Ready for all tasks –
the modern SIMATIC PCS 7 process control system

"Two of Siemens’ key differentiators are its ability to bring together process and discrete automation under a single control environment, as well as its philosophy for ownership of core system technologies."

ARC Study January 2005
"Siemens Process Industry Strategies", page 3
ARC Advisory Group, Dedham /MA, USA

The automation technology of a company is an important key towards increasing productivity, shortening the time-to-market, and fulfillment of market requirements. These challenges are encountered in both the process and production industries, but also in hybrid sectors including production steps from both.

SIMATIC PCS 7, the innovative process control system from Siemens, proves its strengths in all of these sectors. Its flexible architecture not only means that it can take over process control for the main production process, but also for auxiliary, upstream and downstream processes such as e.g. wastewater treatment or power distribution.

SIMATIC PCS 7 is integrated within Siemens’ Totally Integrated Automation (TIA), a complete range of matched products, systems and solutions for uniform and customized automation in all sectors of the production, process and hybrid industries.

TIA can be used to automate complete production processes from incoming to outgoing goods homogeneously and uniformly, or to implement holistic automation solutions for a production site.

Using the comprehensive know-how of our sector specialists in the Competence Centers, sector-specific solutions can also be developed on this basis which can be individually matched to particular customer requirements.
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SIMATIC PCS 7 –
The process control system in Totally Integrated Automation

With Totally Integrated Automation (TIA), Siemens is the only manufacturer offering a comprehensive range of products and systems for implementing automation solutions – for the entire process chain, from input logistics through the production or primary process and downstream processes (secondary processes) up to output logistics. Thanks to its unique uniformity, TIA makes a significant contribution to optimization of the processes and reduction in the total cost of ownership.

TIA permits optimization of all operating sequences of an entire company – covering the ERP (Enterprise Resource Planning) level, MES (Manufacturing Execution System) level, control level, and right down to the field level. This vertical uniformity with its reduced interface overhead provides maximum transparency at all levels.

Throughout the complete lifecycle of a plant, i.e. covering the initial planning steps, operation as well as modernization, the owner profits in that TIA avoids unnecessary changes in system and guarantees a high degree of investment safeguarding through compatible further developments.

The pioneering SIMATIC PCS 7 process control system is a significant component of TIA. It offers a modular, open architecture, powerful basic technologies, selected standard hardware and software components from the state-of-the-art SIMATIC range, as well as complex I&C functions.

Homogenous and uniform complete system
SIMATIC PCS 7 comprises a homogenous and uniform complete system with typical process control features. This is gaining increasing importance as a result of:

- Continuous competition and price pressures
- The demand for increasingly flexible production plants, e.g. to increase productivity
- Increasing complexity which also results through the merging of automation engineering and information technology.
SIMATIC PCS 7 comprehensively satisfies all typical demands placed on a modern process control system, meaning that plant owners are appropriately equipped for future requirements. This is guaranteed by system properties such as:

- High performance, flexibility and scalability
- Uniform data management, communication and configuration
- System openness on the basis of internationally established basic technologies and industrial standards
- Powerful system-wide engineering
- Simple and reliable process control
- User-friendly operation and visualization
- Redundancy at all levels
- Direct interfacing to the IT world
- Safety-related automation solutions
- Comprehensive fieldbus integration
- Flexible solutions for batch processes
- Incorporation of material transport (Route Control)
- Asset management (diagnostics, preventive maintenance and repairs).

**Uniform data management, communication and configuration**

The advantages of SIMATIC PCS 7 are already evident during planning and engineering, but also during installation and commissioning, everyday operation as well as maintenance, repairs and modernization.

Uniform data management means that all software components access a common database. Within a project, inputs and modifications are therefore only necessary at one point. This reduces the work required, and simultaneously avoids potential faults. Data consistency is also guaranteed even if several persons are working simultaneously on a project. Parameters defined in the engineering system can be transferred beyond the network limits down to sensors, actuators or drives in the field.

Uniform communication from the corporate management level down to the field level is based on internationally recognized standards such as Industrial Ethernet or PROFIBUS, and also supports the global flow of information via the Internet. Since the hardware and software components involved also use these communications mechanisms, connections are extremely easy to configure, also cross-system or over different networks.

The use of a central engineering system with a uniform and matched range of tools minimizes the configuration overhead. The engineering tools for the application software, the hardware components and the communications functions can be called from a central project manager (SIMATIC Manager). This is also the basic application for creation, management, saving and documentation of a project.

**SIMATIC PCS 7, integrated in Totally Integrated Automation – your advantages**

Totally Integrated Automation (TIA) with the SIMATIC PCS 7 process control system allows cost-effective implementation and economic operation of I&C plants in all phases of their life and with consideration of all aspects: from planning, engineering, commissioning and training, to maintenance and repair, right up to expansion and retrofitting.

In addition, users enjoy the advantages resulting from the application of standard SIMATIC components, such as:

- Low hardware and engineering costs
- Proven quality and stability
- System components can be defined and selected quickly and easily
- Low spare part costs
- Short delivery times for spare parts and expansion components
- Worldwide availability
- Reduced logistics, maintenance and training costs
- Participation in the innovations of the market leader for automation technology.
Open for the future

SIMATIC PCS 7 is based on modular hardware and software components, which are perfectly matched to one another due to their conformance with TIA. These components can be expanded and innovated seamlessly and with little effort and are open for the future through long-term stable interfaces. This makes long-term protection of customer investments possible, despite the fast pace of innovation and short product cycles.

SIMATIC PCS 7 consistently applies new, powerful technologies together with internationally established industrial standards such as IEC, XML, PROFIBUS, Ethernet Gigabit technology, TCP/IP, OPC, ISA-88 or ISA-95, just to mention a few.

Openness as far as SIMATIC PCS 7 is concerned covers all levels, and applies to automation systems and process I/Os as well as industrial communication networks, operator systems and engineering systems.

It not only comprises system architecture and communication, but also the programming and data transfer interfaces for user programs as well the import and export functions for graphics, text and data, e.g. from the CAD/CAE world. SIMATIC PCS 7 can therefore also be combined with components from other vendors, and integrated in existing infrastructures.

Integration into the company-wide information network

The SIMATIC PCS 7 process control system can be integrated through interfaces based on international industrial standards for data exchange within the corporate IT network. In this manner, process data can be made available at any time and any location within the company for the evaluation, planning, coordination and optimization of operational procedures, production processes and business processes, e.g. for:

- ERP (Enterprise Resource Planning)
- MIS (Management Information System)
- MES (Manufacturing Execution System)
- Advanced Process Control.
SIMATIC PCS 7 supports the system interfacing to SIMATIC IT, the Manufacturing Execution System from Siemens. SIMATIC IT can be used to record data in real-time from the ERP and control levels, to model the complete manufacturing know-how, and to precisely define the operating processes.

The operator stations of SIMATIC PCS 7 provide further facilities for simple access to the IT environment. They can either be an OPC server data source for IT applications or, as an OPC client, access the data of OPC server applications.

Using a PCS 7 Web server, the plant can be operated and monitored via Internet/intranet. The PCS 7 Web server connects the data of the subordinate OS servers, and makes them globally available for remote monitoring, operation, diagnostics and maintenance. The Web access is subject to the same access protection mechanisms as on the client in the control room.

Modernization with SIMATIC PCS 7

Permanently increasing competitive pressures force companies to reduce their costs, to continuously increase productivity and quality, to shorten the time-to-market, and to introduce environmentally-compatible production processes and technologies based on the optimum use of raw materials and energy.

In order to achieve these goals, processes must be continuously optimized, and systems and plants modernized and expanded. Since the installed basis of hardware, application software and know-how of the operating and maintenance engineers represents an enormous value, the safeguarding of investments for companies operating the plants is always assigned a high priority during all modernization plans.

For many years already, Siemens has offered a wide range of innovative products and solutions for its older control systems such as TELEPERM M or APACS to permit migration to SIMATIC PCS 7. The maxim of Siemens’ migration strategy is to modernize the existing installed basis in steps and without completely changing the system – if possible without a plant shutdown.

With its universal migration technology "Data Base Automation", Siemens is also able to migrate control systems from other vendors to SIMATIC PCS 7.
Flexibility and scalability – from small laboratory system up to distributed client/server solution

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Scalability of the SIMATIC PCS 7 process control system

The SIMATIC PCS 7 process control system can be flexibly adapted to different plant sizes and customer requirements when carrying out the plant configuration. A SIMATIC PCS 7 system can be subsequently expanded without problem if there is an increase in capacities or a technological modification.

SIMATIC PCS 7 is scalable from a small single system consisting of approx. 160 process tags (common synonym: measuring points), such as might be used for a laboratory system or a test center, up to a distributed multi-user system with client/server architecture and approx. 60,000 process tags, such as might be used for automation of a very large production plant or for groups of connected facilities.

**SIMATIC PCS 7 BOX**

SIMATIC PCS 7 BOX is a low-cost starter solution for SIMATIC PCS 7 that unites the functionalities for automation, operation, visualization and engineering in one compact PC system. Together with distributed I/Os on the PROFIBUS, this represents a complete process control system suitable for small production applications, autonomous partial processes, or for the automation of a laboratory system or a test center.

SIMATIC PCS 7 BOX uses the standard system software of SIMATIC PCS 7, is scalable, and expandable without interrupting compatibility.

SIMATIC PCS 7 BOX can be operated in stand-alone mode as well as with connected facilities.
SIMATIC PCS 7 Basic Package

The SIMATIC PCS 7 Basic Package designed for approx. 650 process tags has a performance higher than that of the SIMATIC PCS 7 BOX. This attractive product bundle equipped with all basic control system functions (AS, OS, ES) allows a low-cost start to process automation with standard SIMATIC PCS 7 hardware and software components. Thanks to the upward compatibility of hardware and software, all components can be used further and expanded without limitation should the plant configuration be subsequently increased.

Individual and flexible adaptation of the SIMATIC PCS 7 functionality

Depending on the specific requirements, the user and the planning engineer can carry out the following:

- Select various powerful automation systems
- Incorporate distributed or central I/Os step-by-step
- Dimension and configure display and operating components: from single-user system up to distributed multi-user system, also redundant as option
- Specifically expand the operator system functionality using various hardware and software components, e.g. with SFC visualization, special viewers, remote operation and monitoring via Internet, or long-term archiving
- Select the engineering system according to the scaling with process objects, and expand further with optional functions
- Configure the hardware and software components for special automation tasks: SIMATIC BATCH, SIMATIC Route Control
- Configure communication networks and define network components
- Organize asset management (diagnostics, preventive maintenance and repairs)
- Interface SIMATIC PCS 7 to the IT world.

highlights

- Scalable from small laboratory system for approx. 160 process tags up to distributed system with client/server architecture for up to 60,000 process tags
- One uniform control system platform based on standard SIMATIC components
  - Cost savings through personnel know-how and reduced stocking of spare parts
  - Cost savings through reuse of application engineering (e.g. test center)
- Attractive starter systems in the low-end performance range:
  - SIMATIC PCS 7 BOX
  - SIMATIC PCS 7 Basic Package
- Optimum adaptation to dimensions of customer's plant
  - No provision of expensive spare capacities
  - The process control system grows as the plant is expanded
- Numerous expansion facilities for adaptation of functionality
  - Best possible adaptation to individual plant requirements
  - Optimum price/performance ratio
Redundancy at all levels

SIMATIC PCS 7 offers a comprehensive redundancy concept which covers all I&C levels.

The client/server architecture of the process control system enables access from up to 32 clients (OS/Batch/Route Control) to the data of 1 to 12 servers/pairs of servers (OS/Batch/Route Control). Up to 4 process monitors can be connected to a client when using the multi-screen technology.

OS server, Batch server and Route Control server can have a redundant design if required. Synchronization of the redundant pairs of servers is carried out automatically and at high speed.

In the case of a system architecture with redundant OS servers, the OS clients are switched over to the backup server in the event of a fault. Background processes permanently monitor important server applications for faults which may then result in a redundant switchover. Automatic synchronization of process data and message archives is carried out when the partner server starts up again.

Client-server and server-server communication is carried out on a dedicated Ethernet LAN. The communication network identified as OS-LAN or terminal bus can be implemented with standard SIMATIC NET components such as switches, network cards, communications processors (CP), cables etc.

A ring design avoids communication failures if e.g. the line is damaged or opened at a particular point. To increase the availability even further, the OS-LAN can also be distributed redundantly between two rings which are connected together by two pairs of switches. Each of the redundant servers and clients can then be connected to both rings via two separate interface modules. Communication is as standard on ring 1. Communication on ring 2 is only activated in the event of a fault on ring 1 which is relevant to the redundant switchover.
The automation systems (AS) communicate with one another and with the engineering system and operator systems (servers/single stations) over the Industrial Ethernet plant bus. The plant bus can also be implemented in the form of a ring structure, which can additionally be configured as a redundant double ring if the availability requirements are high (two CPs per AS CPU and OS server). Double faults such as OSM/ESM failure on ring 1 with simultaneous interruption in the bus cable on ring 2 can then be tolerated. The two rings are physically separated from each other in such a configuration. The coupling partners are linked together logically when configuring with NetPro by using a fault-tolerant S7 connection (4-way redundancy). One SCALANCE X414-3 switch in each case takes over the function of the redundancy manager for each ring.

The redundant, fault-tolerant AS 414H and AS 417H automation systems are connected by one communications processor (CP) per CPU (AS subsystem) to the plant bus. With a double ring designed for increased availability, each AS subsystem can be connected to both rings via two CPs.

OS LAN (terminal bus) and plant bus can be configured with bus components for transmission rates up to 100 Mbit/s or 1 Gbit/s.

When using internal PROFIBUS DP interfaces or additional communications processors, several PROFIBUS DP segments with distributed process I/Os can be operated on each AS subsystem.

Distributed I/O systems such as the ET 200M or ET 200iSP can be connected via two interface modules (IM) to redundant PROFIBUS DP segments, and intelligent field devices on the PROFIBUS PA are connected via a redundant DP/PA link. For the ET 200iSP system, RS 485-iS couplers initially convert the electrical PROFIBUS DP RS 485 transmission technology into the intrinsically-safe RS 485-iS transmission technology with a transmission rate of 1.5 Mbit/s.

With the ET 200M distributed I/O system, the redundancy extends down to the channel level of the input/output modules. Selected modules from the SIMATIC S7-300 system are available for redundant use – both standard and safety-related modules. A sensor or actuator can be connected to two channels which are distributed on two redundant modules in separate ET 200M stations.

