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Production Capacity Assessment Tool

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0. INTRODUCTION

The Production Capacity Assessment Tool detailed in this document has been reviewed by the Odette Supply Chain Risk Management team and is recommended and endorsed as the preferred, proactive risk management methodology for checking the planned and actual capacity of a production facility. The SCRM team would like to thank GALIA for allowing access to the tool.

The GALIA Work Group started in June 2012 and set out the following objectives:

- Clarify, explain and define precisely customer expectations and the consequences if capacity demand is under or over used,
- Create a glossary of definitions used in capacity management,
- Define the characteristics relevant to medium and long-term capacity management,
- Establish a recommendation to improve control of production capacity management for sub-tier suppliers.

This document is an answer to some of these objectives. Creating a glossary of common terms associated with capacity management was not an easy task. After benchmarking the tools and methods used by companies participating in the Work Group, it was finally decided to take a capacity assessment tool used on the shop floor by PSA Peugeot Citroën as a starting point, and then to simplify and standardise it. This enabled the Work Group to agree on the terms to be used in this new standard assessment.

The Work Group observed that the calculation of a production capacity and the identification of bottlenecks can depend on:

- Communication and co-ordination between the following functions:
  - Commercial: contracted capacity and complementary customer expectations (planning, investments, other contractual items…),
  - Production: capacity impacts due to workshop organisation, labour availability, training and versatility, operational performance of the production processes,
  - Quality: capacity impacts due to product design and conformity (scrap rate, rework…),
  - Methods: capacity impacts due to equipment design, production means layout and associated work processes,
  - Logistics: capacity impacts due to the logistics environment of the supplier (containers, subcontractors, logistics means, floor space, personnel, IT systems…),
  - Purchasing: capacity impacts due to sub-tier suppliers' contracts.
- The good management of the capacity data to be taken into account, which requires:
  - A standard glossary on capacity management,
  - Standard calculation formulae: There are often mistakes when calculating Overall Equipment Effectiveness rates (Operating Time used, taking into account *On-line Rework* or not, minor-stops, downstream scrap etc…).

The **Production Capacity Assessment Tool** described in this document offers the advantage of standardising all of the business parameters that are necessary to calculate production capacity.

Therefore, it enables users to evaluate truly comparable data by utilising standard calculation parameters that are used within the automotive industry.

It has been considered as a good compromise to use the calendar week as a standard timespan.

This Tool can be used to:

- Ensure that the *Estimated Target Capacity* is calculated correctly and is sufficient to satisfy the customer(s) capacity demand,
- Measure a Production Run in order to calculate the actual available capacity and compare it to the *Estimated Target Capacity* and the *Customer Capacity Demand*,
- Identify the bottlenecks of a complete production process,
- Build a complete plant capacity mapping,
- Justify and argue for a complementary investment plan,
- Identify necessary action plans to reach the *Customer Capacity Demand*.

The Tool can be used in the following phases:

- Project phase, after definitive processes are implemented, in order to check:
  - Progress of the production process setup (efficiency, cycle time),
  - The consistency of the supplier's action plan, to ensure convergence of the measured capacity and the *Estimated Target Capacity*.
- Mass production phase: the measured capacity should be close to the *Estimated Target Capacity*.

This tool is useful to assess the capability of a production process to produce in QUANTITY.

It is by no means a guarantee of:

- **the capability to produce in QUALITY**, although before any capacity measurement phase:
  - The product must be considered to meet expectations,
  - Quality and control processes must be in operation and completely respected.
- **the capability of a production site to DELIVER in quantity**, as other items (not directly related to production capacity) can influence capability to deliver on time.

1. PRESENTATION OF THE TOOL

The tool is composed of 4 MS Excel spreadsheets:

☞ The **Capacity Mapping** spreadsheet gives a synthetic summary of the production capacity by comparing the customer(s) capacity demand with the supplier's production process capacity. It enables any bottlenecks in the process to be identified.

☞ The **Process Layout** spreadsheet enables an overall illustration of production flows and *Macro-Steps*. A *Macro-Step* is defined as a grouping of homogenous process/workers without any disruption of flow. A *Macro-Step* can contain several work stations with no flow disruption between them, at the end of which the number of parts produced can be counted.

☞ The **Production Run** spreadsheet enables the collection of the measurements from the shop floor for each *Macro-Step*.

☞ The **Efficiency Evaluation** spreadsheet enables the calculation of:

- The *Estimated Target Overall Efficiency* that the supplier considers to be reached in serial life,
- The *Run Observation Overall Efficiency* measured through a Production Run (using the data entered in the **Production Run** spreadsheet).

In all those spreadsheets, the following initials are used:

☞ **h/w**: hours per week.

☞ **p/w**: parts per week.

☞ **sec or s**: seconds.

In order to facilitate the use of the Assessment Tool, colour codes are used in the different spreadsheets:

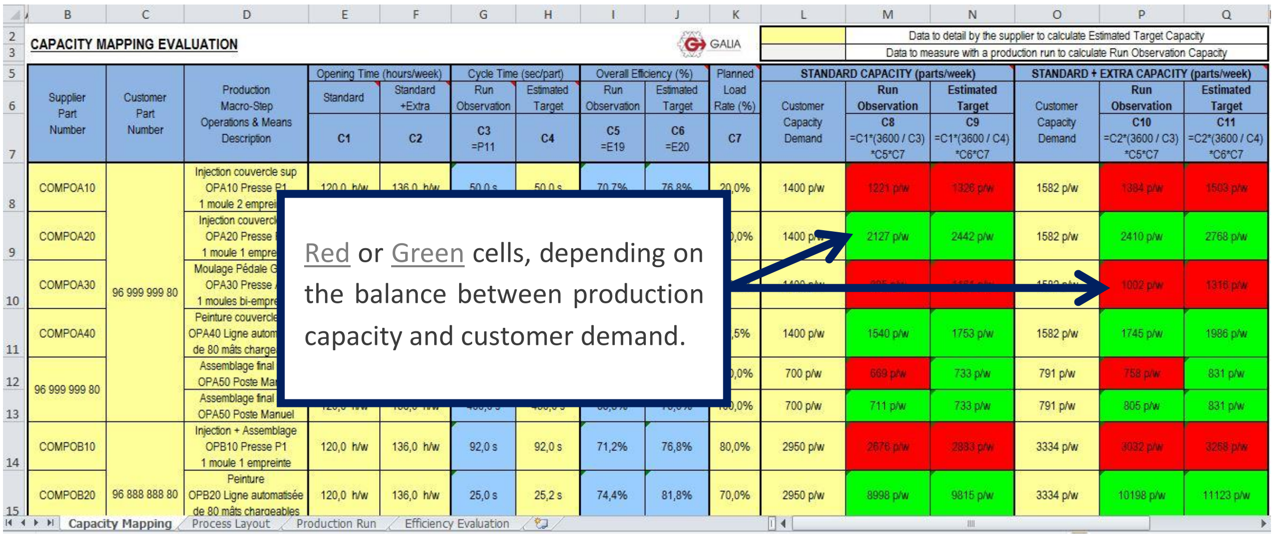
☞ **Yellow**: These cells are to be completed by the user in order to check that the estimated production capacity is in line with customer(s) demand.

