				**" Process B "** ☐				**" Process N "** ☐			
WK#	**Date** ☐	**GPP** ☐	**NICT** ☐	**NAT** ☐	**OEE** ☐	**GPP**	**NICT**	**NAT**	**OEE**	**GPP**	**NICT**	**NAT**	**OEE**	**GPP**	**NICT**	**NAT**	**OEE**
WK1	**Check data is updated for each Phase: from most recent production runs.** **Check there is enough data available to be representative (25 sets)**	**Check only Good parts are included (from all products produced in the process). Question when GPP is the same for all weeks**	**For Shared lines: Compare the cycle times with the parts from Shared Loading** (if using surrogate data, ask for the corresponding shared loading information) **Weighted Cycle Time to be used when parts have different cycle times.** E.g. If a shared line is working with parts with NICT between 20 and 30 seconds, it cannot be to have cycle times lower than 20 or higher than 30	**Check NATconsiders the complete operating pattern** (includes all Ford and other OEM part numbers producing at machine or line)**, and only deduct the contractual planned downtime and the unscheduled time because lack of demand. NAT needs to include all stoppages: breakdowns, downtimes due to internal & external factors, changeovers, maintenance performed during the working pattern etc. Question when NAT is the same for all weeks** **YELLOW: NAT > 144 hours (24 hours x 6 days)**	**Check individual OEE figures:** *** Mix of high & low OEEs indicates variability** **-->** Conduct sensitivity analysis to check OEE sustainability & OEE impact on actual output. *** OEEs close to 100% may indicate that supplier is not calculating properly the OEE** **-->** Deep dive required to check integrity of the data. **Check the trend and outliers in the OEE Graphs for unrealistic average data.** **YELLOW: OEE lower than Required OEE** **RED: OEE> 100%**				-				-				-			
WK2									-				-				-
WK3									-				-				-
WK4									-				-				-
WK5									-				-				-
WK6									-				-				-
WK7									-				-				-
WK8									-				-				-
WK9									-				-				-
WK10									-				-				-
WK11									-				-				-
WK12									-				-				-
WK13									-				-				-
WK14									-				-				-
WK15									-				-				-
WK16									-				-				-
WK17									-				-				-
WK18									-				-				-
WK19									-				-				-
WK20									-				-				-
WK21									-				-				-
WK22									-				-				-
WK23									-				-				-
WK24									-				-				-
WK25									-				-				-
	AVERAGE OEE	**Average OEE will not be calculated if any of the OEEs is higher than 100%, as it indicates that OEEs are not properly calculated**			-				-				-				-
	REQUIRED OEE				-				-				-				-

1.2 Shared Loading Plan

	Shared-Loading Plan			
Type the letter 'X' in one of the twenty cells below to identify the part that is analyzed during .	**Shared Process Loading Plan**	NICT = Net Ideal Cycle Time (sec/part)	Date of Study ☐	Check study date is updated with corresponding PHASE
	Study Phase		PROCESS 1 ☐	Best practice: in addition to the name, to include machine/line number
		Departmental Operating Pattern for Average Weekly	**Departmental Operating Pattern for Max Weekly**	
	Days / Week			
	Shifts / Day			
	Total Hours / Shift			
	Contractual Planned Downtime - lunch, breaks, etc. (minutes/shift)			
	Net Available Time (NAT) (hrs/week)	-	-	
	Demonstrated OEE (Overall Equipment Effectiveness): Enter average OEE from most recent production performance data; Historical Mfg Performance may be used for this calculation ☐	**Question high / very low OEEs. OEE is automatically linked to "HISTORICAL MFG PERFORMANCE" tab, but it ca be overwritten RED: Higher OEE is used than the one in the "HISTORICAL MFG PERFORMANCE" tab YELLOW: Lower OEE is used than the one in the "HISTORICAL MFG PERFORMANCE" tab**		