It is also possible to connect non-redundant PROFIBUS DP devices to the redundant PROFIBUS DP by using the Y-link.

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System-wide engineering with the central engineering system

As a result of its modular design, the scope and functions of the engineering software can be optimally matched to different customer requirements and tasks. The software is available in packages of various sizes to match the number of configurable process objects (PO). The number of configurable process objects can be subsequently increased at any time by means of engineering PowerPacks. The basic functionality covered by the standard software can be expanded if necessary depending on the project-specific task and its implementation.

**Engineering toolset**

The complete functionality for the system-wide and project-oriented engineering – which is also the basis for asset management of the I&C equipment – is available to the planning engineer as an optimally coordinated engineering toolset. This comprises tools for effective engineering:

- of the control system hardware including distributed I/O and field devices,
- of the communication networks,
- of the automation functionality for continuous and batch processes (AS engineering)
- of the HMI functionality (OS engineering),
- of the safety-related applications (process safety),
- of the diagnostics and asset management functionalities,
- of batch processes automated using SIMATIC BATCH,
- of material transport controlled using SIMATIC Route Control, and
- for cooperation with host CAD/CAE planning tools (import and export of process tags and example solutions).

The use of a central engineering system with a uniform and matched range of tools minimizes the configuration overhead. The engineering tools for the application software, the hardware components and the communications functions are called from a central project manager (SIMATIC Manager). This is also the basic application for the creation, management, saving and documentation of a project.

The central engineering system of the SIMATIC PCS 7 process control system is based on powerful PC technology which can be used either in office applications or in industrial environments. Together with the Windows 2000 Professional, Windows XP Professional or Windows Server 2003 operating system, this is an optimum starting point for engineering.

To improve the convenience when configuring, the working range of the planning engineer can be extended by connecting up to 4 process monitors via a multi-VGA graphics card.
Component view: hardware configuration with HW-Config

SIMATIC Manager

The SIMATIC Manager is the integration platform for the engineering toolset as well as the configuration basis for all engineering tasks of the SIMATIC PCS 7 process control system. All aspects of the SIMATIC PCS 7 project are managed, archived and documented here.

Technologists as well as process and production engineers can plan and configure in the environment they are familiar with by utilizing the engineering toolset designed for technological needs and the predefined blocks and charts. The hardware required for use in a SIMATIC project – such as automation systems, communication components and process I/Os – are stored in an electronic catalog, and are configured and parameterized using the HW-Config configuration tool.

In order to implement the automation logic, predefined function blocks are linked to other blocks in the graphic configuration tool CFC. This is easy to learn and quick to accomplish even by technologists without any programming experience.

Standardized function blocks (process tag types) are available for typical devices/components in an I&C library. The planning engineer need only select the predefined blocks, position them in the working area, link them graphically, and assign parameters.

Particularly with large projects, significant rationalization effects can be achieved through multiple application of standardized process tags and example solutions using the import/export assistant for data exchange with host planning systems and functions such as "Extended rename".

The uniform database of the engineering system guarantees that data which have been entered once are available system-wide.

All project modifications associated with the automation systems, the operator systems and SIMATIC BATCH can be compiled and loaded in one step. The engineering system automatically ensures the correct sequence. A central dialog displays and controls the operation.

Selective changes to the configuration can be loaded online into the corresponding system components. Short turnaround times result in short waiting times for the commissioning engineer and have a positive impact on the commissioning costs. Changes to the configuration which are relevant to automation systems can be debugged in a test system before being downloaded into the target system of the running plant.

The SIMATIC Manager supports the various tasks when creating a plant project by providing the following project views:

- The component view (HW-Config) for configuration of hardware such as automation systems, bus components or process I/Os
- The process object view as the central development environment for all aspects of process tags/objects.
Process object view

The process object view of the SIMATIC Manager supports the work carried out by a process engineer by providing a universal view of the process tag. It shows the technological hierarchy of the plant (presented in tree form) in combination with a tabular view of all aspects of the process tag/object (general data, parameters, signals, messages, image objects and measured value archives). This provides the technologist with fast orientation.

All objects in the marked branch of the hierarchy are displayed in the table so that they can be directly processed with user-friendly edit, filter, replace, import and export functions. A special test mode offers the facility for testing process tags and CFCs online and for starting them up.

The OS areas and the image hierarchy for process control, as well as the SIMATIC PCS 7 asset management, can be derived from the technological hierarchy. Furthermore, it also forms the basis for the plant-oriented identification of process objects.

Group displays can be positioned in pictures by means of the image hierarchy, and automatically linked to subordinate images. The configuration engineer is only responsible for the correct positioning. Since the number of group display blocks and their semantics can be configured, it is also possible to implement customized alarm configurations.

Continuous function chart (CFC)

The CFC editor is the tool for graphical configuration and commissioning of continuous automation functions. Preengineered function blocks can be positioned, configured and interconnected within CFCs with the support of powerful autorouting and integral configuration of HMI messages. Special configuration techniques such as chart-in-chart for implementing hierarchical plans or the multiple usage of chart block types (chart compiled as block type) or SFC types (standardized sequential controls) in the form of instances offer an additional rationalization potential.

When creating a new CFC, a new runtime group with the same name as the chart is created. All the blocks that are subsequently entered in the chart are automatically added to this runtime group. Each block is therefore already assigned runtime properties when inserting, and configuration engineers can optimize these properties by means of modifications in the runtime editor or by using algorithms.

The algorithm first determines the optimum block sequence separately for each runtime group, and then the optimum sequence of runtime groups.

In addition to convenient editing functions, the scope of CFC functions also includes powerful test and commissioning functions as well as individually configurable documentation functions.
Sequential function chart (SFC)

The SFC editor is used for the graphical configuration and commissioning of sequential controls for batch production operations. It possesses convenient editing functions as well as powerful test and commissioning functions.

Using a sequential control, basic automation functions usually created using CFC are controlled and selectively processed by means of changes in operating mode and status. Depending on the subsequent use, the sequential controls can be created either as a SFC plan or SFC type.

SFC plan

The SFC plan can be used to implement sequential controls which can be applied once and which access several partial areas of the production plant. Each SFC plan contains standardized inputs and outputs for status information and for control by the user program or the user. The SFC plan can be positioned and linked as a block in the CFC. The required CFC block connections are selected by simple operations and connected to the steps or transitions of the step sequences. A status manager conforming to ISA-88 enables the configuration of up to 8 separate sequences within a single SFC, e.g. for states such as HOLDING or ABORTING, for SAFE STATE, or for different operating modes.

SFC type

SFC types are standardized sequential controls which can be applied repeatedly and which access one partial area of the production plant. They can be organized in libraries, and handled like normal function blocks, i.e. they can be selected from a catalog and positioned, interconnected and parameterized as an instance in a CFC plan. Changes to the original automatically result in corresponding changes in all instances. An SFC type may contain up to 32 sequences. Using the function “Create/update block symbols”, a block symbol is automatically positioned and interconnected in the associated process display for all SFC instances with HMI features.
Engineering software

I&C libraries
Preconfigured and tested blocks, faceplates and symbols are organized in I&C libraries and form the basic elements for the graphic configuration of automation solutions. The use of these library elements plays a major role in minimizing the engineering input and project costs.

The comprehensive range of blocks comprises:

- Simple logic and driver blocks
- Technological blocks with integral operation and signaling functions such as PID controllers, motors or valves
- Blocks for integration of PROFIBUS field devices in line with the PROFIBUS PA profile 3.0 (including standardized evaluation of the process value status).

Graphics designer and faceplate designer
The project data for the engineering of the operator systems are organized with the SIMATIC Manager. All the data relevant to operation and monitoring of a process tag are generated automatically during definition of the automation function. A powerful graphics designer is available for the generation of process displays.

In addition to the standard faceplates, the faceplate designer can be used to generate customized faceplates for operation and monitoring of process tags or plant components. Block symbols can be conveniently interconnected to process tags using drag & drop.

Multi-project engineering
Multi-project engineering permits division of a complex project into several subprojects in accordance with technological criteria in order to allow several teams to work on the project in parallel. To achieve this, a host “Multi-project” is defined in the SIMATIC Manager. Individual (sub)projects can be inserted into or removed from a multi-project at any time. Similarly, projects can be divided or combined (Branch & Merge).

Central configuration functions for multi-projects help to reduce the configuration overhead. For example, a hierarchy folder can be created in the current project and also automatically in all other projects. It cannot be modified there, but objects can be inserted. All block types used in a multi-project can also be updated centrally.

The (sub)projects belonging to a multi-project are saved on a central server and can be sent to local engineering stations for editing. The engineering performance is then not affected by network access.

Branch & Merge
This function supports the division and merging of sub(projects) from the technological viewpoint.

Charts or plant units can be copied into another project and edited there. Interconnections which are not specific to a project, typically for interlocking, become text interconnections. When merged, charts with the same name in the original object are overwritten, and text interconnections (even self-entered ones) can be closed by clicking a button.
Version Cross Checker

The Version Cross Checker tool determines the differences between various versions of a project by:

- Comparison of CFCs/SFCs, block types, signals and sequences in order to determine additional, missing or different objects
- Graphic display of comparison results in a combination of tree and tabular formats
- Color-coded identification of objects and attribute values.

Version Trail

The SIMATIC Version Trail which operates together with SIMATIC Logon is suitable for version assignment of libraries, projects and multi-projects.

During archiving, SIMATIC Version Trail creates a version history with the following information:

- Version
- Version name
- Date and time
- User
- Comment.

Comparison of project versions using the Version Cross Checker

The version history from SIMATIC Version Trail can be displayed and printed. Individual versions can be retrieved from the version history, and used further. SIMATIC Logon organizes the access protection.
Efficient processing of mass data

Import/export assistant

The import/export assistant (IEA) is an efficient tool for rational engineering of mass data. It is based on the multiple application of measuring-point types and example solutions, and is particularly suitable for large plants with many identical measuring points or with several plant components of the same type. Plant data which have already been configured (such as process tag lists or charts from the CAD/CAE world) can be imported into the engineering system and used for automatic generation of process tags. The data of the host planning system can be subsequently matched with the parameters optimized during commissioning.

To permit simple and fast modification, the PCS 7 projects can also be exported, the data processed using the IEA editor or other programs (e.g. Microsoft Excel or Access), and subsequently reimported.

Advantages of the import/export assistant:

- Importing of previously configured plant data, e.g. process tag list, from the host CAD/CAE world
- Automatic, reproducible generation of process tags and copies on the basis of the imported process tag lists and example solutions
- Automatic derivation of the OS display hierarchy, interconnecting of blocks and positioning in displays
- Commissioning of individual process tags with the user-friendly CFC and SFC graphic tools
- Exporting of parameters optimized during commissioning back to the CAD/CAE world provides consistent data in host planning tools

Extended rename

When renaming objects, links affecting the visualization (image objects or variables in archives and scripts) are also changed accordingly. This function offers an enormous rationalization potential, especially for plants with repeated structures or plants requiring validation.

For example, if a completely configured and tested plant section is copied together with all charts, sequential controls and images, and if the copied charts/images are subsequently renamed, all internal connections are automatically adapted. In this manner, complex plant sections or complete production lines can be reproduced in the shortest possible time.
highlights

- Central hardware and software configuration which is uniform throughout the system through use of one engineering system
  - Pixel graphics configuration with user-friendly interface
  - Parameterization of communication without complex configuring
  - Same configuration for redundant and non-redundant applications
  - Integrated configuration for field devices and safety-related applications

- Central dialog for compilation and loading of all AS, OS and SIMATIC BATCH modifications
  - Optimization of all steps, and summary in a dialog with program test
  - Compilation and loading in one run with minimum turnaround times

- Online loading of selective configuration modifications into the corresponding system components

- Technology-oriented configuration without special programming knowledge
  - Functional structure with up to 8 hierarchy levels, organized according to plants, plant sections and technical equipment
  - Hardware-independent engineering: AS assignment and I/O modules can be subsequently selected
  - Area-oriented OS compilation and loading of the server-relevant data
  - Expansion possible with sector add-ons through standard data exchange interfaces

- Process object view for display and processing of all aspects of process tags/objects
  - Convenient editing in tables
  - Project library with process tag types and import/export functions
  - Online mode for testing and commissioning of measuring points and CFCs

- Configuration of large plants through distributed, parallel multi-project engineering with Branch & Merge

- Configurable archive variables (archiving, long-term archiving, no archiving)

- Special SFC functionalities
  - SFC type: standardized sequential control for multiple use, application of SFC instances as block in the CFC
  - SFC plan for sequential controls for single use, also with plan connections
  - Status management conforming to ISA-88 for configuration of separate sequences for statuses such as HOLDING, ABORTING or SAFE STATE

- Reduction in engineering and validation overhead through:
  - Comprehensive libraries with predefined and tested standard blocks, faceplates and symbols
  - Preconfigured charts from the library
  - Project library for process tag types with import/export function in the process object view
  - Simple duplication of plant sections by copying, renaming (extended rename) and compilation
  - Type instance concept with central modification facility for all instances
  - Import/export assistant for mass data configuration (bulk engineering)
  - Central updating of all block types used in a multi-project
  - Numerous configuration steps automatically carried out by the system (auto-engineering)

- Auto-engineering for:
  - Correction of OS links following change of name in AS
  - Optimization of block execution sequence in CFC
  - Connection of text block interconnections

- Version Cross Checker
  - Documentation of engineering changes through comparison of versions with graphical display of differences

- Identification of MIS/MES-relevant information for interfacing to SIMATIC IT

- Automatic generation of diagnostics displays for asset management on the basis of the project data
SIMATIC PDM (Process Device Manager) is a universal, vendor-independent tool for the configuration, parameterization, commissioning, diagnostics and servicing of intelligent field devices (sensors and actuators) and field components (remote I/Os, multiplexers, control room devices, compact controllers), which in the following sections will be referred to simply as devices. Using one software, SIMATIC PDM enables the processing of more than 1,200 devices from Siemens and over 100 vendors worldwide on one homogeneous user interface. With respect to device integration, SIMATIC PDM is the most powerful device manager available on the world market. Devices which previously were not supported can be easily integrated in SIMATIC PDM at any time by importing their device descriptions (EDD).

Parameters and functions for all supported devices are displayed in a consistent and uniform fashion independent of their communications interface.

SIMATIC PDM is also integrated in the asset management. The Process Device Manager provides wider information for all devices described by the Electronic Device Description (EDD), e.g. detailed diagnostics information (vendor information, information on fault diagnostics and troubleshooting, further documentation), modification logbook (audit trial) and parameter information.

