SIEMENS

# SIMATIC

# BRAUMAT/SISTAR Classic Description of the system

System Manual



BRAUMAT/SISTAR Classic V6.0 SP2


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# Preface

## Purpose of the Manual

This manual describes the basic properties of BRAUMAT/SISTAR Classic V6.0 and gives you an overview of the following topics:

- Terms of a batch processing system
- Basics of a batch processing system
- System parameters
- Structure of the system
- Redundancy
- Performance data / cross-references to other manuals

This manual is intended for those responsible for configuring, commissioning, and servicing automation systems.

## Where is this Manual valid?

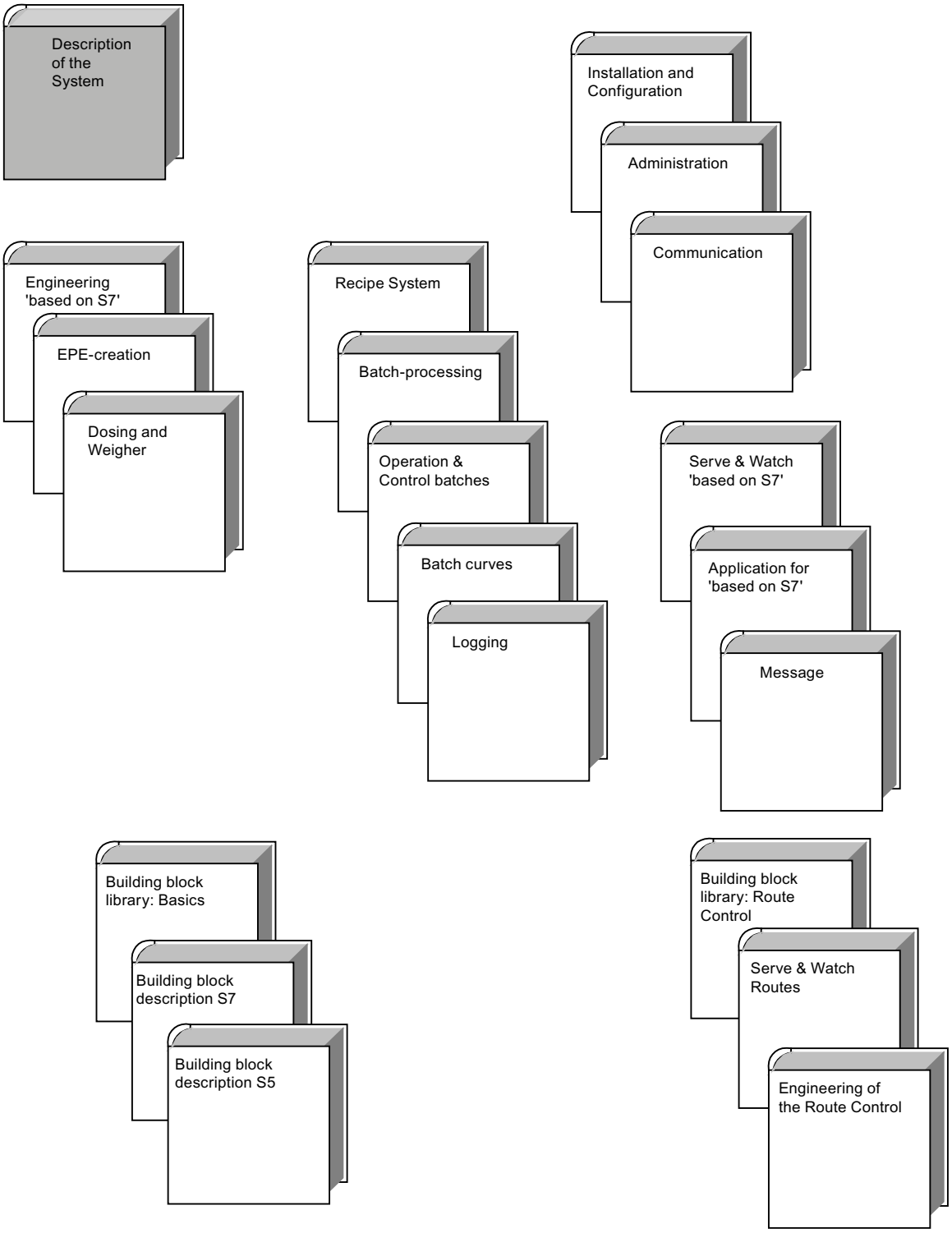
This manual is valid for the software package BRAUMAT/SISTAR Classic from Version V6.0.

The offered electronic manual is most largely identical with the contents of the on-line help. Due to a technically necessary editorial deadline for the generation of electronic manuals occasionally smaller deviations can give up opposite the on-line helps. The statements in the on-line helps are primary to those of the manual.

## Place of this Documentation in the Information Environment

This manual forms part of the BRAUMAT/SISTAR Classic V6.0 documentation package. The following schematic of the document architecture shows the individual manuals as well as their thematic grouping within the entire program package.

## Document structure



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You will find your contact person at:

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You will find a guide to the technical documentation offered for the individual SIMATIC Products and Systems here at: http://www.siemens.com/simatic-tech-doku-portal (http://www.siemens.com/simatic-tech-doku-portal)

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## Training Centers

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- The right documents via our Search function in Service & Support.
- A forum, where users and experts from all over the world exchange their experiences.
- Your local representative for Industry Automation and Drive Technology.
- Information on field service, repairs, spare parts and consulting.

# Table of contents

# General

# 1

## 1.1 Overview

The manual focuses on:

- Give an overview about BRAUMAT/SISTAR Classic V6.0
- Definition of a batch processing system (Chapter 4 - 6)

## 1.2 System name

The process control system described here is called BRAUMAT/SISTAR Classic V6.0. The former name BRAUMAT is well known in the field of breweries, whereas SISTAR is the more common name.

In this manual we use both names in common for the same meaning to keep the costs of document maintenance low, especially as we do support in lots of languages.

Therefore, the system is distributed under two names:

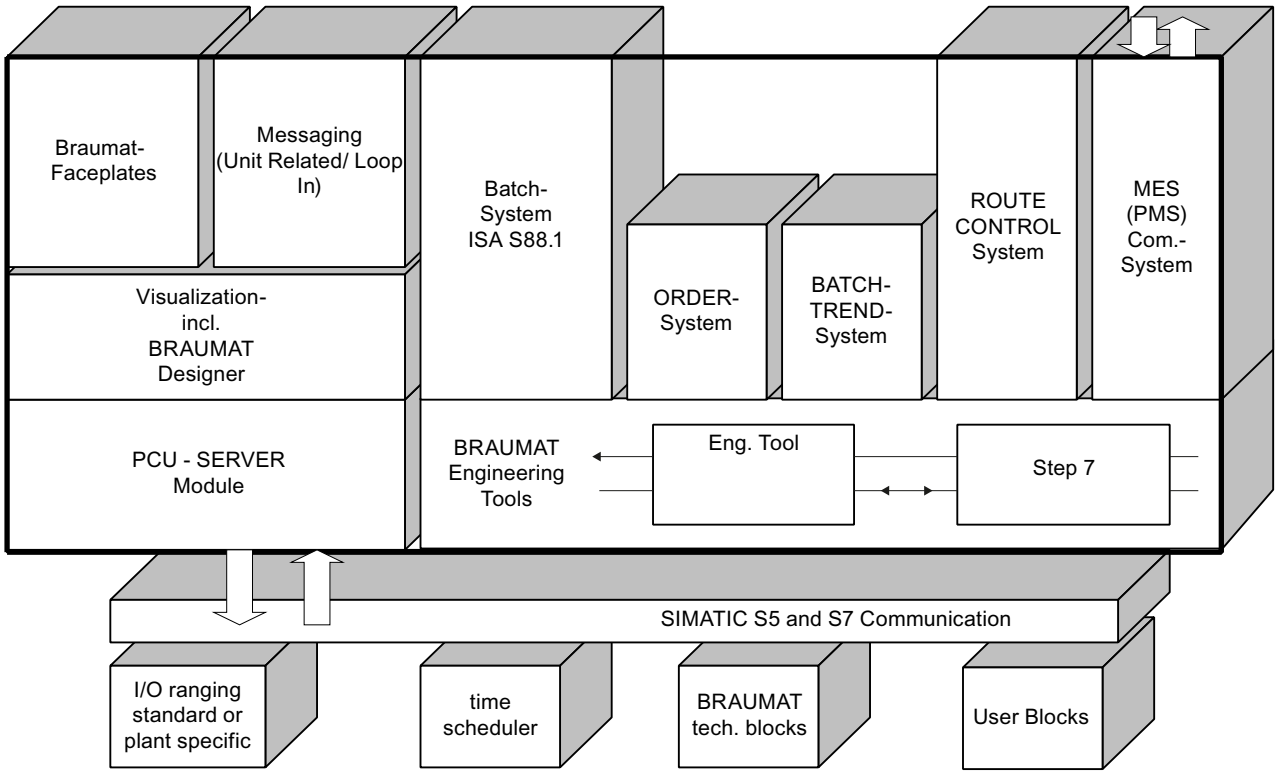
- BRAUMAT based on S7 V6.x
- SISTAR based on S7 V6.x

## 1.3 What is BRAUMAT/SISTAR Classic V6.0?

BRAUMAT/SISTAR Classic V6.0 consists of these major components:

- Batch-system
- Route control

- Visualization (monitoring and control) system
- Framework software SIMATIC




The SIMATIC includes again the runtime environment, but also the visualization elements and the message system.