					Loading Plan to meet Average Weekly						**Loading Plan to meet Max Weekly**							
Mark one part per process ☐	**Part**	**Application / Vehicle Line**	**Ford Part # or "Non-Ford"** ☐	**Req'd Good Parts / Week** ☐	**NICT**	**Time Req'd @ Demonstrated OEE (hrs/week)**	**Tool Changeover Time (min/week)**	**% Allocation Minimum Required**	**% Additional Allocation** ☐	**% Allocation Total Required**	**Req'd Good Parts / Week** ☐	**NICT**	**Time Req'd @ Demonstrated OEE (hrs/week)**	**Tool Changeover Time (min/week)**	**% Allocation Minimum Required**	**% Additional Allocation**	**% Allocation Total Required**
Check that corresponding row is marked with "X" Only ONE part has to be marked for proper function. RED: more than one "X" has been placed	1		**Check that all part numbers that will be produced on shared equipment during model year production period are listed here. Non-Ford Parts can be listed as "non-ford". For Ford parts: use full Ford part numbers**	**Check that "Required Good Parts / Week" for all references is including the scrap of downstream processes. For Ford parts, this figure is coming from Row J from the corresponding PHASE**					**Just to be used in case that: * The part has lower OEE than Average Demonstrated process OEE. * Temporal additional allocation needed due to prolonged time to reach the demonstrated OEE during ramp up stage. The use of Additional Allocation is an Exception, not a rule.**								
	2																	
	3																	
	4																	
	5																	
	6																	
	7																	
	8																	
	9																	
	10																	
	11																	
	12																	
	13																	
	14																	
	15																	
	16																	
	17																	
	18																	
	19																	
	20																	
	21		Other % Allocation - Description ☐	**When Other % Allocation, check there is a proper description.**														
	22		Other % Allocation - Description ☐															
			Percentage of Net Available Time not utilized for production (%) {PM, etc.}															
			☐ **Total % Allocation**	**RED: Higher than 100% or missing "Date of Review of All Shared Loadings" YELLOW: Allocation > 90%. A detailed Shared loading plan is needed. High allocation with High OEE has a risk!**														
				If Total % Allocation > 100%, loading plan exceeds capacity														

DATE OF REVIEW OF ALL SHARED LOADINGS OR THE MASTER ☐	**SUPPLIER OPERATION MANAGEMENT APPROVAL** ☐
RED: Date is missing or it is prior to Date of Study (A2 Section) of the corresponding phase (selected in Introduction tab)	**Signature should be in place**

Note: *Detailed Shared Loading tool is available through* *https://web.qpr.ford.com/sta/Phased_PPAP.html*

1.3 Supplier Declarations and Notes

Capacity Analysis Supplier Declarations and Notes		
Item #	**Declaration/Note**	**User Response (orange shaded cells)**
1	Supplier confirms that all sub-tier suppliers have been verified to meet capacity requirements for the phase (No / Capacity Planning / Phase 0/ Phase 3 / Not applicable when no sub-tier suppliers): ☐	*** Check all sub-tiers (including the tiers N) have a Capacity analysis performed, and have been reviewed and signed-off by a registered Capacity Planner from tier1. * Check volumes used include the scrap of the previous tiers (For Tier2: they need to consider the volumes indicated in Row 29 of the corresponding Phase. For Tier 3, they also need to include the scrap of the tier 2, etc.) * Check all sub tiers can supply the Committed Volumes (APPC & MPPC) adding the scrap of the previous tiers.**
	TOTAL Number of sub-tier suppliers ☐	
	Number of sub-tier suppliers COMPLETED for the corresponding phase ☐	
2	Supplier used the following method to complete sub-tier supplier capacity analysis: ☐	
3	All Committed capacity declared in Ford GCP/MCPV capacity planning systems based on this CAR assessment are validated throughout the value chain and are sustainable as demonstrated by continuous monitoring of manufacturing OEE and Shared Loading. ☐	
4	Date on which Capacity Planner completed CAR training: ☐	*** The Capacity Planner needs to: know the manufacturing processes, have completed the CAR training and be certified in SIM**
5	Name of Capacity Planner: ☐	
6	Email of Capacity Planner: ☐	
7	This row is reserved for an alert pertaining to 24-hour work pattern. ☐	**Check if any error message in the cells.**
8	This row is reserved for an alert pertaining to Study Date - Capacity Planning ☐	
9	This row is reserved for an alert pertaining to Study Date - Phase 0 ☐	
10	This row is reserved for an alert pertaining to Study Date - Phase 3 ☐	
11	Part in cell B6 of the source for Shared-Loading Plan - Phase 3 PPAP (Cap Ver) ☐	
12	Part number marked for analysis in Shared-Loading Plan for Process 1: ☐	
13	Part number marked for analysis in Shared-Loading Plan for Process 2: ☐	
14	Part number marked for analysis in Shared-Loading Plan for Process 3: ☐	
15	Part number marked for analysis in Shared-Loading Plan for Process 4: ☐	
16	Part number marked for analysis in Shared-Loading Plan for Process 5: ☐	
17	Part number marked for analysis in Shared-Loading Plan for Process 6: ☐	
18	Part number marked for analysis in Shared-Loading Plan for Process 7: ☐	
19	Part number marked for analysis in Shared-Loading Plan for Process 8: ☐	
20	This row is reserved for an alert pertaining to OEE - Capacity Planning ☐	
21	This row is reserved for an alert pertaining to OEE - Phase 0 ☐	
22	This row is reserved for an alert pertaining to OEE - Phase 3 ☐	
23	This row is reserved for an alert pertaining to the part marked for analysis on SLP (Shared Loading Plan). ☐	

1.4 Section A (All phases)

A. New Model Required OEE (Overall Equipment Effectiveness)

A1) Supplier & Part Information

Supplier Name

Location/Site Code

YELLOW: Date older than 30 days

A2) Capacity Requirements

		APW	MPW	Select for Analysis
Program Code	<PA> Requirements ☐	Check latest contractual volumes. Ask for evidence		
Model Year	Revised Requirements			
Part PPAP Level	Source Capacity Req			
☐ Date of Study	GCP/MCPV ☐			