Application options
- System-integrated in a SIMATIC PCS 7 configuration environment
- Stand-alone as a service tool on mobile PCs

Core functions
- Adjustment and modification of device parameters
- Comparing (e.g. project and device data)
- Plausibility testing of data input
- Device identification and testing
- Device status indication (operating modes, alarms, states)
- Simulation, diagnostics (standard, detail)
- Management (e.g. networks and PCs)
- Export/import (parameter data, reports)
- Commissioning functions, e.g. measuring circuit tests of device data
- Device replacement (lifecycle management)
- Global and device-specific modification logbook for user operations (audit trail)
- Device-specific calibration reports
- Graphic presentations of echo envelope curves, trend displays, valve diagnostics results etc.
- Display of integrated manuals
- Document manager for integration of up to 10 multimedia files
Support of system management

SIMATIC PDM supports the operative system management in particular through:

- Uniform presentation and operation of devices
- Indicators for preventive maintenance and servicing
- Detection of changes in the project and device
- Increasing the operational reliability
- Reducing the investment, operating and maintenance costs
- Graded user privileges including password protection.

Device Integration

SIMATIC PDM supports all devices described by EDD (Electronic Device Description). EDD is standardized to EN 50391 and IEC 61804. Internationally it is the most widely used standardized technology for device integration. At the same time it is the directive of the established organizations for PROFIBUS (PNO: PROFIBUS International) and HART (HCF: HART Communication Foundation).

The devices are directly integrated in SIMATIC PDM through their EDD or the current HCF catalog. The device is described in the EDD in terms of its functions and construction using the Electronic Device Description Language (EDDL) specified by PNO. Using this description, SIMATIC PDM automatically creates its user interface with the specific device data.

The current device catalog of SIMATIC PDM covers more than 1,200 devices from over 100 manufacturers world-wide. In addition to the devices in the current SIMATIC PDM device catalog, devices from all manufacturers can be integrated in SIMATIC PDM by simply importing their EDDs. It is thus possible to keep the device range up to date at all times and to add to the number of manufacturers and devices supported by SIMATIC PDM. To permit improved transparency, SIMATIC PDM also allows the creation of project-specific device catalogs.

User interface

The user interface satisfies the requirements of the VDI/VDE GMA 2187 and IEC 65/349/CD directives. Through expansion of the EDDL, it is now possible to also display image elements in an excellent manner. Even complex devices with several hundred parameters can be represented clearly and processed quickly. Using SIMATIC PDM it is very easy to navigate in highly complex stations such as remote I/Os and even connected field devices.
Safe and convenient process control with the SIMATIC PCS 7 operator system

The operator system is the human-machine interface of the SIMATIC PCS 7 process control system, and thus represents the user's window to the process. It is extremely flexible, and can be easily adapted to different plant architectures and custom-er requirements.

The basis is formed by perfectly coordinated operator stations for single-user systems (OS single stations) and for multi-user systems with client/server architecture.

Operator stations

All operator stations are based on modern PC technology with different performance levels which have been optimized for use as OS single station, OS client or OS server, combined with the following operating system:

- Microsoft Windows 2000 Professional / 2000 Server

The use of standard components and interfaces from the PC world means that the operator stations are open for custom-er/sector-specific options and expansions. They can be used in harsh industrial environments as well as in the office.

OS single stations and OS clients can be installed with multi-VGA graphics cards to permit the process control of several different plant areas using up to 4 monitors.

The system software of the operator stations is available in differ-ent levels based on the number of process objects (PO) used. The number of POs can be increased at any time by means of PowerPacks to allow for higher requirements or sys-tem expansions.

Single-user system (OS single station)

In a single-user system architecture, all operation and moni-toring functions for a complete project (plant/unit) are concen-trated in one station. A FastEthernet RJ45 port is already on board and can be used for connecting to an OS LAN (termi-nal bus). The OS single station can be connected to the Industrial Ethernet plant bus in two ways:

- Through a CP 1613 communications processor (communication with max. 64 automation systems) or
- through a standard LAN card (Basic Communication Ethernet for communication with max. 8 automation systems).

The OS single station can be operated on the plant bus in par-allel with other single-user systems or with a multi-user sys-tem architecture. By using the WinCC/Redundancy program package it is also possible to operate two OS single stations with redundant architecture.

Multi-user system with client/server architecture

A multi-user system consists of operator terminals (OS clients), which receive data (project data, process values, archives, alarms and messages) from one or more OS servers through an OS LAN (terminal bus). The OS LAN can share the transmission medium with the plant bus or it can be designed as a separate bus (Ethernet with TCP/IP).

In this architecture, redundant OS servers may be set up to meet higher availability requirements. Critical applications running on the OS server are monitored by health check for software faults. If a fault is detected, switchover to the redundant system is triggered. Synchronization of the redundant OS servers takes place automatically and at high speed.

OS clients can access the data of not only one OS server/server pair, but from several OS servers/pairs of servers simulta-neously (multi-client mode).

This makes it possible to divide a plant into technological units and to distribute the data accordingly to several OS servers/ pairs of servers. In addition to scalability, the advantage of dis-tributed systems is the ability to decouple plant areas from each other, which results in higher availability.
SIMATIC PCS 7 supports multi-user systems with up to 12 servers or 12 redundant pairs of servers. In multi-client mode, OS clients can access data from one or more of the 12 servers/pairs of servers in parallel (up to 32 OS clients simultaneously on all).

The OS servers are designed in addition with client functions which permit them to access the data (archives, messages, tags, variables) from the other OS servers of the multi-user system. This means that process graphics on one OS server can also be linked with variables on other OS servers (area-independent displays).

Like the OS single stations, the OS servers can be connected to the Industrial Ethernet plant bus using a communications processor or a standard LAN card. A FastEthernet RJ45 port is already on board and can be used for connecting to an OS LAN (terminal bus).

Performance and technical specifications

The SIMATIC PCS 7 operator system is optimized for processing large quantities of data. It has an impressively high performance – even with large quantity frameworks – and can be operated simply and intuitively at the same time.

Many individual measures reduce the system load and improve the image selection and updating times, e.g.:

- Combination of status and analog values with alarm information into expanded status displays
- Suppression of nuisance alarms and triggering of renewed transmission via acknowledgment
- Data transmission from the automation system only following changes instead of with every cycle
- Blocking/enabling of messages for individual process tags or all tags of an area

<table>
<thead>
<tr>
<th>Operator system</th>
<th>Max. number of OS servers/pairs of servers</th>
<th>12</th>
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</thead>
<tbody>
<tr>
<td>Max. number of automation systems per OS server/pair of servers</td>
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<td>Max. number of OS clients in multi-client mode</td>
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<td>Max. number of monitors per operator station with multi-channel operation</td>
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<td>Max. number of OS areas</td>
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<td>Selection time for OS area display (100 process symbols)</td>
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<tr>
<td>Max. number of variables/process objects:</td>
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<td></td>
</tr>
<tr>
<td>- Per OS single station</td>
<td>150K / 5000 POs</td>
<td></td>
</tr>
<tr>
<td>- Per OS server</td>
<td>256K / 8500 POs</td>
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</tr>
<tr>
<td>- Per OS server</td>
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<tr>
<td>- Per multi-user system</td>
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<tr>
<td>- Process value archiving (per OS server/single station)</td>
<td>Approx. 1000/s</td>
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<tr>
<td>- Message archiving (per OS server/single station)</td>
<td>Steady-state load approx. 10/s Message peak approx. 3000 / 4 s</td>
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<tr>
<td>Long-term archiving:</td>
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<td></td>
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<tr>
<td>- Process value archiving with StoragePlus (process values from up to 4 single stations, servers or pairs of servers)</td>
<td>Process values of one server: Approx. 1000/s</td>
<td></td>
</tr>
<tr>
<td>- Process value archiving with central archive server CAS (process values from up to 11 servers or pairs of servers)</td>
<td>Process values of all servers: Approx. 1600/s</td>
<td></td>
</tr>
</tbody>
</table>
1) If every OS client has access to all OS servers/pairs of servers
OS software

User interface

The predefined user interface of the operator system has all the features typical of a control system: it is multilingual, clearly structured, ergonomic and easy to understand. The operator can survey the process extremely easily, and rapidly navigate between different views of the plant. He is supported by a picture tree manager which organizes the picture hierarchy according to user requirements and permits scrolling in this hierarchy and direct selection of subordinate areas.

Process displays and process tags can also be simply called up by name. An online language selector permits the user to change the display language during runtime.

A standard view and a server view are available for the technological representation of a plant, each with variously designed area overviews. Features provided in both views include:

- Message line for the last received message with configurable display sequence (maximum message class or highest priority)
- Date, time and name of the operator
- Area overview with up to 36/49/64 areas
- Working area for plant displays and movable windows for faceplates, historic trends, etc.
- System function keys

In a special message view it is possible to view the incoming messages and to switch between new list, old list, cleared alarm list, operator action list, control element list and message history list.

The display tools available permit the operator to create individual displays, to save them, and to recall them later.

Trends

Trends can be displayed as a full-size picture or as a window in the working area. Some trends/trend groups are predefined during plant configuration. Further ones can be individually configured in online mode, selected using the process tag names, and saved for reuse.

Trend window on the operator station
The SFC visualization function of the operator system enables display and operation of the sequential controls configured with the SFC editor in the same way as on the engineering system. No additional configuration work is necessary.

In an overview display it is possible, for example, to open step and transition displays and to present step comments or dynamically supplied step enabling conditions.

**Messages and alarms**

Message priorities are issued as an additional attribute to the known signal classes in order to make it easier to assess large quantities of signals and to be better able to distinguish important messages from less important ones.

Operators can specifically disable messages (alarms) from individual process tags or from all process tags of a display/area in the event of faults in a sensor/actuator or during startup. Disabling and enabling are recorded in an input report.

Active messages are signaled by group displays representing preconfigured views based on signal groups. The group displays also indicate whether messages are disabled or not.

The last message to have arrived – or the message with the highest priority when alarm priorities are utilized – is displayed at the top edge of the standard view. A predefined window with further messages can be called up with the "Extended message line" button.

The "Loop-in-alarm" and "Select display using process tag" functions support the quick evaluation and elimination of faults. Using "Loop-in-alarm", the operator can jump directly to the process display in which the fault has occurred, and can then call up the associated faceplate (loop display) through a measuring point marked in color.

The faceplate window can be anchored using a pin button so that it remains visible even when the display is changed.

Flexible sound setting options and priorities which can be defined using signal variables support audible annunciation through a soundcard or by controlling external horns via a signal module.

**Central user management, access control and electronic signature**

SIMATIC Logon offers central user administration with access control for the SIMATIC PCS 7 system components as well as non-SIMATIC components connected through API. It can be used to fulfill the validation requirements of 21 CFR Part 11. An electronic signature function can also be used in conjunction with SIMATIC Logon.

A chip card reader can be additionally used for access control.
OS software, OS archiving

Sign-of-life monitoring

With the "Sign-of-life monitoring function", the operator system is able to monitor the correct operation of all subordinate systems connected to the plant bus. A graphical plant configuration display shows the status of each monitored component. Additional functionality in this respect is offered by the SIMATIC PCS 7 asset management.

Clock synchronization

Together with a SICLOCK time generator, the operator system of the SIMATIC PCS 7 process control system can implement system-wide synchronization on the basis of UTC (Universal Time Coordinated). This feature is especially beneficial for widely distributed plants present in different time zones, e.g. pipelines.

Script languages

Users can also program their own OS applications on the basis of the Visual Basic and C script languages.

OS archiving

A high-performance archive system based on Microsoft SQL server technology can be configured online and saves process values and messages/events (alarms) in cyclic archives. The high-performance archive system is designed as standard for up to 512 variables, and can be expanded as required up to 1500, 5000 or 10000 variables.

Data from the cyclic archives as well as OS reports and batch data from SIMATIC BATCH can be exported time-controlled or event-controlled for permanent archiving in StoragePlus or a central archive server (CAS). StoragePlus, the low-cost version, can archive approx. 1600 process values/s from a total of 4 single stations/servers/pairs of servers. Increased requirements are satisfied by the powerful central archive server which can archive approx. 10000 values/s from up to 11 servers/pairs of servers.

The data managed in the central archive server can be clearly visualized on the OS clients. On the other hand, the archived data of StoragePlus are displayed by the integral Internet Explorer, independent of the PCS 7 runtime systems.

For both long-term archiving systems, data selection is supported by integral filter functions. Messages and process values can be shown in table form, and process values also in graphic form. Tables of process values can be exported in CSV format for processing in other Windows applications, e.g. Microsoft Excel.

The data archived in StoragePlus and in the central archive server as well as their cataloging can be saved on all storage media supported by the operating system.
Operation and monitoring via World Wide Web

The SIMATIC PCS 7 Web server based on the Microsoft Windows Server 2003 operating system permits operation and monitoring of the plant via intranet/Internet. It uses the mechanisms of a multi-client for accessing the subordinate OS servers, and makes the project data globally available via intranet/Internet. For this purpose it uses the Web View Publisher to convert process displays and scripts into a form suitable for display with the Internet Explorer.

When carrying out operation and monitoring via the World Wide Web, the project data made available by the SIMATIC PCS 7 Web server are accessed per Web client. The Web client used is equipped for this with the Internet Explorer and plug-ins which can be installed via the World Wide Web.

Using a Web client, the plant can be operated in the same manner as with an OS client. A differentiation is basically made between the following applications:

- **Standard**
  Up to 50 Web clients can simultaneously access the data of a SIMATIC PCS 7 Web server over intranet/Internet. The server-based license required for this is scalable for 3, 10, 25 or 50 Web clients.
- **Diagnostics**
  One or only a few Web clients have access to several PCS 7 Web servers/single-user systems for remote operation, diagnostics or monitoring. Each system involved requires a PCS 7 Web diagnostics license.

Logging-on and the rules for assignment of privileges with the Web client are identical to that with the OS client. The input operations made on the Web client are recorded in the OS operating log.

The integral OS user management guarantees high security when accessing the OS servers from the SIMATIC PCS 7 Web server. The security requirements of the respective system are supported by access protection using password, firewall technology and individual security strategies.

