

Module5: Smart Buildings

Smart Control and Automation

Building automation

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Erasmus+

Co-funded by the
Erasmus+ Programme
of the European Union



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Building automation

Definitions

Building automation is not only an APP on the Smartphone!



Building automation

Definitions

- Automation of procedures and processes in buildings
- Increasingly the leading discipline for sustainable operation of buildings over their entire life cycle
- Building automation is an application-oriented branch of automation technology
 - (technical) Systems, which are also used in industry
 - Sensors, actuators and control and regulation technology
 - Visualization systems
 - (Building-) field buses and computer networks
 - Software systems

Building automation

Smart-Home vs. building automation

Smart Home:

- Often limited to heating and lighting control as well as voice operation
- Many systems (also for retrofitting, based on radio technology)
- Often based on cloud solutions
- Often poor interoperability of systems from different manufacturers
- Large maker scene and community on the internet
- Strongly growing market
- Many well-known manufacturers and startups



Building automation

Smart-Home vs. building automation

Building automation:

- Standardized systems and interfaces □ good interoperability for different systems
- Connecting building systems for a more economical operation
- Usually not based on cloud solutions
- Easily expandable (e.g. use of existing cable based or radio based systems)
- Strongly growing market
- Many well-known manufacturers and startups



Building automation and control (BAC)

Definition according to EN ISO 16484

"description for products, software, and engineering services for automatic controls, monitoring and optimization, human intervention, and management to achieve energy — efficient, economical, and safe operation of building services equipment

Note 1 to entry: The trade designation and the industry branch are also referred to as building automation and/or building control."

[EN ISO 16484-2; October 2004]

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

CSN EN ISO 16484-1

English Version

Building automation and control systems (BACS) - Part 1: Project
specification and implementation (ISO 16484-1:2010)



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[<https://www.en-standard.eu/csn-en-iso-16484-1-building-automation-and-control-systems-bacs-part-1-project-specification-and-implementation-iso-16484-1-2010/>]

Building automation and control (BAC)

Definition according to VDI guideline series 3814

DIN EN ISO 16484 cannot cover all regional issues.

In Germany this is taken over by the VDI guideline series 3814.

This guideline applies to:

- Automation of buildings and real estate portfolios
- Trades (is partially) whose functionality is achieved by building automation
- Facility management, if BAC functions are used for operation
- Temporally over the entire phases in the life cycle of a building, especially for conception, planning, construction, operation and use
- Application by all natural and legal entities that concert by BAC

ICS 35.240.67, 97.120		VDI-RICHTLINIEN	Januar 2019 January 2019
VEREIN DEUTSCHER INGENIEURE	Gebäudeautomation (GA) Grundlagen Building automation and control systems (BACS) Fundamentals	VDI 3814 Blatt 1 / Part 1	Ausg. deutsch/englisch Issue German/English
Die deutsche Version dieser Richtlinie ist verbindlich.		The German version of this standard shall be taken as authoritative. No guarantee can be given with respect to the English translation.	
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VDI-Gesellschaft Bauen und Gebäudetechnik (GBG) Fachbereich Technische Gebäudeausrüstung		VDI-Handbuch Elektrotechnik und Gebäudeautomation	

Building automation and control (BAC)

Objectives and disciplines

BAC can help stakeholders to pursue and consolidate various objectives.

Possible objectives of using BAC include e.g.:

- operational safety/reliability of supply
- comfort level
- energy savings/energy efficiency
- monitoring
- accessibility

Building automation and control (BAC)

Trades in building automation

Usually integrated in BAC

- Heating
- Ventilation
- Air conditioning
- Power supply
- Lighting
- Shading
- Fire alarm system

Partially/increasingly integrated into BAC

- Intrusion detection system
- Video monitoring system
- Access control
- Multimedia
- Elevators
- Maintenance Management
- Billing systems
- Sanitary

Building automation and control (BAC)

BAC-Functions

Clearest possible description of building automation functions

Indicated by:

- Structure
- Input/output variables
- internal parameters
- State variables
- Interfaces

Classified according to the following groups:

- Input/output functions
- Application functions
- Operating functions
- Monitoring functions
- BAC management functions
- Service and diagnostic functions

Building automation and control systems (BACS)

- Technical implementation of the BAC is carried out by BACS
- Definition of building automation and control systems "comprising all products and engineering services for automatic controls (including interlocks), monitoring, optimization, for operation, human intervention, and management to achieve energy-efficient, economical, and safe operation of building services" [... *EN ISO 16484-2; October 2004*]
- BAC functions are generated by software
 - which are adapted to a process
 - which are tailored for a process
- Interfaces are provided to
 - humans (for operating and monitoring)
 - other system for data exchange

Building automation and control systems (BACS)

[VDI-GUIDELINE 3814 Part 1; January 2019; Figure 1]

Building automation and control systems (BACS)