☞ **Pale Grey**: Cells to be completed during the shop floor measurement phase (during a Production Run).

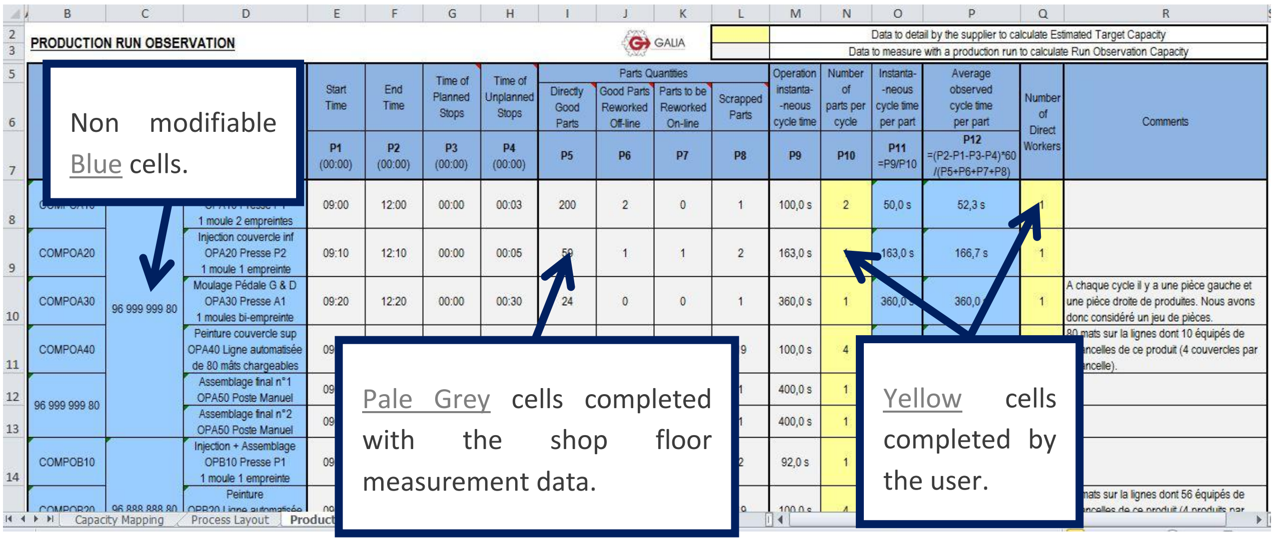
☞ **Blue**: Calculated cells or headers, not to be modified.

☞ **Red / Green**: Results with a conditional format depending on the balance between production capacity and customer demand. These cells are originally unmodifiable **Blue** cells.

Example of the Capacity Mapping spreadsheet:



Example of the Production Run spreadsheet:



In order to understand the formulae better, each required column is quoted in line 7 of each spreadsheet:

- Cx (x represents a number) for the columns in the Capacity Mapping spreadsheet,
- Px for the columns in the Production Run spreadsheet,
- Ex for the columns in the Efficiency Evaluation spreadsheet.

When formulae are described, these are the references used.

Example of the Efficiency Evaluation spreadsheet:

OVERALL EFFICIENCY EVALUATION — GALIA

Data to detail by the supplier to calculate Estimated Target Capacity
Data to measure with a production run to calculate Run Observation Capacity

B	C	D	E	F	G	H	I	J
Supplier Part Number	Customer Part Number	Production Macro-Step Operations & Means Description	RUN OBSERVATION (%) Unplanned Stops E1 =P4/(P2-P1-P3)	Other Losses E2 =1-(P11/P12)	On-line Rework E3 =P7/(P5+P6+P7+P8)	Scrap E4 =P8/(P5+P6+P7+P8)	Downstream Scrap to Re-impact E5	Run Operationnal Efficiency E6 =(1-E1)*(1-E2)*(1-E3-E4)*(1-E5)
COMPOA10	96 999 999 80	Injection couvercle sup OPA10 Presse P1 1 moule 2 empreintes	1,7%	4,4%	0,0%	0,5%	19,7%	75,1%
COMPOA20		Injection couvercle inf OPA20 Presse P2 1 moule 1 empreinte	2,8%	2,2%	1,6%	3,2%	5,9%	85,2%
COMPOA30		Moulage Pédale G & D OPA30 Presse A1 1 moules bi-empreinte	16,7%	0,0%	0,0%	4,0%	5,9%	75,3%
COMPOA40		Peinture couvercle sup OPA40 Ligne automatisée de 80 mâts chargeables	3,3%	7,3%	0,0%	14,7%	5,9%	71,9%
96 999 999 80		Assemblage final n°1 OPA50 Poste Manuel	0,0%	24,4%	0,0%	5,9%	0,0%	71,1%
		Assemblage final n°2 OPA50 Poste Manuel	0,0%	0,0%	0,0%	5,6%	0,0%	75,6%
COMPOB10		Injection + Assemblage OPB10 Presse P1 1 moule 1 empreinte	2,8%	4,5%	0,9%	1,8%	16,2%	75,6%
		Peinture						