A3) Key Contacts

	Name	Phone #	Email
STA Site Engineer			

YELLOW: GCP / MCPV Total APW/MPW volume higher than the volume used for this Capacity Analysis. Clarify the situation

Capacity Requirements

Check all processes from VSM / Process flow are included.
If any one of the processes is subcontracted, it also needs to be included (e.g. surface treatment, painting, etc.).
Check no parallel processes are combined in one CAR (non realistic scrap among processes)

A4) Planned Departmental Operating Pattern & Net Available Time

		☐ Process 1		Process 2		Process 3		Process 4		Process 5		Process 6		
		APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	
A	Process description (in value stream order) ☐	Best practice: in addition to the name, to include machine/line number												
B	Days / Week ☐	YELLOW: APW cannot be greater than 5days and MPW cannot be greater than 6days,unless there is a Capacity deviation approved												
C	Shifts / Day ☐	Check working pattern is matching with the reality												
D	Total Hours / Shift ☐													
E	Contractual Planned Downtime - lunch, breaks, etc. ☐													
F	Dedicated or Shared Process													
F1	Allocation Percent (automatically displayed) ☐	YELLOW: Process is "Dedicated" but the Shared Loading Plan shows more parts manufactured in this process RED: More than one "X" placed in the Shared Loading Plan. Please correct												
G	Net Available Time (hours / week) [B*C*(D-(E/60))*F] ☐	RED: the working pattern in this Phase (B, C, D or E) does not match with working pattern in "SHARED LOADING" tab												
G1	Planned Minutes per Changeover (into this part #) ☐	If the CAR is done for a family of parts, check changeover is in place, if applicable												
G2	Planned Changeover Frequency/Week (into this part #) ☐	Check that frequency of changeovers is reasonable and matches the reality												

A5) Required 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	
H	Percent of parts scrapped													
J	**Req'd Good Parts / Week to Support Next Process** (Accounts for the scrap loss of each process) ☐	RED: Required Good parts in "SHARED LOADING" tab do not match with this row												

	Avg. Weekly	Max Weekly	
Required Incoming Parts for Process 1			☐ Check these figures are the volumes used for the Capacity Analysis of subtiers

A6) Required OEE (Overall Equipment Effectiveness)

		APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	
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*M)] ☐	RED: the NICT in "SHARED LOADING" tab does not match with this row												
P	Theoretical Parts per week at 100% OEE [G x 3600 / N]													
Q	**Required OEE** [J / P] ☐	RED: the NICT in "SHARED LOADING" tab does not match with row N in this Phase or OEE>100% For dedicated lines, if OEE is too low, please check the working pattern												
R	Percent of parts reworked (re-run through process)													
S	Can process contain its changeover, scrap & rework													
T	% Remaining for Availability & Performance Efficiency losses {P - [(J/(100%-H)) + (JxR) + (G1x60xG2/N)]} / P ☐	YELLOW: Remaining % for Availability and Efficiency losses is less than 10%. Check OEE feasibility RED: OEE is not feasible, it cannot contain the changeover, scrap & rework												
	Enter any other assumptions for clarification													

A7) Shared Process - Total Allocation Plan

U	Total % Allocation from "SHARED LOADING Plan" Sheet ☐	YELLOW: Total Allocation is >90%, therefore a Detailed Shared Loading Tool is mandatory RED: Total Allocation is >100% RED & "Check Shared tab": Please check date in "SHARED LOADING", row 71

1.5 Section B – Capacity Planning

B. Supplier Demonstrated OEE (Overall Equipment Effectiveness) - Historical Performance																
B1) Historical Performance (from Historical Mfg Performance Summary)																
	Process Description															
V	Supplier Name	☐	**Check data is clearly identifying the source of the Historical / Surrogate OEE**													
W	Supplier Location	☐														
X	Site Code for Surrogate Process	☐														
Y	Surrogate Customer & Program Reference (~Ford P221) List reference Surrogate Process (~Stamping Press #12)	☐														
Z	**Average Historical OEE**	☐	**RED: One or more OEE figures in the Historical Mfg Performance are higher than 100%**													
	Enter any other assumptions for clarification (Part Number, Annual Volume, Operating Pattern, etc.)	☐	**Use this row to clarify the Historical / Surrogate performance data**													
B2) Process Specific Weekly Part Estimate [P * Z]																