The application program is created with the AWL- or SCL-editor of Step 7. The user program consists mainly of the block configuration.

# Definitions 2

## 2.1 Overview

The table below shows terms used in these manuals.

### procedural control

Control that directs equipment-oriented actions to take place in an ordered sequence in order to carry out some process-oriented task.

### procedural element

A building block for procedural control that is defined by the procedural control model.

### process cell

A logical grouping of equipment that includes the equipment required for production of one or more batches. It defines the span of logical control of one set of process equipment within an area.

NOTE: This term applies to both the physical equipment and the equipment entity.

### area

A component of a batch manufacturing site that is identified by physical, geographical or logical segmentation within the site.

NOTE: An area may contain process cells, units, equipment modules, and control modules.

### equipment procedure

A procedure that is part of equipment control.

### exception handling

Those functions that deal with plant or process contingencies and other events which occur outside the normal or desired behavior of batch control.

### basic control

Control that is dedicated to establishing and maintaining a specific state of the equipment or process condition.

### mode

The manner in which the transition of sequential functions is carried out within a procedural element or the accessibility for manipulating the states of equipment entities manually or by other types of control.

### state

The condition of an equipment entity or of a procedural element at a given time.

NOTE: The number of possible states and their names vary for equipment and procedural elements.

### arbitration

A form of coordination control that determines how a resource should be allocated when there are more requests for the resource than can be accommodated at one time.

### batch

The material that is being produced or that has been produced by a single execution of a batch process.

An entity that represents the production of a material at any point in the process.

NOTE: Batch means both the material made by and during the process and also an entity that represents the production of that material. Batch is used as an abstract contraction of the words “the production of a batch”.

### batch control

Control activities and control functions that provide a means to process finite quantities of input materials by subjecting them to an ordered set of processing activities over a finite period of time using one or more pieces of equipment.

### batch process

A process that leads to the production of finite quantities of material by subjecting quantities of input materials to an ordered set of processing activities over a finite period of time using one or more pieces of equipment.

### batch schedule

A list of batches to be produced in a specific process cell.

NOTE: The batch schedule typically contains such information as what is to be produced, how much is to be produced, when or in what order the batches are to be produced, and what equipment is to be used.

### control module

The lowest level grouping of equipment in the physical model that can carry out basic control.

NOTE: This term applies to both the physical equipment and the equipment entity.

### equipment control

The equipment-specific functionality that provides the actual control capability for an equipment entity, including procedural, basic, and coordination control, and that is not part of the recipe.

### equipment entity

A collection of physical processing and control equipment and equipment control grouped together to perform a certain control function or set of control functions.

### exclusive-use resource

A common resource that only one user can use at any given time.

### phase

The lowest level of procedural element in the procedural control model.

### common resource/shared resource

A resource that can provide services to more than one requester.

NOTE: Common resources are identified as either exclusive-use resources or shared-use resources.

### master recipe

A type of recipe that accounts for equipment capabilities and may include process cell-specific information.

### ID

An ID is a unique identifier for objects of the physical model and the batch objects. These can be: units, equipment operations, batches, raw materials, recipes, etc.

### coordination control

A type of control that directs, initiates, and/or modifies the execution of procedural control and the utilization of equipment entities.

### operation

A procedural element defining an independent processing activity consisting of the algorithm necessary for the initiation, organization, and control of phases.

### shared-use resource

A common resource that can be used by more than one user at a time.

### lot

A unique amount of material having a set of common traits.

NOTE: Some examples for common traits are material source, the master recipe used to produce the material, and distinct physical properties.

### line/train

See definition for “train”.

### procedure

The strategy for carrying out a process.

NOTE: In general, it refers to the strategy for making a batch within a process cell. It may also refer to a process that does not result in the production of a product, such as a clean-in-place procedure.

### process

A sequence of chemical, physical or biological activities for the conversion, transport or storage of material or energy.

### process action

Minor processing activities that are combined to make up a process operation.

NOTE: Process actions are the lowest level of processing activity within the process model.

### process control

The control activity that includes the control functions needed to provide sequential, regulatory, and discrete control and to gather and display data.

### process input

The identification and quantity of a raw material or other resource required to make a product.

### process management

The control activity that includes the control functions needed to manage batch production within a process cell.

### process operation

A major process activity that usually results in a chemical or physical change in the material being processed and that is defined without consideration of the actual target equipment configuration.

### process output

An identification and quantity of material or energy expected to result from one execution of a control recipe.

### process parameter

Information that is needed to manufacture a material but does not fall into the classification of process input or process output.

NOTE: Examples of process parameter information are temperature, pressure, and time.

### process stage

A part of a process that usually operates independently of other process stages and that usually results in a planned sequence of chemical and physical changes in the material being processed.

### recipe

The necessary set of information that uniquely defines the production requirements for a specific product.

NOTE: There are four types of recipe defined in this standard: general recipe, site recipe, master recipe and control recipe.

### recipe header

Information about the purpose, source, and version of the recipe such as the recipe and product identification, creator, and issue date.

### recipe management

The control activity that contains the functions for creating, storing, and maintaining general, site, master, and control recipes.

### recipe operation

An operation that is part of a recipe procedure in a master or control recipe.

### recipe phase

A function, that is part of a recipe procedure in a basic or control recipe.

### recipe procedure

The part of a recipe which defines the strategy for producing a batch.

### personnel and environmental protection

The control activity that prevents events from occurring that would cause the process to react in a manner that would jeopardize personnel safety and / or harm the environment

and / or

takes additional measures, such as starting standby equipment, to prevent an abnormal condition from proceeding to a more undesirable state that would jeopardize personnel safety and/or harm the environment.

### formula

A category of recipe information that includes process input, process parameters, and process outputs.

### train / line

A collection of one or more units and associated lower level equipment groupings that has the ability to be used to make a batch of material.

### control recipe

A type of recipe which, through its execution, defines the manufacture of a single batch or a specific product.

### equipment module

A functional group of equipment that can carry out a finite number of specific minor processing activities.

NOTE:

An equipment module is typically centered around a piece of process equipment (a weigh tank, a process heater, a scrubber, etc.). This term applies to both the physical equipment and the equipment entity.

Two examples of minor process activities are dosing and weighing.

### equipment operation

An operation that is part of equipment control.

### equipment phase

A phase that is part of equipment control.

### equipment unit procedure

A unit procedure that is part of equipment control.

### unit

A collection of associated control modules and/or equipment modules and other process equipment in which one or more major processing activities can be conducted.

NOTE:

Units are presumed to operate on only one batch at a time. Units operate relatively independently of one another.

This term applies to both the physical equipment and the equipment entity.

Examples of major processing activities are react, crystallize, and make a solution.

### unit procedure

A strategy for carrying out a contiguous process within a unit. It consists of contiguous operations and the algorithm necessary for the initiation, organization, and control of those operations.

### unit recipe

The part of a control recipe that uniquely defines the contiguous production requirements for a unit.

NOTE: The unit recipe contains the unit procedure and its related formula, header, equipment requirements, and other information.

### recipe unit procedure

A unit procedure that is part of a recipe procedure in a master or control recipe.

### enterprise

An organization that coordinates the operation of one or more sites.

### general recipe

A type of recipe that expresses equipment and site-independent processing requirements.

**site**

A component of a batch manufacturing enterprise that is identified by physical, geographical or logical segmentation within the enterprise.

NOTE: A site can contain areas, process cells, units, equipment modules, and control modules.

**site recipe**

A type of recipe that is site-specific.

NOTE: Site recipes may be derived from general recipes recognizing local constraints, such as language or available raw materials.

# System Overview 3

## 3.1 General

Although the process control system is predestined for the automation of batch tasks and was developed for that reason, also continuous processes can be handled by the system as the successful adaptation in several "continuous" plants shows.

Aims of the automation are:

- A constant product quality
- Increase of the safety of operation
- Improvement of the transparency of the operating actions
- Reproducibility of well-proved recipes
- best usage of raw materials
- Reducing of repetitive work of the personnel
- engineering according to ISA-S88 (IEC 61512-1) rules
- automatic weighing
- Route control system
- Stock location management

The systems software matched the technological requirements and contains standard functions for control modules, monitoring and control, recipe management, alarming and logging, communication, test and diagnosis.