B	K	L	M	N	O	P	Q	R	S	
Supplier Part Number	ESTIMATED TARGET (%) Unplanned Stops E7	Other Losses E8	On-line Rework E9	Scrap E10	Downstream Scrap to Re-impact E11	Target Operationnal Efficiency E12 =(1-E7)*(1-E8)*(1-E9-E10)*(1-E11)	PLANNED ST… Standard Opening Time E13 =C1 h/week	Preventive Maintenance Planned Operations E14 h/week	Description	E… h/w…
COMPOA10	1,0%	1,0%	0,0%	1,0%	16,0%	81,5%	120,0 h/w	5,0 h/w	Une heure par jour	2,0
COMPOA20	1,0%	1,0%	0,0%	1,0%	1,0%	96,1%	120,0 h/w	5,0 h/w		2,0
COMPOA30	1,0%	1,0%	0,0%	1,0%	1,0%	96,1%	120,0 h/w	2,5 h/w	10 min par équipe	0,0
COMPOA40	1,0%	1,0%	0,0%	15,0%	1,0%	82,5%	120,0 h/w	1,0 h/w	Une heure par semaine	0,0
96 999 999 80	5,0%	10,0%	1,0%	1,0%	0,0%	83,8%	120,0 h/w	0,5 h/w	30 min par semane	0,0
	5,0%	10,0%	1,0%	1,0%	0,0%	83,8%	120,0 h/w	0,5 h/w		0,0
COMPOB10	1,0%	1,0%	0,0%	1,0%	16,0%	81,5%	120,0 h/w	5,0 h/w	Une heure par jour	2,0

Capacity Mapping / Process Layout / Production Run / Efficiency Evaluation

Example of the Production Run spreadsheet:

PRODUCTION RUN OBSERVATION — GALIA

Data to detail by the supplier to calculate Estimated Target Capacity
Data to measure with a production run to calculate Run Observation Capacity

B	C	D	E	F	G	H	I	J	K	L
Supplier Part Number	Customer Part Number	Production Macro-Step Operations & Means Description	Start Time P1 (00:00)	End Time P2 (00:00)	Time of Planned Stops P3 (00:00)	Time of Unplanned Stops P4 (00:00)	Parts Quantities: Directly Good Parts P5	Good Parts Reworked Off-line P6	Parts to be Reworked On-line P7	Scrapped Parts P8
COMPOA10	96 999 999 80	Injection couvercle sup OPA10 Presse P1 1 moule 2 empreintes	09:00	12:00	00:00	00:03	200	2	0	1
COMPOA20		Injection couvercle inf OPA20 Presse P2 1 moule 1 empreinte	09:10	12:10	00:00	00:05	59	1	1	2
COMPOA30		Moulage Pédale G & D OPA30 Presse A1 1 moules bi-empreinte	09:20	12:20	00:00	00:30	24	0	0	1
COMPOA40		Peinture couvercle sup OPA40 Ligne automatisée de 80 mâts chargeables	09:30	10:30	00:00	00:02	110	0	0	19
96 999 999 80		Assemblage final n°1 OPA50 Poste Manuel	09:40	12:40	00:30	00:00	16	0	0	1
		Assemblage final n°2 OPA50 Poste Manuel	09:50	12:50	00:30	00:00	17	0	0	1
COMPOB10		Injection + Assemblage OPB10 Presse P1 1 moule 1 empreinte	09:10	12:10	00:00	00:05	105	1	1	2
COMPOB20	96 888 888 80	Peinture OPB20 Ligne automatisée	09:30	10:30	00:00	00:02	110	0	0	19

B	M	N	O	P	Q	R
Supplier Part Number	Operation instanta--neous cycle time P9	Number of parts per cycle P10	Instanta--neous cycle time per part P11 =P9/P10	Average observed cycle time per part P12 =(P2-P1-P3-P4)*60/(P5+P6+P7+P8)	Number of Direct Workers	Comments
COMPOA10	100,0 s	2	50,0 s	52,3 s	1	
COMPOA20	163,0 s	1	163,0 s	166,7 s	1	
COMPOA30	360,0 s	1	360,0 s	360,0 s	1	A chaque cycle il y a une pièce gauche et une pièce droite de produites. Nous avons donc considéré un jeu de pièces.
COMPOA40	100,0 s	4	25,0 s	27,0 s	4	80 mats sur la lignes dont 10 équipés de balancelles de ce produit (4 couvercles par balancelle).
96 999 999 80	400,0 s	1	400,0 s	529,4 s	1	
	400,0 s	1	400,0 s	500,0 s	1	
COMPOB10	92,0 s	1	92,0 s	96,3 s	1	
COMPOB20	100,0 s	4	25,0 s	27,0 s	4	80 mats sur la lignes dont 56 équipés de balancelles de ce produit (4 produits par

Capacity Mapping / Process Layout / Production Run / Efficiency Evaluation

In the remainder of the guidelines, we will refer to the Excel columns (A, B, C, D…).

2. GUIDE TO USE OF THE TOOL

2.1 ESTIMATED TARGET CAPACITY

In order to calculate the *Estimated Target Capacity* of the supplier's production process and to compare it with the *Customer Capacity Demand*, it is necessary to start by completing all the **Yellow** cells of the Excel spreadsheets.

2.1.1 CAPACITY MAPPING SPREADSHEET

- Enter all the *Macro-Steps* of your process (column D). Reminder: a *Macro-Step* is defined as a grouping of homogenous processes/workers without any disruption of flow. A *Macro-Step* can contain several work stations with no flow disruption between them, at the end of which the number of parts produced can be counted.
- Link these operations with customer and supplier part numbers (columns B and C).
- Enter *Opening Time* in hours per week (columns E and F). Refer to the glossary for the definitions.
- For each *Macro-Step*, enter the *Estimated Target Cycle Time*, in seconds per part (column H).
- Enter the *Planned Load Rate* attached to the *Macro-Step* (column K). Beware: the global load of a production means (for all products and all customers) must not exceed 100%!
- *Customer Capacity Demand* columns are completed based on customer data (columns L and O).

Columns G, I, J, M, N, P, Q calculate automatically using data coming from other Tabs of the Excel spreadsheets.

2.1.2 PROCESS LAYOUT SPREADSHEET

- Describe each *Macro-Step* and their links in the production process (see specific instructions written at the top of this spreadsheet).

