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Civil Engineering and
Building Services

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Technical standards as generally accepted rules of engineering and indispensable part of the legal framework

VDI 3805 and ISO 16757:

Building Services product catalogue data in BIM

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Vereine Deutscher Ingenieure – VDI e.V.

- The voice of engineers and technology
- Germany's largest technical-scientific association
- A developer and multiplier of engineering knowledge
- A competent adviser for industry, government and technology
- A service provider for engineers
- Technical, professional, political and international engineering network

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Verein Deutscher Ingenieure – VDI e.V.

- ✓ More than 150,000 individual members
- ✓ 12,000 honorary experts
- ✓ 120 full-time employees
- ✓ 400 working groups
- ✓ 2.000 valid VDI Standards
- ✓ apr. 230 standards/year

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Technical standards as generally accepted rules of engineering and indispensable part of the legal framework

VDI Society for Civil Engineering and Building Services

- ✓16,000 affiliated VDI members
- ✓ 200 topical standards
- ✓ 100 active committees
- ✓ 5 full-time consultants + 2 secretaries

Communication platform for all parties involved in building and construction.

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VDI Standards

about 2000 valid VDI Standards

- describe the state of the art
- are acknowledged rules of technology
- topics range from securing loads on road vehicles to structural safety of buildings and up to biomimetics etc…
- create confidence in safety and quality

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How to produce an acknowledged rule of technology (ART)?

- Observe **strict procedural rules**.
- Strive for **consensus**.
- involvement of **all interested parties**
- independence and impartiality
- Make your work **public and transparent**
- keep rules **up to date**

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How to produce an acknowledged rule of technology (ART)?

- invite the public to participate
- bilingual (German/English) standards
- keeping the finger on the pulse of the branch
- accessible for all market participants
- everyone can suggest a topic for a VDI Standard

⇒ This creates trust!

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Legal obligations through ARTs?

- Application is voluntary
- enables informed decisions
- An ARTs is similar to an anticipated expert‘s opinion.
- “condensed expertise“
- can become part of laws and contracts

⇨ Deviations are permitted,
⇨ resulting in a reversal of the burden of proof.

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ARTs for BIM?

- One of the main objectives for the next years is to support and enable the use of BIM
- platform for all involved experts and initatives
- standards for data exchange and CAD since almost 20 years
- BIM committee was founded in 2013
- working groups will start to create standards 2013/ 2014

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Thank you for your kind attention!

see an example of a VDI Standard now:

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VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