1.6 Section B – Phase 0

B. Supplier Demonstrated OEE - Phase 0 PPAP (Run @ Rate)															
B1) Equipment Availability															
V	Total Available Time (ACTUAL changeover NOT included for Shared) (minutes) ☐	**Check that Changeover is NOT included**													
W	Planned Downtime - lunches/breaks/mtgs. (minutes) ☐	**Check data is consistent with the Contractual downtime** (e.g. if contractual downtime is 30 minutes per shift, we cannot have 40 minutes in 4 hours)													
X	Net Available Time (minutes) [V - W]														
Y	Shared Equip Changeover Time ACTUAL (minutes)	NOT REQUIRED		NOT REQUIRED		NOT REQUIRED		NOT REQUIRED		NOT REQUIRED		NOT REQUIRED			
Z	Shared Equip Changeover Time Weekly Scaled (minutes) [(G1 * G2 * X) / (60*G - (G1 * G2))]														
AB	Observed Unplanned Downtime (minutes)														
AC	Operating Time (minutes) [X - AB]														
AD	**Equipment Availability [(X - AB) / (X + Z) * 100]** ☐	**RED: Check operating time: more downtime than Total Available Time**													
B2) Performance Efficiency															
AE	Total Parts Run (Good, Scrapped, & Reworked)														
AF1	# of CURRENT Tools or Machines in parallel ☐	**RED: ERROR: More tools or machines in place than planned (L) / YELLOW: Not all tools or machines are in place as planned (L)**													
AF2	# of identical parts produced per Tool or Machine Cycle ☐	**RED: ERROR: More parts produced / YELLOW : Less parts produced - per Tool or Machine Cycle than planned (M)**													
AF	Planned Net Ideal Cycle Time (seconds/part) [N or Other]														
AG	**Performance Efficiency (AE * AF / AC)** ☐	**RED: ERROR: Over Performance: OEE is not calculated properly (process running faster than Ideal CT or OEE data not recorded properly)**													
AH	"Availability" and/or "Performance Efficiency" Losses Not Captured (minutes) [AC - (AE * AF)] ☐	**If figure too high, there is an issue with the cycle time or with the data collection system as losses are not being properly recorded**													
B3) Quality Rate		#	%	#	%	#	%	#	%	#	%	#	%		
AJ	# Parts Scrapped ☐	**YELLOW: Scrap rate higher than planned (H)**													
AK	# Parts Reworked ☐	**YELLOW: Rework rate higher than planned (R)**													
AL	**Quality Rate [(AE - AJ - AK) / AE]**														
B4) Overall Equipment Effectiveness (OEE)															
AM	**Phase 0 OEE [AD * AG * AL]** ☐	**Compare the OEE figure with the updated HISTORICAL MFG PERFORMANCE OEE data to understand if Phase 0 OEE is realistic and Demonstrated Capacity can be sustained. Also compare Phase 0 OEE with Required OEE**													
B5) Process Specific Weekly Part Estimate [P * AM]															
B6) Observed Average Cycle Time (sec/cycle) ☐		**YELLOW: Observed average CT is higher/lower than Planned NICT (AF), considering the number of tools and parts produced per tool for the Phase 0 run. If faster CT observed, Ideal Cycle time K needs to be adjusted. If slower, an action plan should be placed**													

1.7 Section B – Phase 3

B. Supplier Demonstrated OEE - Phase 3 PPAP (Capacity Verification)														
B1) Equipment Availability														
V	Total Available Time (Include ACTUAL changeover time for Shared) (minutes) ☐	**Check run duration is representative and Changeover Time is included**												
W	Planned Downtime - lunches/breaks/mtgs. (minutes) ☐	**Check data is consistent with the Contractual downtime** (e.g. if contractual downtime is 30 minutes per shift, we cannot have 40 minutes in 4 hours)												
X	Net Available Time (minutes) [V - W]													
Y	Shared Equip Changeover Time ACTUAL (minutes)													
Z	Shared Equip Changeover Time Weekly Scaled (minutes) [Y * (X / 60) / (G / G2)] ☐	**YELLOW: Actual / Demonstrated Changeover Time (Y) is significantly lower or higher than planned (G1)**												
AB	Observed Unplanned Downtime (minutes)													
AC	Operating Time (minutes) [X - Y - AB]													
AD	**Equipment Availability [(X - Z - AB) / X * 100]** ☐	**RED: * Missing Change Over Time ACTUAL (Y) when there is a planned CHOT identified in Section A) (rows G1 & G2) * More downtime than Total Available Time**												
B2) Performance Efficiency														
AE	Total Parts Run (Good, Scrapped, & Reworked)													
AF	Net Ideal Cycle Time (seconds/part) [N]													
AG	**Performance Efficiency (AE * AF / AC)** ☐	**RED: ERROR: Over Performance: OEE is not calculated properly (process running faster than Ideal CT or OEE data not recorded properly)**												
AH	"Availability" and/or "Performance Efficiency" Losses Not Captured (minutes) [AC - (AE * AF)] ☐	**If figure too high, there is an issue with the cycle time or with the data collection system as losses are not being properly recorded**												
B3) Quality Rate		#	%	#	%	#	%	#	%	#	%	#	%	
AJ	# Parts Scrapped ☐	**YELLOW: Scrap rate higher than planned (H)**												
AK	# Parts Reworked ☐	**YELLOW: Rework rate higher than planned (R)**												
AL	**Quality Rate [(AE - AJ - AK) / AE]**													
B4) Overall Equipment Effectiveness (OEE)														
AM	**Phase 3 OEE [AD * AG * AL]** ☐	**Compare the OEE figure with the updated HISTORICAL MFG PERFORMANCE OEE data to understand if Phase 3 OEE is realistic and Demonstrated Capacity can be sustained. Also compare Phase 3 OEE with Required OEE**												
B5) Process Specific Weekly Part Estimate [P * AM]														
B6) Observed Average Cycle Time (sec/cycle) ☐		**YELLOW : Observed average CT is higher / lower than Planned NICT (AF), considering the number of tools and parts produced per tool for the Phase 3 run. If faster CT observed, Ideal Cycle time K needs to be adjusted. If slower, an action plan should be placed**												