The system is so built up that it can be adapted to the system optimally with a comparably small project planning expenditure onto the requirements. Project planning and servicing of the system can be done by technologists or operating technicians.

## 3.2 Configuration

Tools running on the OS provide dialogs where the needed properties of the system are configured by the user.

Based on the given information by the user, the system presets data structures by saving up to several weeks of engineering.

Beside a new created configuration the system can also be modified in its configuration, known as reconfiguration.

## 3.3 Parameterization

In other dialogs system-specific arguments are adapted in the according lists.

System-specific arguments are: names of individual control modules (ICMs), ranges of measured values, sort names, units, etc.

As by the configuration the lists not only are created, but also are preset with default values, normally only a part of the parameters needs to be reedited by the user.

## 3.4 Argument addressing

In the system every element has its own name (property or attribute) and is grouped together with other elements into a parameter set (object or instance of a class). Several parameter sets are assembled to a parameter list (filed as *.pcu files in the system).

The parameter set of the component MESS (Measurement) contains, e.g., arguments for the following:

- Process value (XIST)
- lower scale and upper scale value (XANF, XEND)
- state bits

In addition it is assigned a system-specific name.

Parameter sets of the same structure (class) are numbered starting by 1. Therefore MESS, 25,XIST is the 25th measuring object.

The physical address of a parameter the automation device of the arguments stands is not important for the user and normally he doesn't want to know the address. He wants to select "an object" instead of a physical address. This way brings an advantage that with process specific names can be worked easier and the system performs calculating the address (DB data block number, DW data word number = address).

## 3.5 System blocks

The system has a lot of parameterizable blocks. Every block is related to a process function (e.g., analog output, unit sequencer, PID control). The number of functions that can be done at runtime must be configured. Detailed information is provided by the respective manual.

## 3.6 Recipe management

Recipes contain the necessary specifications for the task, processed by the sequencer of a unit.

The executable control recipe is downloaded into the PLC

and is divided into recipe procedures for every unit. General information is:

- Technical operation to be processed
- Monitoring time and / or max. duration
- Set points ("how" it is supposed to be made)

The operating and editing functions contain input, correct, copy, and log mechanisms of recipes, for working offline as well as online. Correcting means modifying set point values, deleting and inserting whole parts of recipes or placeholders in system recipe version 3.

## 3.7 Linking functions

For the linking of function modules with each other, e.g., measurement, measured value check, control module, analog output, control system, etc., a conventional model is used like modules wired together.

Function modules provide output parameters serving as sources for other modules input parameters.

E.g., a PID control receives its actual value (XIST) from a MESS object or the set point value (W) from the sequencer (TEILANL).

## 3.8 Diagnostic functions

For test purposes and for a fast fault location the system provides test routines for:

- states of individual control modules (ICMs)
- Interlocking ICMs
- Simulation of measured values
- Program status with symbolic names for interlocking and triggering operations
- Setting variables in the AS (for example I(n), O(ut), M(emory), ...)
- Object state via parameterization

## 3.9 Standard functions

A basic concept of the system is to offer a large amount of standard functions, so that the user has to do not as many complex and repetitive tasks.

To be flexible for automation, the system provides default attributes that can be modified by the user through parameterization. The systems software contains components for:

- monitoring individual control modules
- sequencer modules
- Analog value processing
- Production logs (e.g., brewing or cleaning logs)
- Event log files
- Recipe management
- order management system
- control routines

- Process visualization
- Data exchange and communication
- Test and diagnosis

## 3.10 Alarms and messages

Events during operations, both disturbances and also manual interactions of the automatic process, the beginning and ending of production are recorded at the message printer, displayed on the screen in a message window and archived on the hard disk. What is recorded depends on configured criteria.

In order to reduce the time of engineering the appropriate standard functions are provided with an interface to a buffer and write messages into this buffer on occurrence, time and additional message flags are added.

On the OS a program receives each message from the buffer, converts the message and additional information into one line and outputs the message to the printer and / or onto the screen.

The message texts contain the names of the control elements, units, measure or control modules extended with "INTERRUPT", "AUTOMATIC", "MANUAL", "ERROR" texts. The texts are to be parameterized by the user so that also foreign-language versions based on ASCII code are possible.

For user-specific messages an own alarm block is available which can be linked together with user signals. Per message a message text is available for incoming and outgoing messages. (Please refer to the chapter MELD.)

The alarm system, including display and recording, is described in chapter 'LOGGING'.

## 3.11 Operating philosophy

Control elements are the screen, keyboard with function keys, and mouse and/or trackball. The function keys are numbered; they are explained in the menus. With the function keys:

- select an application
- trigger commands
- go forward or backward within data sets.

The system is handled by menu and additional dialogs which are language-dependent.

Detailed information about the screen layout and control elements is in chapter MONITORING & CONTROL.

## 3.12 Monitoring and control

The system supports several client working stations per area dependent on the configuration and also several PLCs. Every work station consists of a color screen, a keyboard, and/or a

mouse and/or trackball. For usage in dirty and dusty process environments you can use a keyboard with protection according to IP65.

Ready made dialogs and using routines are standard.

## 3.13 Logging

The system supports a printer per OS for printing messages, logs, and hardcopies.

Printing logs are on request by the user.

Stepping and alarm logs are stored on hard disk.

## 3.14 Picture construction

The picture construction program provides tables, masks, and mimic diagrams for full-graphic color monitors. Background pictures are created "offline".

Background pictures are created with a standard tool. The picture program reads this bitmap and places dynamic elements on top of it.

# Processes and batches 4

## 4.1 Overview

A process is a sequence of chemical, physical or biological activities which transform, transport or store material or energy. Industrial production processes can be subdivided into continuous processes, into processes with single job production or into batch processes.

The classification of a process, when regarding the process output

- with a continuous product flow (continuous)
- with specific numbers of individual jobs of product (job production) or
- with specific amount of product (batch process).

Even if individual subjects of this description are valid for processes with job production or continuous processes these process types are not described more detailed.

## 4.2 Continuous processes

In a continuous process the material flows continuously through the processing equipment. If a stationary operating state is achieved, the production process is independent of the duration of the operation. The start up, transient, and shutdown steps are usually unimportant.

## 4.3 Single job production

A process with job production divides products into several production lots, that are based on common raw materials, production requirements, and production histories. Processes with job production transport a specific amount of a product from unit to unit whereas the specific properties are preserved.

## 4.4 Batch processes

In this chapter the modeling of a batch system, the procedures, and their recipes are handled. The models are the base of the system.

The models are:

- process model
- physical model
- technical procedural model

A batch process provides an amount of product as the output of the preceding step, which is called a batch. Within a batch process specific amounts are transformed on different units. A batch process is neither continuous nor discrete, but has, however, such features.

Example of a batch process:

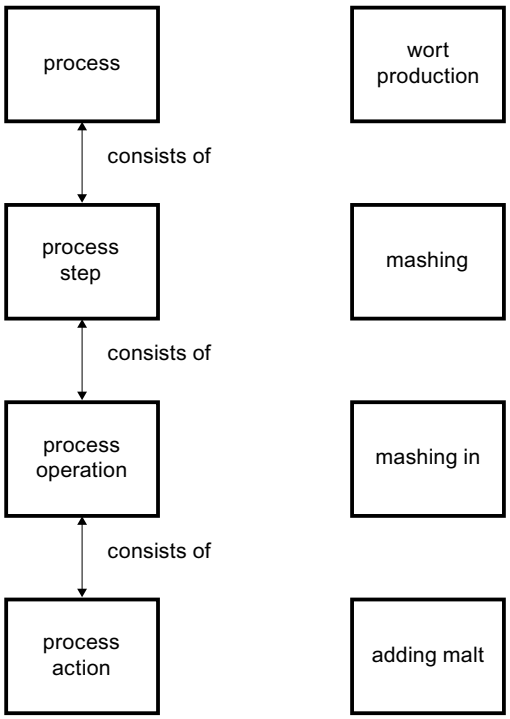



Figure 4-1 Process model and example of the Wort production

## 4.4.1 Process step

A process consists of one or several steps. These process-steps are processed together and can run sequentially or simultaneously. A process-step is part of a process that runs independently of other process-steps and creates a planned order of chemical or physical transformations of dealt materials.

For the example of the Wort production these are:

- Milling / Grinding
- Mashing
- Lautering
- Heating
- Casting wort
- Cooling

### 4.4.2 Process operation

Every one process step consists of process operations, which describe larger production sequences. A process function transforms the material either chemically or physically.

For the example of the Wort production / mashing these are:

- Providing water
- Mashing in
- Heating
- Saccharifying
- Mashing out

### 4.4.3 Process action

Every process function consists of process actions. The process actions are needed for the execution of the processing. These smaller parts of processing build a process operation.

For the example of the Wort production / mashing / Mashing in these are:

- Providing water
- Agitation <A[Agitator|Propeller]>activate
- Pre-mashing
- Draining grind<A[fuselage|hull]>

## 4.5 Physical model

In this part the physical model of a batch system is described.