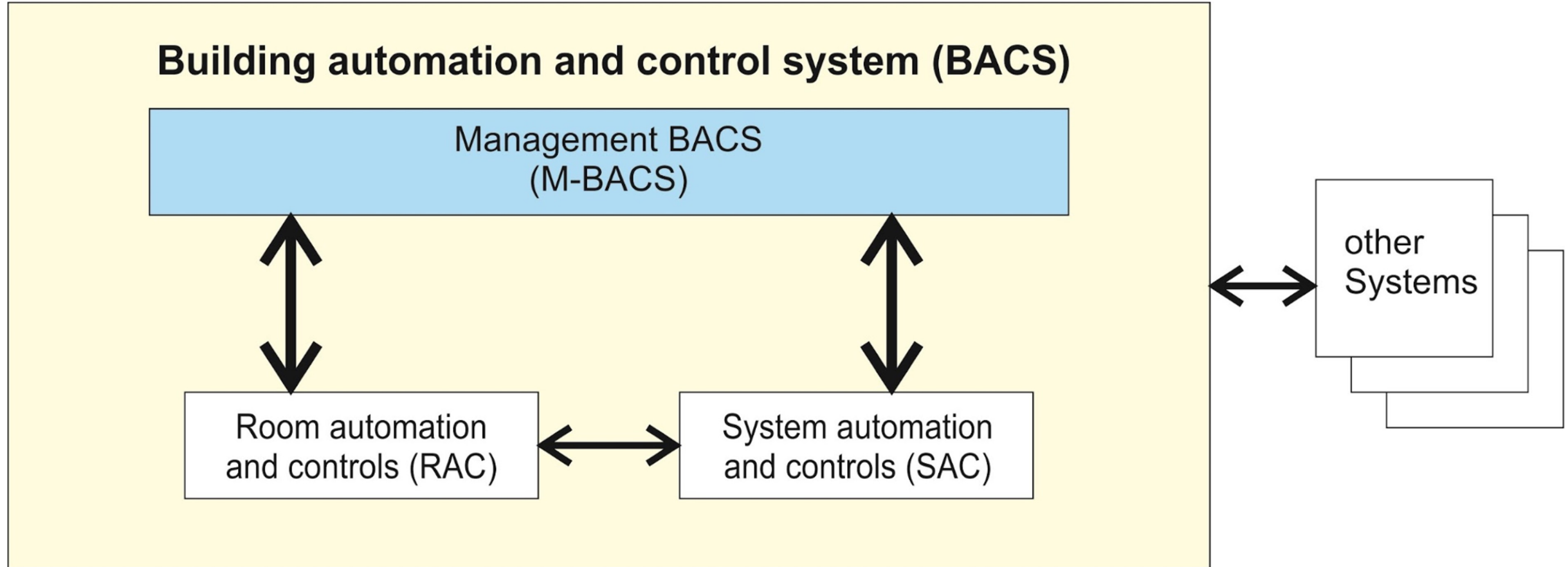
- "BACSs, which are able to control and monitor building service systems and devices via building management systems are some of the most important FM tools"
- "BACSs are particularly important for building management in the “operation and use” life cycle phase, in particular for the sustainable (automated) operation of buildings in the context of TBM."

[VDI guideline series 3814 Part 1; January 2019]

- Cost structure according to DIN 276
- Structural classification in:
 - System automation and controls (SAC)
 - Room automation and controls (RAC)
 - Management BACS (M-BACS)

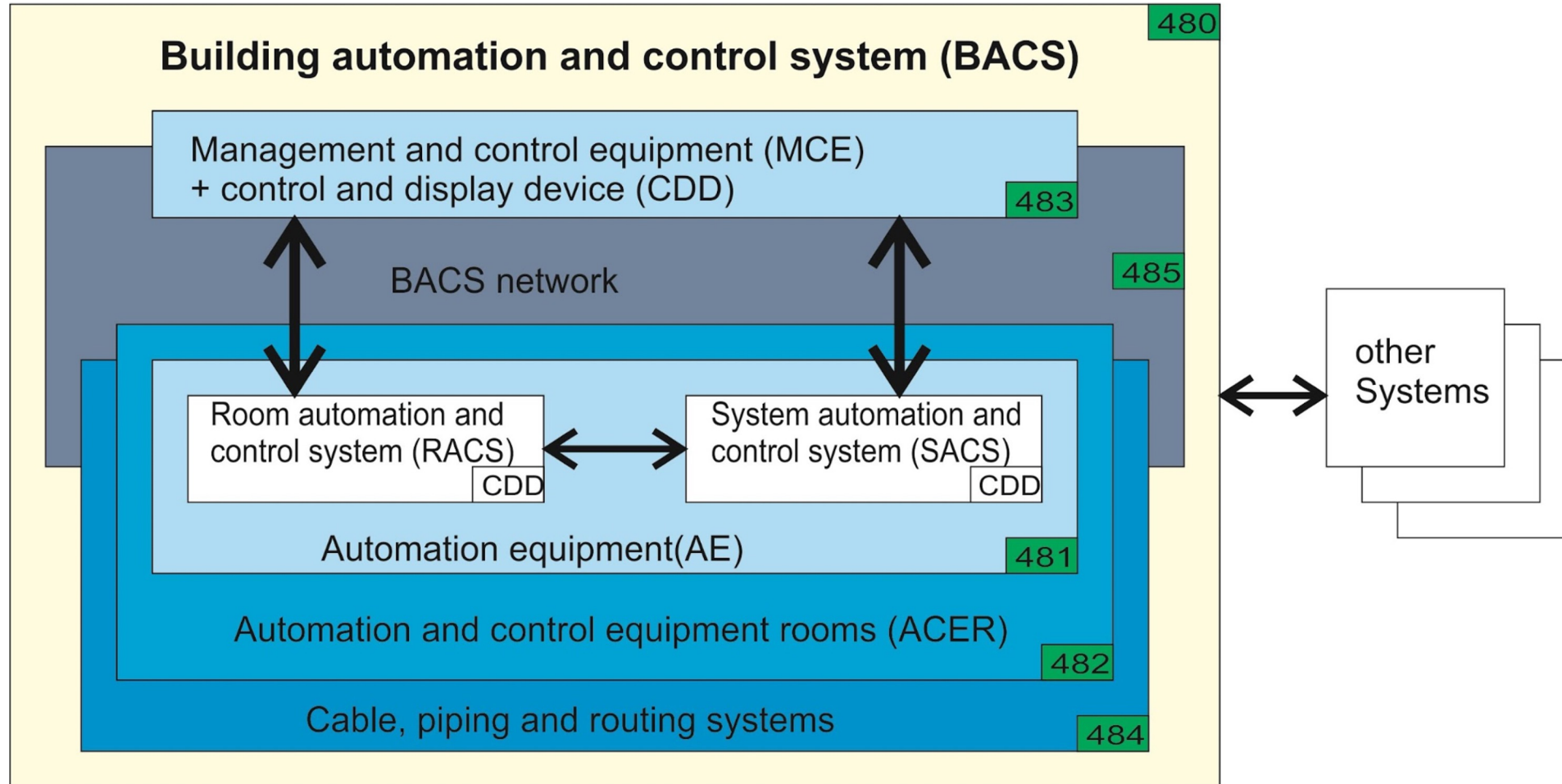
Building automation and control systems (BACS)