1.8 Section C (All Phases)

C. Gap Analysis - Required OEE vs. Demonstrated OEE; Predicted Good Parts / Week

		Process Description	"OEE>100": Required OEE or Demonstrated OEE is >100% "RISK": Demonstrated OEE < Required OEE "See Row U": Total allocation is not in place (the corresponding Phase needs to be selected in the Introduction Sheet) or Total allocation is higher than 100% "See Row S": Process OEE cannot contain Changeover, Scrap & Rework assumptions
		Demonstrated OEE ≥ Required OEE? (Is AM ≥ Q?) ☐	
Predicted Good Parts per wk	Average	Maximum	
Required Capacity (APW/MPW)			"Check Declarations and Notes": Supplier Declar. and Notes is not properly filled in or the corresponding Phase (Planning, Phase 0 or Phase 3) is not done for all subtiers "See Capa Results": Capacity Analysis Results RED warning is not allowing to properly calculate real Capacity "Missing Process Data": A process identified with data in A) Section has no data in B) section RED & Message of Downstream scrap: Due to planned or demonstrated downstream scrap, there is not enough capacity. Bottleneck process due to downstream scrap is identified in the row below "Process Description"
Planned / Demonstrated Capacity ☐			
Commitment (APPC/MPPC) ☐			Check PPC entries in: PSW, GCP & MCPV are aligned with the CAR before sign-off RED : Commitment volumes are lower than Required Capacity or higher than Demonstrated Capacity
NOTES			
Use the Notes section to improve communication about CAR data, assumptions, clarifications, etc. ☐ When CAR is for a FAMILY of parts: Check that individual PPC volumes for each part reference are indicated in the Notes section			

SUPPLIER OPERATION MANAGEMENT APPROVAL

Authorized Representative Name / Title | Email

Signature | Date | Phone Number

Check CAR version ☐

Version 5.6

☐ YELLOW : PPC >10% than volumes used for this Analysis. Check Phase 3 OEE can be sustained and all sub suppliers can provide these higher volumes

☐ Approved
☐ Rejected

Site Engineer | STA LL6 Supervisor

Signature/Date | Signature/Date

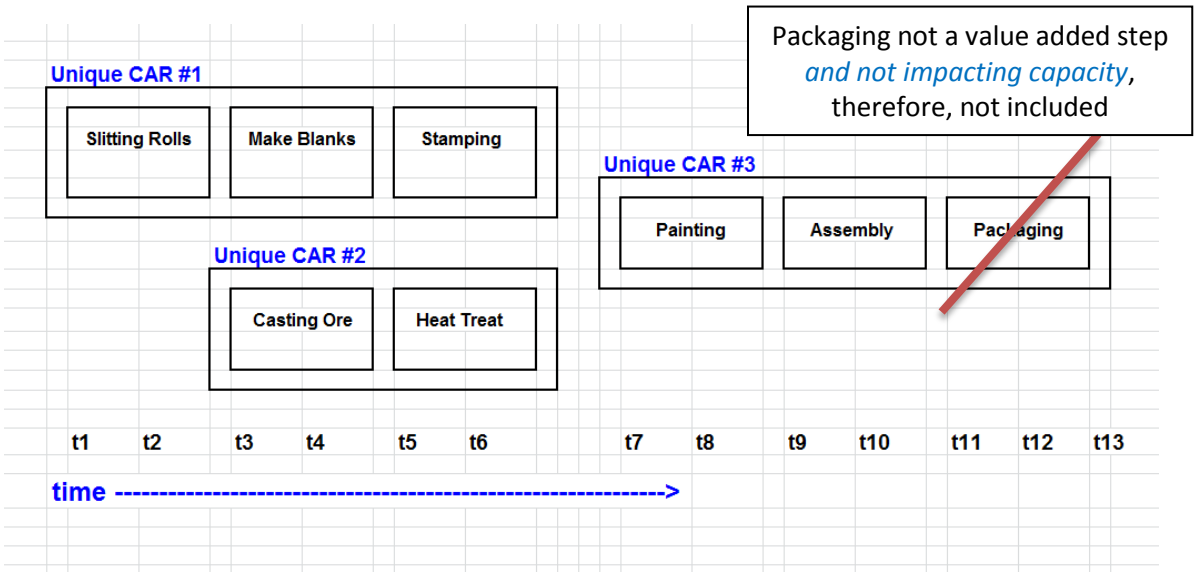
2. PROCESS SEQUENCING / VALUE-ADD INCLUSION
Section A: Establishing the Processes