The model consists of seven levels. At the top it starts with an enterprise, an area, and a site. It is used to show the relationship of the lower levels to the producing enterprise. These three levels are not described here in detail.

The lower four levels of this model refer to concrete types of equipment. In Figure 4-2 a type was combined into a group of procedural and technical controls. These four levels (process cell, units, equipment units, and single control units) are determined through engineering. The single control units are grouped on a lower level to get an element on a higher level. This handling simplifies the operation of this equipment. This created unit can not be split, except for through further engineering on this level.

For an easier understanding the entire model is shown, whereas the part is covered by the BRAUMAT/SISTAR system from "area" and below.

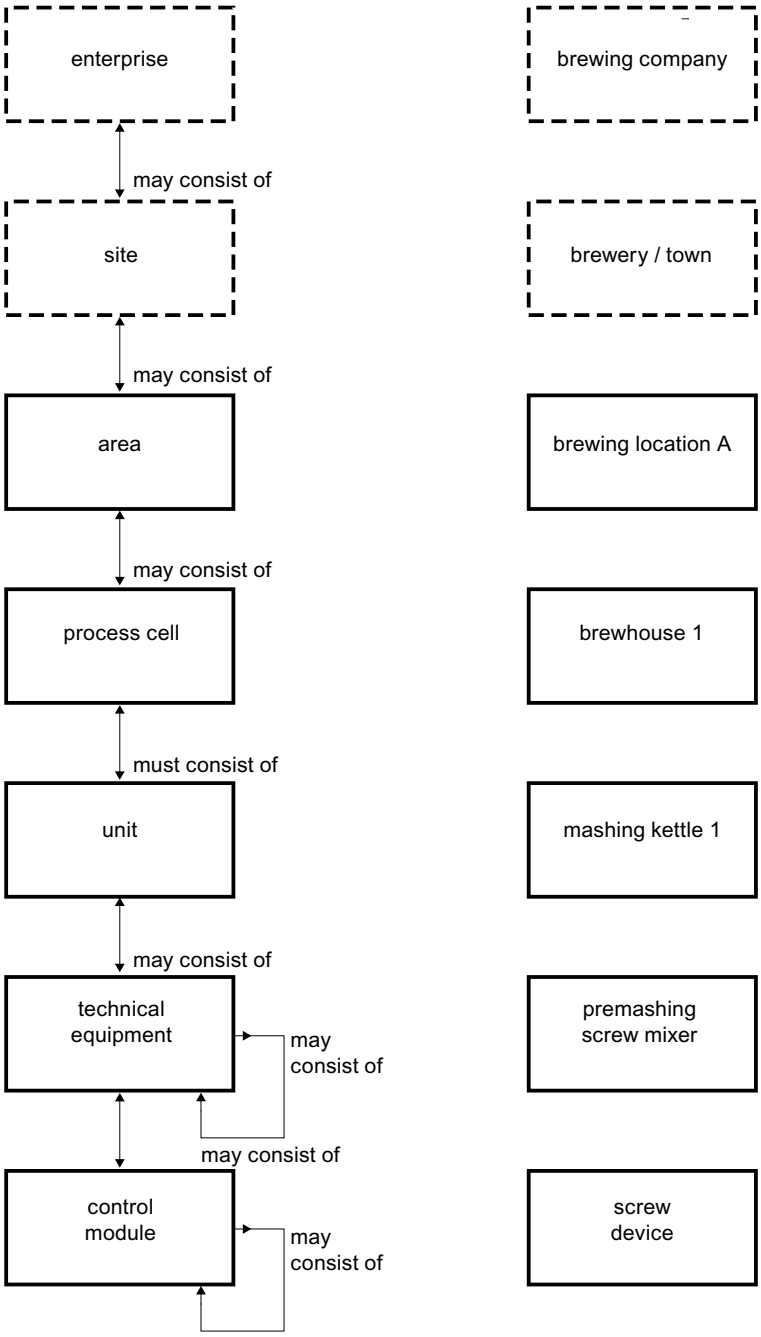



Figure 4-2 Physical model

## 4.5.1 Enterprise level

An enterprise consists of one or more areas. It includes sites, process cells, units, technical equipment, and single control units.

The enterprise plans where, which, and what products are produced.

Beside the charge oriented production of an enterprise, there are still many other facts that affect the limitation of the enterprise. This limitation is not described here.

This level is not covered by the system.

### 4.5.2 Site level

A site is a structural, geographical or logical classification of an enterprise. It can contain areas, process cells, units, technical equipment, and single control units.

The classification of a factory is related to organizational and entrepreneurial criteria.

Beside the charge oriented production, there are still many other facts that affect the classification. This limitation is not described here.

This level is covered by PMS (production management system).

### 4.5.3 Area

An area is a physical, geographical or logical group described by an enterprise. The Area can consist of process cells, units, technical equipment, and single control units.

Next to the charge oriented production, there are still many other factors that affect this limitation. This limitation is not described here.

### 4.5.4 Process cell

A process cell contains all units, technical equipment, and single control units to produce a batch.

The activities for the process control system match the requirements, where many different methods and technologies are necessary. Physical actions related to control are fixed through process-specific circumstances or administrative requirements.

A line is a part of the process cell which consists of all units and other equipment which depends on the batch to be produced. But a batch does not necessarily use all units within a line, whereas several batches and products can use a line simultaneously. The order in which the batch passes the units is named a path. An area can consist of several lines, which must, however, be part of the area.

All units which are used during the batch production are grouped logically within a system. Here it is determined which logical control options for the units within a process cell are available. A process cell provides the possibility of a disposition on process cell-level and the planning of further controlling strategies. This can be useful especially in case of emergency.

### 4.5.5 Unit

A unit consists of technical equipment and Single Control Units. Parts of the unit can be assigned either to the unit itself or be part of a resource pool and used for a specific time to perform tasks.

A unit is able to execute larger processing activities and connects the required procedural and control procedures in order to run it as an independent equipment group. A unit is related to bigger processing equipment, e.g., a mixing kettle. It contains the logical statements of the equipment for greater processing activities in order to occupy these or to run completely. The individual units work mostly independently of each other.

A unit contains a complete batch at a time. A unit can contain also only a part of a batch. It is expected, that the unit only runs one batch at a time.

### 4.5.6 Technical equipment

The technical Equipment consists of single control units and related technical equipment. It can be part of a unit or an independent group of elements of a system. As an independent resource element it can be used exclusively or in parallel.

Technical equipment runs specific, smaller processing activities, e.g., scaling or dosing. It contains the control and procedural equipment necessary for the execution. It is located mostly around a part of processing equipment, e.g., a filter. The frame of the technical equipment sets the number of steps which can be executed on equipment.

### 4.5.7 Single control unit

A single control unit is a group consisting of sensors, control elements, control modules, and the related equipment. Several single control units can be combined into another single control unit, e.g., several individual control modules (ICMs) are grouped into a dosing unit.

## 4.6 Classification of plants

Batch systems can be divided according to two criteria:

- Products being created or transformed with it (1 or more products can be produced by the system)
- by means of the physical structure

BRAUMAT/SISTAR Classic V6.0 allows both types.

### 4.6.1 Single line production

Is called "Single path structure".

A batch uses a sequence of units, where based on the input materials the final product is created within several process steps.

In the system several batches can run simultaneously but sequentially related to a unit.

The design is created via recipe procedures. A recipe procedure is related to units, where.

**Design in BRAUMAT/SISTAR Classic V6.0:**

A mashhouse represents a single production line that can be designed directly with the BRAUMAT/SISTAR Classic V6.0 recipe system.

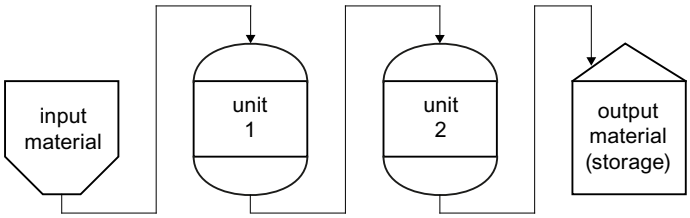



Figure 4-3 single line production

## 4.6.2 Multiple line production

Is called "multiple path structure".

A multiple line system consists of several single line paths. Single line systems share raw materials and the used containers (units) and several batches can run in parallel in the system. The units of the lines can be physically equal or similar but it is also possible that they are completely different. A batch can run on 1 line only.

**Design in BRAUMAT/SISTAR Classic V6.0:**

In BRAUMAT V4.60 and BRAUMAT/SISTAR Classic V6.0 these systems are designed as line recipe functions. An automatic multiplication onto different units can be achieved by suitable engineering.

The fermenting cellar and also the storage cellar of a brewery are examples of multiple line systems. Also mashhouses with several brewing lines are multiple line systems.