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**operator systems**

- Flexible, modular architecture with scalable hardware and software components for single-user and multi-user systems
- Powerful operator stations based on standard PC technology, can be used in office and industrial environments
- Client/server multi-user systems with up to 12 OS servers/pairs of servers, each for 5000 process objects and up to 32 OS clients per server/pair of servers
- High-performance archiving system with short-term archives and integral archive backup
- OS health check for monitoring important server applications
- Online modifications without interrupting runtime operations, and online testing with selective loading of redundant servers
- Optimized AS/OS communication: data transmission only following change in data, independent of AS reply cycle
- Convenient process control and high operational safety
- Alarm suppression during startup or on malfunction of a sensor/actuator
- Alarm priorities as additional attribute for filtering important messages
- Central user management, access control, electronic signature
- Sign-of-life monitoring for subordinate systems connected to the plant bus
Automation systems – based on selected SIMATIC S7-400 components

Selected SIMATIC S7-400 components can be combined in the automation systems (AS) of the SIMATIC PCS 7 process control system.

The following characteristics make the SIMATIC S7-400 predestined for use as a SIMATIC PCS 7 automation system:

- Modular design without fans
- High expansion capability and ruggedness
- Single or redundant design
- Comprehensive communication facilities
- Integral system functions
- Simple linking of central or distributed I/O.

Various automation systems are available with a price/performance ratio which can be tailored to your system requirements. All automation systems are equipped with an onboard PROFIBUS DP fieldbus connection. Additional PROFIBUS communication modules can be fitted if required.

**Components**

The automation systems are delivered as preassembled and tested complete systems without surcharge. They comprise:

- Racks with 9 or 18 slots, which can be physically separate in the case of redundant systems
- Standard SIMATIC CPU 414-3, 416-2, 416-3 or 417-4 as well as the redundant CPU 414-4H or 417-4H
- 24 V DC or 120/230 V AC power supply including backup battery/batteries
- Main memory from 1.4 MB to 20 MB
- Memory card with 2 to 64 MB RAM
- Interface to industrial Ethernet

**Standard automation systems**

The AS 414-3 automation systems are tailored for small applications with small quantity frameworks. They therefore meet the demand for low-cost initial implementation with a modular and scalable system. Larger quantity frameworks can be implemented with the AS 416-2, AS 416-3 and AS 417-4 automation systems. These systems are preferred for medium-sized systems and bigger.
Fault-tolerant automation systems

Fault-tolerant automation systems are used to minimize the risk of production failures. The higher investment in fault-tolerant automation systems is often negligible compared to the costs resulting from production stoppages. The higher the costs resulting from loss of production, the more important a fault-tolerant system becomes.

The AS 414H and AS 417H models are the fault-tolerant automation systems for use with SIMATIC PCS 7. They are based on the 1-out-of-2 principle and switch to the backup system in the event of a fault. These systems use a completely redundant design to maximize availability. This means: all major components such as CPU, power supply and hardware for coupling the two CPUs are present in pairs. Which other components are also made available in pairs in the interest of availability depends on the particular automation task.

The two subsystems of a redundant automation system are electrically isolated from one another. This increases the system stability with respect to EMC interferences. A redundant automation system can be installed mechanically in a one-rack or two-rack architecture. Automation systems are installed in two racks, for example, if the two parts of the automation system have to be physically separated from one another by a fire-resistant wall. Appropriate complete units are available for every type of application. Mixed operation of redundant and standard systems is also possible.

Safety-related automation systems

Safety-related automation systems (F/FH systems) are used for critical applications in which an incident can result in danger to persons, plant damage or environmental pollution. They detect not only faults in the process but also their own internal errors, and will automatically set the plant to a safe state if a fault is detected.

The safety-related automation systems are based on the hardware of the fault-tolerant AS 414H and AS 417H systems. They are available in two versions:
- As single-channel AS 414F/AS 417F (with only one CPU)
- As fault-tolerant AS 414FH/AS 417FH (with redundant CPU)

The safety-related automation systems are TÜV-certified, and comply with the safety requirements up to SIL 3 according to IEC 61508. They process standard and safety functions in one single system. The safety functions are processed twice in different processor sections of one CPU. Potential errors are detected by the system during the subsequent comparison of results.

The redundancy of the FH systems only serves to increase the availability. It is not relevant to processing of the safety functions or the associated fault detection.

Technical specifications

<table>
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</table>

Typical mixed quantity frameworks for SIMATIC PCS 7 automation systems
Asset management for optimum diagnostics and preventive maintenance

Asset management for plant engineering is understood to be the administration and management of the plant equipment, particularly the I&C equipment, as well as all activities and measures which serve to retain or increase the value of a plant.

These primarily include:
- the reaction to existing fault and diagnostics messages (corrective maintenance),
- preventive diagnostics and maintenance, and
- predictive maintenance and diagnostics.

In the past, maintenance functions and information were usually only available in a separate level independent of the production. Parallel to process control, the integral asset management function of SIMATIC PCS 7 provides uniform maintenance information and functions for the system components in the plant (assets). The PCS 7 asset management therefore supplements SIMATIC PCS 7 by an instrument for minimization of the total cost of ownership of a plant. Supplementary hardware or software tools for asset management functions are superfluous.

SIMATIC PCS 7 asset management takes into account the NAMUR requirements (process control standards committee in the chemical and pharmaceutical industries) defined in the following documents for systems for asset management at plant level and for status messages from field devices.

These requirements include:
- NAMUR recommendation NE91 (requirements for systems for asset management at plant level)
- NAMUR recommendation NE107 (status messages from field devices)
- NAMUR recommendation NE 105 (requirements for the integration of fieldbus devices in engineering tools).

In addition, it is oriented on IEC 61804-2 for self-diagnostics of devices described by the Electronic Device Description (EDD).

Whereas the plant operator receives all information relevant to the process via the operator system and can specifically access the process, the maintenance engineer checks the hardware of the automation plant via the maintenance station, and processes its diagnostics messages and maintenance requests.

Maintenance cycle and strategies

As a result of monitoring (recording and evaluation of process values and status variables), the status can be determined for a component or device, e.g. a field device. If a sensor no longer delivers a signal, the diagnostics function indicates that a line breakage may be present. This fact triggers a maintenance request which in turn results in a maintenance measure. Following completion of maintenance on the maintenance station, the status displays are reset to the normal status. The complete maintenance cycle is documented on the maintenance station without gaps – automatically and without additional configuration overhead. Further details of the maintenance cycle depend on the maintenance strategy, the diagnostics result, and the detailed information available specific to the type.

A differentiation is made between the following maintenance strategies:
- Failure-oriented (corrective) maintenance
  - Failures are risked or minimized by redundant configurations
  - Maintenance in the form of a repair or replacement
- Preventive maintenance
  - Appropriate maintenance measures are initiated already before a fault occurs
  - Maintenance which is time-dependent, status-dependent or preventive
Component/device spectrum
Devices/components of the SIMATIC PCS 7 process control system and of the connected process I/O belong to the described maintenance cycle. These include:

- PC basic devices (server, client, single station)
- Automation systems (controller)
- Network components for plant bus, terminal bus and fieldbus
- Distributed I/O (remote I/Os)
- Field devices (sensors/actuators).

Integration in SIMATIC PCS 7
The PCS 7 asset management is integrated seamlessly into the SIMATIC PCS 7 process control system as a sector-independent software package. It consistently uses the hardware and software components of the engineering system and operator system.

The system interface for maintenance engineers is the maintenance station based on the engineering system. Via this, they have access to the complete hardware structure of the process control system, and can process diagnostics messages and maintenance requests.

Configuration
The PCS 7 asset management is based on the hardware and software project of the application which is generated during the standard configuration with the engineering system. All data relevant to the PCS 7 asset management are derived from the project data simply by pressing a button, and the diagnostics displays are also generated. The procedure is simple, and no additional overhead is required for the asset management:

- Generation of the hardware and software project.
- System-supported generation of the diagnostics displays with all components present in the project, including the display hierarchy according to the project’s hardware structure. The names of the displays, symbols etc. imported from the project can be changed by users according to personal requirements or depending on project-specific features. These modifications are retained during further operations.
- Compilation of the configuration data, and downloading to the operator station and maintenance station with subsequent test and commissioning phase.

Maintenance station
Architecture
The maintenance station for the PCS 7 asset management provides comprehensive maintenance information for the system components of the plant (assets).

Depending on the project-specific SIMATIC PCS 7 architecture, the maintenance station can be based on a SIMATIC PCS 7 BOX, PCS 7 single station or client/server combination. It uses the hardware and software components of the engineering system and operator system.

As a result of the close interlacing, ES, OS and asset management functions execute on common hardware. Such a multifunctional station cannot only be used for asset management, but also for system engineering or HMI.

Message system, user desktop, display hierarchy and operator prompting are oriented according to the HMI philosophy of the operator system. The diagnostics data of all assets are displayed on uniform faceplates. This means that working with the maintenance station is simple and intuitive, complex familiarization is not required.

The diagnostics displays structured according to the plant hierarchy with the operating states of all SIMATIC PCS 7 components can be displayed on the maintenance station and also on an OS client. However, enhanced online diagnostics functions in conjunction with HW-Config or SIMATIC PDM can only be called from the maintenance station.
Asset management

Standard diagnostics functions
In order to obtain information on the diagnostics status of individual plant areas or components, maintenance engineers can change from the overview display to the respective diagnostics display of the subordinate hardware level. If a fault is signaled in the overview display, the "loop in alarm" function permits rapid switching to the diagnostics faceplate of the associated component.

The following information is available for all components:
- Display of diagnostics status determined by the system
- Information on component such as process tag name, vendor or serial number (depending on the respective component)
- Display of diagnostics messages of a component
- Visualization of type and current state of initiated maintenance measure

Detailed diagnostics for assets according to IEC 61804-2
Additional detailed information can be called for assets described by the electronic device description (EDD) according to IEC 61804-2. This information is automatically read out of the components and made available by SIMATIC PDM in the background.

- Detailed diagnostics information
  - Device-specific information from the vendor
  - Information on fault diagnostics and troubleshooting
  - Additional documentation
- Display of associated modification logbook (audit trail) of this component with all entries on the persons, times and types of operator intervention on the component
- Parameter view of the component (display of parameters saved in the component and in the project; if required, also differences between them)
Visualization of maintenance information

The hierarchical structuring of information and the uniform symbols support the overview, facilitate orientation, and permit the maintenance engineer to rapidly access detailed information starting from the plant overview.

The symbol set defined for the PCS 7 asset management contains symbols which identify the diagnostics status of the devices/components, the relevance of the maintenance request, and the status of the maintenance measure.

Group displays in the plant overview visualize the diagnostics status of the subordinate structures/components according to a type of traffic light with red, yellow or green.

Diagnostics displays represent the status of components and subordinate devices/components through standardized symbols. These contain the following elements:

- Bitmap of component
- Tag identification of component
- Maintenance status display
- Group display for diagnostics status of subordinate components

Clicking an element in the symbol display either opens the subordinate hierarchy level or a component faceplate. The component faceplate offers various views of the associated component with further device-specific information, e.g. an identification, message or maintenance view.

 Worce

Faceplate for maintenance view

**highlights**

- Instrument for minimization of the total cost of ownership for the complete lifecycle of the plant
- Diagnostics and maintenance management of the SIMATIC PCS 7 plant for
  - PC basic devices,
  - bus components (Ethernet/PROFIBUS),
  - automation systems and
  - Distributed I/Os
- Homogenous integration of maintenance functionality in SIMATIC PCS 7 – no additional engineering overhead
- Consistent utilization of architecture and basic performances of SIMATIC PCS 7
- Maintenance station as system interface for maintenance engineer
- Same look & feel as with process control on the operator system
- Optimized workflow from diagnostics up to termination of maintenance measure
- Uniform display of diagnostics and maintenance status throughout the plant
- Compliance with international standards and directives:
  - NE91 (plant-level asset management)
  - NE107 (status messages from field devices)
  - NE 105 (integration of fieldbus devices)
  - EDD according to IEC 61804-2 (self-diagnostics of devices)
The SIMATIC PCS 7 process control system always offers a suitable solution for low-cost, effective implementation of batch processes:

- Simple batch processes with parameterizable sequential controls are automated using the SFC and CFC tools included in the engineering system.
- SIMATIC BATCH is the user-friendly solution for more complex tasks with recipe-controlled operation. This allows simple, flexible processing of complex tasks that incorporate changing control sequences.

Modular architecture

SIMATIC BATCH is configured as a single-user system or as a client/server system, and can be used in plants of any size due to its modular architecture and scalability in 5 steps with 150, 300, 600, 1800 and >1800 batch process objects (instances of plant units and equipment modules).

With small applications, e.g. for laboratory automation, SIMATIC BATCH can also be combined with the PC-based starter system SIMATIC PCS 7 BOX. The capacity of SIMATIC BATCH is limited to 150 batch process objects in this case.

However, characteristic for the automation of batch processes using SIMATIC BATCH are client/server architectures with which one batch server and several batch clients process a plant project together. The batch server can also be configured with redundancy in order to increase availability.

Integration in SIMATIC PCS 7

SIMATIC BATCH is completely integrated in SIMATIC PCS 7. The plant data can be configured entirely using the engineering system. This passes on all data required for recipe creation to the batch server, making recipe processing possible separate from the engineering system. Changes to the configuration which are made on the engineering system are available to the batch server using an update function.

Depending on the load on the operator system, the batch server software can also be executed on the OS server. However, it is usually executed on separate server hardware (batch server), isolated from the OS servers. SIMATIC BATCH clients and OS clients can run on separate or common basic hardware.

Communication with the automation systems

SIMATIC BATCH communicates with the automation systems through the PCS 7 operator system. Operator instructions and dialogs can also be integrated into the communication. These permit additive data inputs (e.g. for laboratory values) or references to necessary operator inputs. SIMATIC BATCH provides special faceplates for controlling and monitoring plant units and equipment modules.

SFC instances derived from an SFC type are generally used as the interface to the subordinate automation level. The properties of the SFC type, such as modes of operation, setpoints/actual values, instance parameters, times etc. can be defined through a properties dialog.
Batch control center

The SIMATIC BATCH batch control center (BatchCC) is the “command center” for monitoring and controlling batch processes with SIMATIC BATCH. Using BatchCC it is possible to manage all data relevant to SIMATIC BATCH through a graphical user interface.

BatchCC offers powerful functions for the following tasks:
- Reading in and updating the plant data of the basic automation
- Definition of user privileges for all functions, for clients, or for plant units of SIMATIC BATCH
- Definition of material names and codes
- Management of master recipes, and starting the recipe editor in order to enter the recipe structure
- Management of libraries with recipe elements (library operations)
- Editing of formula categories and management of associated formulae (parameter sets)
- Creation of batches with master recipes
- Starting of batch processing and controlling of batches
- Monitoring and diagnostics of batch processing
- Recording and archiving of recipes and batch data
- Exporting and importing of basic recipes, formulae and library objects.