Common error states impact:
- Parallel processes
- Non Value-add processes, *not impacting the capacity and not altering the part.*

An error state exists when a Capacity Planner includes processes {on a single CAR (Capacity Analysis Report) Form} that are parallel to one another, and therefore are not in sequential order. Two processes that run concurrently (which both supply a third process) need to be assessed on separate analyses, on separate CAR Forms. An error state also exists when a Capacity Planner includes processes on the CAR Form that do not add value to the manufacturing process (which does not alter a part) *and it is not impacting the capacity*, such as packaging.

Exhibit 1.1 presents a set of manufacturing value streams where two or more processes run parallel to one another. Note that parallel processes are to be analyzed on separate CAR Forms (and as separate streams). Exhibit 1.1 demonstrates this by showing that three CAR Forms are required to analyze the eight processes listed. Parallel processes are those which run separately and simultaneously, assuming coordinated cycle times between the parallel process, and which typically end at the same time, but may or may not begin at the same time. A Capacity Planner attempting to analyze all eight of the processes in a single CAR Form would find it impossible to determine the appropriate contribution to the downstream process from each of the parallel processes separately.

Exhibit 1.1: Manufacturing Value Streams



In Exhibit 1.2 below, it is not clear if **Process 1** (Machining) and **Process 2** (Casting) are correctly entered in Section A4 of the CAR Form. This is because it is often the case that a machining process will not occur before a casting process. Generally, machining will follow a casting process step. Upon encountering an example such as the one in Exhibit 1.2 below, a Capacity Planner would need to confirm that the parts actually flow from the Machining process into the Casting process. If this is not the case, then the Capacity Planner would conclude that the CAR Form is set up incorrectly and that Casting is to be assessed as a process step prior to Machining (see arrow below suggesting transfer of the casting step to prior to Machining).

In Exhibit 1.2 below, **Process 3** is entered correctly. However, it is not likely that **Process 4** is entered correctly, since packaging does not generally alter a manufactured part or have any impact on capacity and therefore is not value added for manufacturing. In this example, **Process 4** may need to be removed. **However, if Packaging does impact capacity, Packaging would be included in the CAR.**

Packing removed due to no manufacturing value added and no impact on capacity

Exhibit 1.2

	A4) Planned Departmental Operating Pattern & Net Available Time for All Customers	Process 1		Process 2		Process 3		Process 4	
		APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan	APW Plan	MPW Plan
A	Process description (in value stream order)	Machining		Casting		Assembly		Packagin	
B	Days / Week	5	6	5	6	5	6	5	6
C	Shifts / Day	3	3	3	3	3	3	3	3
D	Total Hours / Shift	8	8	8	8	8	8	8	8
E	Contractual Downtime - lunch, breaks, etc. (min/shift)	40	40	40	40	40	40	40	40
F	Dedicated or Shared Process	Shared		Shared		Dedicated		Dedicated	
F1	Allocation Percent (automatically displayed)	50,0%	50,0%	30,0%	30,0%	100,0%	100,0%	100,0%	100,0%
G	Net Available Time (hours / week) [B*C*(D-(E/60))*F1]	55,00	66,00	33,00	39,60	110,00	132,00	110,00	132,00
G1	Planned Minutes per Changeover (into this part #)	180		90					
G2	Planned Changeover Frequency / Week (into this part #)	1,00		2,00					

Processes must be input on the CAR Form in value-stream order, to linearly represent the impact of expected scrap losses. When a separate analysis is used for an upstream parallel process, the Capacity Planner should enter unique volume requirements in Section A2 of the CAR Form, accounting for downstream scrap losses. The Capacity Planner should not simply enter the Ford volume (APW and MPW) requirements into the separate upstream CAR form(s), because those capacity requirements do not account for the subsequent downstream scrap losses.

Note 1: in Exhibit 1.1 above, CARs 1 and 2 analyze the parallel upstream processes, whereas CAR 3 analyzes the single downstream process. Therefore, CAR 3 would use Ford's APW and MPW as capacity requirement inputs and CARs 1 and 2 would use capacity requirements of APW and MPW increased to account for the scrap loss of the CAR 3 processes.