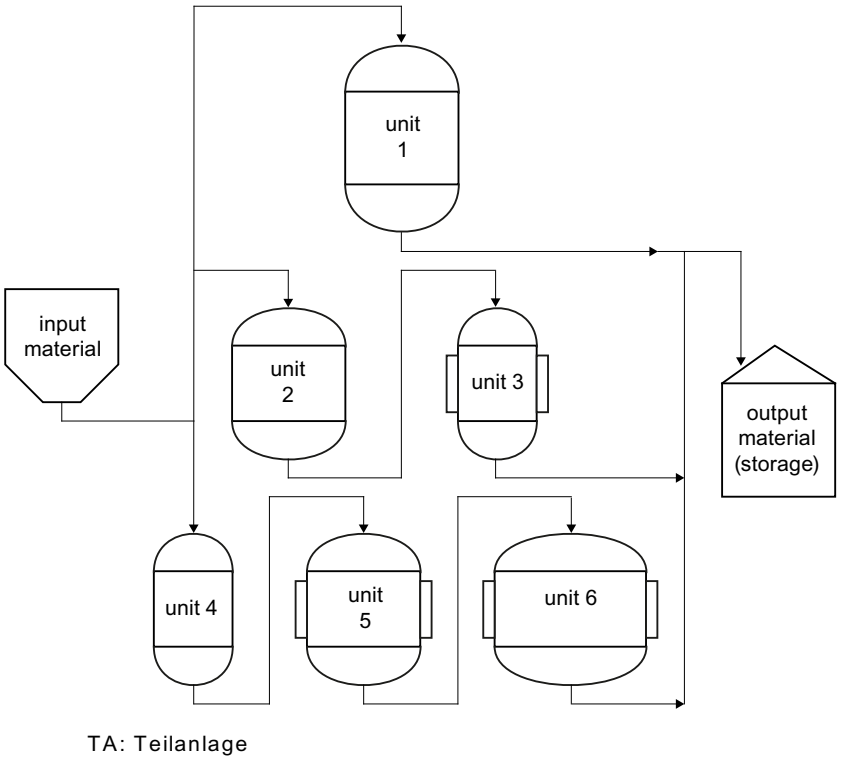



Figure 4-4 multiple line production

## 4.6.3 Network systems

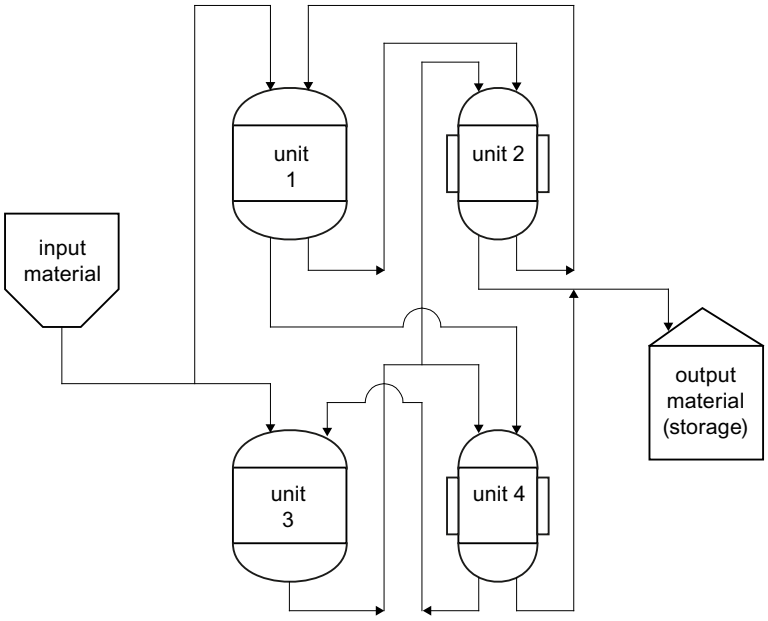
Network systems are called "network structure". The paths through the system can be fixed or variable. Before a batch runs into the next unit the destination unit can be changed.

**Design in BRAUMAT/SISTAR Classic V6.0:**

A network structure can be designed in BRAUMAT/SISTAR Classic V6.0 in three different ways:

1. Line structure (as in version 3.52 and higher):
   - All possible combinations of units have to be engineered in the recipe system.
   - It is not possible to change the unit at runtime.
2. Dynamic lines (as in version 4.60 and higher):
   - Possible combinations of units are created,
   - where at runtime the user can and must decide whether to change a unit or not.
   - The system checks whether switching is allowed.
   - The operator must actively perform switching.
3. Free path selection (as in version 5 and higher):
   - For the recipe unit procedures (RUP) of the recipe procedure more than one unit can be provided, they are called "candidates".
   - The RUP is assigned automatically a candidate,
   - whereas a default path can be assigned.
   - The switching can be done by the operator or through the "Late binding" functionality.

A complex mashhouse with paths between the lines is an example of a network system.




TA: Teilanlage

# Batch controlled operating

# 5

## 5.1 Base automation

The automation of a system is done in several levels. The bottom level represents the base automation

that includes:

- Control modules
- Interlock mechanisms
- Monitoring programs
- Exception handling
- Manual or automatic control

The base automation of a batch system is not different to a continuous production system.

## 5.2 Procedure control

Procedural functions using base level elements provide an automated controlling of an area and are divided into:

- procedure
- unit procedure
- operation
- phase

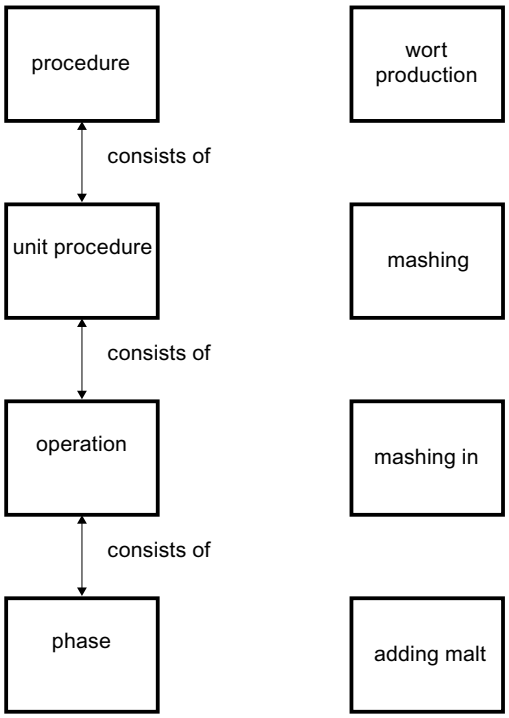



Figure 5-1 Procedural model of a batch system

## 5.2.1 Procedure

The procedure is a pattern for the system to run and create a batch. A procedure consists of several recipe unit procedures. "Wort" is an example of a procedure of a product, but there are also production for cleaning units (CIP) and other sequences in the unit.

## 5.2.2 Recipe unit procedure

The recipe unit procedure consists of a sequential order of phases (operations), where at a time only one phase is active. All operations of a recipe unit procedure run on the same unit. The recipe unit procedure may contain in BRAUMAT/SISTAR Classic V6.0 also:

- synchronization lines
- labels
- jumps
- alternatives

### 5.2.3 Operations

Operations include phases and modify a charge in a

- chemical (Saccharification)
- biological (Fermentation) or
- physical (Fill one container, transportation) manner

Transients of operations represent mostly a secure state within a procedure at which delays or breaks are possible without effects.

### 5.2.4 Phases

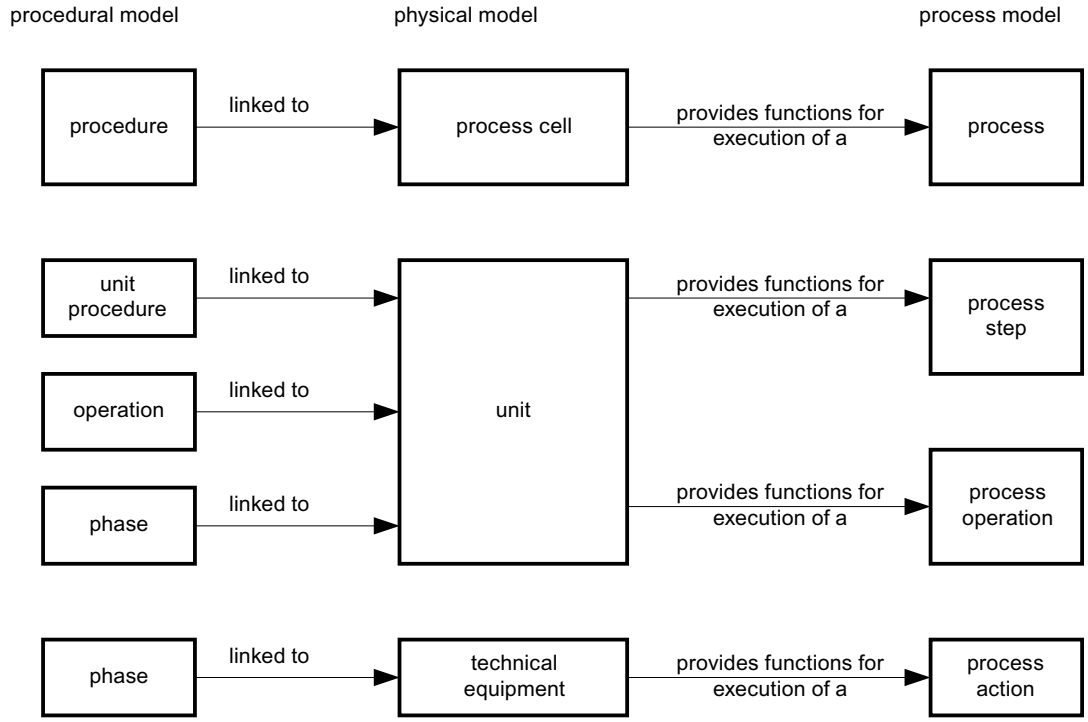
The smallest procedural elements in a batch controlled system are the phases. A phase can be subdivided even more into actions which are designed in BRAUMAT/SISTAR Classic V6.0 with SFC- as steps and -transitions or EPE-actions.