Batch planning

BatchCC enables the creation of individual production orders and batches. A greatly increased planning functionality is offered by the Batch Planning option package with which the batches can already be planned in advance for a large number of production orders.

Creation and distribution of the batches for a production order are therefore possible manually, but can also be carried out automatically depending on definition of the batch number or production quantity.

All batches including their occupation of plant units can be clearly presented in a combination of Gantt diagram and table. Time conflicts or those resulting from multiple occupation of plant units are identified by symbols. Time conflicts can be eliminated simply by shifting the associated batches in the Gantt diagram.

In addition to planning, the scope of functions include the modification, cancellation, deletion and enabling of batches. Until enabled, the following batch properties can be set and modified:
- Quantity
- Start mode (immediately, following operator input, or time-controlled)
- Occupation of plant units
- Formula (parameter set)
- Execution sequence (linking to previous or subsequent batch)
- Display of planned runtime for a batch.
Recipe editor

The recipe editor is a convenient tool for simple, intuitive creation and modification of master recipes and library operations. It has a graphical user interface, editing functions for single and grouped objects, and a structural syntax check function.

The basis for recipe creation are the batch objects created from the batch plant configuration using the SIMATIC PCS 7 engineering system, e.g. plant units and technological functions. The batch recipe editor can be started individually, but can also be called from BatchCC.

The recipe editor can be used to:

- Create new master recipes and library operations
- Modify existing master recipes and library operations (changes to structures or parameters)
- Scan the statuses of recipe objects (RUP, ROP, RPH) and process values in transition criteria
- Document master recipes and library operations
- Carry out plausibility tests, also with incorporation of user-specific plausibility tests
- Select plant unit candidates through limitation of equipment properties
- Assign enables for test or production of master recipes and library operations.

Hierarchical recipes according to ISA-88.01

SIMATIC BATCH and SIMATIC PCS 7 form a functional unit that fully covers the models described in the ISA-88.01 standard. The hierarchical recipe structure is mapped on the plant module as follows:

- Recipe procedure for controlling the process or the production in a plant
- Partial recipe procedure for controlling a process step in a plant unit
- Recipe operation/function for the process engineering task/function in an equipment module.
Example of a batch report

**Batch Report**

The Batch Report function integrated in BatchCC is used to produce recipe and batch reports. These can be displayed and printed using BatchCC or the separate protocol viewer.

**Batch reports**

The batch reports contain all data required for reproduction of the batch process, for proof of the quality, and for compliance with statutory directives. These include, for example:

- Identification data
- Control recipe data
- Effective production data
- Time sequence of steps
- Operator interventions
- Process values.

**Recipe reports**

The recipe reports contain the production data, e.g.

- Recipe header data
- List of used materials and products
- Procedure directives.

**Neutrality and assignment of plant units**

Creation of a recipe which is neutral to the plant unit minimizes the engineering overhead and provides significant advantages for validation. During creation of the recipe, the partial recipe procedures are only assigned plant unit classes. The final assignment of the plant units is only carried out during runtime. In the cases of batches which run for a longer period and where the plant units are not to be already determined and occupied at the start of a batch, the assignment is only carried out at the time of use. Conflicts in the occupation of plant units are detected by the system, and displayed.

The following occupation strategies for plant unit assignments permit optimum orientation according to the special plant situation:

- "Manual selection of plant unit" for preselection at time of recipe creation
- "Preferred plant unit" for preselection at time of recipe creation
- Determination of "plant unused for longest time" to achieve uniform utilization
- Assignment of plant unit to be used by means of "process parameters" from external module (e.g. scheduler)

The occupation strategy can also be modified during the batch runtime, just like the plant unit assignment.
Batch data archiving and logging in XML format

The batch data which are only accessible to authorized persons or systems are saved in XML format. The Batch Report function provides an XML-based batch report as standard which can be displayed and printed by means of BatchCC or the protocol viewer. In addition, the XML data can also be processed further by an external report system.

Library with recipe operations (ROP)

The management of recipe operations is conveniently supported by a user library (ROP library). Library recipe operations can be inserted as a reference in recipe procedures and can thus be modified from a central location. This reduces the requirements for engineering and validation. If the reference link is broken, the recipe operation becomes a fixed component of the recipe procedure, and is thus independent of further central modifications.

Validation according to 21 CFR Part 11

The number of plants which have to be validated for observance of quality standards because of marketing and statutory requirements is permanently increasing. The process control system and its manufacturer play an important role in the validation procedure.

SIMATIC BATCH particularly supports validation according to 21 CFR Part 11 through:

- Consistent standardization, e.g. with type/instance concept of the SFC, recipe creation independent of plant unit, isolation from procedure and formula, library recipe operations
- Audit trail (modification logbook):
  - Recording of changes in recipes and recipe operations (saved with modified object)
  - Recording of changes during production (in the batch report), including the
  - operations at the individual control level belonging to the corresponding batch
- Version assignment (lifecycle of recipes, recipe operations, formulae)
- Central user administration with access control through SIMATIC Logon
- Electronic signature for release of master recipes, formulae and library objects based on SIMATIC Logon

Furthermore, Siemens as a manufacturer of process control systems has specially trained personnel as well as many years of experience in quality management and plant validation.

MIS/MES interfacing

Interfacing of MIS/MES systems is supported by:

- Integration of SIMATIC PCS 7 into SIMATIC IT
- An open interface (API) for customized expansions.

Separation of procedure and formula

The flexibility achieved by recipes which are independent of plant units can be increased even further if the procedure and parameter sets (formulae) are separated from one another. Various master recipes can be created by linking several formulae using a recipe procedure. This enables central modification of procedures. The formula structure is determined by the formula category defined by the user.

Separation of procedure and formula

<table>
<thead>
<tr>
<th>Formula 1</th>
<th>Formula 2</th>
<th>Formula 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>1000 kg</td>
<td>500 kg</td>
</tr>
<tr>
<td>Temperature</td>
<td>90 °C</td>
<td>90 °C</td>
</tr>
<tr>
<td>Time</td>
<td>10 min</td>
<td>15 min</td>
</tr>
<tr>
<td>Salt</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Pepper</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugar</td>
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</tbody>
</table>

Quantity | Temperature | Time | Salt | Pepper | Sugar
---|-------------|------|------|--------|--------|
1000 kg | 90 °C | 10 min | Yes | No | 150 g
500 kg | 90 °C | 15 min | Yes | Yes | 50 g
900 kg | 90 °C | 12 min | No | Yes | 50 g

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highlights

■ Modular architecture with flexible scalability (hardware and software)
  – Optimum adaptation to plant size and individual requirements
  – Grows with the plant configuration; no expensive spare capacities

■ High availability thanks to redundant batch servers
  – No loss of batch data
  – Automatic matching of batch data

■ Homogenous integration of SIMATIC BATCH into the HMI strategy and the engineering of SIMATIC PCS 7 via system interface
  – No customized interfaces
  – No double configuring for batch-specific engineering data

■ Recipes independent of plant unit
  – Great simplification in recipe management and validation
  – Flexible operation and optimum plant utilization through modification of occupation strategy and assignment of plant units during batch runtime

■ Hierarchical recipes according to ISA-88.01
  – Creation of recipes oriented according to process engineering
  – Quick, easy and fault-minimizing creation

■ Importing and exporting of master recipes, formulae and library objects

■ Saving, archiving and comprehensive reporting of batch data in XML format
  – Production becomes transparent and comprehensible
  – Reliable operator prompting, safe response to process faults

■ Reduction in engineering and validation overhead through:
  – Type-instance concept of SFC
  – Separation of procedure and formula
  – ROP library and configuration independent of plant unit
  – Multiple usage, central modification

■ Validation support according to 21 CFR Part 11 through:
  – Audit trail (modification logbook)
  – Version assignment for recipes
  – Libraries with recipe operations and formulae
  – User administration with access protection and electronic signature for master recipes, formulae and library objects
Control of material transport with SIMATIC Route Control

SIMATIC Route Control (RC) expands the SIMATIC PCS 7 process control system by a tool for the configuration, control, monitoring and diagnostics of material transport in pipeline networks. It is not specialized on any particular industry.

With SIMATIC Route Control, users of SIMATIC PCS 7 are capable of automating not only their production processes and associated warehouses but also the material transport linking both areas. SIMATIC Route Control can handle complex networks as well as simple transport routes. In particular, SIMATIC Route Control is predestined for plants with a multitude of complex route combinations or extensive tank farms such as are found above all in the chemical, petrochemical and food and drinks industries.

Preferred applications:
- Plants in the medium and high capacity range with an extensive route/pipeline network
- Frequent conversions and extensions of the transport network incl. actuators and sensors
- Transport routes with high flexibility:
  - Regularly changing materials
  - Dynamic selection of the origin and destination of the material transport (incl. reversing of direction on bidirectional transport routes)
  - Numerous simultaneous material transports
  - Plant projects in combination with SIMATIC BATCH

Modular architecture
SIMATIC Route Control is represented by the following software modules:
- Route Control Engineering (component of the SIMATIC PCS 7 engineering system)
- Route Control Server
- Route Control Center (RCC)

Thanks to its modularity and 3-step scalability for up to 300 simultaneous material transports, SIMATIC Route Control can be flexibly adapted to various plants sizes and architectures (single-user/multi-user systems).

Integration in SIMATIC PCS 7
The Route Control Engineering software, consisting of engineering tool, wizard and block library, is concentrated together with the other engineering tools in the central SIMATIC PCS 7 engineering system.

For small plants, SIMATIC Route Control can be installed either alone or together with the OS software on a single station system. Distributed multi-user systems with client/server architecture, expandable with up to 32 clients per server, are typical for the automation of material transport with SIMATIC Route Control.

SIMATIC PCS 7 supports multi-user systems with up to 12 servers/pairs of servers. In the case of multi-user systems with small quantity frameworks, it is possible to operate the Route Control Server, Batch server and OS server on shared basic hardware. However, availability will be higher and performance better if they are installed on separate server hardware, which can also be redundant as an option.

The Route Control client is represented by the Route Control Center (RCC). The RCC can be installed on an OS client, a Batch client or separate client hardware.

The graded user privileges for engineering, operation and maintenance personnel are integrated into the user administration with SIMATIC Logon.
SIMATIC PCS 7 process display: route network overview

Route Control engineering

The configuration of Route Control builds on the basic configuration of the SIMATIC PCS 7 process control system using blocks from the PCS 7 standard library. Even existing SIMATIC PCS 7 plants are therefore easy to expand with SIMATIC Route Control.

Technological elements of relevance to control of material transport (RC elements) are adapted in the CFC editor using uniform interface blocks from the Route Control library. The RC elements include:

- Control elements (actuators)
- Sensors elements (sensors)
- Parameter elements (setpoints)
- Connection elements (material information related to partial routes)

Route Control library

The Route Control library contains blocks for RC configuration, blocks for creating transport routes, and interface blocks for RC elements. It is made available in the catalog of the CFC editor.

Route Control wizard

The Route Control wizard constitutes the interface between the RC configuration and the SIMATIC PCS 7 basic configuration. The wizard, which can be called up from the SIMATIC Manager menu, receives the RC-specific configuration data of the SIMATIC PCS 7 project for importing into the Route Control engineering. In doing so it carries out a plausibility check, defines the AS-RC server and AS-AS communication connections, and creates the RC server signals.

Route Control Engineering tool

Once the RC-relevant basic data of a PCS 7 project have been adopted in an RC project, the next step is to configure the RC-specific objects with the Route Control Engineering tool:

- Partial routes: through division of the transport paths into partial routes, it is possible to increase the flexibility and reduce the configuring overhead through repeated applications. Relevant partial route parameters: “bidirectional” and “priority” (lowest total of partial route priorities is decisive when searching for the overall route)
- Locations: marking of beginning and end of each partial route and thus also of the origin and destination of a material transport through plant points; these are parameters for the requirements of a material transport (origin, destination, intermediate points/via).
- Interconnections: “interconnection” of the RC elements through installation in a partial route; the elements acquire additional properties depending on their type (e.g. “close valve” in base position). These properties can be edited in configuration windows.
- Function catalogs: partial routes can be assigned to certain function catalogs, e.g. “Cleaning” or “Product transport”, according to technological and product-specific aspects. When searching for routes, function catalogs allow you to limit the results to the type of material transport.
- Function steps/sequence functions: each function catalog contains as many as 32 configurable technological sequence functions, e.g. base position of the control elements, open transport valves, open origin valve, switch on pump. Together with the RC elements interconnected in the partial routes, the sequence functions determine the sequence of material transport.

Special configuration functions make it easier to perform repetitive routine work and extend the range of options for controlling material transport, e.g.:

- Exporting configuration data in the form of CSV files to MS Excel, copying and editing the data there, and then importing the files back into Route Control
- Controlling the joint use of partial routes by configurable function IDs
- Checking material compatibilities and interlocking partial routes in case of incompatible material sequences based on the material ID saved in the connection element of the partial route
- Connecting dynamic (external) setpoints arriving from the process (e.g. weighed quantity) to the route block in runtime
After the transport network has been configured and the variants of a material transport tested, the Route Control configuration data are transferred to the Route Control Server where they can then be activated at a suitable time. Configuration changes are immediately taken into account in the determination of a suitable transport route after transfer from the Route Control Engineering tool to the Route Control Server and subsequent activation through the Route Control Center (online loading).

The Route Control Server (RC Server) supplies the Route Control Clients (Route Control Center) with the necessary data and transfers their operations to the automation systems. When a material transport is requested through the Route Control Center (RCC), it is the job of the RC Server to dynamically compile a suitable transport route from the partial routes which were configured using a map of the automation systems on the basis of the selected parameters (origin, destination and intermediate locations) and configured parameters (e.g. material or function IDs).

For maintenance purposes, an automation system can be specifically set to “in maintenance” (out of service). Material transport being carried out by this automation system is still continued until finished. However, new material transports are no longer permitted.

In the process displays of the operator systems, each route block is represented by an RC block symbol and an RC faceplate. The RC block symbol of the route block can be used to select its RC faceplate. The RCC can be called from the RC faceplate of the route block or from the keyset on the operator station. It displays all of a material transport’s relevant route data and error information in several coordinated views.