2.1.3 EFFICIENCY EVALUATION SPREADSHEET

- Columns K to O must be completed with the *Estimated Target* values of process operational losses (see detailed definitions in comment of each column header):
  - % of Unplanned Stops,
  - % of Other Losses,
  - % of On-line Rework,
  - % of Scrap,
  - % of Downstream Scrap to Re-impact (the formula to use is described in the glossary).
- Columns R to W shall be completed with the specific *Planned Stops* values and descriptions for the *Macro-Step*.

In the **Capacity Mapping** spreadsheet:

- Columns *Estimated Target Overall Efficiency* (column J), *Estimated Target Capacity* (columns N and Q) are updated automatically and are now meaningful.
- The *Estimated Target Capacity* (columns N and Q) can be compared to the *Customer Capacity Demand* (columns L and O). If values are greater or equal to the *Customer Capacity Demand*, the cells will show in **Green**, otherwise they will show in **Red**.

2.2 PRODUCTION RUN

In order to calculate the available capacity (*Run Observation Capacity*) and compare it to the *Estimated Target Capacity* and the *Customer Capacity Demand*, it is necessary to measure the results of a Production Run.

2.2.1 PRODUCTION RUN SPREADSHEET

Before performing a Production Run, don't forget to:

- Complete column N with the number of parts produced per cycle for each *Macro-Step*.
- Enter in column Q the number of direct workers assigned to each *Macro-Step*.

Then, print all the spreadsheets, and go to the shop floor.

It is recommended to begin measurement once the production line has started and already produced a few parts (full production rate with trained workers).

For each *Macro-Step*:

- Identify the location points for counting *Good Parts* and *Scrapped Parts*.
- Ask if *On-line Rework* can occur on this process. If the answer is positive:
  - If possible, ask that parts needing to be reworked on the line are segregated during the Production Run, so that they can be counted separately at the end of the run, in order to avoid distorting the measures.
  - If it is not possible to put them aside during the run (because rework should be done immediately in the flow) it will increase *Other Losses* rate.
- Ask if *Off-line Rework* can occur on this process. If the answer is positive, those parts shall be segregated during the run. At the end of the run, count them, and have them reworked out of the line in order to identify:
  - Good Parts Reworked Off-line.
  - Parts scrapped while trying to rework them.
- If production monitoring sheets are used (or IT system), check that they will enable, at the end of the run, to collect downtime (*Planned Stops* and *Unplanned Stops*) that occurred during the run.

- If Production Run downtime cannot be identified accurately at the end of the run (through monitoring sheets or IT system), downtime will be embedded in *Other Losses* rate.
- Then, make sure to isolate the parts already produced, to exclude them from measurement. It is recommended to start the run with empty containers.
- At a given time, start measurement and enter the run *Start Time* in column E.
- A few tenths of minutes after the start of the Production Run, measure the *Macro-Step Cycle Time*. Enter it in column M.
- Check that the number of parts per cycle (column N) is correct in order to have a correct *Cycle Time* per part in column O.
- Check that the number of direct workers of the *Macro-Step* is the same as the one in column Q.
- At a given time, end the run and enter the *End Time* in column F, count the quantities of *Good Parts*, *Scrapped Parts* and parts to be reworked. Enter these quantities in columns I to L.
- Collect and add up *Planned Stops*, and report the total value in column G.
- Collect and add up *Unplanned Stops*, and report the total value in column H.

After the run, update the **Production Run** spreadsheet with the data collected on paper during the run.

2.2.2 EFFICIENCY EVALUATION SPREADSHEET

Then, in the **Efficiency Evaluation** spreadsheet, complete column I with the *Downstream Scrap to Re-impact* (the formula to use is described in the glossary).

2.2.3 CAPACITY MAPPING SPREADSHEET

In the **Capacity Mapping** spreadsheet, *Run Observation Overall Efficiency* (column I) and *Run Observation Cycle Time* (column G) are updated automatically.

Standard Run Observation Capacity (column M) and *Standard+Extra Run Observation Capacity* (column P) are also updated. They represent the true available capacity of the means and can now be compared to:

- The *Customer Capacity Demand*: if the values are greater or equal to the *Customer Capacity Demand*, the cells will show in **Green**, otherwise they will show in **Red**.
- The *Estimated Target Capacity*.

Data from the 4 spreadsheets can be analysed in total to identify improvement actions.

3. RESULTS ANALYSIS

Once the file is fully completed (*Estimated Target* and *Run Observation*), it becomes easy to identify improvement actions if the *Customer Capacity Demand* (both in *Standard* organisation and *Standard+Extra* organisation) is not obtained.

Below are 2 examples that may arise:

Case N° 1: Run Observation Capacity and Estimated Target Capacity cells are both **Green**.

This means that the installed capacities are sufficient to satisfy the *Customer Capacity Demand*. Nevertheless, it is interesting to identify if there is a gap between the *Run Observation* data and *Estimated Target* data. It can allow the identification of anomalies and enables them to be corrected.

Example of the **Capacity Mapping** spreadsheet:

CAPACITY MAPPING EVALUATION — GALIA

(yellow)	Data to detail by the supplier to calculate Estimated Target Capacity
(grey)	Data to measure with a production run to calculate Run Observation Capacity