Functional structure of a BACS



Building automation and control systems (BACS)

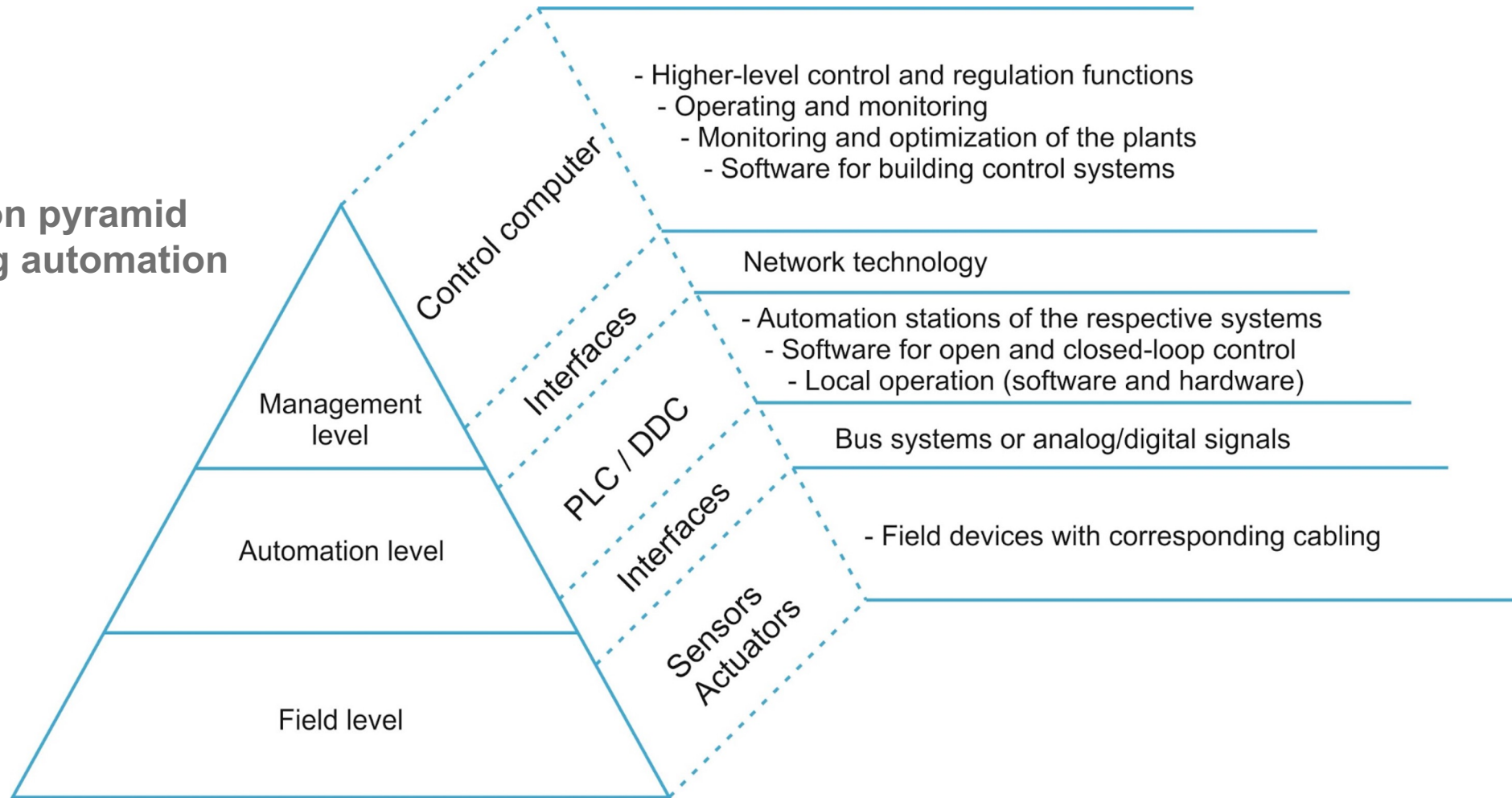
Functional and cost structure of a BACS according to DIN 276



Building automation and control systems (BACS)