Key functional features are:

- Overview of all RC elements and request details
- Operation of selected material transport depending on selected mode: manual/automatic.
- The following applies to manual mode:
  - Request, start, stop, continue and terminate material transport
  - Set/modify requirement parameters (plant points: origin, destination, intermediate points)
  - Set/modify general properties (function catalog, function ID, material ID and "ignore fault")
  - Enable/disable sequence functions
- Diagnostics of material transport request errors caused by locked RC elements, locked partial routes, inconsistent actuations or prohibited sequential material
- Diagnostics of currently running material transports:
  - Transport route status display shown in color and text in the route view of the RCC
  - Detailed analysis by evaluation of feedbacks from RC elements
- Server functions: Select RC server, display RC server status, update view (read in data again from the RC server)
- Display of the operator who has logged on
highlights

- Flexible, modular architecture with scalable hardware and software components for single-user and multi-user systems
  - Optimum adaptation to plant size and individual requirements
  - Grows with the plant configuration; no expensive spare capacities
- High availability thanks to redundant Route Control servers
- Homogenous integration into the HMI strategy and the engineering of SIMATIC PCS 7
  - No customized interfaces
  - No double configuring
  - Subsequent integration possible into existing SIMATIC PCS 7 projects
- Can be combined with SIMATIC BATCH
- Plant transparency
  - Identical mapping of route network of plant through partial routes
  - Simple assignment of RC elements to the partial routes using plant plans
- Fast response to plant modifications (e.g. additional valves) during configuration, commissioning or runtime
  - Consideration of changes in configuration immediately following online loading
- Reduction in configuration overhead and commissioning times
  - Division into partial routes and their configuration through repetitions
  - Export configuration data as CSV file, copy into Excel, edit and reimport
  - Reduction in complex, repeated tasks through RC wizard
  - Encapsulation of functionality from viewpoint of user program, control as entity
- Exclusive assignment of RC elements and partial routes involved in material transport
- Material transport using common partial routes (several origins or destinations with bumpless switchover facility)
- Consideration of material compatibilities to avoid undesired mixing or material sequences
- Automatic calculation of shifted quantities
- Recording of route reports with filter functions, screen output and printer output
- Offline testing for completeness during configuration, as well as for inconsistencies and undesired combinations
- Detailed diagnostics of material transport requirement faults and current material transport
Fast and safe communication with Industrial Ethernet for plant bus and OS LAN

**Industrial Ethernet**

Industrial Ethernet, a powerful area and cell network for industrial applications in line with the international IEEE 802.3 standard (Ethernet), is used as the plant bus as well as the OS LAN (terminal bus) for multi-user systems in client/server architecture.

For small systems, the "Basic Communication Ethernet" integrated in the ES/OS/BATCH/IT basic devices permits operation of single stations and servers on the plant bus even without a communications processor.

In medium and large plants characterized by high requirements, SIMATIC PCS 7 applies modern Gigabit and FastEthernet technology which combines the high security provided by optical rings with the scalable performance provided by switching technology and high transmission rates up to 1 Gbit/s.

As of SIMATIC PCS 7 V6.1, Industrial Ethernet switches from the SCALANCE X range are available for the configuration of the plant bus and OS LAN (terminal bus) in addition to the proven ESM and OSM switches. Many possible configurations and a scalable performance can then be achieved at an attractive price.

As a result of their interference resistance and high availability, optical rings are preferably used for the plant bus and OS LAN (terminal bus). Both the OSM/ESM switches and the SCALANCE X414-3E can be used as the redundancy manager in a ring.

If particularly high availability requirements exist, it is also possible to distribute the communication on two redundant rings:

- With the OS LAN, the two rings are connected together by two pairs of SCALANCE X414-3 switches. The redundant servers and clients are connected to the two rings by means of two separate interfaces each (redundant terminal bus adapter package).
- With the plant bus, the two rings are physically separate. One SCALANCE X414-3 switch in each case takes over the function of the redundancy manager for each ring. The coupling partners connected to the two rings by means of two CPs per AS CPU and OS server are linked together logically when configuring with NetPro by using a fault-tolerant S7 connection (4-way redundancy).

**SIMATIC NET**

With the SIMATIC NET network components based on globally established standards, SIMATIC PCS 7 possesses a powerful and rugged range of products for implementing totally integrated communication networks for reliable data exchange between all system components and levels in a plant.

The SIMATIC NET products specially designed for industrial use are optimally suitable for plants from all sectors. They are matched to one another, and meet high standards, especially in areas where they are subject to extreme influences, such as

- interfering electromagnetic fields,
- corrosive liquids and atmospheres,
- explosion hazards,
- high mechanical loads.

The SIMATIC NET products guarantee expandability and safeguard investments through compatible further developments as well as uniformity from incoming goods to outgoing goods and from field devices up to the management information system.
Industrial Ethernet switches

- ESM (electrical) and OSM (optical) with 2 ring ports each for transmission rates up to 100 Mbit/s and, depending on the type, up to 8 ports (RJ45, ITP or BFOC) for data terminals or network segments
- SCALANCE X414-3E with
  - 2-Gigabit Ethernet ports for Gigabit rings: electrical or optical
  - Up to 20 electrical 100-Mbit/s ports (12 integrated and 8 per extender) for connecting data terminals or network segments
  - Up to 4 optical ports, of which 2 for 100-Mbit/s rings
  - Up to 12 optical 100-Mbit/s ports, of which 8 per extender for connecting data terminals or network segments
- SCALANCE X208 with 8 ports for transmission rates up to 100 Mbit/s, suitable for electrical Industrial Ethernet structures with linear, star or ring topology
- SCALANCE X204-2 with 2 optical ports and 4 electrical ports for transmission rates up to 100 Mbit/s, suitable for optical Industrial Ethernet structures with linear or ring format

1) In conjunction with media module

Industrial Wireless LAN (IWLAN)

SIMATIC PCS 7 allows you to integrate mobile or stationary remote clients into the OS-LAN via a SCALANCE W788-1PRO access point.

Via IWLAN, mobile remote clients (e.g. notebooks) can communicate with the access point using a CP 7515 communications processor, stationary remote components in a desktop/tower housing can communicate using a SCALANCE W746-1PRO Ethernet client module.

The following applications can then be implemented:

- Use of additional remote OS clients (up to 2 on IWLAN)
- Linking of Web clients to a PCS 7 Web server (up to 2 on IWLAN)
- Remote access to an engineering station with application of Remote Desktop or PC Anywhere, e.g. during commissioning.

All components used are very rugged, apply state-of-the-art authentication and encryption procedures, and guarantee high reliability of the radio channel.

Technical specifications for Industrial Ethernet

<table>
<thead>
<tr>
<th>Plant bus / OS LAN</th>
<th>Industrial Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of stations</td>
<td>1,023 per network segment (IEEE 802.3)</td>
</tr>
<tr>
<td>Number of switches</td>
<td>Up to 50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of the network</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Local network</td>
<td>Electrical: up to approx. 5 km</td>
</tr>
<tr>
<td></td>
<td>Optical: up to approx. 150 km</td>
</tr>
<tr>
<td>WAN</td>
<td>Worldwide with TCP/IP</td>
</tr>
<tr>
<td>Topology</td>
<td>Linear, tree, ring, star</td>
</tr>
</tbody>
</table>

Highlights

Industrial Ethernet

- Universally implementable:
  - In all sectors
  - In office environments just as in harsh industrial environments
- Fast commissioning through:
  - Simple connection system
  - Local assembly using the FastConnect cabling system together with RJ45 technology
- EMC interference resistance through optical transmission media
- Continuous monitoring of network components through a simple yet effective signaling concept
- Plant-wide clock system for exact assignment of events within the complete plant
- High availability thanks to redundant network topologies
- Resistant to power failure through fast switchover to redundant system
- High flexibility through reaction-free expansion of existing plants
- Scalable performance with switching technology for almost unlimited communications performance
- Modern and future-oriented network components, e.g. SCALANCE X Industrial Ethernet switches
- Investment security through compatible further developments
Fast and safe communication with PROFIBUS for the field area

Distributed peripherals such as I/O modules, transmitters, drives, valves or operator terminals communicate with the automation systems at field level through a powerful real-time bus system. This communication is characterized by the deterministic transmission of process data and the exception-based transmission of alarms, parameters and diagnostics data.

PROFIBUS is predestined for these tasks because it enables high-speed communication with the intelligent distributed I/Os by means of a communications protocol (PROFIBUS DP) as well as communication and simultaneous power supply for transmitters and actuators (PROFIBUS PA).

PROFIBUS is simple, rugged and reliable, can be expanded on-line by further distributed components, and can be used in both standard environments and hazardous areas. On account of these characteristics, PROFIBUS is now established in all sectors of the production, process and hybrid industries and has become the most successful open fieldbus in the world. This is proven by more than 15.4 million installed PROFIBUS nodes, of which 2.8 million are in the process industry with a share of approx. 530000 installed PROFIBUS PA nodes (values at end of 2005).

In addition to the properties already referred to, the following PROFIBUS functions are particularly relevant to process automation:
- Integration of previously installed HART devices
- Redundancy
- Safety-related communication with PROFIsafe up to SIL 3 according to IEC 61508
- Clock synchronization
- Time tagging

PROFIBUS transmission systems

**PROFIBUS DP**
- RS 485: Simple and low-cost electrical transmission system based on shielded two-wire cable.
- RS 485-iS: Intrinsically-safe electrical transmission system for hazardous areas up to Ex zone 1, implemented using a shielded two-wire cable with a transmission rate of 1.5 Mbit/s.
- Fiber-optic: Optical transmission system with glass or plastic fiber-optic cables, for fast transmission of large quantities of data in environments with high interferences or for covering long distances.

**PROFIBUS PA**
- MBP (Manchester coded; bus powered): Intrinsically-safe transmission system which permits simultaneous transmission of digital data and powering of the field devices by means of a two-wire cable. It is suitable for direct interfacing of devices in environments up to Ex zone 0 or 1.
Device interfacing with GSD and EDD

Automation systems (PROFIBUS master) and process device managers such as SIMATIC PDM communicate with field devices and distributed I/O components (PROFIBUS slaves) on the basis of an exact and complete description of the device-specific data and functions, e.g.

- Type of application function
- Configuration parameters
- Dimensional units
- Limits and default values
- Ranges.

This description is provided by the vendor in the following form:

- As a GSD file for the cyclic data exchange between the PROFIBUS master and the PROFIBUS slaves or
- optionally as an Electronic Device Description (EDD) with standard and vendor-specific properties for acyclic communication, e.g. for enhanced configuration, commissioning, diagnostics, measured-value monitoring, asset management or documentation.

The device-specific GSD and EDD files are either already included in the catalogs of the configuration tools or can be simply integrated by importing. New GSD and EDD files are published by the vendors on the Internet – both in their own presentation and in that of PROFIBUS International: www.profibus.com

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<table>
<thead>
<tr>
<th>Technical specifications</th>
<th>PROFIBUS DP</th>
<th>PROFIBUS PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transmission</td>
<td>RS 485</td>
<td>Fiber-optic</td>
</tr>
<tr>
<td>Transmission rate</td>
<td>9.6 kbit/s...12 Mbit/s</td>
<td>9.6 kbit/s...12 Mbit/s</td>
</tr>
<tr>
<td>Cable</td>
<td>Two-wire shielded</td>
<td>Two-wire shielded</td>
</tr>
<tr>
<td>Type of explosion protection</td>
<td>EEx(ib)</td>
<td>EEx(ia/ib)</td>
</tr>
<tr>
<td>Topology</td>
<td>Linear, tree</td>
<td>Linear, tree</td>
</tr>
<tr>
<td>Participants per segment</td>
<td>32</td>
<td>32 (1)</td>
</tr>
<tr>
<td>Participants per network (with repeater)</td>
<td>126</td>
<td>126</td>
</tr>
<tr>
<td>Cable length per segment depending on transmission rate</td>
<td>1200 m at max. 93.75 kbit/s 1000 m at 187.5 kbit/s 400 m at 500 kbit/s 200 m at 1.5 Mbit/s 100 m at 12 Mbit/s</td>
<td>1000 m at 187.5 kbit/s 400 m at 500 kbit/s 200 m at 1.5 Mbit/s 100 m at 12 Mbit/s Max. 80 m (plastic) 2.3 km (multi-mode glass fiber) &gt;15 km at 12 Mbit/s (single-mode glass fiber)</td>
</tr>
<tr>
<td>Repeater for signal boosting with RS 485 networks</td>
<td>Max. 9</td>
<td>Max. 9 (1)</td>
</tr>
</tbody>
</table>
Communications and line diagnostics

Diagnostics tools from various vendors (e.g. Amprolyzer) which are directly connected to the PROFIBUS network by means of a PC/notebook interface offer comprehensive functions for bus diagnostics and analysis, including:

- Recording and interpretation of telegrams
- Automatic detection of transmission rate
- Lifelist of all bus participants
- Operating states of all bus participants
- Statistical evaluation of bus events.

The diagnostics repeater available for the connection of PROFIBUS DP segments with RS 485 technology also includes functions for online fault monitoring of the connected segments. It passes on the cause of the fault to the PROFIBUS master (e.g. line interruption, short-circuit, terminating resistor absent, too many participants, or participants too far away) as well as detailed information on the fault location.

Diagnostics of intelligent field devices

The standardized diagnostics mechanism of the PROFIBUS permits the user to rapidly recognize and eliminate faults in the devices connected to the bus.

The diagnostics messages from the field devices can also be utilized e.g. for early initiation of preventive maintenance measures as a result of abnormalities detected long before a device fails. If a fault occurs on the field device or if maintenance becomes necessary, e.g. through contamination of a capacitive level sensor, diagnostics information is transmitted and a corresponding message sent to the operator station and the maintenance station.

Enhanced diagnostics information with detailed information about the devices on the PROFIBUS (e.g. production date, operating hours counter or vendor information) can be made available via SIMATIC PDM on the basis of an EDD provided by the vendor.

highlights

**PROFIBUS**

- Simple and rugged fieldbus
- Small planning and engineering overheads as well as low commissioning costs
- Optimum distributed system structure with low hardware and space requirements
- Significantly reduced overhead for wiring, jumpering, distribution, power supply and field mounting
- High-speed communication with high measurement accuracy
- Efficient engineering, interoperability and replaceability of devices through vendor-independent device description
- Short commissioning times through short loop tests, easy parameterization and the absence of calibration work
- Bidirectional communication and high amounts of information permit enhanced diagnostics functions for fast fault locating and troubleshooting
- Optimum life cycle management through processing and evaluation of diagnostics and status information by an asset management system
The SIMATIC PCS 7 process control system offers various possibilities for connecting I/O devices as well as for detecting and emitting process signals through sensors and actuators:

- Analog and digital I/O modules of the SIMATIC S7-400 operated centrally in the automation system
- ET 200M, ET 200S, ET 200iSP distributed I/O systems with an extensive range of cost-effective signal and function modules, connected through PROFIBUS DP to the automation system (AS)
- Direct AS connection of intelligent, distributed field/process devices and operator terminals through PROFIBUS DP/PA (also redundant or in hazardous zones 1 or 2, sensors also in zone 0)

In practice, automation in the field area is largely characterized by distributed process I/Os:

- ET 200 remote I/Os in conjunction with classical field/process devices and HART field devices as well as intelligent field/process devices directly on PROFIBUS.