Supplier Part Number	Customer Part Number	Production Macro-Step Operations & Means Description	Opening Time (hours/week) Standard C1	Opening Time (hours/week) Standard +Extra C2	Cycle Time (sec/part) Run Observation C3 =P11	Cycle Time (sec/part) Estimated Target C4	Overall Efficiency (%) Run Observation C5 =E19	Overall Efficiency (%) Estimated Target C6 =E20	Planned Load Rate (%) C7	STANDARD CAPACITY (parts/week) Customer Capacity Demand	STANDARD CAPACITY (parts/week) Run Observation C8 =C1*(3600 / C3) *C5*C7	STANDARD CAPACITY (parts/week) Estimated Target C9 =C1*(3600 / C4) *C6*C7	STANDARD + EXTRA CAPACITY (parts/week) Customer Capacity Demand	STANDARD + EXTRA CAPACITY (parts/week) Run Observation C10 =C2*(3600 / C3) *C5*C7	STANDARD + EXTRA CAPACITY (parts/week) Estimated Target C11 =C2*(3600 / C4) *C6*C7
COMPOA10	96 999 999 80	Injection couvercle sup OPA10 Presse P1 1 moule 2 empreintes	120,0 h/w	136,0 h/w	50,0 s	50,0 s	70,7%	76,8%	20,0%	1400 p/w	1221 p/w	1326 p/w	1582 p/w	1384 p/w	1503 p/w
COMPOA20		Injection couvercle inf OPA20 Presse P2 1 moule 1 empreinte	120,0 h/w	136,0 h/w	163,0 s	160,0 s	80,2%	90,5%	100,0%	1400 p/w	2127 p/w	2442 p/w	1582 p/w	2410 p/w	2768 p/w
COMPOA30		Moulage Pédale G & D OPA30 Presse A1 1 moules bi-empreinte	120,0 h/w	136,0 h/w	360,0 s	350,0 s	73,7%	94,1%	100,0%	1400 p/w	885 p/w	1161 p/w	1582 p/w	1002 p/w	1316 p/w
COMPOA40		Peinture couvercle sup OPA40 Ligne automatisée de 80 mâts chargeables	120,0 h/w	136,0 h/w	25,0 s	25,2 s	71,3%	81,8%	12,5%	1400 p/w	1540 p/w	1753 p/w	1582 p/w	1745 p/w	1986 p/w
96 999 999 80		Assemblage final n°1 OPA50 Poste Manuel	120,0 h/w	136,0 h/w	400,0 s	430,0 s	61,9%	73,0%	100,0%	700 p/w	669 p/w	733 p/w	791 p/w	758 p/w	831 p/w
		Assemblage final n°2 OPA50 Poste Manuel	120,0 h/w	136,0 h/w	400,0 s	430,0 s	65,8%	73,0%	100,0%	700 p/w	711 p/w	733 p/w	791 p/w	805 p/w	831 p/w
COMPOB10	96 888 888 80	Injection + Assemblage OPB10 Presse P1 1 moule 1 empreinte	120,0 h/w	136,0 h/w	92,0 s	92,0 s	71,2%	76,8%	80,0%	2950 p/w	2676 p/w	2883 p/w	3334 p/w	3032 p/w	3268 p/w
COMPOB20		Peinture OPB20 Ligne automatisée de 80 mâts chargeables	120,0 h/w	136,0 h/w	25,0 s	25,2 s	74,4%	81,8%	70,0%	2950 p/w	8998 p/w	9815 p/w	3334 p/w	10198 p/w	11123 p/w

Capacity Mapping / Process Layout / Production Run / Efficiency Evaluation

In this example, it can be seen that the *Overall Efficiency* expected of 90.5% is in fact only at 80.2%!

The *Estimated Target Cycle Time* is also 160 seconds when the one measured during the Production Run is 163 seconds.

The **Efficiency Evaluation** spreadsheet enables the causes to be identified with regards to the expected and measured parameters influencing the *Overall Efficiency*:

- % of Unplanned Stops,
- % of Other Losses,
- % of On-line Rework,
- % of Scrap,
- % of Downstream Scrap to Re-impact.

Example of the **Efficiency Evaluation** spreadsheet:

OVERALL EFFICIENCY EVALUATION — GALIA

Data to detail by the supplier to calculate Estimated Target Capacity
Data to measure with a production run to calculate Run Observation Capacity

Supplier Part Number	Customer Part Number	Production Macro-Step Operations & Means Description	RUN OBSERVATION (%)						ESTIMATED TARGET (%)						PLANNED ST			
			Unplanned Stops	Other Losses	On-line Rework	Scrap	Downstream Scrap to Re-impact	Run Operationnal Efficiency	Unplanned Stops	Other Losses	On-line Rework	Scrap	Downstream Scrap to Re-impact	Target Operationnal Efficiency	Standard Opening Time	Preventive Maintenance Planned Operations		
			E1 =P4/(P2-P1-P3)	E2 =1-(P11/P12)	E3 =P7/(P5+P6+P7+P8)	E4 =P8/(P5+P6+P7+P8)	E5	E6 =(1-E1)*(1-E2)*(1-E3-E4)*(1-E5)	E7	E8	E9	E10	E11	E12 =(1-E7)*(1-E8)*(1-E9-E10)*(1-E11)	E13 =C1 h/week	E14 h/week	Description	E h/w
COMPOA10		Injection couvercle sup OPA10 Presse P1 1 moule 2 empreintes	1,7%	4,4%	0,0%	0,5%	19,7%	75,1%	1,0%	1,0%	0,0%	1,0%	16,0%	81,5%	120,0 h/w	5,0 h/w	Une heure par jour	2,0
COMPOA20		Injection couvercle inf OPA20 Presse P2 1 moule 1 empreinte	2,8%	2,2%	1,6%	3,2%	5,9%	[illegible]	1,0%	1,0%	0,0%	1,0%	1,0%	96,1%	120,0 h/w	5,0 h/w		2,0
COMPOA30	96 999 999 80	Moulage Pédale G & D OPA30 Presse A1 1 moules bi-empreinte	16,7%	0,0%	0,0%	4,0%	5,9%	75,3%	1,0%	1,0%	0,0%	1,0%	1,0%	96,1%	120,0 h/w	2,5 h/w	10 min par équipe	0,0
COMPOA40		Peinture couvercle sup OPA40 Ligne automatisée de 80 mâts chargeables	3,3%	7,3%	0,0%	14,7%	5,9%	71,9%	1,0%	1,0%	0,0%	15,0%	1,0%	82,5%	120,0 h/w	1,0 h/w	Une heure par semaine	0,0
96 999 999 80		Assemblage final n°1 OPA50 Poste Manuel	0,0%	24,4%	0,0%	5,9%	0,0%	71,1%	5,0%	10,0%	1,0%	1,0%	0,0%	83,8%	120,0 h/w	0,5 h/w	30 min par semane	0,0
		Assemblage final n°2 OPA50 Poste Manuel	0,0%	20,0%	0,0%	5,6%	0,0%	75,6%	5,0%	10,0%	1,0%	1,0%	0,0%	83,8%	120,0 h/w	0,5 h/w		0,0
COMPOB10		Injection + Assemblage OPB10 Presse P1 1 moule 1 empreinte	2,8%	4,5%	0,9%	1,8%	16,2%	75,6%	1,0%	1,0%	0,0%	1,0%	16,0%	81,5%	120,0 h/w	5,0 h/w	Une heure par jour	2,0
		Peinture																

Capacity Mapping / Process Layout / Production Run / Efficiency Evaluation

Case N° 2: Run Observation Capacity and/or Estimated Target Capacity cells are **Red**.