Hierarchical structure

Automation pyramid of building automation

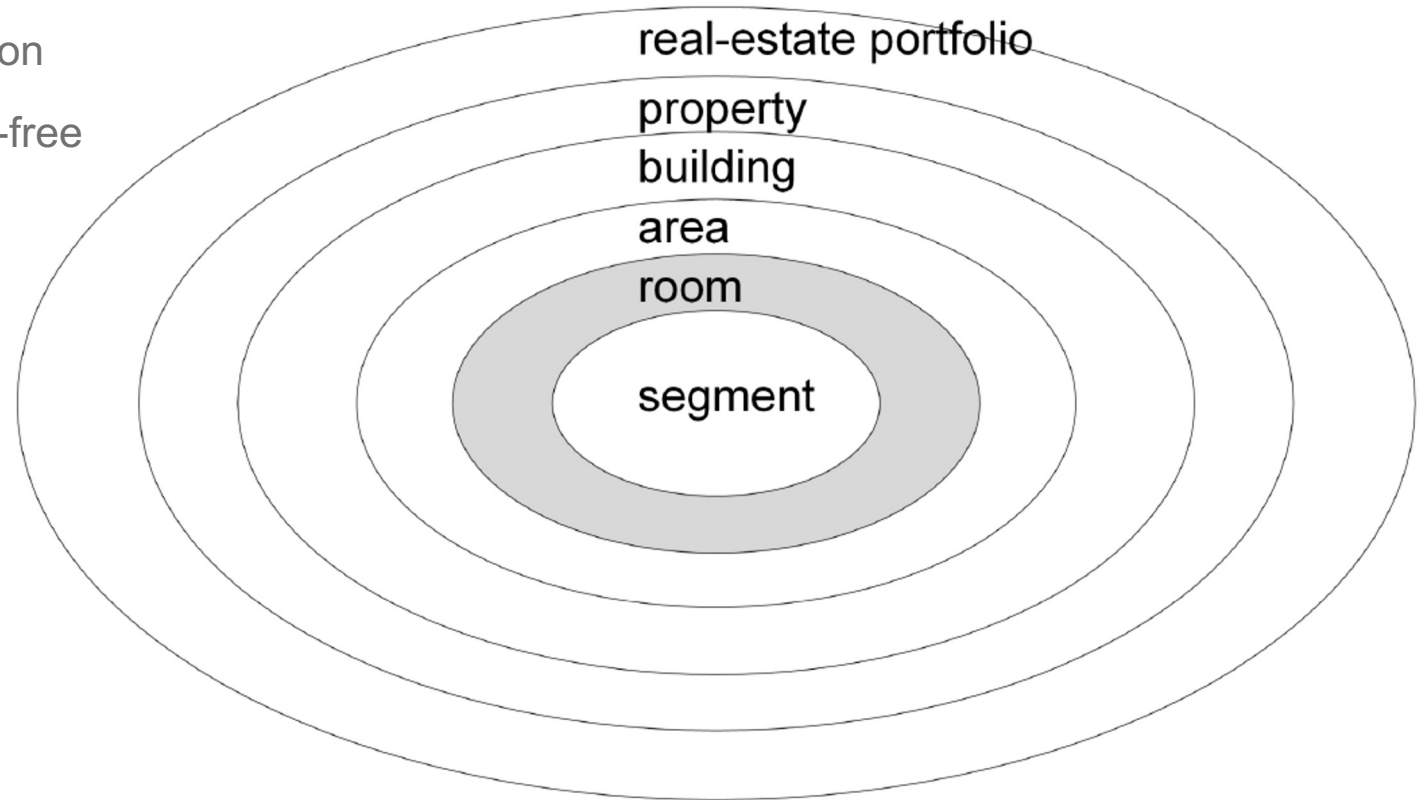


Building automation

Spatial structure

Segmentation of the building into segments with similar building services

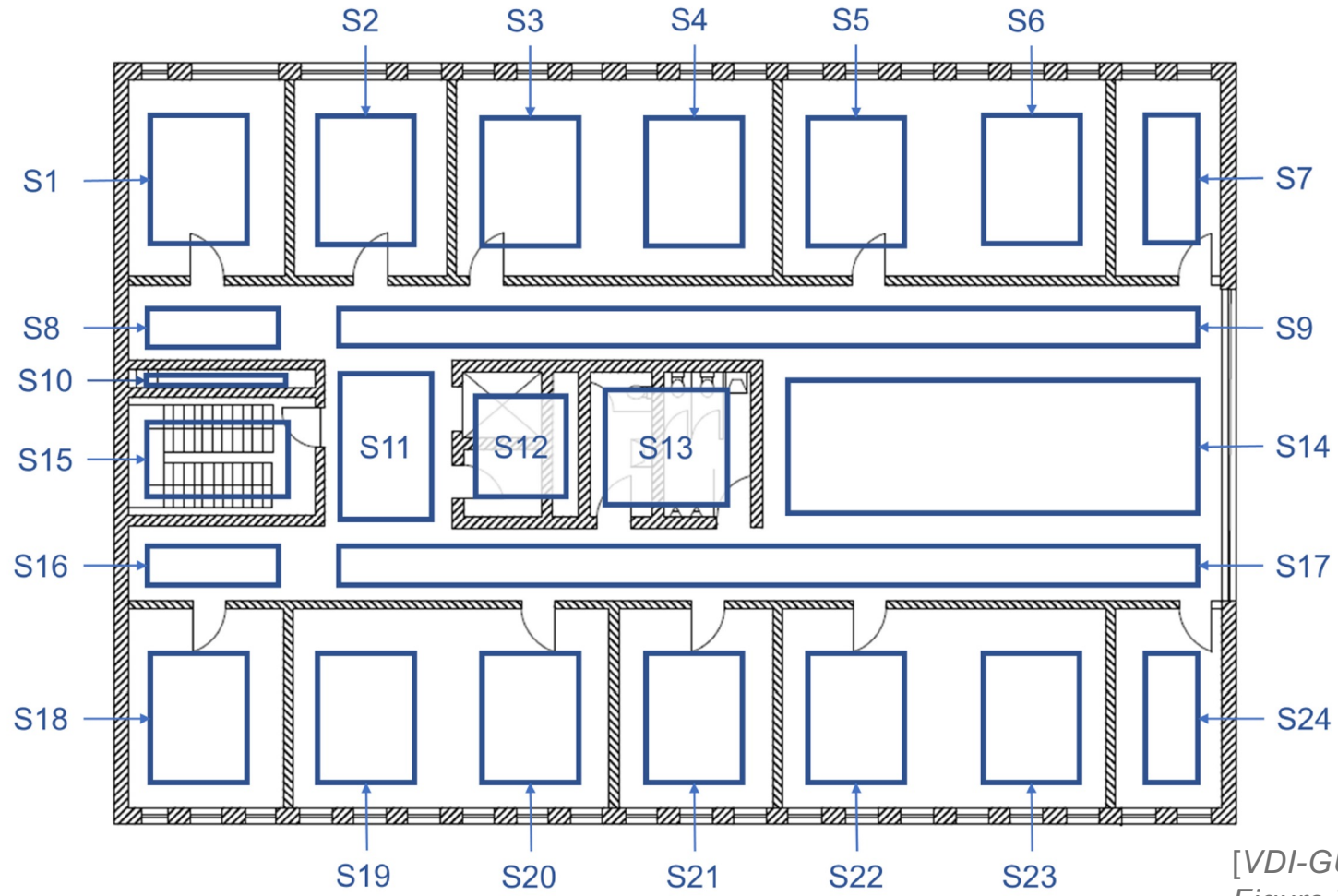
- ☐ high flexibility for relocation/conversion
- ☐ inexpensive, fast and largely trouble-free