A phase can:

- lock and unlock control modules
- control and check limits
- provide set points
- read process values and calculate them

## 5.3 Connection between models

The representation of the three models is shown in the figure below. Basically each level of the process level is assigned to a level of the physical or procedural model.




### 5.3.1 Tasks of a process cell

The unit must include the following tasks:

- Processing activity and controlling of one or several batches
- Monitoring resources
- Control unit allocation
- Base automation of functions spread over several units
- Controlling procedures
- Coordination of the unit recipes

### 5.3.2 Tasks of a unit

The unit must include the following tasks:

- Base automation
- Controlling unit procedures
- Coordinated control of units

# Recipes 6

## 6.1 Using the model of BRAUMAT/SISTAR Classic V6.0

### 6.1.1 Area

The area provides functions for several process cells.

For input and start of batches BRAUMAT/SISTAR Classic V6.0 offers a charge management system (batch list). In this batch system batches based on different recipes can be handled. Starting a batch can be triggered by time, an event or load of the system.

### 6.1.2 Process cell

The process cell controls all functions necessary for one or several batches. The control orders are transferred down to the underlying objects. These are units, technical equipment elements, and single control units. According to the complexity of the system the batch can run on one or more units in parallel. The allocation of units is done by the control recipe. According to the system type (single line, multiple line or network structure) the allocation of units can vary dynamically.

#### 6.1.2.1 Base automation of the system

In the base automation of the system units are interlocked with each other. BRAUMAT/ SISTAR Classic V6.0 provides interfaces where the user can implement own interlocking mechanisms.

#### 6.1.2.2 Procedure control of the system

Running a procedure is done on the server of BRAUMAT/SISTAR Classic V6.0, the server starts, coordinates, and controls the execution of each recipe unit procedure. Starting a procedure is done by starting a recipe unit procedure, all other recipe unit procedures are started via synchronizations.

#### 6.1.2.3 Coordination of units

For coordinating recipe unit procedures BRAUMAT/SISTAR Classic V6.0 provides several mechanisms:

- Synchronizations: unit procedures are held until other unit procedures have reached a specific state (synch. line)
- Alternatives: Within a unit procedure one out of several procedures can be started based on conditions
- Start call: Within a component (function block in SIMATIC) make a call to start other unit procedures

#### 6.1.2.4 Units

Units coordinate the functions of the elements on lower levels, as for example technical equipment and single control units. The main purpose of the equipment control within a unit is to control the execution of a batch running on this unit at this time.

# Structure of the System 7

## 7.1 Structure of a PLC (AS)

For the process control level of the plant PCUs (process control unit) are employed, consisting of automation devices of type SIMATIC S7-400 or S5-155U with all technological program modules. They do control tasks, monitoring of the process execution, as well as measurement and processing. References to technical data and quantity schedules see Performance data (Page 53).

### 7.1.1 Standard structure of data blocks

The data block of BRAUMAT/SISTAR Classic V6.0 has a standardized structure.

#### Standard structure

Each data block consists of three parts. The first part is the header data, the second part is a temporary copy of the actual active dataset (runtime copy), and the third part is a field of the datasets. Each dataset contains the data of one object. The data of one dataset is defined as STEP 7 UDT.

#### Header data

| Data word | Function |
|---|---|
| DBW2: | offset to the array of datasets |
| DBW4: | dataset length |
| DBW6: | maximum number of datasets |
| DBW8: | actual used datasets |
| DBW10: | offset to the runtime copy |
| DBW12: | number of the actual dataset which is working |

Depending on the module, the header data can contain more information.

#### Runtime copy

The runtime copy is stored in the variable "u" of the data block. In the runtime copy the actual dataset is copied. After the copy the corresponding function block is called and executes the function.

The variable "u" has the data type of the corresponding UDT of the module.

### Array of datasets

The datasets are stored in an array of the corresponding UDT. Normally the data block is prepared with the maximum number of datasets.

## 7.1.2 Description of block structures in *.pcu files

The structure of data blocks is used internally by the system mainly and preconfigured in description files. During startup of the system, the object manager (OM) reads these files and provides them to all clients.

For user-defined blocks the description can be extended. Since this is important only for the version “BRAUMAT based on S7”, please refer to the engineering manual of this version.

# 7.2 Structure of a server (OS)

BRAUMAT/SISTAR Classic V6.0 OS systems are used for the visualization and logging of data in the process control system. These are based on standard system components such as PC hardware and Windows operating systems with a SISTAR systems software expansion.

References to technical data and quantity schedules see chapter 8 "Performance data (Page 53)”.

SISTAR offers easy, intuitive operator control and an extensive functionality.

## 7.2.1 Multilingual facility

The system can run in different languages by setting the language in the system setting application the corresponding language library is loaded (folder ..\WINDCS\DLL.<language number >*.dll) and when accessing text files, the appropriate folder is taken (\WINDCS \TEXTE.<language number>*.*).

In the delivery version of the system only the "German" and "English" are available. On request other languages can be supplied (at the moment only single byte fonts possible). The Language libraries and text files must be stored into corresponding folders. In addition you must configure these languages within the system (SYS.INI):

[Languages]

Numbers=0,1,<other language numbers>

0=German

1=English

2=Spanish

10=English S88

:

<new number>=<language>

After restarting the system the operator can select new languages via the system settings.

The system setup creates the following DLL subfolders in the \\ WINDCS \ directory:

| | |
|---|---|
| \ WINDCS \ DLL.0 | Index 0 = German |
| \ WINDCS \ DLL.1 | Index 1 = English |
| \ WINDCS \ DLL.10 | Index 10 = English S88 |

Further folders can be added for the installing of additional languages (available for project-specific implementations):

\ WINDCS \ DLL.xIndex x = any further languages

Example of already existing project-specific languages:

| | |
|---|---|
| \ WINDCS \ DLL.2 | Index 2 = Spanish |
| \ WINDCS \ DLL.3 | Index 3 = French |
| \ WINDCS \ DLL.4 | Index 4 = Swedish |
| \ WINDCS \ DLL.5 | Index 5 = Polish |
| \ WINDCS \ DLL.6 | Index 6 = Portuguese |

These folders contain exactly one DLL for each system application. The DLL contains language-specific resources (texts, dialogs, menus, icons ... ) for the corresponding application. The DLL file name represents the application name, with the file name extension "*.DLL". The last character of the application name is the underscore “_”.

Example: System applications, system overview

\ WINDCS \ SYS \ seqctrl.exe

| | |
|---|---|
| \ WINDCS \ DLL.0 \ seqctrl_.DLL | German resources |
| \ WINDCS \ DLL.1 \ seqctrl_.DLL | English resources |
| \ WINDCS \ DLL.2 \ seqctrl_.DLL | Spanish resources |
| \ WINDCS \ DLL.10 \ seqctrl_.DLL | English S88 resources |
| \ WINDCS \ DLL.x \ seqctrl_.DLL | other foreign language resources |

In addition the COMMLIB.DLL is filed in each of the library folders and contains language-dependent resources which are used by all system applications and by the system library WINDCS.DLL. The file WINDCS.DLL is stored in the folder \ WINDCS \ SYS and exists only once. It contains only language-independent resources.

The current language is configured in the file \ WINDCS \ SYS \ SYS.INI. When the first SISTAR application is started, this file is loaded to the data segment of the WINDCS.DLL. The active language can be queried from the applications using the sysini_language( ) function. The texts are loaded to the relevant data segment when a system application is started, but the other resources are only loaded if necessary. The user changes the language via the system setting application. Once the language has been changed, a message box informs the operator that the main menu will now be exited. Restarting the system is done by ending the menu, but has to be confirmed (password required) the system restarts with the new language setting.