In addition to the wide technical bandwidth, the following properties speak for the distributed process I/Os:

- Modularity and uniformity
- Flexible adaptability to the plant structure
- Minimum cabling and engineering requirements
- Low commissioning, servicing and lifecycle costs.

On the other hand, SIMATIC S7-400 signal modules used centrally in the automation system have little significance in the context of SIMATIC PCS 7. These modules are at most an alternative to distributed I/Os for small applications or plants with limited distributed expansion.

### Standard process I/Os for SIMATIC PCS 7

The following standard process I/Os are recommended for the SIMATIC PCS 7 process control system for automation in the field area:

- ET 200M distributed I/O system
- ET 200iSP distributed I/O system
- ET 200S distributed I/O system
- PROFIBUS PA devices according to PA profile 3.0

Further process I/Os can be integrated into SIMATIC PCS 7 via the PROFIBUS using add-on blocks. Some examples include:

- SIMOCODE pro motor management system
- MICROMASTER 4 frequency converters
- SIWAREX M/U/FTA/FTC weighing systems
ET 200 in potentially explosive gas atmospheres

Use of the process I/Os for SIMATIC PCS 7

The graphics show the various interfacing possibilities for the distributed I/Os of SIMATIC PCS 7 with consideration of various ambient conditions.

ET 200 in potentially explosive dust atmospheres

1) Dusty atmosphere: Installation of components always in an enclosure with IP6x degree of protection. A manufacturer’s declaration is required for installation in zone 22. Certification for the dusty area must be provided for installation in zone 21.

Sensors/actuators, analyzers as well as weighing and dosing systems

For operation with the SIMATIC PCS 7 process control system, Siemens offers a comprehensive range of devices through the Process Instrumentation Group of the Automation and Drives Division. These include, for example:

- Devices for measurement of pressure, flow, temperature or level
- Positioners
- Gas analyzers
- SIWAREX weighing systems

These devices are available in versions with PROFIBUS DP/PA interface and for HART communication. The majority of devices is already included in the device catalog of the SIMATIC PDM process device manager.

An overview of the current range of devices with further information, technical specifications and ordering data is available at the following Internet site:

www.siemens.com/fielddevices
# Distributed I/O systems

## Recommended devices for field automation

<table>
<thead>
<tr>
<th>Distributed I/O systems</th>
<th>DP</th>
<th>PDM</th>
<th>Safety</th>
<th>Description</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200M</td>
<td></td>
<td></td>
<td></td>
<td>Modular remote I/Os for process control applications with SIMATIC PCS 7 in IP20 degree of protection</td>
<td>Wide range of I/O modules of S7-300 design (up to 8 per station):  - DI, DO, AI, AO signal modules (simple, with diagnostics capability, redundant and Ex version)  - Function modules (controllers, counters)  - HART modules  - F-modules for fail-safe applications  - Supports online modifications:  - Addition of station  - Addition of I/O modules  - Parameter assignment</td>
</tr>
<tr>
<td>ET 200iSP</td>
<td></td>
<td></td>
<td></td>
<td>Intrinsically-safe, modular I/O system with independent wiring and IP30 degree of protection for up to 32 electronics modules</td>
<td>Available electronics modules:  - DI NAMUR  - DO  - AI for temperature measurements using resistance thermometer/thermocouple  - AO  - AI HART (for two-wire and four-wire transmitters)  - AO HART  - Supports online modifications:  - Addition of station  - Expansion of station with modules  - Modification of module parameters  - Replacement of individual modules during operation without fire certificate</td>
</tr>
<tr>
<td>ET 200S</td>
<td></td>
<td></td>
<td></td>
<td>Bit-modular, extremely compact I/O system with independent wiring and IP20 degree of protection</td>
<td>Range of I/Os comprises:  - Power modules  - DI, DO, AI and AO signal modules  - Integral motor starters up to 7.5 kW  - Supports online modifications:  - Addition of station</td>
</tr>
<tr>
<td>SIMOCODE pro</td>
<td></td>
<td></td>
<td></td>
<td>Flexible, modular motor management system for constant-speed motors in the low-voltage range</td>
<td>Can be used wherever solid, liquid or gaseous materials have to be moved, conveyed, pumped or compressed, e.g. for operation of:  - Pumps and fans  - Compressors  - Extruders and mixers  - Mills</td>
</tr>
<tr>
<td>MICROMASTER 4</td>
<td></td>
<td></td>
<td></td>
<td>Standard frequency converter with high dynamic performance for variable-speed drives</td>
<td>For universal use, especially for:  - Operation of pumps and fans  - In conveyor systems</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drives</th>
</tr>
</thead>
</table>

## Motor management

| SIMOCODE pro motor management and control devices (can be integrated in SIMATIC PCS 7 using PCS 7 block library) | Flexible, modular motor management system for constant-speed motors in the low-voltage range | Can be used wherever solid, liquid or gaseous materials have to be moved, conveyed, pumped or compressed, e.g. for operation of:  - Pumps and fans  - Compressors  - Extruders and mixers  - Mills |

## Frequency converter

| MICROMASTER 4 (can be integrated in SIMATIC PCS 7 using PCS 7 block library) | Standard frequency converter with high dynamic performance for variable-speed drives | For universal use, especially for:  - Operation of pumps and fans  - In conveyor systems |

Columns 2-4: DP: can be connected to PROFINET DP, PDM: parameters can be assigned using SIMATIC PDM, Safety: with PROFIsafe profile
The process industry frequently features complex production sequences where materials and mixtures which are explosive or dangerous to health are produced or processed. A failure or fault could have fatal consequences in this case for mankind, machines, plants and the environment.

With modern safety instrumented systems (SIS) such as the modular SIMATIC Safety Integrated from Siemens, safety-related functions and processes can be automated such that non-calculable risks are minimized and their effects reliably limited. Typical application examples of SIS-based safety applications are e.g. burner management systems, emergency stop / process shutdown systems, fire or gas alarm systems.

In contrast to the common practice of solving safety tasks using separate safety systems, SIMATIC Safety Integrated integrates the safety technology into the standard automation, i.e.:

- Processing of standard functions (S) and safety functions (F) on one automation system
- Mixed operation of safety-related I/O modules and standard modules in the ET 200M/S distributed I/O station
- Standard communication and safety-related communication over PROFIBUS (DP/PA) – expanded by the PROFIsafe protocol:
  - Between automation system and distributed I/O systems or
  - between automation system and field/process devices connected directly over the fieldbus
- Mixed operation of devices with or without PROFIsafe profile directly on the PROFIBUS PA

The resulting reduction in required space, scope of hardware and wiring, as well as assembly, installation and engineering overheads provide significant cost savings for the complete lifecycle of the plant.

The high modularity and flexibility of SIMATIC Safety Integrated also permits separation of standard and safety functions in the plant configurations (functionally separated automation systems, PROFIBUS segments and ET 200M/S I/O stations).

Significant components of SIMATIC Safety Integrated are:

- S7-400F/FH automation systems
- S7 F Systems engineering tool.
- Safety-related PROFIsafe communication over PROFIBUS (DP/PA)
- Safety-related F modules for ET 200M/S distributed I/O systems
Benefits

Through combination with the SIMATIC PCS 7 process control system, SIMATIC Safety Integrated offers additional advantages:

- One engineering system for standard and safety-related applications
- Homogenous integration of the safety technology into the automation system of SIMATIC PCS 7
- Integration of the safety-related applications into the convenient process visualization on the SIMATIC PCS 7 operator station
- Automatic consideration of safety-related fault messages in the process visualization, with identical time tagging
- Uniform data management for standard and safety automation, including process visualization and diagnostics; no complex data handling between process control system and SIS
- Uniform diagnostics, from sensor to automation system right up to the operator system
- Integration of safety-related hardware into the PCS 7 asset management for diagnostics and preventive maintenance

Standards

S7-400F/FH automation systems
The safety-related automation systems are TÜV-certified and NRTL-listed. They comply with the following standards and safety directives:
- IEC 61508 up to SIL 3
- EN 954-1 up to Category 4
- NFPA 72
- NFPA 79-2002
- NFPA 85
- ANSI/ISA S84, API 14C, BLRBAC.

PROFIBUS with PROFIsafe
PROFIsafe communication complies with the following standards and safety directives:
- IEC 61508 up to SIL 3
- EN 954-1 up to Category 4
- NFPA 79-2002
- NFPA 85.

Safety-related I/O modules
The safety-related I/O modules are in conformance with:
- IEC 61508 up to SIL 3
- EN 954-1 up to Category 4
- NFPA 79-2002
- NFPA 85.

They are TÜV-certified as well as UL- and NRTL-listed.
Safety-related automation systems

The safety-related SIMATIC PCS 7 automation systems are available in two design versions:

- As single-channel AS 414F/AS 417F (with only one CPU)
- As fault-tolerant AS 414FH/AS 417FH (with redundant CPU)

The safety-related AS 414 F/FH and AS 417 F/FH automation systems are able to process standard and safety functions on one system. Mutual influencing is prevented in that the safety-related and standard program components are strictly separated and that the data exchange is carried out by special conversion blocks.

The F/FH AS 414 F/FH and AS 417 F/FH automation systems detect not only errors in the process but also their own internal errors, and will automatically set the plant to a safe state if an error is detected. This applies in association with

- the safety-related signal modules of the ET 200M/S distributed I/O system or
- the safety-related devices connected directly via the fieldbus.

The safety functions configured by the user by means of CFC (Continuous Function Chart, see section on engineering) or with the Safety Matrix are processed twice by completely redundant command processing in different processor sections of a CPU. Faults detected when subsequently comparing the results do not lead to a CPU stop since the standard functions continue to run without being influenced.
S7 F Systems, SIMATIC Safety Matrix

S7 F Systems with F block library

The engineering tool "S7 F Systems" is used to parameterize an AS CPU and safety-related F signal modules. It supports configuration by means of functions for:

- Comparison of F programs
- Recognition of changes in the F program using the checksum
- Separation of S and F functions.

Access to the F functions can be password-protected.

The F block library integrated in S7 F Systems contains predefined function blocks for generation of safety-related applications with the CFC or the Safety Matrix based on it. The certified F blocks are extremely robust and intercept programming errors such as division by zero or out-of-range values. They save the necessity for performing diverse programming tasks for detecting and reacting to errors.

SIMATIC Safety Matrix

In addition to CFC, Siemens offers the SIMATIC Safety Matrix as an innovative tool for convenient configuration of safety applications. The tool based on the proven principle of a causes & effects matrix is suitable for processes where defined statuses require specific safety reactions. The Safety Matrix not only means that programming of the safety logic is significantly simpler and more convenient, but also much faster than in the conventional manner.

During the risk analysis of a plant, the configuration engineer can assign exactly defined reactions (effects) to events (causes) which may occur during a process. The possible process events (inputs) are initially entered in the horizontal lines of a matrix table comparable to a spreadsheet program, and then their type and quantity, logic operations, any delays and interlocks as well as any tolerable faults are configured. The reactions (outputs) to a particular event are then defined in the vertical columns.

The events and reactions are linked by simply clicking the cell at the intersection point of line and column. Using this procedure, the Safety Matrix automatically generates complex, safety-related CFC programs. Special programming knowledge is not required, and the configuration engineer can concentrate fully on the safety requirements of his plant.
PROFIsafe, safety-related I/O modules

PROFIBUS with PROFIsafe

The standard PROFIBUS is used together with the PROFIsafe profile for safety-related communication between the CPU of the automation system and the F modules. This solution supports operation of standard and safety-related components on the same bus. A separate and expensive safety bus is unnecessary.

The PROFIsafe profile is implemented as an additional software layer within the devices/systems without modifying the communication mechanisms of the standard PROFIBUS. PROFIsafe expands the telegrams by additional information with which the PROFIsafe communications partner can recognize and compensate transmission errors such as delays, incorrect sequences, repetitions, losses, faulty addressing or data falsification.

Safety-related I/O modules

The safety functions of the F/FH automation systems are perfectly matched to the safety-related I/O modules of the ET 200M and ET 200S distributed I/O systems. The redundant F signal modules/submodules of ET 200M/S (DI/DO/AI) can be used for diagnostics of both internal and external faults. They carry out self-tests, e.g. for short-circuit or open-circuit, and automatically monitor the discrepancy time defined in the parameter settings.

The input modules work with single-channel, 2-out-of-3 (only F AI module) or 2-out-of-2 channel evaluation. A safety response is triggered immediately there are any differences. The digital output modules enable safe disconnection through a second disconnect path in the event of a faulty output.

Safety-related ET 200M module

The PM-E F power module of the ET 200S is used to monitor and fuse the load and sensor supply voltages and for safe deactivation of the subsequent digital standard output module 24 V DC (up to 10 A) in the same rack.

Initiated by a switch-off signal from the F/FH automation system, safety-related ET 200S motor starters can be selectively switched off by the series-connected PM-D F PROFIsafe power module. In addition to a circuit-breaker/contactor combination, the safety-related motor starters have a safe electronic evaluation circuit for fault detection. If the contactor to be switched in the case of an emergency stop fails, the evaluation electronics detects a fault and deactivates the circuit-breaker in the motor starter in a safety-related manner.