[VDI-GUIDELINE 3814 Part 1; January 2019; Figure 5]

Building automation and control systems (BACS)

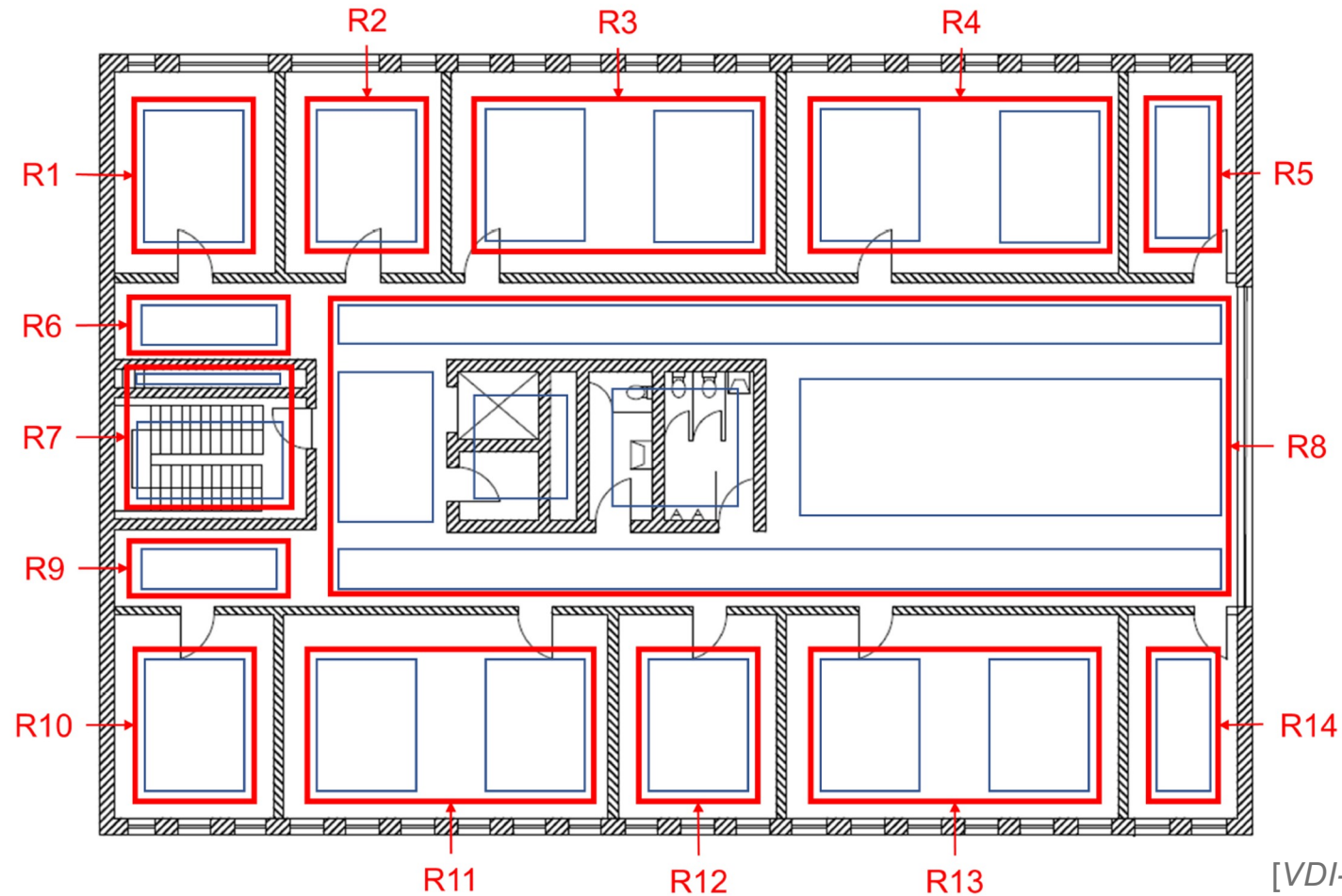
Example for the allocation of segments (S) in the specimen building



[VDI-GUIDELINE 3814 Part 1; January 2019;
Figure 7]

Building automation and control systems (BACS)