## 7.2.2 AREA-Selection dialog inside the applications

### 7.2.2.1 AREA-Selection on application-start

On starting the application the following dialog-sequence takes place:

- First, a selection dialog appears with the projected AREAs
- Selection of the area (default = last area selected) and OK button starts the application and connects to the respective area server
- Selection of the option box "Hide dialog" saves the area-selection and the dialog is hidden for all applications from now on
- Activating the dialog once more takes place via <Ctrl>+double-click on the application icons

### 7.2.2.2 AREA-Selection on file open

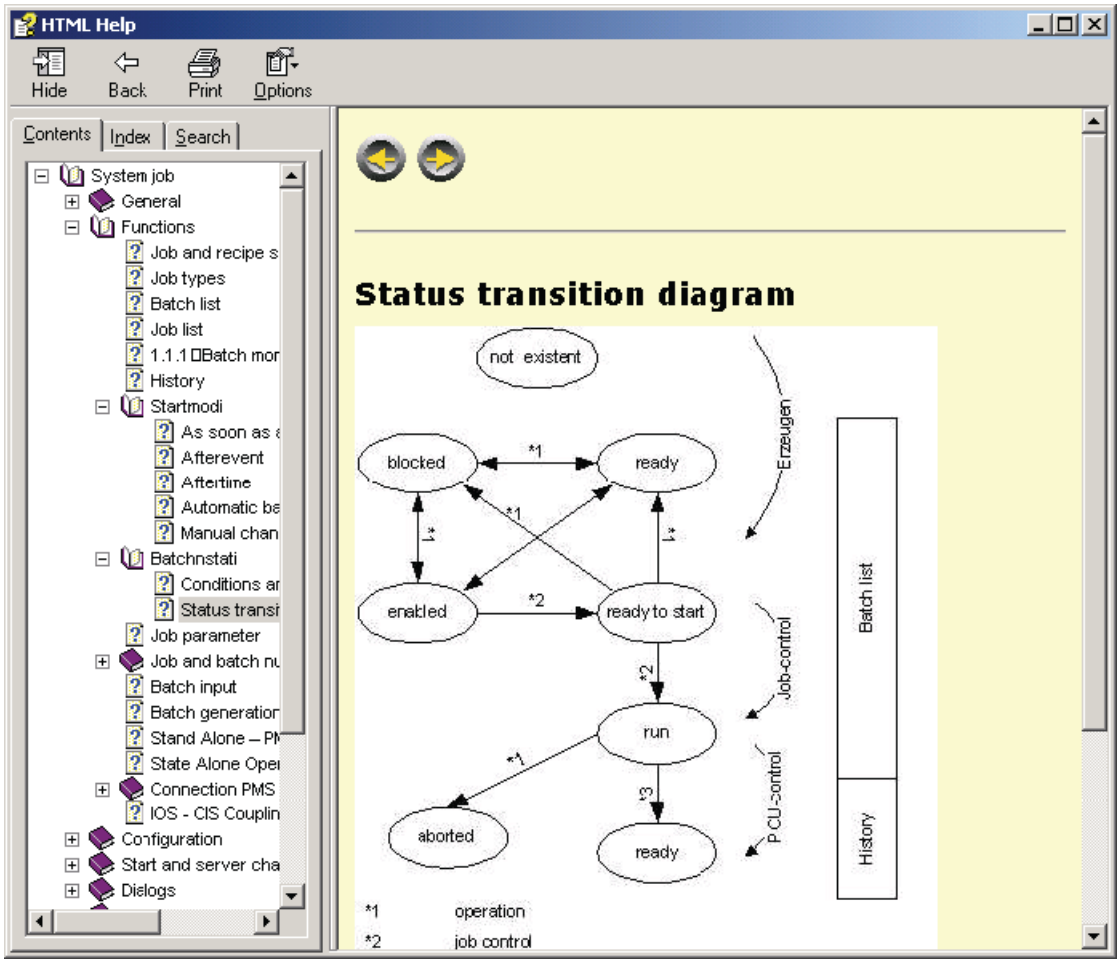
In all applications that start with empty Workspace per default, the area selection dialog occurs first during the file opening.

**Notes:**

- Default setting before an AREA reference was selected is the own AREA, later the at last selected AREA, that means the AREA selection is stored.
- In the case of several opened instances of an application the at last opened determines the active AREA.

## 7.2.3 Help functions

The system provides a lot of online-help. In every application you can start the online help via the menu.




## 7.2.4 Printing

The system supports a printer per OS for printing messages, logs, and hardcopies.

Printing logs are on request by the user.

Stepping and alarm logs are stored on hard disk.

## 7.2.5 Hardcopy

On an OS you can create a hard copy. Start clipprnt.exe which runs as a background process. Press the PRINT key if you want to make a hardcopy, a menu appears and you can decide on the page orientation (landscape or portrait).

### 7.2.6 Redundancy

The function of an OS is taken over automatically from another standby OS in case of disturbance of a critical component.

## 7.3 dBase files

A lot of data needed by the system is stored into dBase files. For accessing these files a definition file is required. System files are already installed.

The user fitted the possibility for certain functions the mounting. With functions Free Records and this must be done to scales.

### 7.3.1 Creating a definition file

The definition file is built up line by line and describes a data record of the dBase file. A data record dBase is order of ASCII-signs, thus the header file describes the structure of one string.

Example:

```
  0 Definition: OS component list of a batch
 53
  1 ORDER_NR   CINT  5    Ordernr.
  6 BATCH_NR   CINT  5    batchnr.
 11 YEAR       CINT  2    year
 13 REC_TYPE   CINT  5    recipe type
 18 IOS_K_ID  CINT  5   component no.
 23 KOMP_SIZE  CINT 12.3 quantity
 35 TA_NR      CINT  5    silonr
 40 DOS_GR     CINT  5    dosing group
 45 PCU_NR     CINT  3    plc nr.
 48 SPEZGEW    CINT  5    specific weight [g/dm3]
```

#### First line with offset specification

In the first line the offset is given. This value usually is 0.

The line has the following syntax:

```
<offset number> <comment>
```

Example:

```
0 Header file for Free Recipe Category Record 1
```

#### Second line with record length

The second line contains the length of a record. It is the offset of the last line added to the length of the element of the last line.

The line has the following syntax:

```
<offset number> <comment>
```

### Example:

```
180 record length
```

### Field definition

One or more lines with definitions of elements follow.

Structure:
```
<offset> <field name> <type> <length in bytes> <comment>
```

Example:
```
1 FIELDNAME CINT 5 order number
```

- Offset
  **The first line must have** offset 1 since the dBase saves a deletion flag in the first byte of a data record. The offset is the offset of the predecessor line to that one the field length of the predecessor line is summed up. Reserved bytes (gaps) in the field definition are allowed.
- Field name
  The field name may be a maximum of 9 characters. The name may contain no special characters or other characters forbidden near array which dBase doesn't allow.
- Type
  BRAUMAT/SISTAR Classic V6.0 supports the data types "CINT" and "CHAR".
- Length
  With this specification the field length is defined. With the type "CINT" a number of digits before and after the point can be configured (example: 5.3).
- Comment
  The comment can be up to 59 characters.

**Note**

For some system functions (for example: free protocols) the comment field is used for other functions.

# Performance data

# 8

## 8.1 Overview

BRAUMAT/SISTAR Classic V6.0 represents the product of continuous development starting at V3.11, V3.52, and V4.x.

The major difference is its extended functional scope, found mainly in the batch system and route control system, and in Versions >= V5.3 the multiple client mode and the latest operating system platforms.

References to the HW and SW-prerequisites (PCU- / IOS-hardware, operating system releases) as well as compatibility statements to other Simatic products are to be taken from the supplied File "SP1_Readme.wri". Further information to supported HW- and SW configurations can be referred also in the Simatic Customer Support website (area Braumat/ Sistar, Tab Updates / FAQ) mentioned in the preface of the manual.