This means that the installed capacities are not sufficient to satisfy the *Customer Capacity Demand*.

Example of the **Capacity Mapping** spreadsheet:

CAPACITY MAPPING EVALUATION — GALIA

Data to detail by the supplier to calculate Estimated Target Capacity
Data to measure with a production run to calculate Run Observation Capacity

Supplier Part Number	Customer Part Number	Production Macro-Step Operations & Means Description	Opening Time (hours/week)		Cycle Time (sec/part)		Overall Efficiency (%)		Planned Load Rate (%)	STANDARD CAPACITY (parts/week)			STANDARD + EXTRA CAPACITY (parts/week)		
			Standard	Standard +Extra	Run Observation	Estimated Target	Run Observation	Estimated Target		Customer Capacity Demand	Run Observation	Estimated Target	Customer Capacity Demand	Run Observation	Estimated Target
			C1	C2	C3 =P11	C4	C5 =E19	C6 =E20	C7		C8 =C1*(3600 / C3)*C5*C7	C9 =C1*(3600 / C4)*C6*C7		C10 =C2*(3600 / C3)*C5*C7	C11 =C2*(3600 / C4)*C6*C7
COMPOA10		Injection couvercle sup OPA10 Presse P1 1 moule 2 empreintes	120,0 h/w	136,0 h/w	50,0 s	50,0 s	70,7%	76,8%	20,0%	1400 p/w	1221 p/w	1326 p/w	1582 p/w	1384 p/w	1503 p/w
COMPOA20		Injection couvercle inf OPA20 Presse P2 1 moule 1 empreinte	120,0 h/w	136,0 h/w	163,0 s	160,0 s	80,2%	90,5%	100,0%	1400 p/w	2127 p/w	2442 p/w	1582 p/w	2410 p/w	2768 p/w
COMPOA30	96 999 999 80	Moulage Pédale G & D OPA30 Presse A1 1 moules bi-empreinte	120,0 h/w	136,0 h/w	360,0 s	350,0 s	73,7%	94,1%	100,0%	1400 p/w	885 p/w	1161 p/w	1582 p/w	1002 p/w	1316 p/w
COMPOA40		Peinture couvercle sup OPA40 Ligne automatisée de 80 mâts chargeables	120,0 h/w	136,0 h/w	25,0 s	25,2 s	71,3%	81,8%	12,5%	1400 p/w	1540 p/w	1753 p/w	1582 p/w	1745 p/w	1986 p/w
96 999 999 80		Assemblage final n°1 OPA50 Poste Manuel	120,0 h/w	136,0 h/w	400,0 s	430,0 s	61,9%	73,0%	100,0%	700 p/w	669 p/w	733 p/w	791 p/w	758 p/w	831 p/w
		Assemblage final n°2 OPA50 Poste Manuel	120,0 h/w	136,0 h/w	400,0 s	430,0 s	65,8%	73,0%	100,0%	700 p/w	711 p/w	733 p/w	791 p/w	805 p/w	831 p/w
COMPOB10		Injection + Assemblage OPB10 Presse P1 1 moule 1 empreinte	120,0 h/w	136,0 h/w	92,0 s	92,0 s	71,2%	76,8%	80,0%	2950 p/w	2676 p/w	2883 p/w	3334 p/w	3032 p/w	3268 p/w
COMPOB20	96 888 888 80	Peinture OPB20 Ligne automatisée de 80 mâts chargeables	120,0 h/w	136,0 h/w	25,0 s	25,2 s	74,4%	81,8%	70,0%	2950 p/w	8998 p/w	9815 p/w	3334 p/w	10198 p/w	11123 p/w

Capacity Mapping / Process Layout / Production Run / Efficiency Evaluation

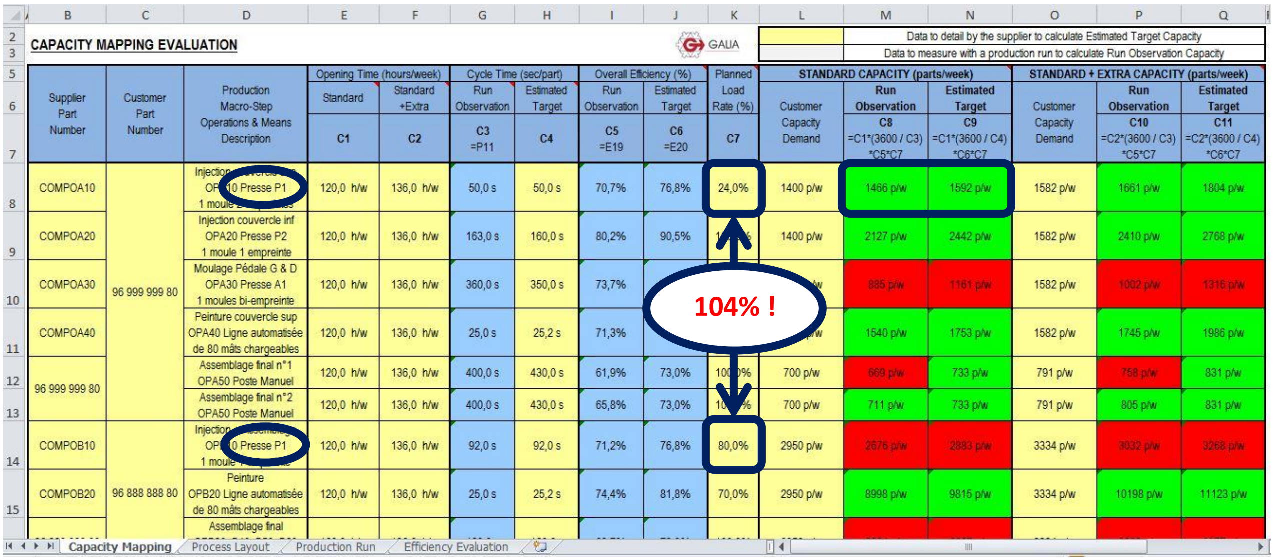
The tool enables the assessor to play with the parameters to identify potential solutions.