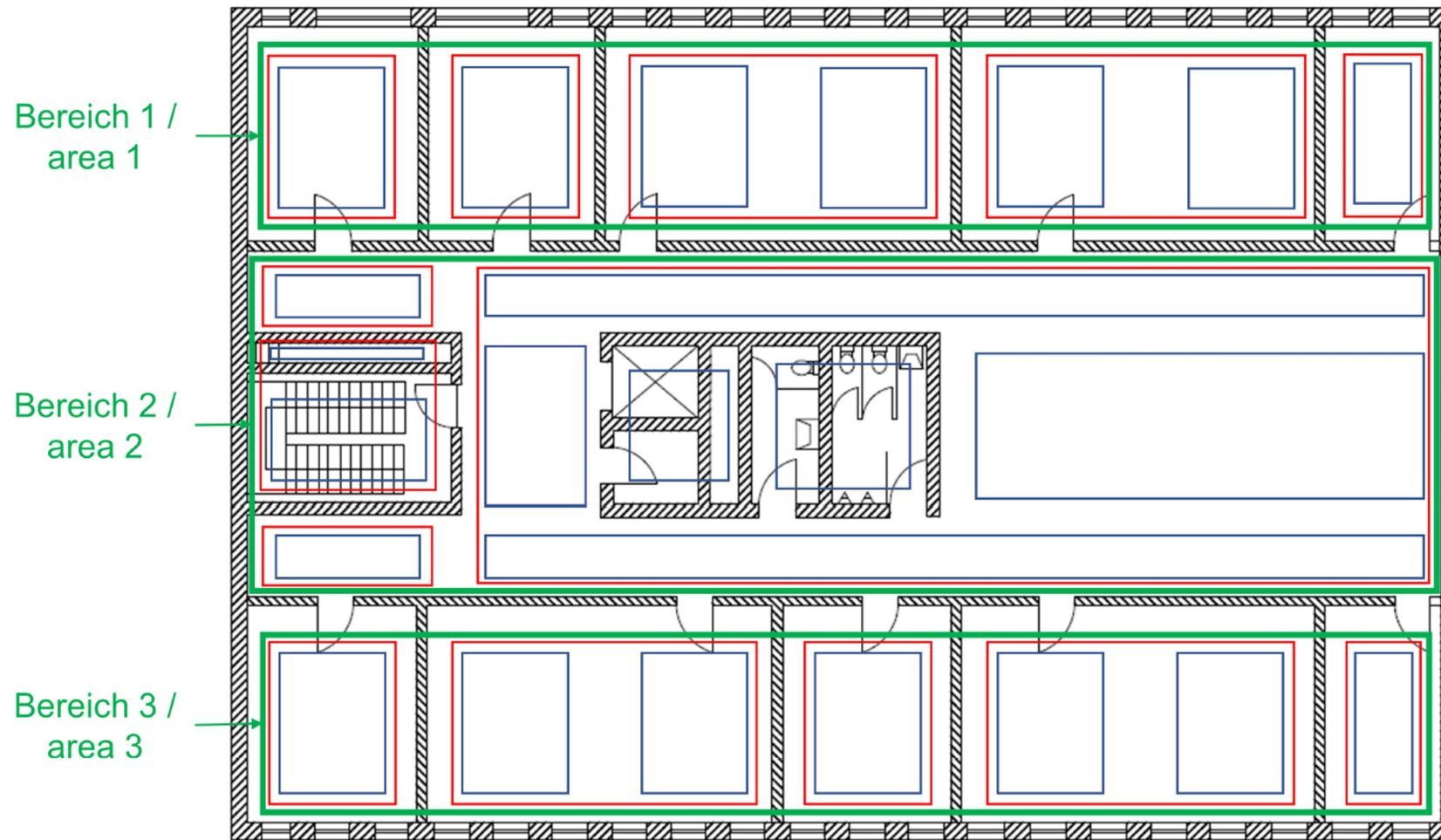
Example for the allocation of rooms (R) and segments in the specimen building



[VDI-GUIDELINE 3814 Part 1; January 2019;
Figure 8]

Building automation and control systems (BACS)

Example for the allocation of rooms (R), segments, and areas (A) in the specimen building



[VDI-GUIDELINE 3814 Part 1;
January 2019; Figure 9]

Building automation

Energy efficiency with BAC

Goals:

- High quality of building use (e.g. productivity, comfort, flexibility, safety, ...) at the same time
- Efficient use of energy and resources in building operation over the life cycle
- Available standards for BA and Technical Building Management (TBM) requirements in the context of the energy performance of buildings:

DIN EN 15232 and DIN V 18599-11

Building automation

Energy efficiency with BAC

EN 15232 Part 1:

Influence of building automation and building management Method for calculating the contribution of building automation to the energy efficiency of buildings

Efficiency classes according to EN 15232:

- Class A: highly energy-efficient BAC system and TBM functions
- Class B: extended BAC systems and some special TBM functions
- Class C: Standard BAC system
- Class D: BAC system that is not energy efficient. Buildings with such systems must be retrofitted. New buildings must not be constructed with such systems

BACS Energy Performance Classes – EN 15232

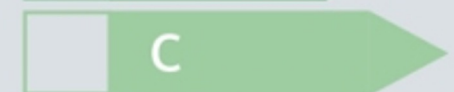
High energy performance
BACS and TBM



Advanced BACS and TBM
BACS and TBM



Standard
BACS



Non-energy-efficient
BACS



BACS Building Automation and Control System
TBM Technical Building Management System