Individuals who review CAR Forms will sometimes identify processes that do not impact the manufacturing process flow's capacity. As previously stated; packaging may not belong in Exhibit 1.2, because packaging does not generally modify a produced part or potentially create scrap or rework. Other examples of processes which may not impact capacity include material movement activities, warehousing, and staging.

3. IDEAL CYCLE TIMES

Common error state:
• Using incorrect cycle times or cycle times that include efficiency loss factors, such as 85%.

One of the most common error states is in documentation of Ideal Cycle Times per Tool or Machine (seconds per cycle). Since Ideal Cycle Times factor directly into calculations of Required OEE and Demonstrated OEE, it is imperative that Ideal Cycle Times be accurately documented. For clarification on what Ideal Cycle Time **is** and what Ideal Cycle Time **is not,** refer to the two following lists:

Ideal Cycle Time **IS** the following**:**

1) The intended long term cycle time for an operation.
2) The best cycle time that is achieved and sustainable.
3) The amount of time that passes between the beginning of one cycle and the beginning of the next cycle *(without inefficiencies).*

Ideal Cycle Time **IS NOT** the following**:**

1) **NOT** an engineering standard cycle time.
2) **NOT** inclusive of efficiency loss factors. (Statements such as "we adjust for 85% efficiency" are red flags and should not be used in analysis).
3) **NOT** adjusted to compensate for multiple machines (for example, it is not recorded as 10 seconds where there are two machines making the same parts at a rate of 20 seconds per part)

4. REQUIRED OEE (Overall Equipment Effectiveness)

Required OEE cannot represent reality and exceed 100%, even for a part of a manufacturing process. If the Required OEE is calculated to be greater than 100%, then a problem exists with the inputs used to calculate Required OEE. OEE is calculated using good parts produced (total parts minus scrap and rework), net ideal cycle time and net available time. Review all those inputs or values contributing to those parameters for accuracy.

On the other hand, for dedicated processes, if Required OEE is very low, it may indicate that we are not placing a realistic working time. It is recommended to place the expected working time for the dedicated process based on the volumes.

If **required OEE is higher than demonstrated OEE**, the *most* effective method is to **increase the demonstrated OEE** by methodically finding and eliminating losses in the manufacturing process, including: reducing scrap and rework of the demonstrated run, more closely aligning the net ideal cycle time with that which was planned, improving changeover time and consistency, eliminating unplanned downtime, etc. and then re-running the line.

Also the **required OEE may be reduced**. The following actions can reduce the Required OEE:

1) Increase the operating pattern

The operating pattern may be increased by increasing the Days / Week (Line B), Shifts / Day (Line C),
Total Hours / Shift (Line D), or Allocation Percent for shared processes (Line F). Additionally, the Contractual Planned Downtime (Line E) may be reduced.

2) Reduce Scrap Loss for DOWNSTREAM processes

Scrap loss in downstream processes does have an impact on upstream process Required OEEs. If possible, explore reducing the scrap loss (Line H) for downstream processes.

3) Reduce the Net Ideal Cycle Time (NICT)

Assuming that the dataset is accurate, including the ideal cycle time used, it may be possible to reduce the NICT by cycle time reductions, load / unload optimization, or if possible the use of additional processes.

5. DEMONSTRATED OEE (Overall Equipment Effectiveness)

Demonstrated OEE must be broken into two unique subsets for analysis, due to the source of the data at different periods in the capacity analysis methodology.

1) In Capacity Planning, surrogate or historical processes are used – which bring their own potential error states.
2) Phase 0 PPAP and Phase 3 PPAP use demonstrated OEE values from actual production events for the part(s) being analyzed.

Capacity Planning (Historical or Surrogate OEE)
Common error states include:

- Individual OEE values, even for short periods, greater than 100% are not physically possible
- Use of ramp-up, or Phased PPAP data for Surrogate / Historical (or other non-steady-state production) data
- Net Available Time (NAT) that is the same for each of the 25 weeks (potential error state indicating potentially unrealistic data)
- *Use OEE data only for the part being analyzed and not covering all other parts produced in the process.*

OEE cannot, for any data point on any process, be greater than 100%, even if the overall OEE is less than 100%. If a data point reflects such an error, there is likely confusion about the Net Ideal Cycle Time (NICT) for the process, or the Net Available Time (NAT) is understated. NAT typically varies from week to week as releases for surrogate/historical parts vary.
We also need to consider that for shared processes with different NICT, weighted NICT calculation is needed. See attached file to help the calculation.

*Click on the red icon to open the "**WEIGHTED NICT**" Excel file* 

Note that wide variance among weekly entries within the ***Historical Mfg Performance*** sheet also may indicate incorrect data collection.

Depending on the availability of production data, or the confidence that the supplied production data is accurate, it may be necessary to initiate the acquisition of data for calculation of historical OEE and subsequent analyses.

6. CAPACITY REQUIREMENTS:

Common error state:
• Selection of an inappropriate source of capacity requirements

The source of capacity requirements is documented by the Capacity Planner at the top of any one of the three main sheets by selecting from the drop down menus in cell P5 (Section A2).