In the following example, we can see that the *Load Rate* of the moulding machine P1 must be at least 24% to satisfy the *Customer Capacity Demand* in *Standard* and *Standard+Extra* organisation.

But this machine is already allocated at 80% for another product.

Therefore, the moulding of this product will have to be allocated to another machine with sufficient spare capacity.

Example of the **Capacity Mapping** spreadsheet with a *Load Rate* of 24%:



CAPACITY MAPPING EVALUATION

GALIA

	Data to detail by the supplier to calculate Estimated Target Capacity
	Data to measure with a production run to calculate Run Observation Capacity

Supplier Part Number	Customer Part Number	Production Macro-Step Operations & Means Description	Opening Time (hours/week) Standard C1	Standard +Extra C2	Cycle Time (sec/part) Run Observation C3 =P11	Estimated Target C4	Overall Efficiency (%) Run Observation C5 =E19	Estimated Target C6 =E20	Planned Load Rate (%) C7	STANDARD CAPACITY (parts/week) Customer Capacity Demand	Run Observation C8 =C1*(3600 / C3) *C5*C7	Estimated Target C9 =C1*(3600 / C4) *C6*C7	STANDARD + EXTRA CAPACITY (parts/week) Customer Capacity Demand	Run Observation C10 =C2*(3600 / C3) *C5*C7	Estimated Target C11 =C2*(3600 / C4) *C6*C7
COMPOA10	96 999 999 80	Injection [illegible] OP[illegible]10 Presse P1 1 moule [illegible]	120,0 h/w	136,0 h/w	50,0 s	50,0 s	70,7%	76,8%	24,0%	1400 p/w	1466 p/w	1592 p/w	1582 p/w	1661 p/w	1804 p/w
COMPOA20		Injection couvercle inf OPA20 Presse P2 1 moule 1 empreinte	120,0 h/w	136,0 h/w	163,0 s	160,0 s	80,2%	90,5%	[illegible]	1400 p/w	2127 p/w	2442 p/w	1582 p/w	2410 p/w	2768 p/w
COMPOA30		Moulage Pédale G & D OPA30 Presse A1 1 moules bi-empreinte	120,0 h/w	136,0 h/w	360,0 s	350,0 s	73,7%	[illegible]	[illegible]	[illegible]	885 p/w	1161 p/w	1582 p/w	1002 p/w	1316 p/w
COMPOA40		Peinture couvercle sup OPA40 Ligne automatisée de 80 mâts chargeables	120,0 h/w	136,0 h/w	25,0 s	25,2 s	71,3%	[illegible]	[illegible]	[illegible]	1540 p/w	1753 p/w	1582 p/w	1745 p/w	1986 p/w
96 999 999 80		Assemblage final n°1 OPA50 Poste Manuel	120,0 h/w	136,0 h/w	400,0 s	430,0 s	61,9%	73,0%	[illegible]	700 p/w	669 p/w	733 p/w	791 p/w	758 p/w	831 p/w
		Assemblage final n°2 OPA50 Poste Manuel	120,0 h/w	136,0 h/w	400,0 s	430,0 s	65,8%	73,0%	[illegible]	700 p/w	711 p/w	733 p/w	791 p/w	805 p/w	831 p/w
COMPOB10	96 888 888 80	Injection [illegible] OP[illegible]0 Presse P1 1 moule [illegible]	120,0 h/w	136,0 h/w	92,0 s	92,0 s	71,2%	76,8%	80,0%	2950 p/w	2676 p/w	2883 p/w	3334 p/w	3032 p/w	3268 p/w
COMPOB20		Peinture OPB20 Ligne automatisée de 80 mâts chargeables	120,0 h/w	136,0 h/w	25,0 s	25,2 s	74,4%	81,8%	70,0%	2950 p/w	8998 p/w	9815 p/w	3334 p/w	10198 p/w	11123 p/w
[illegible]		Assemblage final	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

We can see that *Run Observation Capacity* and *Estimated Target Capacity* cells became **Green** thanks to an increase of *Load Rate* from 20% to 24%.

4. GLOSSARY

MACRO-STEP

A *Macro-Step* is defined as a grouping of homogenous processes?/workers without any disruption of flow. A *Macro-Step* can contain several work stations with no flow disruption between them, at the end of which the number of parts produced can be counted.

STANDARD OPENING TIME (IN HOURS PER WEEK)

Workers' standard attendance time per week. This time includes everything: work, breaks…

Example:

- 3 teams of 8 hours, 5 days a week = 120 hours per week.
- 3 teams of 8 hours, 5 days a week + 2 Saturday teams of 8 hours = 136 hours per week.

« STANDARD + EXTRA » OPENING TIME (IN HOURS PER WEEK)

Workers maximum attendance time that can be implemented quickly and maintained without additional customer resources/investment or as defined in the contract. "Quickly" has to be defined in the customer's contract.

GOOD PART

A Part that is in accordance with the customer's specification.

RUN OBSERVATION CYCLE TIME (IN SECONDS PER PART)

Cycle Time measured between two good parts without any disturbance, during a Production Run, on definitive serial life production process and tools, with trained workers.

ESTIMATED TARGET CYCLE TIME (IN SECONDS PER PART)

Target *Cycle Time* between two good parts without any disturbance, on definitive serial life production process and tools, with trained workers (target considered to be reached after final set up of the process).

Example:

If a moulding tool produces 4 parts in 20 seconds, the Cycle Time for one single part is 20 sec / 4 = 5 seconds.

OVERALL EFFICIENCY (%)

Percentage of the *Opening Time* during which the process makes *Good Parts* with no disturbance:

$$\%\, Overall\ Efficiency = \%\, Operational\ Efficiency * \%\, Working\ Time\ Rate$$

% Operational Efficiency =

(1 – % Unplanned Stops)(1 – % Other Losses)*(1 – % On-line Rework – % Scrap)*(1 – % Downstream Scrap to Re-impact)*

$$\%\, Working\ Time\ Rate = \frac{Opening\ Time - Planned\ Stops}{Opening\ Time}$$

PLANNED STOPS

Planned downtime such as:

- Preventive maintenance **if planned during** *Opening Time*,
- Batch changes and/or tool changes,
- Breaks/pauses, lunch, start and end of shift,
- And any other planned downtime.