Safety-related ET 200M I/O modules

- Digital input DI 24 x 24 V DC
- Digital input DI 8 x NAMUR [EEx ib]
- Digital output DO 10 x 24 V DC/2 A
- Analog input AI 6 x 4...20 mA, 13 bits

PROFIBUS PA devices with PROFIsafe

- SITRANS P DS III PROFIsafe
- Pointek CLS 200/300 Rev. 2
Safety-related ET 200S I/O modules

- Digital input F-DI
  - 4/8 x 24 V DC PROFIsafe
- Digital output F-DO
  - 4 x 24 V DC/2 A PROFIsafe,
- PM-E F 24 V DC PROFIsafe power module with relay
  - 1 x 24 V DC/10 A for safe switching-off of DO
    - Version pp for grounded loads (ground and earth connected together)
    - Version pm for ungrounded loads (ground and earth separate); 2 additional safety-related DO 2 x 24 V DC/2 A
- PM-D F PROFIsafe power module for failsafe motor starters
  - For selective deactivation of up to 6 switching groups with emergency stop applications

- PM-D F X1 power module, for control of series-connected F motor starters with externally applied safety-related switch-off signals (1 to 6 switch-off groups)
- F-CM contact multiplier with 4 safe floating NO contacts
- Safety-related motor starters up to 7.5 kW, can be expanded by brake control module
  - F-DS1e-x direct-on-line starter
  - F-RS1e-x reversing starter
- SIGUARD safety system: SIGUARD PM-D power modules in combination with high-feature motor starters and failsafe kit for the following functions:
  - Evaluation of emergency stop circuits with function “Monitored start”
  - Monitoring of protective doors with function “Automatic start”
  - Expansion for time-delayed switch-off
  - Expansion of safety circuits
  - Transmission of status to external safety equipment

Highlights

- SIMATIC Safety Integrated as a comprehensive range of products and services from Siemens for safe, fault-tolerant and high-availability applications in the process industry:
  - Simple to implement, operate and maintain
  - Permit flexible adaptation to changing conditions (high innovation potential)
  - Reliable in elimination of dangers and risks

- SIMATIC Safety Integrated integrates safety engineering into the standard automation:
  - Standard and safety-related functions execute together on one automation system
  - Standard and safety-related components use the standard fieldbus for communication: PROFIBUS with PROFIsafe
  - Standard and safety-related I/O modules can be mixed within an ET 200M/S station
  - Same operating philosophy for safety and standard automation

- SIMATIC Safety Integrated is homogenously integrated into the system architecture of SIMATIC PCS 7

- Integration of safety-related technology into diagnostics and maintenance with the PCS 7 asset management

- The safety-related configuration is part of the totally integrated system configuration with the PCS 7 engineering system:
  - S7 F Systems, CFC and SIMATIC Safety Matrix are components of the engineering toolset
  - Configuration of standard and safety-related functions with one engineering tool, the CFC
  - Safety Matrix instead of CFC configuration: creation of safety-related functions without programming knowledge, even faster, simpler and more conveniently

- Safety level SIL 3, AK 6 with only one CPU

- Mixed configurations of standard and safety-related technology reduce the costs for hardware, assembly, wiring, installation, engineering and commissioning

- Low acquaintance and training requirements as result of uniform system/tool landscape

- Uniform diagnostics and maintenance from sensor/actuator via automation system up to the operator system

- Cost-effective stocking of spare parts through minimization of types and parts

- Minimization of total lifecycle costs
Evaluation and management of process data via OPC (OLE for Process Control)

 OPC support in the SIMATIC PCS 7 process control system

Systems for process data evaluation and management as well as production planning systems are important levers for process optimization and reduction of operating costs. SIMATIC PCS 7 supports the standardized access of host information systems, office applications or user-specific applications to the process data in the OS single stations/OS servers via OPC.

Since the PCS 7 operator system is OPC-compliant, operator stations as OPC servers can be the data source for other applications. An OPC data access server for access to all online values and complying with the OPC data access standards 1.1 and 2.0 is already integrated in the OS single stations and OS servers. Further open interfaces for access to archive data and messages of the operator system are provided in the form of an optional WinCC/Connectivity Pack:

- **OPC HDA (historical data access server)**
  As an OPC HDA server, the PCS 7 operator station provides other applications with historical data from the WinCC archive system. The OPC client, e.g., a reporting tool, can specifically request the required data by defining the start and end of a time interval. Numerous functions, e.g., variance, mean value or integral, already permit preprocessing by the HDA server and thus contribute towards reduction of the communications load.

- **OPC A&E (alarm & events server)**
  As an OPC A&E server, the PCS 7 operator station passes on WinCC messages together with all accompanying process values to the subscribers at the production and corporate management levels. They can of course also be acknowledged there. Filter mechanisms and subscriptions ensure that only selected, modified data are transmitted.

- **OLE-DB provider**
  Simple, standardized direct access to the archive data in the Microsoft SQL server database of the operator system is possible with the OLE-DB provider. Through this, all WinCC archive data are accessible with the accompanying process values, message texts and user texts.
Integration and synchronization of all business processes with SIMATIC IT

SIMATIC IT Production Suite

SIMATIC IT consists of various components designed for different tasks which can be coordinated by the SIMATIC IT Production Modeler.

The basic functions are implemented using SIMATIC IT components. They are marketed in the form of product bundles of various composition which permit optimum matching to individual requirements:

- SIMATIC IT MIS (Management Information System) defines key performance indicators in agreement with the plant model. Realistic evaluation of the plant performance is possible with SIMATIC IT MIS.
- SIMATIC IT Genealogy Management for material management throughout the complete company with observation of the statutory directives. Typical tasks are reverse and forwards genealogy, fundamental material monitoring, and synchronization of material master data with the ERP system.
- SIMATIC IT Orders Management for order management from planning up to execution, including shipping, replanning of sequences, supervision of execution, and recording.

Bundles are additionally available which combine several of those mentioned here. Each of these product bundles includes one license for the following components:

- SIMATIC IT Report Manager offers comprehensive reporting functions. It delivers valuable knowledge on the company, and provides support for compliance with statutory directives for ad hoc reporting (e.g. EU directive EC 178/2002, US Bio-Terrorism Act).
- SIMATIC IT Client Application Builder provides the graphic HMI for MES applications on the basis of a complete Web-based environment.

The MES product range of SIMATIC IT is rounded off by the following components for special ISA-95 functions which are also offered as stand-alone products:

- SIMATIC IT Unilab Laboratory Information Management System for management and control of laboratory data and processes.
- SIMATIC IT Interspec Specifications Management System for management and control of production specifications within the complete company. It facilitates product lifecycle management.
Migration

The investment in the future

Migration strategy

Globalization and permanently increasing competitive pressures are forcing companies to continuously increase productivity and shorten market launch times. To achieve this, it is necessary to continuously optimize the engineering and process, with simultaneous observation of new industrial requirements and regulations.

Many systems and plants must now be expanded and modernized to ensure that companies can continue to provide products complying with market requirements. However, since the installed basis of hardware, application software and know-how of the operating and maintenance engineers represents an enormous value, the safeguarding of investments for companies operating the plants is always assigned a high priority during all modernization plans.

Experience has shown that the success of migration is decisively determined by the provision of a technical solution optimally matched to customer requirements and the respective plant. Minimization of the technical and financial risks together with safeguarding of investments for as long a period as possible are the prime objectives. The different life cycles of the system components must also be considered, which currently vary from 5 years for PC-based workstations, 15 years for controllers, up to 25 years or more for input/output components and wiring.

Therefore Siemens does not consider its task to simply be the complete replacement of an existing system, but in the close elaboration together with customers and their system integrators of an individual, future-oriented solution based on the state-of-the-art SIMATIC PCS 7 process control system – always under the directives:

- **Step-by-step** system innovation
- **Adaptable** to the specific conditions of the plant
- **Flexible** according to production requirements

Portfolio of the migration products

Siemens already recognized the significance of migration for process automation at an early point in time, and has offered a wide range of innovative migration products and solutions for its globally proven systems for many years already. Right from the beginning, the maxim of Siemens’ migration strategy is to modernize the existing installed basis in steps and without completely changing the system – if possible without a plant shutdown or with minimum production downtimes. In this manner, Siemens supports customers’ endeavors to achieve long-term safeguarding of investments together with maximization of the return on assets.

Basic technology "Data Base Automation"

Siemens’ know-how in the migration sector has continuously grown as time has passed. The experience gained in numerous migration projects has been incorporated into new products and technologies which are even more efficient. The basic technology for current and new migration solutions is the "Data Base Automation" (DBA) integrated in the engineering system of SIMATIC PCS 7. Using DBA and a plug-in interface, it is possible to download the configuration data from any process control system, and to display and configure them using a standardized user interface. DBA allows system-based migration of controller, batch and operator system data from different initial systems in standardized form, and guarantees uniform software quality, security and understandability.
The migration products can be categorized as follows:

Typical migration scenarios

A large number of different migration scenarios is imaginable depending on the specific technical and economical factors of each migration project. The migration products offer the modularity and flexibility required to implement such scenarios.

Typical migration scenarios which can be implemented using these migration products:

Scenario 1: Replacement of existing HMI system by a SIMATIC PCS 7 operator system
If the HMI (Human Machine Interface) system is technically obsolete, if the stocking of spare parts is too expensive, if it no longer complies with current directives and standards for operator workstations, or if functional expansions are required (e.g. IT integration), it is possible to simply replace the existing HMI system by a SIMATIC PCS 7 operator system. The controller, process I/O and application software are retained.

- Minimum costs
- Clear risk
- Lengthening of service life of complete plant
- New application possibilities
- Opening of system for IT world

Scenario 2: Expansion of existing plant
The existing plant is initially retained, and is modernized by expanding with further sections/units with SIMATIC PCS 7.

- Simple, step-by-step increase in production capacity
- Clear risk
- Introduction of new technologies (e.g. PROFIBUS fieldbus, HMI)
- Opening of system for IT world
- Together with scenario 1, enables process control using a uniform operator system

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<thead>
<tr>
<th>No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>SIMATIC PCS 7 operator stations with connection to the old system as replacement for the latter’s HMI components</td>
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<tr>
<td>2</td>
<td>Engineering libraries for SIMATIC PCS 7 controllers and operator stations for importing the valuable configuration information from the old system</td>
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<td>3</td>
<td>Network gateways for trouble-free exchange of information between controllers of the old system and the SIMATIC PCS 7 controllers</td>
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<td>4</td>
<td>Interfaces for SIMATIC PCS 7 controllers for integrating the existing I/O level of the old system</td>
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<td>5</td>
<td>Field connection components for SIMATIC PCS 7 to enable utilization of existing field wiring</td>
</tr>
<tr>
<td>6</td>
<td>Tool-based conversion service for converting tried-and-tested plant graphics for further use in SIMATIC PCS 7 operator stations</td>
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Scenario 3: Comprehensive modernization

Bottlenecks in the provision of spare parts, insufficient support, and the necessity for functional expansions (e.g. fieldbus technology or IT integration) can also force comprehensive modernization of the old system using the future-oriented SIMATIC PCS 7 process control system. Conversion may also be possible during operation. Further use of the existing I/O level is supported, and the investments made for wiring, hardware components or application engineering are safeguarded.

- Increase in performance
- Introduction of new technologies (e.g. PROFIBUS fieldbus, HMI)
- Opening of system for IT world
- Lengthening of service life of complete plant
- Reduction in number of system suppliers
- Elimination of bottlenecks and dependencies

Migration spectrum

The migration of own process control systems with the modern SIMATIC PCS 7 is a matter of course for Siemens, and a significant component of the continued supplier/customer relationship. Using its universal migration technology "Data Base Automation", Siemens is additionally able to offer migration solutions for control systems from other vendors, e.g. for systems from ABB, Honeywell or Emerson.

Siemens works closely with the customer’s system integrators when implementing migration projects, for they have the know-how gained over many years and exactly know the plant as well as the customer’s requirements. This partnership is a guarantee for the companies operating plants that they will receive an optimum migration solution.

A further important aspect is that Siemens supports the migration products as well as the standard products by means of product updating and customer support. A special strength of Siemens compared to other migration providers is the ability to offer customers long-term support concerning know-how, servicing, and delivery of components, spare parts and upgrades.

With the future-oriented SIMATIC PCS 7 process control system, innovative migration solutions and services, many years of know-how in process automation and migration, as well as continuous worldwide servicing, Siemens demonstrates its expertise and offers the security of a reliable partner.
Whoever decides in favor of the SIMATIC PCS 7 process control system can rely on first-class services with which we support you rapidly and reliably worldwide. Whatever service topic is concerned: we can provide the right and competent partner rapidly and non-bureaucratically – worldwide.

The right training – exactly tailored to your requirements!

Correct training helps towards using the process control system particularly efficiently – in the shortest possible time. Irrespective of whether you are converting within the PLC world, whether you wish to start with process automation, or whether you already have sound knowledge in this field: we offer you professional training oriented according to the target group.

Training centers in more than 60 countries worldwide will help you to gain profound knowledge of the SIMATIC PCS 7 system or to expand your existing know-how. Regardless of whether you attend a standard course or a special user-specific course: SIMATIC courses rapidly provide you with qualifications and comprehensive know-how direct from the manufacturer – in a modular structure, and all with practice-oriented contents. Hands-on training with system specialists can also be carried out directly on site on your plant.

More information on the Internet: www.siemens.com/sitrain

Service & Support – our services in every phase of a project

Online support
Comprehensive information system available at all times via Internet: www.siemens.com/automation/service&support

Technical support
Competent advice on technical issues with a broad spectrum of carefully tailored services based on our products and systems.

Technical consulting
Support in planning and designing your project: from detailed analysis of the current situation and definition of objectives through advice on products and systems through to designing the automation solution.

Field service
All services concerning commissioning and maintenance to guarantee availability of automation plants and systems.

Optimization and modernization
High-quality services for optimization and modernization in order to increase productivity or save costs.

Project engineering and software engineering
Support during development and project engineering with services tailored to your requirements from the configuration stage through to implementation of an automation project.

Repairs and spare parts
Comprehensive repair and spare parts services offer a maximum of operational safety.
Further information

Comprehensive information concerning the SIMATIC PCS 7 process control system is available on the Internet at: www.siemens.com/simatic-pcs7

In addition to information on the SIMATIC PCS 7 product range and the add-on products from Siemens and external partners, you will also find:

- Access to the catalog and online ordering system (mall)
- Current catalogs for SIMATIC PCS 7 and add-on products
- System descriptions and product briefs, presentation slides and references
- Technical documentation such as manuals or PCS 7 Update
- FAQ sites with tips and tricks
- Access to tools & downloads and to the range of services
- Current training information
- Newsletter for the complete range of process automation
- Range of services for process automation
- Info Center for process industry
- Access to the process automation portal with links to the migration center, process instrumentation and analytics, weighing technology or to the individual sector portals (chemical, oil and gas, pharmaceutical, drinks, semiconductor, pulp & paper, automotive, cement industries, etc.)

Further information on SIMATIC

You can find more detailed information in the SIMATIC Guide documentation:
www.siemens.com/simatic-docu

You can order further documents on the topic of SIMATIC at:
www.siemens.com/simatic/printmaterial

For a personal discussion, you can locate your nearest contact at:
www.siemens.com/automation/partner

In the A&D Mall you can place orders electronically via the Internet:
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