## 8.2 Quantity schedule of functions and classes

The table below contains information about the quantity structure and the following preconditions apply:

- Number per function or instances per object class
- Per PCU or AS
- The information applies to the standard CPU type **CPU 416-3, order number 6ES7 416-3XR05-0AB0.**

**The following applies when using smaller CPU types:**

Any restrictions depend on the project engineering requirements; in other words, the project engineer needs to calculate and assess whether the use of the relevant CPU is possible for the required BRAUMAT application and make sure that the available resources are adequate.

| Object class/Function | Quantities (up to) |
|---|---|
| Final control elements | 4 x 255 |
| Sequences | 64 (SEQU) |
| Measurement | 256 (MESS) |
| Measured value check | 128 (MEKO) |
| PID control module | 64 (PID) |
| Three position control module | 96 (DREIP) |
| Analog value outputs | 256 (ANAU) |
| Incremental encoder | 16 (INKU) |
| User messages | 1024 (MELD) |
| Analog constants | 255 (ANA) |

| Object class/Function | Quantities (up to) |
|---|---|
| Process start module | 96 (ASTA) |
| Multiple functions block | 128 (MULT) |
| Polygon adaptation | 32 (POLY) |
| Special values | S5 255 (Special Value) 255 (SpeValue)<br>S7: 510 |
| Batch start module | 64 (CAS) |
| Digital function module | 4 x 255 (DFM0 - 3) |
| Trend reference values | 64 (KURVSW) |
| Send buffer | 6 (SendPu1 - 6) |
| FIFOs (buffer) | 6 (FIFO1 - 6) |
| Maintenance ICMs | 1023 (MAINT_ESG) |
| Delay modules | 2 x 512 (SE_TIMER) |
| Silo group | 128 (SILO_W01- Y) |
| Scale data set | 32 (GFWAAGE) |
| **Miscellaneous** | |
| Technical operations | 999 per AS |
| Recipe categories | 255 |
| Master recipes per category | 10000 |
| Recipe procedures | 32767 |
| Recipe unit procedures per recipe procedure | 256 |
| Recipe operations per recipe unit procedure *) | S5: max. 255<br>S7: 255 guaranteed; more ROPs available, Max. number depends on number of setpoint values per operation and on the type of operation |
| Set points per recipe operation | 20 for S7 PCUs with recipe system V5<br>13 for S7 and S5 PCUs with recipe system V3 |
| Setpoints per sequence | 24 |
| Total number of batches of all jobs | 10000 |
| Process pictures (OS) | Any |
| Tags per picture | 510 for standard variables; 1200 for faceplates |
| Analog measured values per curve server | 1200<br>With S5, max. 1020 per AS |
| Digital measured values per curve server | 2400 |
| Number of curves per image | 8 analog or 32 digital or 8 analog + 16 digital |
| Number of curve groups: | 240 (triggering of start/end of recording) |
| **System configuration** | |
| Cross-coupling AS – AS | 31 connections with S7 control (32 AS possible)<br>512 QK jobs with S7 – S7 communication<br>15 connections with S5 control (16 AS possible)<br>256 QK jobs with S5 – S5 communication |
| OS – OS communication | Any number of connections<br>Terminal bus/standard Ethernet LAN (TCP/IP) |

| Object class/Function | Quantities (up to) |
|---|---|
| Total number of PCUs/PCU number range | A process cell can consist of a maximum of 64 PCUs.<br>The PCU numbers may range from 1 to 239 and are unique throughout the process cell. |
| Number of PCUs per server/area | 16 |
| Number of clients per server | Sensible upper limit = 32 |
| Number of servers per area | 1 server or 1 redundant server pair |
| Number of areas per site | Max. 16 areas per process cell (site) |
| "Route control system" (RCS) option | |
| Number of PCUs per area | 16 |
| Number of simultaneous material transport operations (routes) | 300 |
| Number of elements per calculated route | 450 per PCU |
| Control elements (CE) | 1024 per PCU |
| Sensor elements (SE) | 1024 per PCU |
| Parameter elements (PE) | 1024 per PCU |
| Link elements (LE) | 1024 per PCU |
| Locations/partial routes/process cells | Any |

*) Note on the number of operations per unit procedure

Unit control recipes are stored in the PCU recipe data blocks, in an S5 system in a DX, in an S7 system in a DB. Unit control recipes are created dynamically. Their size depends on the number of operations, the type of operation used and on the reference value for each operation. This is why there is no specified fixed maximum for the operations. The length of recipes is automatically verified when the recipe procedure is saved and when new operations are added.

## 8.3 Overview of BRAUMAT/SISTAR Classic V6.0 applications

The table below shows a list of all applications supplied with BRAUMAT/SISTAR Classic V6.0, sorted in alphabetical order:

- Application name (without ".EXE" extension)
- Notes on functions
- Notes on use
- Cross-reference to the BRAUMAT/SISTAR Classic V6.0 manual, including the description or notes on usage

| Application | Function | Use | Description |
|---|---|---|---|
| ARCH_MAN | Archive manager | Engineering | HB 3<br>Administration |
| ARCHEDIT | Archive Editor f. PI trends | Configuration/ Administration | HB 13<br>Batch curves |

| Application | Function | Use | Description |
|---|---|---|---|
| BALIEDIT | Batch Editor | Engineering | HB 12<br>Operator control and monitoring of batches |
| BIKO | Picture construction | Engineering | HB 15<br>Operator control and monitoring based on S7 |
| CLIPPRNT | Printer program operated in the background | Tool | |
| CONFIG.EXE | SYS Config 1 | Configuration/ Administration | HB 3<br>Administration |
| CONTROLREC.EXE | Recipe control application | Process diagnosis | HB 11<br>Batch processing |
| DATACONN | Interconnection view (as of V4.60) | Process diagnosis | HB 16<br>Applications based on S7 |
| DBEDIT | DB Editor | Process diagnosis | HB 16<br>Applications based on S7 |
| DFM | DFM overview | Process diagnosis | HB 16<br>Applications based on S7 |
| EDITREC.EXE | Recipe Editor (new) | Engineering | HB 10<br>Recipe system |
| ENDEXPL | Close Windows Explorer | Tool | HB 02<br>Installation & Configuration |
| ESG | Final control elements | Process diagnosis | HB 16<br>Applications based on S7 |
| ENTITYDEF.EXE | Conf. of entities | Engineering | HB 15<br>Operator control and monitoring based on S7 |
| KURVEIN | Trend input | Engineering | HB 16<br>Applications based on S7 |
| KURVEN | Trend input | Engineering | HB 13<br>Batch curves |
| LZSYS | Process pictures | Operator control and monitoring of the process | HB 15<br>Operator control and monitoring based on S7 |
| MEASEDIT | MWBL Editor | Archive/logging | HB 13<br>Batch curves |
| MELDARCH | Message archive | Archive/logging | HB 16<br>Applications based on S7 |

| Application | Function | Use | Description |
|---|---|---|---|
| MENU | Main menu | Control Center | HB 3<br>Administration |
| NEWMENU | New main menu | Control Center | HB 3<br>Administration |
| PARAM | Parameterization | Engineering | HB 16<br>Applications based on S7 |
| PARATXT | Text configuration | Engineering | HB 16<br>Applications based on S7 |
| PASSWCHK | Password check (for .exe) | Tool | HB 03<br>Administration |
| PATHSUPV | Path monitoring | Tool | HB 02<br>Installation & Configuration |
| PCU_SERV | PCU server | System process | HB 12<br>Operator control and monitoring of batches |
| PROSCHED | Program execution | System process | HB 01<br>Administration |
| PROVIEW.EXE | Delta logs | Archive/logging | HB 14<br>Logging |
| RCS_ONLINE.EXE | Online module for RCS | Operator control and monitoring of the process | HB 19<br>Operator control and monitoring of routes |
| RECCONTR | Recipe control, operator control and monitoring | Process diagnosis | HB 12<br>Operator control and monitoring of batches |
| REGLER | Operator control of the controller | Process diagnosis | HB 16<br>Applications based on S7 |
| SEQCTRL | System overview (as of V4.60) | Operator control and monitoring of the process | HB 12<br>Operator control and monitoring of batches |
| SETNOTSYNC.EXE | Writes the sync file | Configuration/ Administration | HB 02<br>Installation & Configuration |
| SITECFG.EXE | ConfigTool for AREA.INI | Configuration/ Administration | HB 02<br>Installation & configuration |
| SONDWERT | Special values | Process diagnosis | HB 16<br>Applications based on S7 |
| SRPNEU | Step protocols | Archive/logging | HB 14<br>Logging |

| Application | Function | Use | Description |
|---|---|---|---|
| STATUS | Status S5 program | Process diagnosis | HB 16<br>Applications based on S7 |
| STATUS_S7 | Status S7 program | Process diagnosis | HB 16<br>Applications based on S7 |
| STEUERN | Variable control | Process diagnosis | HB 16<br>Applications based on S7 |
| SYNCHRO | File synchronization | Configuration/ Administration | HB 12<br>Operator control and monitoring of batches<br>HB 3<br>Administration |
| SYSINI | System settings | Configuration/ Administration | HB 19<br>Operator control and monitoring of routes |
| TRACESVR | Trace Viewer | Tool | HB 14<br>Logging |
| TRACEVWR | Trace Viewer - offline | Tool | HB 14<br>Logging |
| TRANSBST | Block transfer | Configuration/ Administration | HB 3<br>Administration |
| TRENDMAN | PI trend archive manager | Archive/logging | HB 13<br>Batch curves |
| USERMAN.EXE | SYS Config 2 | Configuration/ Administration | HB 3<br>Administration |
| WARTDAT | Maintenance data | Archive/logging | HB 16<br>Applications based on S7 |

# 8.4 Important notes and restrictions

## 8.4.1 Special characters in the object name

For system-related reasons, BRAUMAT/SISTAR Classic V6.0 is subject to some restrictions relating to naming conventions for the various technological objects. Users should always conform with these naming conventions:

Special characters not allowed: , ; / ? * ~ ~# | @