Please see below the lists of available sources of capacity requirements for each of the three main capacity analysis sheets. Refer to the capacity training for details on the appropriate timing and selection of capacity requirements source through https://www.lean.ford.com/cqdc/supplier_training.asp.

Capacity Planning dropdown menu	**Phase 0 PPAP (Run @ Rate)**	**Phase 3 PPAP (Cap Ver)**
Long-Lead Tool Order	Tool Order (Initial or Revised)	Tool Order (Initial or Revised)
WebQuote	WebQuote	Capacity Study
SOBA (Supplier On Board Agreement)	SOBA (Supplier On Board Agreement)	WebQuote
CPA (Commercial and Program Agreement)	CPA (Commercial and Program Agreement)	SOBA (Supplier On Board Agreement)
Capacity Study	Capacity Study	CPA (Commercial and Program Agreement)
Other (specify in Notes at bottom left)	Other (specify in Notes at bottom left)	Other (specify in Notes at bottom left)

Review the capacity source single point lesson available on https://web.qpr.ford.com/sta/Phased_PPAP.html.

7. COMMITTED VOLUMES:

Common error state:

• The commitment APPC / MPPC is not aligned with the analysis.

The purpose of the Capacity Planner entering the commitment APPC/MPPC onto the CAR is as follows:

- The commitment APPC / MPPC is the Average Purchased Part Capacity and Maximum Purchased Part Capacity the supplier can confidently and consistently produce within the operating patterns for APW and MPW as stated on the CAR.
- The supplier needs to meet the required capacity so the commitment APPC / MPPC need to be at least as high as the APW / MPW requirements
- If the demonstrated capacity is higher than the APW / MPW, that means for the run *(phase 0 or 3)* the supplier was able to make more parts than required under the demonstrated manufacturing assumptions of scrap, rework, shift pattern, breaks, shutdowns, changeovers, etc.
- The supplier may not be able to sustain the *Phase 0 or 3* production rate over a sustained period due to special causes
- *The supplier needs to ensure that all sub-tiers though the complete value chain can sustain the commitment APPC / MPPC*
- Therefore, the Capacity Planner may choose to document the commitment APPC / MPPC values to be less than the demonstrated capacity and to be at least as high as the required capacity APW/MPW as the committed sustained capacity. This is the value up to which the Ford plants plan to issue releases.
- Subject to local fluctuations, the Ford plants are not expected to issue sustained releases over APPC for regular running at the Ford plants and not over MPPC for overtime running. This is why it is very important for Capacity Planners to enter sustainable and realistic APPC and MPPC values onto the CAR.

Please note that

- Suppliers are required to enter their capacity commitments (APPC / MPPC) into Ford capacity planning systems (GCP/MCPV)
- In some cases, where the end item parts are not shipped directly to a Ford Assembly or Powertrain Manufacturing plant, but to a sequencer or assembler as the Ford customer; capacity requirements or the affected part numbers may not be available in GCP/MCPV and therefore, it is not possible to report APPC/MPPC for those parts.
- Suppliers are required to evaluate their APPC / MPPC commitments every quarter (3 months) and enter the updated APPC / MPPC values via the Purchased Part Capacity maintenance screens in GCP / MCPV. Suppliers should use the CAR to determine the quarterly APPC/MPPC values.
- Sub-tier suppliers capacity limitation may lead to a tier 1 supplier limiting the APPC/MPPC commitment

What should suppliers/STA do?

- Suppliers record their capacity commitment on the PSW (PPAP Part Submission Warrant AND on the CAR as well as in GCP / MCPV)
- Suppliers must include a screen print of the Purchased Part Capacity maintenance screen with their PPAP submissions and PPAP records to demonstrate the values entered into GCP / MCPV.
- STA site engineers need to interpret whether or not the supplier capacity commitment (PPC) is reasonable and likely to be sustainable for the duration of the program when compared with the Phase 3 CAR output (Predicted Good Parts Per Week) by comparing Good Parts Per Week with the APPC / MPPC values
- Ford required APW/MPW is the minimum requirement for the Commitment APPC / MPPC. If the commitment (APPC/MPPC) numbers are lower than the Ford required numbers (APW/MPW), it means there is a shortfall and the CAR should be rejected. However, the supplier is still required to enter the APPC and MPPC into GCP / MCPV, even if lower than required.

8. RECORD OF REVISIONS:

More Error States can be added to this document as appropriate.

The CAR 5.*6* User Guide and training page are at the following address:
https://www.lean.ford.com/cqdc/supplier_training.asp

Date	Approved by / Update Description
February 2010	STA OCM / Original release
February 2016	STA OCM / Rewrite for version 5.5 CAR with clarifications of existing error states
February 2018	STA Site director forum / R*ewrite for version 5.6 CAR with clarifications of colour codes and existing error states*

Significant updates are marked in blue italics