UNPLANNED STOPS

Breakdowns or any other unplanned production downtime caused by technical failure of production means (equipment and/or tools).

OTHER LOSSES (%)

Micro-stops and/or losses due to:

- Organization of the work station (resupply if made by a direct worker),
- Worker performance (speed losses),
- Retuning of production parameters,
- *Cycle Time* deviation.

In other words, all losses that cannot be identified or measured as:

- Downtime (Planned Stops or Unplanned Stops),
- Rework,
- Scrap.

PLANNED LOAD RATE (%)

The Percentage of the *Opening Time* when the production means is fully dedicated for production of a specific product or group of products. In the case of a painting line, the load rate is the percentage of carriers dedicated to the product by the total number of carriers present on the line.

CAPACITY (IN NUMBER OF GOOD PARTS / WEEK)

$$Capacity = Opening\ Time * \left(\frac{3600}{Cycle\ Time}\right) * Overall\ Efficiency * Planned\ Load\ Rate$$

For a Standard Capacity, use Standard Opening Time.

For a maximum capacity, use Standard+Extra Opening Time.

For a Run Observation Capacity, use Run Observation Cycle Time and Run Observation Overall Efficiency.

For an Estimated Target Capacity, use Estimated Target Cycle Time and Estimated Target Overall Efficiency.

GOOD PARTS REWORKED OFF-LINE

Parts detected during the run as needing to be reworked out of the line and finally checked as good after being reworked. The parts finally checked as NOK after *Off-line Rework* have to be counted as *Scrapped Parts*. Ideally the rate of parts reworked off-line should be stable at a low level because additional resources are needed, for example a quality inspection which is out of the working standard process.

Example: Door Trim with 6 fastening pegs

Default: Automatic detection of a missing peg. The part is moved aside.

Rework action: Manual fitting of the missing peg by personnel independent of the line.

Conclusion: The part is declared OK.

Example: Painted plastic part removed by the operator at the end of the painting process

Default: Minor aspect default, small scratch.

Rework action: Trial to rework by polishing but the part is finally rejected.

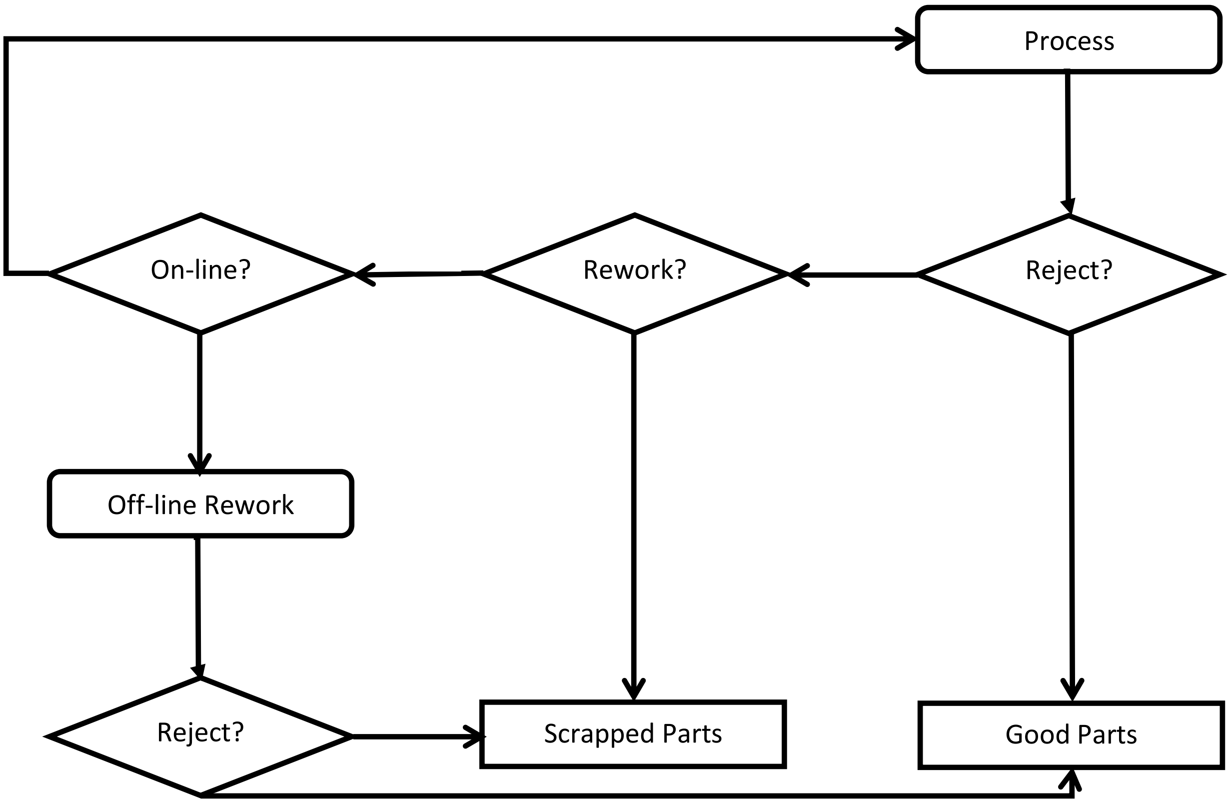
Conclusion: The part is declared NOK.

PARTS TO BE REWORKED ON-LINE

Parts detected during the run as needing to be reworked on the line and for which we have lost a production cycle. Those parts have to be reworked after the run. Ideally the *On-line Rework* rate should be stable at a low level.

SCRAPPED PARTS OR SCRAP

It is not only the direct scrap, but also the parts reworked off-line and finally declared NOK.



DOWNSTREAM SCRAP TO RE-IMPACT

To reach the expected output level, the downstream scrap rate to re-impact for one operation is the combination of the *Scrap* rates of all the downstream operations (to be determined with the flow diagram).

i.e.: Each operation has to produce enough parts including parts which are scrapped in the downstream operations.

Example: