Description
FORCAM FORCE™
Best Practices

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Contents

1 Introduction

This document describes specific best practices implementation scenarios within the FORCAM FORCE™ product suite. These examples are based on typical customer requirements.

This document and a corresponding reference configuration can be delivered to the customer upon request as an initial setup of the system. It serves to speed up implementation and help users understand the FORCAM FORCE™ product suite features.

The following chapters describe all the best practices and build on one another. Finalizing the section is the chapter "Summary/Matrix of Functionality" which displays a functional matrix of all best practices in order to facilitate a good assessment.

The chapter "Basic Configuration" gives a complete overview of the predefined system configuration and FORCAM FORCE™ Best Practices.

This document can also be seen as an information bridge between the highly flexible and configurable software product FORCAM FORCE™, with its standard product descriptions/manuals and the customer-specific **Project Rollout Specification**.

The following graphic illustrates the distinction between documentations:

Product	Customizing	Project
•Product Description •Manual •→ Technical Overview	•Best Practices •→ Examples of Implementation	•Project Summary •→ Detailed Description of Implementation
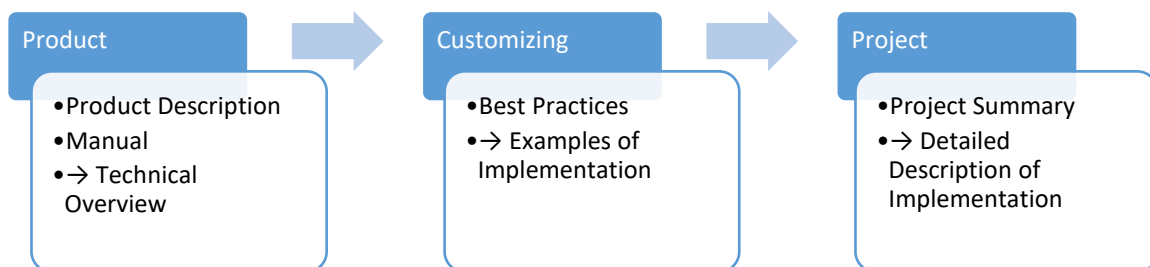
The following best practices describe different possible implementations of FORCAM FORCE™. These best practices build on each other as different functionality is added to the implementation. As new best practices are described, the defined functionality mentioned in a previous best practice will not be repeated. In each case, only the extensions are presented.

The seven use cases are comprised as follows:
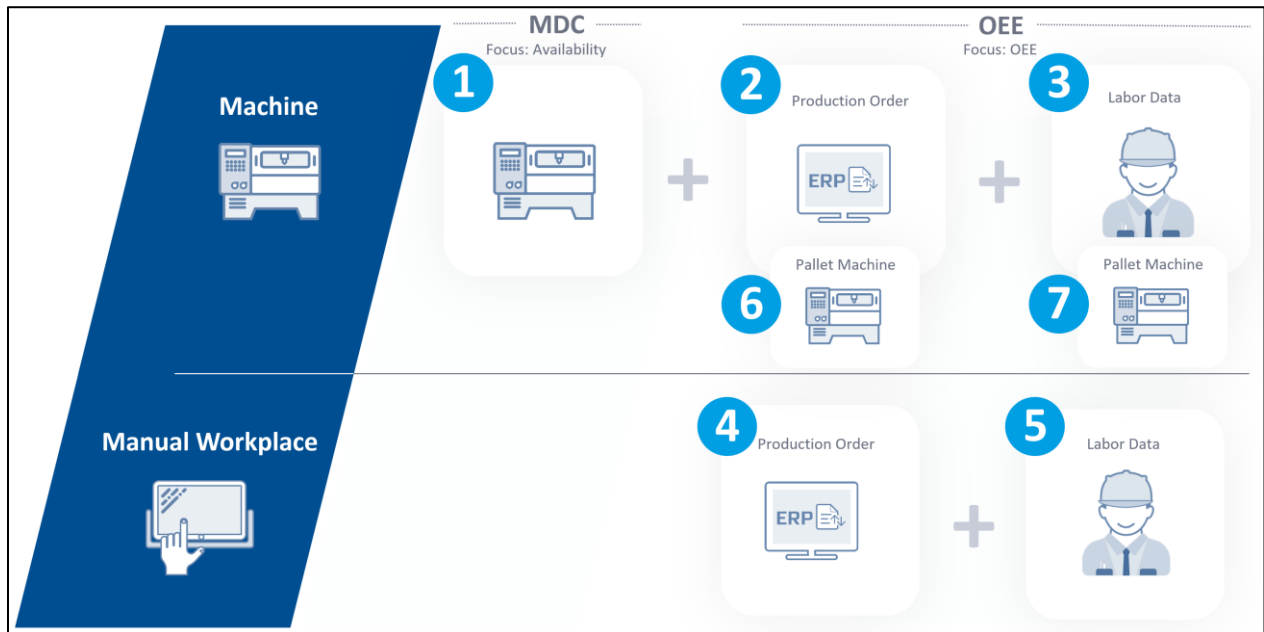
Figure 1: Overview of 7 best practices

2 Best Practice 1: Machine Data Collection

Best Practice 1: Machine Data Collection delivers data and information about real-time status of machine equipment and stores it for further reporting and analysis of development/trends and a comparison of different machines.

2.1 Benefits

This best practice provides the following benefits:

- Real-time transparency and current availability of a workplace (machine or plant)
- Duration and frequency of different operating states provide important information for optimizing the production process and maintenance responsiveness
- The actual operating state of each workplace (machine or plant) can be seen at a glance
- Downtime and maintenance costs can be better calculated by data collected based on "true availability"

2.2 FORCAM FORCE™ Bridge (MDC)

The FORCAM FORCE™ Bridge receives data from each machine/plant and converts the information into one of the following operating states:

- Machine is running (production)
- Machine is not running (stoppage)
- No connection to the machine (operating state unknown)

2.3 Shop Floor Terminal

2.3.1 Overview

In general, the system will differentiate between the operating states "Production" and "Undefined stoppage", which are automatically captured from the machine via FORCAM FORCE™ Bridge. "Operating state unknown" appears if no connection can be established between FORCAM FORCE™ Bridge and the plant due to network reasons.

The operating states received during the currently running shift are chronologically sorted and displayed. The operating state "Undefined stoppage" must be promptly and manually specified by the machine operator via the Shop Floor Terminal, in order to document the operating state for the system.

The operating state "Setup" has a distinct function: "Setup" must be specifically activated on the Shop Floor Terminal and is active until it is deactivated again manually. The machine states collected during setup are completely ignored.

The layout of the Shop Floor Terminal in the best practice "Best Practice 1: Machine Data Collection" differs from the layout of the remaining best practices in that no production orders/operations are displayed. An online report and the list of past operating states are shown instead.
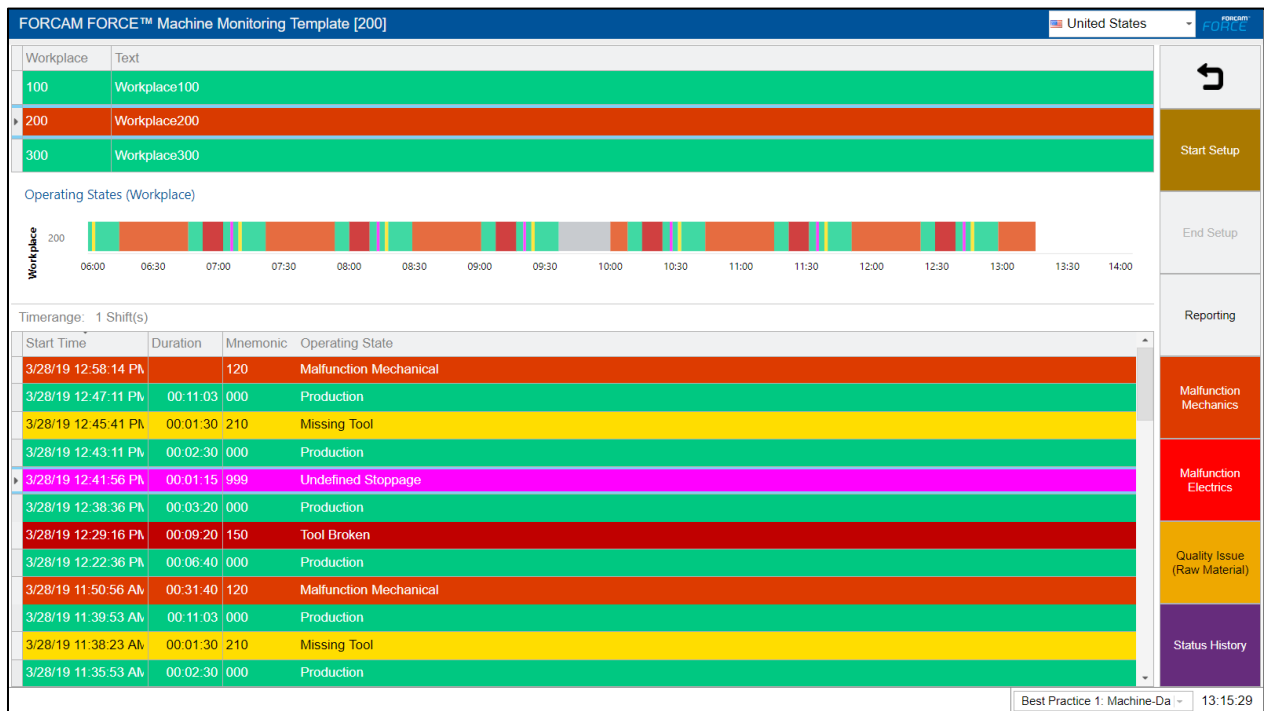
Figure 2: Main screen of Shop Floor Terminal (Best Practice 1: Machine Data Collection)

2.3.2   Booking Process and Functionality

- Start setup
- Finish setup
- Change operating states (e.g. "Undefined stoppage" to something specific)
- Open reports

2.4   Performance Analysis

2.4.1   Reports

The reports listed below are relevant for the performance analysis. The documents "Product Description Performance Analysis" and "Manual Performance Analysis" contain detailed descriptions on these reports. A summary of available reports for the individual best practices can be found in the annex of this document.

- Operating State Timeline (Workplace)
- Operating State Log (Workplace)
- Message Log
- Availability (Overall View)
- Operating State Class Report (Workplace)
- Operating State Class Development (Workplace)
- Operating State Report (Workplace)
- Operating State Development (Workplace)
- Hitlist Operating States (Workplace)
- Scheduled Operating Time
- Shift Schedule

- Maintenance Report
- Maintenance Development
- Stoppage Reason Development

2.4.2 Dashboards

This best practice contains the following dashboards. The documents "Product Description Performance Analysis" and "Manual Performance Analysis" contain detailed descriptions on these reports.

- Dashboard Operating State

2.4.3 Visualization

The Visualization displays the actual real-time status of each machine on the shop floor:
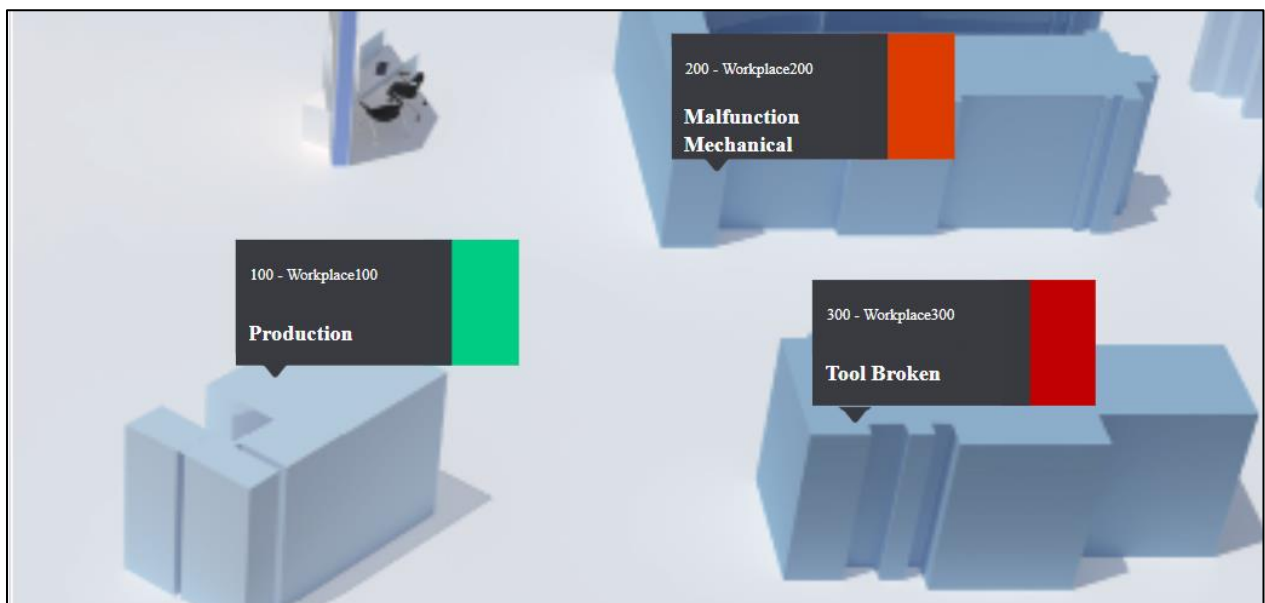
Figure 3: Visualization (Best Practice 1: Machine Data Collection)

2.5 Customer Responsibilities

For a successful implementation of FORCAM FORCE™, the customer is responsible for providing the following:

- Dedicated project lead
- Shop floor personnel to serve as advocates for project acceptance on the shop floor (clear communication of project goals required)
- Definitions of machine signals (e.g. via maintenance team). FORCAM will train the connection on one machine. The connection of further machines is subsequently carried out by the customer's maintenance department.
- Terminals for operators on the shop floor (e.g. PCs to interact with the Shop Floor Terminal)
- IT server equipment (host) including operating system based on FORCAM FORCE™ system requirements
- IT communication and network infrastructure (between different components of FORCAM FORCE™, e.g. via LAN)
- Remote access for FORCAM team to install, configure and maintain FORCAM FORCE™ software
- Dedicated person for continuous improvement process
- Compliance with operational and regulatory requirements
- Database system access where FORCAM FORCE™ "On-Premises" software solution is used
- Communication interface between shop floor LAN and remote FORCAM FORCE™ server (secured connection of a minimum data transfer rate of 2Mbit/s via VPN) (where FORCAM FORCE™ "Platform as a Service" solution is used)
- IT person responsible for the productive running software system FORCAM FORCE™
- An email account for sending auto reports and alerts

3 Best Practice 2: Machine Data Collection with Integration of Production Orders/Operations

Best Practice 2: Machine Data Collection with Integration of Production Orders/Operations enables continuous information flow from sales to the machine and back:

- Displaying the production orders to be processed at the Shop Floor Terminal
- Booking confirmation about the status of the operation, quantities and times (without labor times) back to the ERP system

A single operation can be set up or processed on a single workplace.

3.1 Additional Benefits

In addition to the benefits presented in chapter 2.1 Benefits, this best practice provides the following additional benefits:

- Metrics for optimizing your production, e.g.:
  - o OEE
  - o Availability
  - o Performance
  - o Quality
- Full machine cost monitoring (in ERP system)
- Material/part and order-related reports
- Full transparency on all levels from enterprise to shop floor
- Detailed overview about the real-time situation in the production shop floor (including orders, operations, quantities, progress)
- Full information control: All information relating to shop floor personnel is bundled and available at one location

3.2 FORCAM FORCE™ Bridge (ERP): Order Data Management and ERP Connection

The ERP system transfers orders and operations with mandatory information about planned quantity and time of each operation to FORCAM FORCE™.

Confirmations (status, actual quantities, actual time) are transferred on operations level from FORCAM FORCE™ to the ERP system.

3.3 FORCAM FORCE™ Bridge (MDC)

The FORCAM FORCE™ Bridge (MDC) offers an added functionality to the previous best practice by collecting quantity-based counter information from the machine, allowing calculation of the actual produced quantity.

In addition, malfunctions identified by the machine are recorded so that manual input from the shop floor personnel is no longer necessary.

Optional Function: Auto Status

This option differs from the previous method of machine status collection in that the machine status is determined indirectly: If FORCAM FORCE™ does not register a specific and "hard coded" production

information signal over the predefined stroke time or machine cycle time, the machine operating status is defined as "Undefined stoppage". This application is required for workstations that cannot deliver a production signal.

3.4 Shop Floor Terminal

3.4.1 Overview
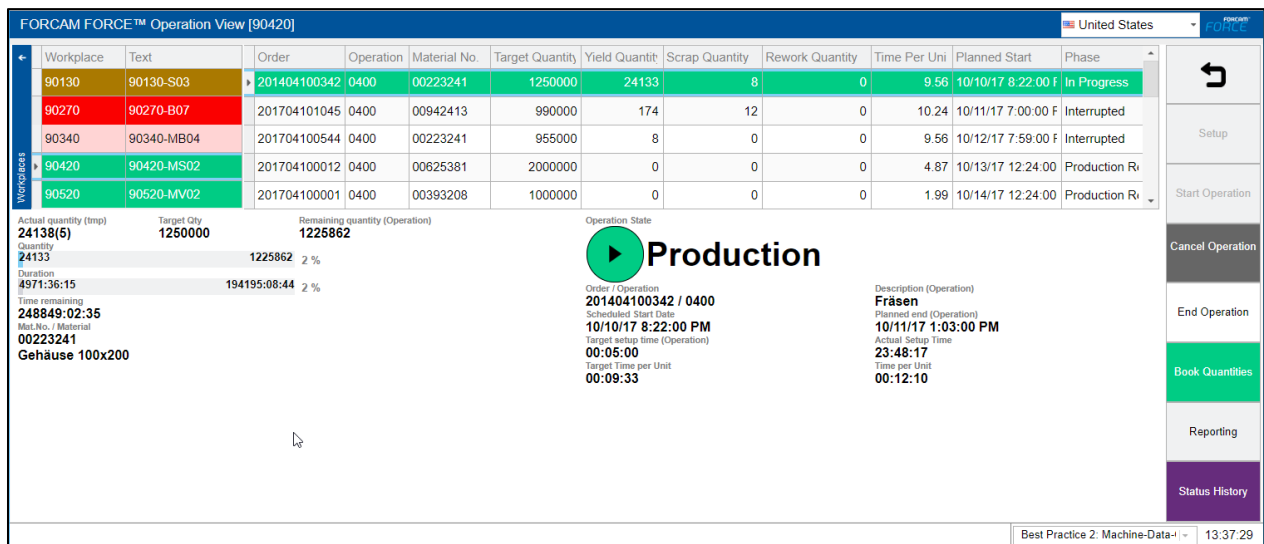
Figure 4: Main view of the Shop Floor Terminal (Best Practice 2: Machine Data Collection with Integration of Production Orders/Operations)

The mapping of operating states and quantities on the individual processes of a production order is initiated when the respective operation is logged-on to at the shop floor terminal and is finished at log-off. Log-on is carried out through the operation-specific setup of the plant or with the processing of an operation by pushing the appropriate button. Independent of machine status, the operating state is set to "Setup" during setup in a working shift. The operating state "production" is derived from the machine status "Production" during the processing phase within a working shift. The operating state "Undefined stoppage" is derived from the machine status "Stoppage" in the beginning. As described in the above use case, the reason for the stoppage should be specified as soon as possible. If no operation is logged in during a working sift, the workplace is in the operating state "Available capacity within shift". If a production occurs during a shift break, the operating state "Break" is overwritten with "Production".

3.4.2 Booking Process and Functionality

- Start setting up an operation ("Start setup")
- Finish setting up an operation ("Finish setup")
- Start processing an operation ("Start production")
- Confirm operation quantities ("Confirm quantity") (with differentiation of good-, scrap- and rework-quantities including reasons, see chapter "Quality Types and Details")
- Abort an operation process (Partial confirmation) ("Abort operation") (order/operation partially produced, "PCNF")
- Finish processing an operation (Final confirmation) ("Finish operation") (order/operation completely finished, "CNF")
- Change operating states (e.g. "Undefined stoppage" to something specific)

3.5 Performance Analysis

3.5.1 Additional Reports

The following additional reports are relevant for this use case. Details on these reports are further defined and described in the documents "Product Description Performance Analysis" and "Manual Performance Analysis".

- Quantity Status Diagram (Workplace)
- Quantity Status Diagram (Operation)
- Operating State Timeline (Operation)
- Operating State Timeline (Order)
- Quantity Log
- Shift Book
- Shift Log
- Daily Log
- OEE (Overall View)
- OEE Report (Workplace)
- OEE Development (Workplace)
- OEE Report (Operation)
- Operating State Class Report (Material)
- Operating State Class Development (Material)
- Operating State Report (Material)
- Operating State Development (Material)
- Hitlist Operating States (Material)
- Operating State Class Report (Order)
- Operating State Report (Order)
- Hitlist Operating States (Order)
- Operating State Class Report (Operation)
- Operating State Report (Operation)
- Hitlist Operating States (Operation)
- Performance Report (Operation)
- Quality Report (Workplace)
- Quality Details (Workplace)
- Quality Development (Workplace)
- Quality Details (Development per Workplace)
- Hitlist Quality Details (Workplace)

- Quality Report (Material)
- Quality Details (Material)
- Quality Development (Material)
- Quality Details (Development per Material)
- Hitlist Quality Details (Material)
- Quality Report (Operation)
- Quality Details (Operation)
- Hitlist Quality Details (Operation)
- OPE (Overall View)
- Production Process Ratio (Overall View)
- Order Analysis
- Operation Analysis
- Workplace Allocation
- Workplace Availability
- Order Overview
- Order Details
- Order Backlog
- Operations in Progress
- Operations Completed
- Operation Details

3.5.2 Additional Visualization

In addition to the currently active order/operation, the visualization displays quantity messages from the machine (unqualified) and those qualified by the operator (e.g. quantities for good, scrap, rework):
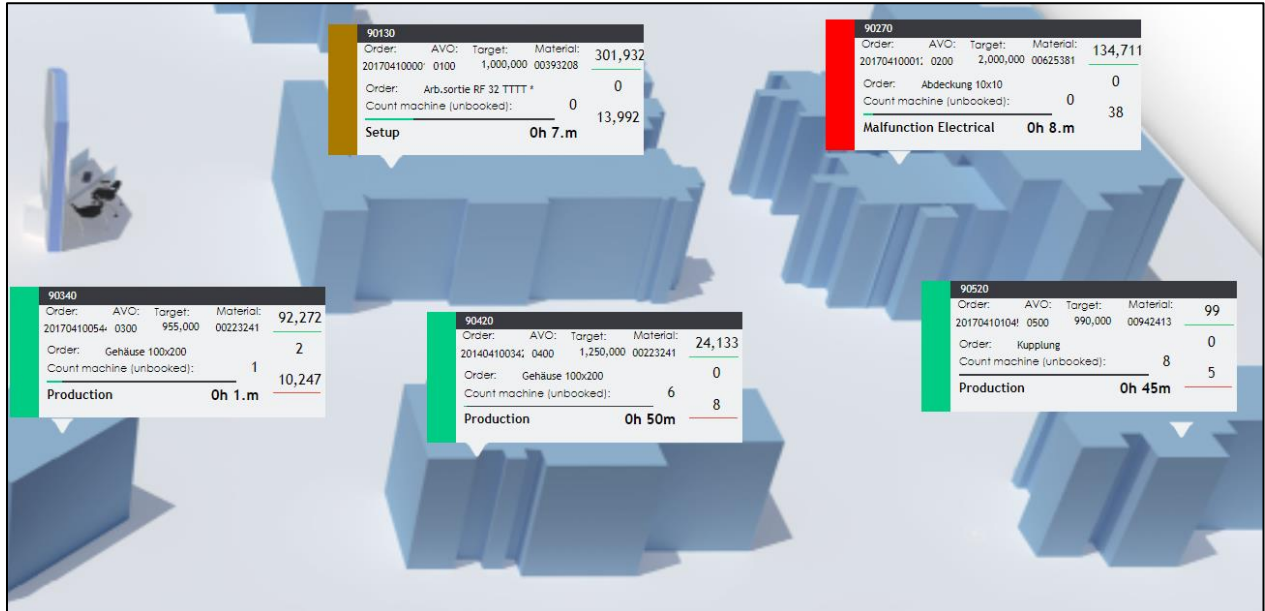
Figure 5: Visualization (Best Practice 2: Machine Data Collection with Integration of Production Orders/Operations)

3.6 Additional Customer Responsibilities

- The customer is responsible for providing the above mentioned production order data, e.g. via:
    - Manual input into FORCAM FORCE™ or
    - Installation of "FORCAM FORCE™ Bridge for SAP" (certified by SAP interface) or
    - XML based data transfer via interface from any ERP system

4 Best Practice 3: Machine Data Collection with Integration of Production Orders/Operations and Personnel (Workplace Log-On)

This best practice creates a corresponding reference to a person processing the operation.

4.1 Additional Benefits

In addition to the aforementioned benefits, this best practice provides the following benefits:

- Total cost calculation per product (targeted action management)
- Detailed cost controlling on product level in the ERP system: Planned costs vs. actual costs
- Full production cost controlling up to one single piece
- Possibility of real-time analysis of business data for the daily work
- Control of production based on OEE and cost overviews
- True confirmations to the ERP between production and financial controlling (same structures)
- True product cost values by confirming actual personnel time and conversion into costs
- Real traceability of the OEE via actual cost accounting
- Joint cooperation between controlling and manufacturing with the same goal and the same data

4.2 FORCAM FORCE™ Bridge (ERP): Order Data Management and ERP Connection

The ERP system transmits "personnel mini master data" to FORCAM FORCE™.

FORCAM FORCE™ additionally transmits the actual personnel time spent on operation level to the ERP system. These personnel hours are calculated and summed up anonymously for all logged-on shop floor personnel for any given production order or operation. This data is then sent to the ERP system.

4.3 Shop Floor Terminal

Figure 6: Main view of the Shop Floor Terminal (Best Practice 3: Machine Data Collection with Integration of Production Orders/Operations and Personnel (Workplace Log-On))

4.3.1 Booking Process and Functionality

- Start setting up an operation ("Start setup")
- Finish setting up an operation ("Finish setup")
- Start processing an operation ("Start processing")
- Confirm operation quantities ("Confirm quantity") (with differentiation of good, scrap and rework quantities including details, see chapter "Quality Types and Details")
- Abort an operation process (partial confirmation) ("Abort operation") (order/operation partially produced, "PCNF")
- Finish processing an operation (final confirmation) ("Finish operation") (order/operation completely finished, "CNF")
- Change operating states (e.g. changing "Undefined stoppage" to something specific)
- Personnel log-on to a workplace
- Personnel log-off from a workplace

5 Best Practice 4: Manual Workplace with Integration of Production Orders/Operations

With manual workplaces, the operating state cannot be derived from a machine. Therefore, the operating state must be set by the shop floor personnel via the Shop Floor Terminal. This allows transparent data collection even on workplaces that do not have a built-in machine control unit.

5.1 Additional Benefits

In addition to the aforementioned benefits, this best practice provides the following benefits:

- Full visibility of all workplaces in the shop floor
- Integration of personnel workplace evaluation on manual workplaces

5.2 Shop Floor Terminal

5.2.1 Overview

The status of these manual workplaces is defined via different buttons in the Shop Floor Terminal:

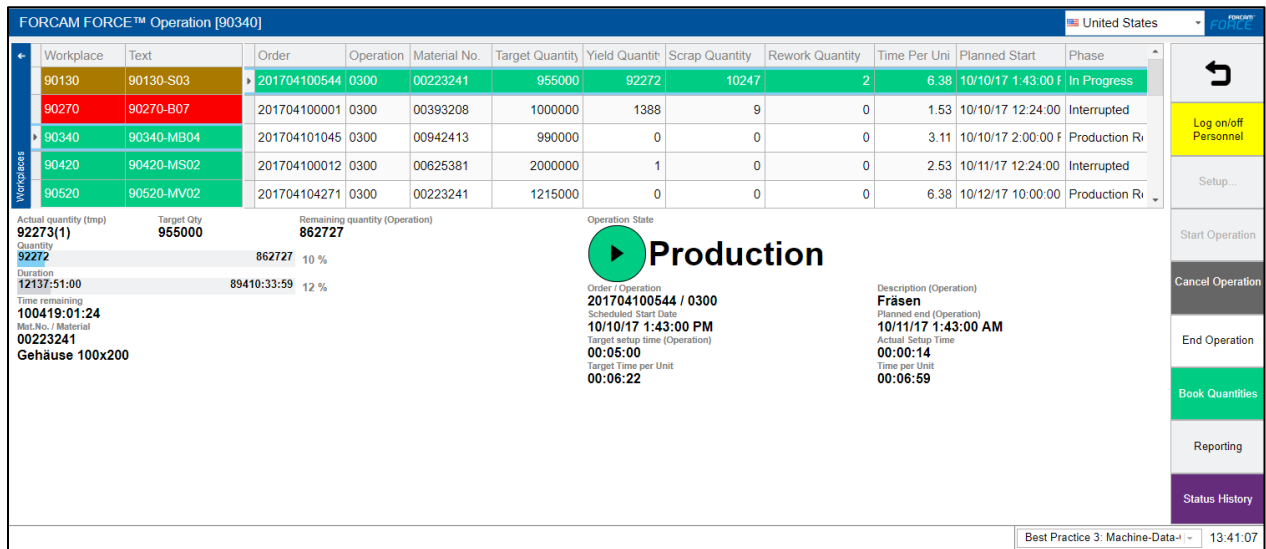*Figure 7: Main view of the Shop Floor Terminal (Best Practice 4: Manual Workplace with Integration of Production Orders/Operations)*

5.2.2 Booking Process and Functionality

- Start setting up an operation ("Start setup")
- Finish setting up an operation ("Finish setup")
- Start processing an operation ("Start processing")
- Confirm operation quantities ("Confirm quantity") (with differentiation of good-, scrap- and rework-quantities including details, see chapter "Quality Types and Details")
- Abort an operation process (partial confirmation) ("Abort operation") (order/operation partially produced, "PCNF")
- Finish processing an operation (final confirmation) ("Finish operation") (order/operation completely finished, "CNF")
- Set workplace stoppage
- Continue workplace production (finish workplace stoppage)
- Change operating states (e.g. changing "Undefined stoppage" to something specific)

6 Best Practice 5: Manual Workplace with Order/Operations and Personnel (Workplace Log-On)

6.1 Additional Benefits

In addition to the aforementioned benefits, this best practice provides the following added benefits:

- Financial controlling at the product level (for cost unit accounting) in the ERP system: Planned costing vs. actual costing
- Complete transparency: Both the ERP and manufacturing have the same structures ("equal truth")

6.2 Shop Floor Terminal

6.2.1 Overview

The status of these manual workplaces is defined via different buttons in the Shop Floor Terminal:

Figure 8: Main view of the Shop Floor Terminal (Best Practice 5: Manual Workplace with Order/Operations and Personnel (Workplace Log-On))

6.2.2 Booking Process and Functionality

- Start setting up an operation ("Start setup")
- Finish setting up an operation ("Finish setup")
- Start processing an operation ("Start processing")
- Confirm operation quantities ("Confirm quantity") (with differentiation of good-, scrap- and rework-quantities including details, see chapter "Quality Types and Details")
- Abort an operation process (partial confirmation) ("Abort operation") (order/operation partially produced, "PCNF")
- Finish processing an operation (final confirmation) ("Finish operation") (order/operation completely finished, "CNF")
- Personnel log-on to a workplace
- Personnel log-off from a workplace
- Set workplace stoppage
- Continue workplace production (Finish workplace stoppage)
- Change operating states (e.g. changing "Undefined stoppage" to something specific)

7 Best Practice 6/7: Pallet Machine

7.1 Additional Benefits

In addition to the aforementioned benefits, this best practice provides the following added benefits:

- Parallel processing of multiple operations in sequenced order to determine the actual processing time to achieve a detailed cost overview

This version is different from the aforementioned best practices because multiple operations can be processed at the same time.

7.2 Realization in FORCAM FORCE™

7.2.1 Overview

A machine with an automatic pallet changer (APC), shuttle table/rotary table, exchangeable workpiece carriers or multiple stations is called "pallet machine". This method is significant for increased productivity because processing can be done with the yield-relevant machine part while raw material is fed to the machine or the finished part is collected.

Machine stoppages during setup times are considerably minimized, since the setup is moved primarily out of the machine workspace and over to the pallets. This is called "Setup parallel to primary time". Generally, gathering data of actual personnel time is not relevant when using this specific manual "pallet machine" sequence.

The pallet machine application requires the following definitions:

- Definition of one or more sequences (pallets), which contain a number of process steps (clamping/pallet-sided).
- A process step is a list of operations that are to be processed simultaneously. They are designed with the assisting construct for parallel processing called "Block". This enables reaching an identical processing start/finish, as well as equal operating states and costs.

Depending on the use case, this type of machine can be displayed in FORCAM FORCE™ if the following characteristics apply:
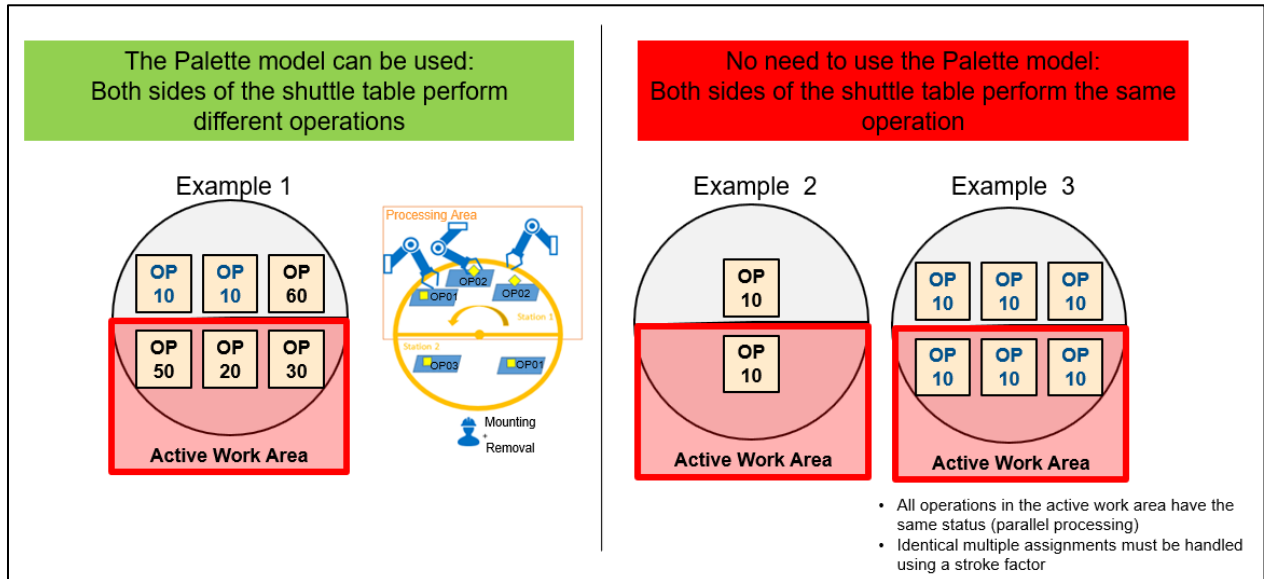
Figure 9: Characteristics of a palette machine

1. More than one order/operation can be active at the same time, i.e.:
   - There is a defined number of orders/operations within the machining area ("Processing").
   - At the same time, a defined number of orders/operations waits outside the machining area ("Waiting for processing").
2. The order/operation configuration of the single pallet/station/workpiece carrier exists longer than one processing cycle (e.g. Multiple orders are being processed in alternating order and a manual order/operation change at each processing cycle cannot be expected from the worker).

7.2.2   Use Case: Welding Robot Cell with Two Stations (Rotary/Shuttle Table)
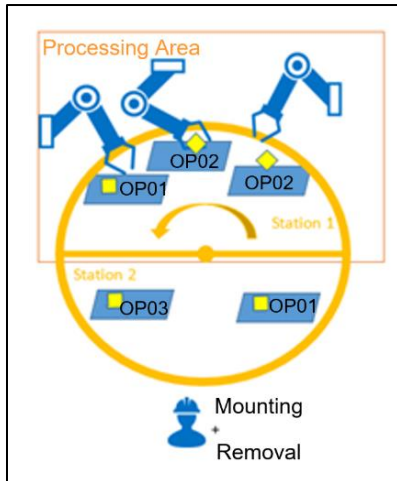
Figure 10: Welding robot cell with two stations

Machine with split rotary shuttle table/clamping table: While station 1 is being processed in the machining area, the worker is able to feed and collect units in the loading area of station 1 and from the off-loading area of station 2. As soon as the processing is done and the worker finished the loading, the rotary table revolves. This ensures the continuous operation of the machine.

7.2.3   Procedure

Pallet order (OP) mapping at the Shop Floor Terminal:

- Assignment/mapping/predefinition of OPs to pallets at the Shop Floor Terminal (which OPs are located on which pallet?).
- The machine provides the information of which pallet is in the machining area (signal is provided by the plant).
- A corresponding automated OP change is triggered.

7.3 Framework

The following table shows the framework for best practice 6.

Identification	The machine is **unable** to provide any unique data that enables identifying an operation being processed. For cost reasons, it is necessary to record and determine the actual processing time of sequential operations.
Assignment	The user must map the operations to machine signals (pallet and possibly pallet-sided (clampings)). The machine operations are processed in chrono-logical order.
Identifier/Auto-ID	For the identification, the machine must provide a pallet number byte/page number byte.
FORCAM FORCE™ Assignment	The worker manually assigns operations to pallet number and pallet side number (clamping).

Table 1: Framework pallet machine/Best Practice 6

8 Summary/Matrix of Functionality

Function/Best practice	Best Practice 1: MDC	Best Practice 2: MDC & PO/OP	Best Practice 3: MDC& PO/OP & Personnel	Best Practice 4: Manual WPL & PO/OP	Best Practice 5: Manual WPL & PO/OP & Personnel	Best Practice 6/7: Pallet Machine
Availability analysis	✓	✓	✓	✓	✓	✓
Performance and productivity analysis		✓	✓			✓
Quality analysis		✓	✓	✓	✓	✓
OEE		✓	✓			✓
Operating state analysis	✓	✓	✓	✓	✓	✓
Planned time vs. actual time analysis		✓	✓	✓	✓	✓
Production cost transparency (equipment costs)		✓	✓	✓	✓	✓
Production cost transparency (personnel costs)			✓		✓	✓
Visualization of complete real-time status of the production shop floor	✓	✓	✓	✓	✓	✓
Directly booking and confirming production cost collectors into the ERP system – Standardized structure of costing		✓	✓	✓	✓	✓
Real-time product cost controlling (including quality costs)		✓	✓	✓	✓	✓
Paperless production: Display of production order data on the Shop Floor Terminal		✓	✓	✓	✓	✓
Displaying the latest/actual status of an order/operation in the ERP system		✓	✓	✓	✓	✓
Push notifications when events occur	✓	✓	✓	✓	✓	✓
Parallel processing of multiple operations						✓

Table 2: Summary/Matrix of Functionality

9 Basic Configuration

The predefined system configuration is shown on the next pages.

9.1 Workplaces

The following workplaces are defined:

WPL[1]	Text	Workplace type/Comment	Best Practice	MDC: Interface	MDC: Signals
90130	S03	Welding robot cell #3	Best Practice 1: Machine Data Collection	IBH-Link	Status: Production, Alarm
90270	B07	5-Axis-CNC center #7	Best Practice 2: Machine Data Collection with Integration of Production Orders/Operations	CP	Piece counter (absolute value); Status: Production, Alarm
90340	MB04	Automatic assembly line #4	Best Practice 3: Machine Data Collection with Integration of Production Orders/Operations and Personnel (Workplace Log-On); Option Auto Status	FORCAM IO	Piece counter (impulse); Status: Alarm, Machine off
90420	MS02	Manual assembly station with final inspection #2	Best Practice 3: Machine Data Collection with Integration of Production Orders/Operations and Personnel (Workplace Log-On); Option auto status	FORCAM IO	Piece counter (impulse)
90520	MV02	Manual assembly station #2	Best Practice 5: Manual Workplace with Order/Operations and Personnel (Workplace Log-On)	-	-
90640	DC500	Rotary table machine with 2 clampings	Best Practice 5: Manual Workplace with Order/Operations and Personnel (Workplace Log-On)	IBH-Link	Piece counter (impulse); Status: Production, Alarm, Machine off
90720	X300	Palette machine with 2 clampings	Best Practice 5: Manual Workplace with Order/Operations and Personnel (Workplace Log-On)	IBH-Link	Piece counter (impulse); Status: Production, Alarm, Machine off

Table 3: Workplaces

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[1] ERP-ID or unique Workplace-ID

9.2 Operating States

The following operating states are pre-configured:

Text/Description	Abbrev.	Short text	Color	Color code	Operating state group[2]
Production	000	PROD	Green	#00CC84	Production
Waiting for processing	013	WFP	CYAN	#00EEEE	Production
Setup	020	SETUP	Orange	#AA7900	Setup
Post-setup/clamping[3]	025	PSETUP	Orange	#E3A100	Setup
Production without order	027	Production without order	Green	#009684	Production
Machine off	101	Machine off	Yellow	#FFFF00	Tech. malfunct.
Auto off	103	Auto off	Yellow	#FFFF00	Tech. malfunct.
Malfunction machine[4]	110	TB1	Red	#F30000	Tech. malfunct.
Malfunction mechanics	120	TB2	Red	#DD3B00	Tech. malfunct.
Malfunction electrics	130	TB3	Red	#FF0000	Tech. malfunct.
Malfunction hydraulics/pneumatics	140	TB4	Red	#6B0000	Tech. malfunct.
Tool defect	150	TB5	Red	#C00000	Tech. malfunct.
Missing tool	210	OB1	Yellow	#FFDD00	Org. malfunct.
Tool life expired	220	OB2	Yellow	#DDBB00	Org. malfunct.
Missing material	230	OB3	Yellow	#FFB500	Org. malfunct.
Quality issue (raw material)	240	OB4	Yellow	#EEA800	Org. malfunct.
Missing personnel	250	OB5	Yellow	#F38400	Org. malfunct.
Reparation mechanics	310	RE1	Red	#660033	Tech. malfunct.
Reparation electrics	320	RE2	Red	#660022	Tech. malfunct.
Reparation hydraulics/pneumatics	330	RE3	Red	#660011	Tech. malfunct.
Unplanned cleaning	340	RE4	Red	#660000	Tech. malfunct.
Planned maintenance	410	MAINT	Blue	#075287	Planned maint.
Machine interrupted during prod.	904	Machine interrupted during prod.	Red	#FF0000	Tech. malfunct.
Planned break	993	BREAK	Grey	#B6BABF	Planned break

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[2] Operating state groups are used to sum up operating states, as a consolidated base for executing performance analysis reports based on it. The definite use is planned to start with version 5.7.1.

[3] Setup, during phase of "Production". E.g.: Re-Adjusting the Setup, Installing a new part on fixtures.

[4] Technical malfunction of a machine, that is not further qualifiable at the time. corresponds with „General technical malfunction"

Text/Description	Abbrev.	Short text	Color	Color code	Operating state group[2]
Free capacity outside of shift	991	FCOS	Grey	#B6BABF	Planned break
Free capacity inside of shift	992	FCIS	Pink	#FFD4D4	Planned break
No connection	998	NCON	Magenta	#550033	Org. malfunct.
Undefined Stoppage	999	UNDEF	Magenta	#ff00ff	Org. malfunct.

Table 4: Operating States

9.3   Hierarchy

The Hierarchy outlines the different organizational structures in the shop floor in order to define and map a shift model or perform reports on workplaces.

The following 5-level hierarchy is part of the standard delivery (Code: "Workplace hierarchy"):

Text/Description	Short text	Level
Company	COM	1
Plant	PLA	2
Department	DEP	3
Cost center	CC	4
Workplace	WPL	5

Table 5: Workplace hierarchy

The pre-defined workplaces are assigned to the above-mentioned hierarchy.

9.4   Shifts

The following shifts are pre-defined in "**FORCAM FORCE™ Best Practices**" (24h format):

Text	Short text	Start	End	Start of break	End of break
Third shift (1 break)	T1B	22:00	06:00	01:30	02:00
First shift (1 break)	F1B	06:00	14:00	09:30	10:00
Second shift (1 break)	S1B	14:00	22:00	17:30	18:00

Table 6: Shifts

9.5   Shift Week Model

FORCAM FORCE™ delivers the following pre-configured "15-shift-week with 1 break per shift" ("15S1B") model:

Text	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Shift 1	-	T1B	T1B	T1B	T1B	T1B	-
Shift 2	-	F1B	F1B	F1B	F1B	F1B	-
Shift 3	-	S1B	S1B	S1B	S1B	S1B	-

Table 7: Shift Week Model

The third shift (night shift) in this model is the first shift of the "shift day". This means that the third shift of the "shift day" always begins on the previous calendar day. Example: The "shift day" December 17, 2020 actually begins on December 16, 2020 at 22:00h.
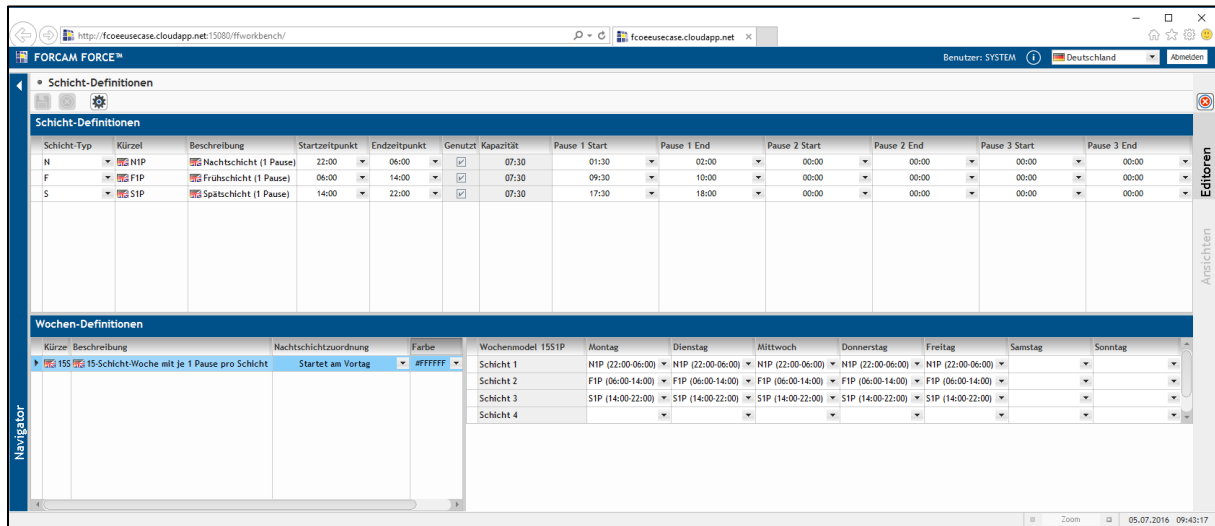
Figure 11: Shift Week Model

This week model is assigned to the hierarchy element "Sample Co", which means all workplaces listed under "Sample Co" follow that shift model.

9.6   Quality Types and Details

The following configuration is used for all the best practices using the "quality metric" (e.g. all best practices with production order and operation integration):

Quality type	Color code
Yield	#00CC84
Scrap	#C60A44
Rework	#FFB500

Table 8: Quality types

Scrap reason	Color code
Surface	#C60A44
Geometry	#660033

Table 9: Quality details scrap

Rework Reason	Color code
Surface	#FFB500
Geometry	#FFDD00

Table 10: Quality details rework

9.7 Time Bases/Activity Types

A time base defines a set of selected operating states. Each time base will be used for a different calculation of operating states; for instance, sending different metrics or different activity types to the ERP system.

Abbreviation	Description	Integrates durations of the following operating states
AT1	Setup time equipment (machine time)	Setup
AT2	Setup time personnel (personnel time)	Setup
AT3	Processing time equipment (machine time)	Production, setup, post-setup/clamping, machine malfunction, mechanics malfunction, electrics malfunction, hydraulics/pneumatics malfunction, tool defect, missing tool, tool life expired, missing material, quality issue (raw material), missing personnel, reparation mechanics, reparation electrics, reparation hydraulics/pneumatics, unplanned cleaning, machine interrupted during production, auto off, machine off
AT4	Processing time personnel (personnel time)	Production, setup, post-setup/clamping, machine malfunction, mechanics malfunction, electrics malfunction, hydraulics/pneumatics malfunction, tool defect, missing tool, tool life expired, missing material, quality issue (raw material), missing personnel, reparation mechanics, reparation electrics, reparation hydraulics/pneumatics, unplanned cleaning, machine interrupted during production, auto off, machine off
OEE	Planned operating time	All operating states except: Free capacity outside of shift, planned break, planned maintenance
PROD	Production time	Production
SETUP	Setup time	Setup, post-setup/clamping
MAINT	Maintenance time	Planned maintenance, reparation mechanics, reparation electrics, reparation hydraulics/pneumatics
U/M	Unplanned maintenance time	Reparation mechanics, reparation electrics, reparation hydraulics/pneumatics, unplanned cleaning
MALFUNCTION	Disruptions	All technical disruptions: Tool defect, machine malfunction, mechanics malfunction, electrics malfunction, hydraulics/pneumatics malfunction, reparation mechanics, reparation electrics, reparation hydraulics/pneumatics, unplanned cleaning, machine interrupted during production, auto off, machine off

Table 11: Time basis and descriptions

9.8 User Rights and Roles

Each user of the system must be defined and assigned to a specific role. The following user roles are pre-defined in "FORCAM FORCE™ Best Practices". The Performance Analysis elements (reports, dashboards and visualization) of best practice "Best Practice 1: Machine Data Collection" are integrated. This can be revised when another best practice is implemented.

9.8.1 Manager

- Display and export functionality of reporting results
- Display dashboards
- Display visualizations

9.8.2 Maintenance

- Display and export functionality of reporting results
- Display dashboards
- Display visualizations

9.8.3 Foreman

- Perform corrections on historical data (operating states and quantities)
- Display and export functionality of reporting results
- Display dashboards
- Display visualizations

9.8.4 Administrator

- System administration: Change and revise the system's basic configuration (user management, create workplaces, adjust shift model etc.)
- Perform corrections on historical data (operating states and quantities)
- Display and export functionality of reporting results
- Display dashboards
- Display visualizations

9.9 Auto-Reporting

The user "Admin" receives an "Availability Report" via email, which is a daily report of the previous shift day (Monday through Saturday). It is recommended to adjust the different receivers of this report after creating new FORCAM FORCE™ users.

9.10 Alerting

After 60 minutes of an "Undefined Stoppage" of a machine, the user "Admin" receives a specific email regarding this stoppage. It is recommended to adjust the different receivers of this report after creating new users of FORCAM FORCE™.

9.11 Shop Floor Terminal Templates

The "Shop Floor Terminal Templates" define the content and layout of the user interface for the shop floor operators. The following "Shop Floor Terminal Templates" are pre-defined, represent the different best practices, and are delivered with the "FORCAM FORCE™ Best Practices":

Name	Description
Best Practice 1: Machine Data Collection	Only for machine data collection
Best Practice 2: Machine Data Collection with Integration of Production Orders/Operations	
Best Practice 3: Machine Data Collection with Integration of Production Orders/Operations and Personnel (Workplace Log-On)	Personnel log-on per workplace
Best Practice 4: Manual Workplace	Manual definition of operating states via Shop Floor Terminal possible
Best Practice 5: Manual Workplace with Order/Operations and Personnel (Workplace Log-On)	Manual definition of operating states via Shop Floor Terminal possible. Personnel log-on per workplace
Best Practice 6: Pallet Machine, Machine Data Collection with integration of Production Orders/Operations	Manual assignment/mapping/predefinition of operations to palettes
Best Practice 7: Pallet Machine, Machine Data Collection with integration of Production Orders/Operations and Labor (Workplace Log-On)	Personnel log-on per workplace

Table 12: Shop Floor Terminal templates

The details on the functionality and usage of the "Shop Floor Terminal Templates" are defined in the aforementioned FORCAM FORCE™ Best Practices.

9.12 Shop Floor Terminal Profile

The following "Shop Floor Terminal Profile" is used:

Name	Plant 9000
Language	German - Germany
Time zone	UTC+1h - Europe/Berlin
Direct access	Yes
Log-on password	Not set
Touch functionality	No

Table 13: Shop Floor Terminal profile

10 Attachments

10.1 Overview of Reports in the FORCAM FORCE™ Performance Analysis

No.	Report name	1	2	3	4	5	6/7
		Available in Best Practice					
1	**Quantity Status Diagram (Workplace)**		✓	✓			✓
2	**Operating State Timeline (Workplace)**	✓	✓	✓	✓	✓	✓
3	**Operating State Log (Workplace)**	✓	✓	✓	✓	✓	✓
4	**Quantity Status Diagram (Operation)**		✓	✓			✓
5	**Operating State Timeline (Operation)**		✓	✓	✓	✓	✓
6	**Operating State Timeline (Order)**		✓	✓	✓	✓	✓
7	**Quantity Log**		✓	✓	✓	✓	✓
8	**Shift Book**		✓	✓	✓	✓	✓
9	**Shift Log**		✓	✓	✓	✓	✓
10	**Daily Log**		✓	✓	✓	✓	✓
11	**OEE (Overall View)**		✓	✓			✓
12	**OEE Report (Workplace)**		✓	✓			✓
13	**OEE Development (Workplace)**		✓	✓			✓
14	**OEE Report (Operation)**		✓	✓			✓
15	**Operating State Class Report (Workplace)**	✓	✓	✓	✓	✓	✓
16	**Operating State Class Development (Workplace)**	✓	✓	✓	✓	✓	✓
17	**Operating State Report (Workplace)**	✓	✓	✓	✓	✓	✓
18	**Operating State Development (Workplace)**	✓	✓	✓	✓	✓	✓
19	**Hitlist Operating States (Workplace)**	✓	✓	✓	✓	✓	✓
20	**Operating State Class Report (Material)**		✓	✓	✓	✓	✓
21	**Operating State Class Development (Material)**		✓	✓	✓	✓	✓
22	**Operating State Report (Material)**		✓	✓	✓	✓	✓
23	**Operating State Development (Material)**		✓	✓	✓	✓	✓
24	**Hitlist Operating States (Material)**		✓	✓	✓	✓	✓
25	**Operating State Class Report (Order)**		✓	✓	✓	✓	✓
26	**Operating State Report (Order)**		✓	✓	✓	✓	✓
27	**Hitlist Operating States (Order)**		✓	✓	✓	✓	✓
28	**Operating State Class Report (Operation)**		✓	✓	✓	✓	✓
29	**Operating State Report (Operation)**		✓	✓	✓	✓	✓
30	**Hitlist Operating States (Operation)**		✓	✓	✓	✓	✓
31	**Performance Report (Operation)**		✓	✓			✓
32	**Quality Report (Workplace)**		✓	✓	✓	✓	✓
33	**Quality Details (Workplace)**		✓	✓	✓	✓	✓
34	**Quality Development (Workplace)**		✓	✓	✓	✓	✓

No.	Report name	Available in Best Practice
		1	2	3	4	5	6/7
35	**Quality Details (Development per Workplace)**		✓	✓	✓	✓	✓
36	**Hitlist Quality Details (Workplace)**		✓	✓	✓	✓	✓
37	**Quality Report (Material)**		✓	✓	✓	✓	✓
38	**Quality Details (Material)**		✓	✓	✓	✓	✓
39	**Quality Development (Material)**		✓	✓	✓	✓	✓
40	**Quality Details (Development per Material)**		✓	✓	✓	✓	✓
41	**Hitlist Quality Details (Material)**		✓	✓	✓	✓	✓
42	**Quality Report (Operation)**		✓	✓	✓	✓	✓
43	**Quality Details (Operation)**		✓	✓	✓	✓	✓
44	**Hitlist Quality Details (Operation)**		✓	✓	✓	✓	✓
45	**OPE (Overall View)**		✓	✓			✓
46	**Production Process Ratio (Overall View)**		✓	✓	✓	✓	✓
47	**Order Analysis**		✓	✓	✓	✓	✓
48	**Operation Analysis**		✓	✓	✓	✓	✓
49	**Scheduled Operating Time**	✓	✓	✓	✓	✓	✓
50	**Workplace Allocation**		✓	✓	✓	✓	✓
51	**Workplace Availability**		✓	✓	✓	✓	✓
52	**Shift Schedule**	✓	✓	✓	✓	✓	✓
53	**Order Overview**		✓	✓	✓	✓	✓
54	**Order Details**		✓	✓	✓	✓	✓
55	**Order Backlog**		✓	✓	✓	✓	✓
56	**Operations in Progress**		✓	✓	✓	✓	✓
57	**Operations Completed**		✓	✓	✓	✓	✓
58	**Operation Details**		✓	✓	✓	✓	✓
59	**Stoppage Reason Development**	✓	✓	✓	✓	✓	✓

10.2 Figures

10.3 Tables

10.4 Abbreviations

Abbreviation	Text/Description
APC	Automatic pallet changer
CNF	Order/operation completely finished
MDC	Machine data collection
OEE	Overall equipment effectiveness
PCNF	Order/operation partially produced
PO/OP	Production order/operation
WPL	Workplace