Building automation

Energy efficiency with BAC

DIN V 18599-11 Energy efficiency of buildings

Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting

Part 11: Building automation

- DIN V 18599 provides the basis for the calculation of energy requirements
- Supplemented by EN 15232 in part 11
- No consideration of existing buildings, only new construction

Gemessener Energieverbrauch des Gebäudes

Energieverbrauchskennwert



Verbrauchserfassung: Heizung und Warmwasser

Energiegerät	Anschaffungszeitpunkt		Energieeffizienzklasse (effiz.)	Netto-Warmwasser (effiz.)	Klima-Anlage	Energieverbrauchskennwert in kWh/m²·a (berechnet, nicht gemessen)		
	von	bis				Heizung	Warmwasser	Gesamt
Formidat	01.01.2010	31.12.2010	200000	0	1.000	100.0	0	100.0
Formidat	01.01.2010	31.12.2010	200000	0	1.000	100.0	0	100.0
Formidat	01.01.2010	31.12.2010	200000	0	1.000	100.0	0	100.0

Gesamt: 95,4

Vergleichswerte Endenergiebedarf

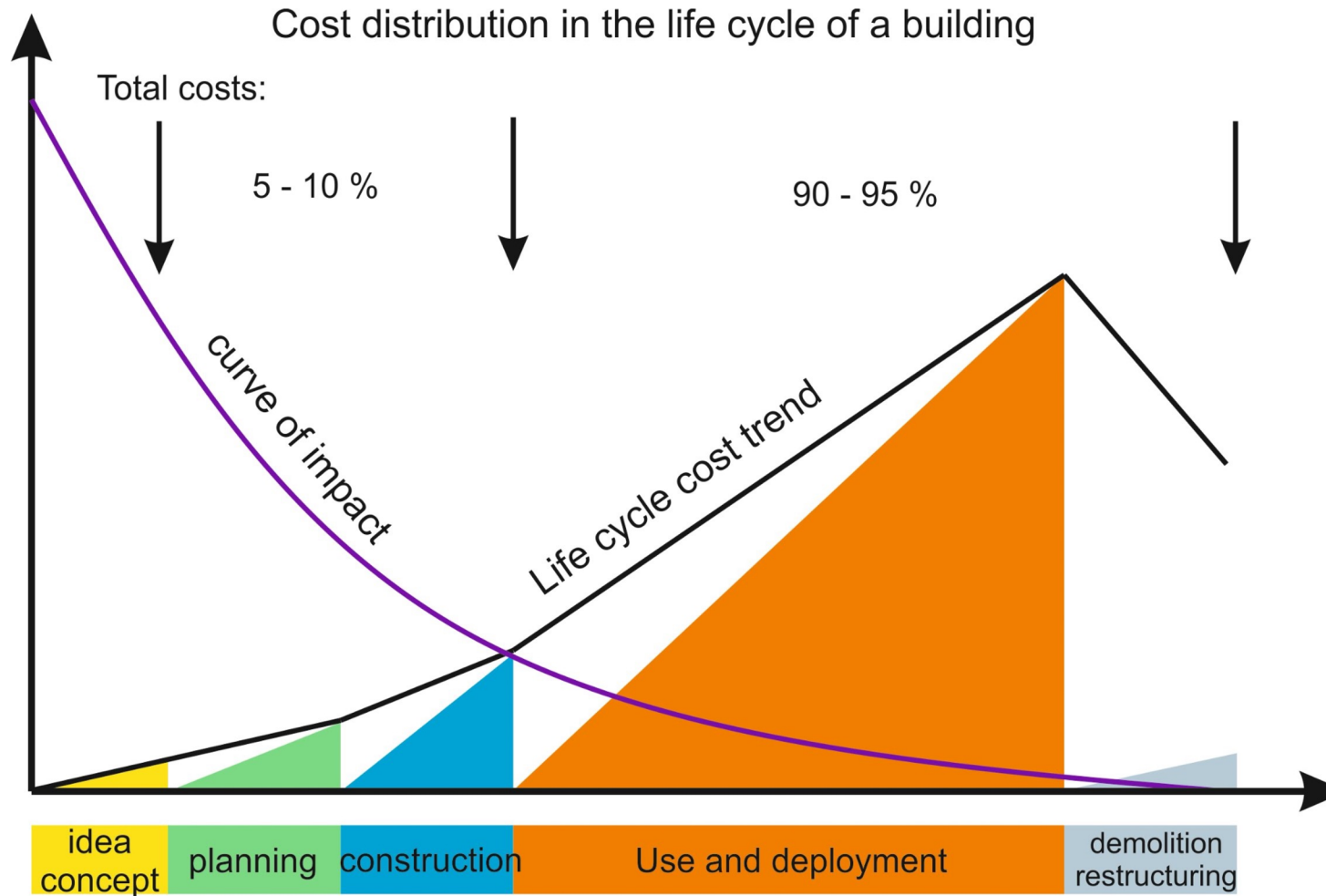


Erläuterungen zum Verfahren

Das Verfahren zur Ermittlung des Energieverbrauchskennwerts ist durch die Energieeffizienzrichtlinie vorgegeben. Die Werte sind nach der Methode der Endenergieverbrauchskennwerte (EN 15232) nach Energieeffizienzrichtlinie. Der Endenergieverbrauchskennwert ist die Summe der Endenergieverbräuche für Heizung, Warmwasser, Klima und Beleuchtung, dividiert durch die Fläche des Gebäudes.