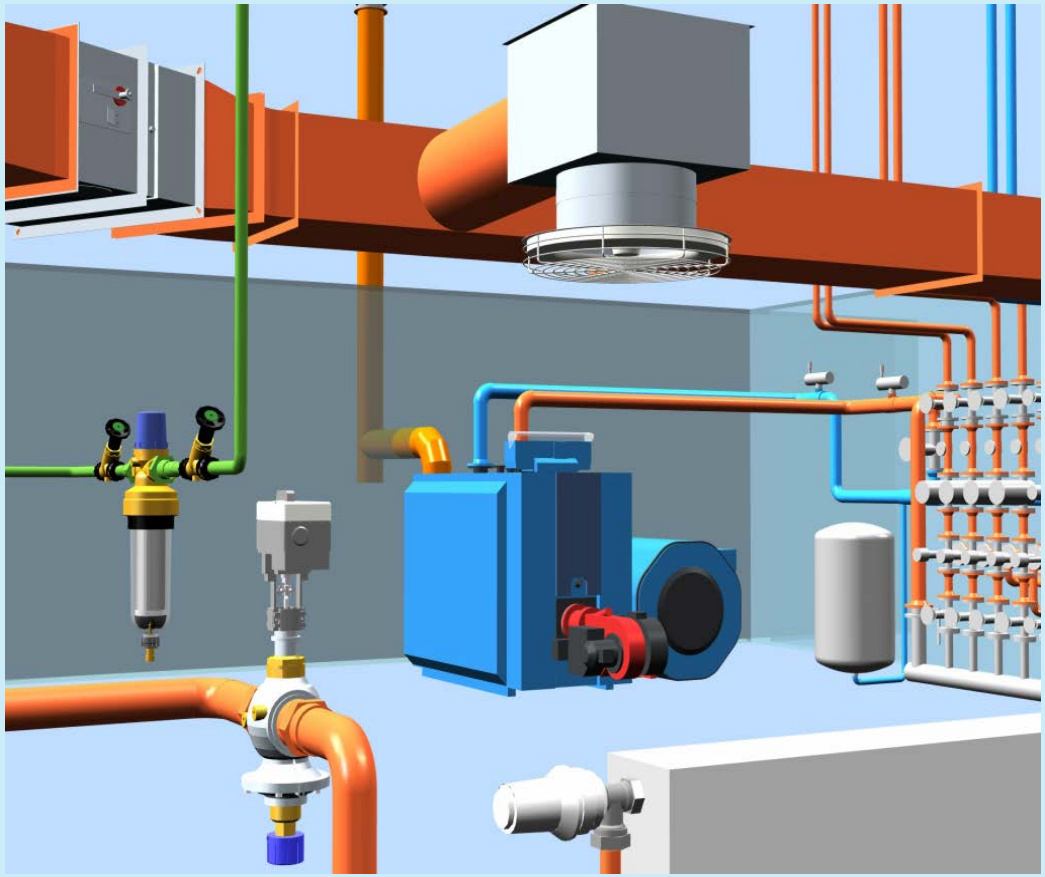
Content

What is VDI 3805 ?
- Standards
- Manufacturer and software systems

Why VDI 3805 ?
- The situation in BS design
- The need for accurate design
- Influences to a BS system

VDI 3805:
- Objectives
- Catalogue data and catalogue structure
- Examples

ISO 16757: new ISO standard
- Based on VDI 3805
- In building data cycle
- Embedded in buildingSMART
- Catalogue structure



System performance calculation in CAE tools – as of today

- Calculation of performance, energy consumption, etc.:
  - ***only in early design phases***
  - ***before components have been selected***
  - ***based on "no name products"***
- Origin of the calculation data?
  - ***assumptions of designers***
  - ***reference data from similar buildings***
  - ***...***
- Manufacturers calculation data?
  - ***Scattered in different formats depending from product group***
  - ***Scattered in different layout programs depending from manufacturer***
  - ***No realistic possibility to calculate big systems accurately***

Calculations are based on insufficient and inaccurate data!

What is VDI 3805 ?

- A series of standards for building services products defining a format for data exchange of product catalogue from the manufacturer to CAD/CAE-dimensioning- and calculation systems
- A high condensed parameterized data representation, achieving special requirements of product catalogue data:
  - ***Complete product description***
  - ***Including layout and geometry data***
  - ***Quick selection within millions of variants***
  - ***Small data files***
- An exportable single-product-data-format to embed in IFC
- A data description using standardized property dictionaries

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VDI 3805 and ISO 16757:

Building Services product catalogue data in BIM

VDI 3805:

Part	Content
1	Fundamentals
2	Heating valve assemblies/accessoriy
3	Heat generators/accessory
4	Pumps
5	Air openings
6	Radiators, heating and cooling convectors
7	Ventilators
8	Burners
9	Modular ventilation equipment
10	Air filter
11	Heat exchanger fluid/steam-air
12	Heat exchanger fluid/fluid
13	Heat exchanger air/air
14	HVAC-silencers, passive
15	Compact air conditioning appliances
16	Fire damper
17	Drinking water fittings
18	Surface heating/cooling

Standards

Part	Content
19	Solar collectors
20	Storage tanks and instantaneous water heater
21	Refrigeration machines
22	Heat pumps
23	Ventilation decvices for flats
24	Pressure maintaining stations
25	Ceilings floor
27	Induction devices
28	Radiant heating systems
29	Pipes and moulded parts
30	Measuring devices for heating cost billing
32	Distributor/collector liquid media
33	Control
35	Dampers, blinds, volume flow control unit
37	Decentralized facade ventilation systems
99	General components
100	Systems

VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

VDI 3805: Manufacturer and software systems (2010-10)

Arbonia
Ari-Armaturen
Belimo
Bemm
Biral
Brötje
Buderus
Cuprotherm
Danfoss
DiaNorm
Elco
Frese
Gampper
Hagan
Hawle
Heimeier
Herz
Honeywell

Hora
G+R Heiz-/Kühlsysteme
Gunzenhauser
Junkers
KAN-therm
Kemper
Kermi
KaMo
KSB
Meibes
Möhlenhoff
Oreg
Oventrop
ProLux
Purmo
Rehau
Roßweiner
Robur

Sauter-Cumulus
Siemens Building Technologies
Stiebel-Eltron
Taconova
Tecalor
Trox
Uponor
Vaillant
Victaulic
Viessmann
Watts
Weißhaupt
Westaflex
Wolf
Zehnder
Zewotherm

Autodesk
CADENAS
C.A.T.S.
ConSoft
Data Design
Dendrit
ETU-Software
G.O.L.D.
Hottgenroth Software
liNear
mh-software
pit-cup
Plancal
Rehau Akademie
RoCAD
Rubicon
SOLAR-COMPUTER
TACOS
Wilms

Associations: VDI, VdZ, BDH Bundesindustrieverband Deutschland Haus-, Energie- und Umwelttechnik e.V., VDMA