Building automation

Life cycle cost - optimization potential



Building automation

Life cycle costs - optimization potential

- Investment in automation technology (BAC)
 - Energy cost make up for the largest part of the total cost with up to 80 %.
 - Influence of BAC quantified at up to 20 % (14.2 % on the median)
- Operating costs depend largely on the quality of the technical equipment and the BAC
- Retrofitting is relatively costly
- Investment cost for BAC approx. 5-10% of total investment (planning and construction phase)
- Different point of views of the building stakeholders (investor/owner/user)
- Minimal operating cost as a marketing instrument for the investor
- Minimal operating cost as a benefit for the user
- BAC for recording energy efficiency, monitoring of parameters through monitoring

Building automation

Auditing and certification

- EN ISO 50001
- eu.bac
- DGNB
- LEED

Building automation

Auditing and certification

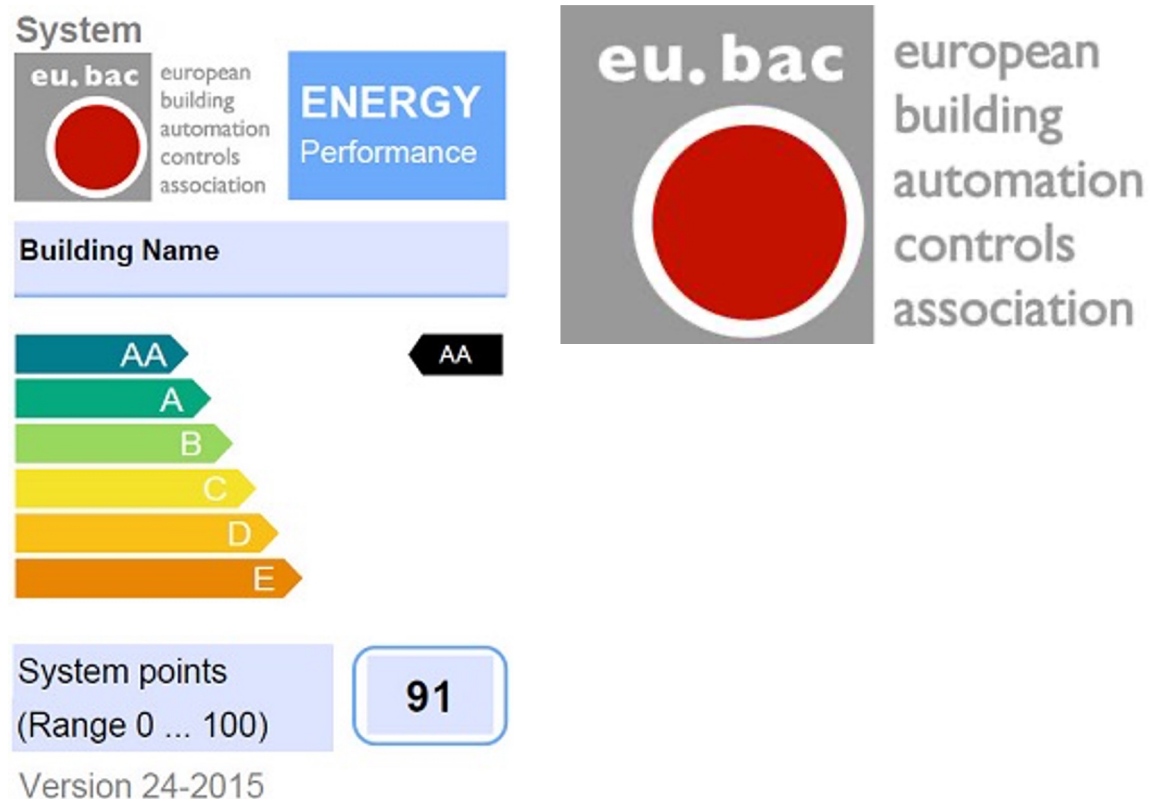
EN ISO 50001

- Energy Management
- Definition of the Energy Services Act (EDL-G)
- For companies with more than 250 employees
- whose annual turnover is more than € 50 million
- public institutions partly excluded
- Enterprises applying for peak tax relief or subsidies
- Energy management is a matter for the boss
- Energy Manager* is a FULL-TIME position/staff position!

Building automation

Auditing and certification

eu.bac - European Building Automation and Controls Association is the European Building Automation and Controls Association and represents the European manufacturers for Home and Building Automation and Energy Service Companies.



Since early 2013, eu.bac has been offering the eu.bac System Audit for energy-efficient and sustainable operation of building automation systems

Building automation

Auditing and certification

German Sustainable Building Council - **DGNB** e.V. is Europe's largest network for sustainable building and has around 1,200 member organizations.

The DGNB has established and expanded a certification system for sustainable buildings and has awarded a Sustainable Building Certification in the quality levels platinum, gold, silver and bronze.



Building automation

Auditing and certification

The American **LEED** model (Leadership in Energy and Environmental Design) is the most widely used rating system for environmentally friendly buildings worldwide. It was developed in 1998 by the U.S. Green Building Council.

In Germany, the German Green Building Association e.V. (GGBA) has been the official partner of the U.S. Green Building Council (USGBC) and thus the responsible contact for the entire DACH region at national level.



Building automation

Explanation of terms - Abbreviations

• BIM	Building Information Modeling	• TGM	Technical building management
• BA	Building automation	• OS	Operational systems
• HVAC	Heating, ventilating and air conditioning	• CCT	Central control technology
• BMS	Building management system	• PMCT	Process measuring and control technology
• MCE	Management and control equipment	• BST	Building Systems Technology
• BMS	Building Management System	• RAC	Room automation and controls
• BAS	Building Automation System (Controller)	• SAC	System automation and controls
• AE	Automation equipment	• DDC-BA	Direct Digital Control Building automation
• FAS	Fire alarm system	• PLC	Programmable logic controller
• TBE	Technical building equipment	• SCADA	Supervisory Control and Data Acquisition