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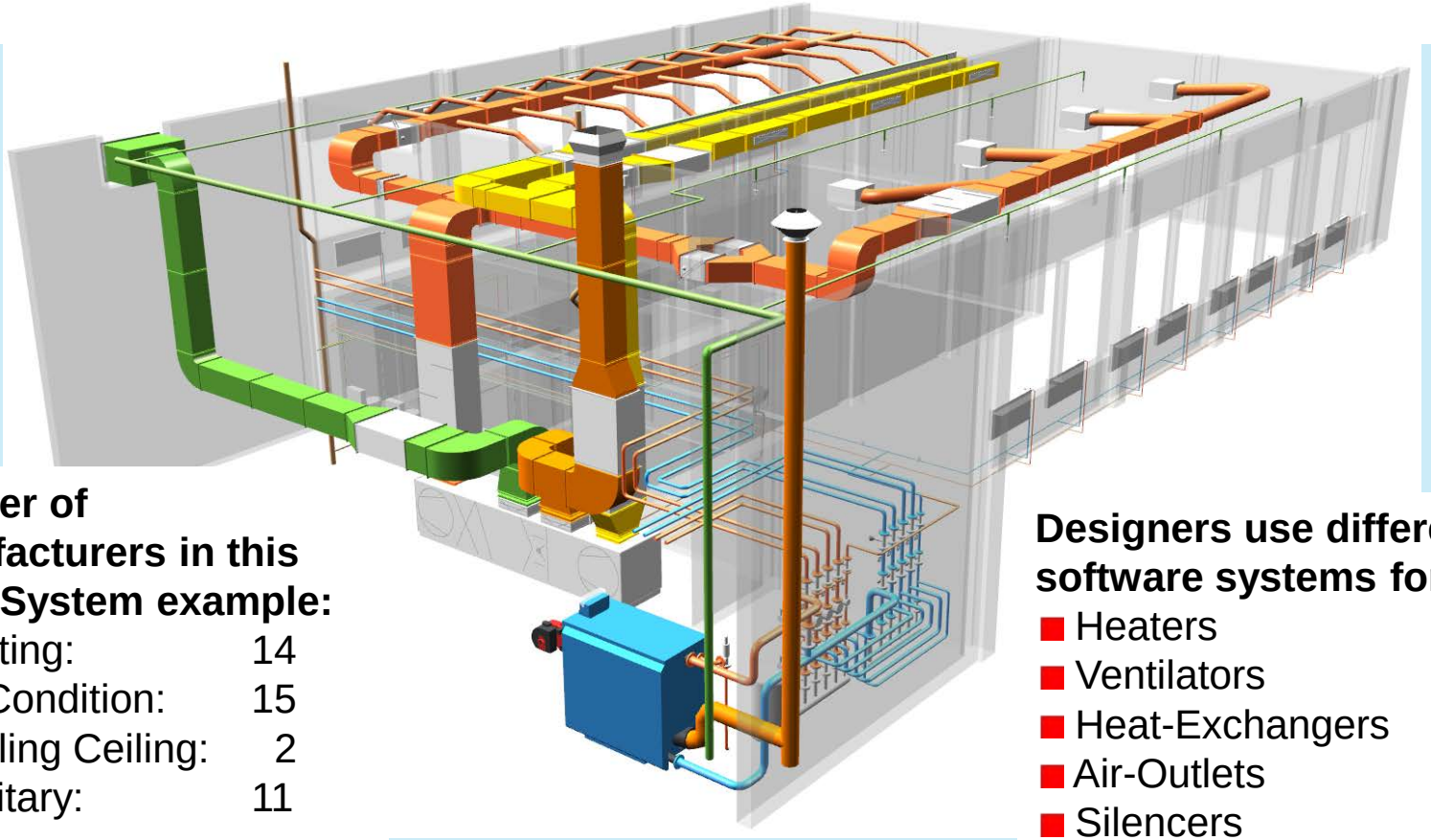
Building Services product catalogue data in BIM

Why VDI 3805:

The situation in BS design



Number of manufacturers in this small System example:

Heating:	14
Air Condition:	15
Cooling Ceiling:	2
Sanitary:	11
total	**42**

Designers use different software systems for e.g.:

- Heaters
- Ventilators
- Heat-Exchangers
- Air-Outlets
- Silencers
- Valves

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VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

Why VDI 3805 ?

The need of accurate design
Example fan

In 2011 fans (125 W – 500 kW) in Europe consumed:

344 terawatt-hours
= 344.000.000.000 Wh
~ 38.000.000.000 € (industrial price)

In 2020 they will consume:
560 terawatt hours

Potential saving by better design of fans: **10%** :
= 34 terawatt hours per year

Source: Regulation (EU) No. 327/2011 by the European commission of 30 March 2011, Official Journal of the European Union

But consumption depends on:

- degree of efficiency (η) **and** quality of system (!)

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Building Services product catalogue data in BIM

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The need of accurate design
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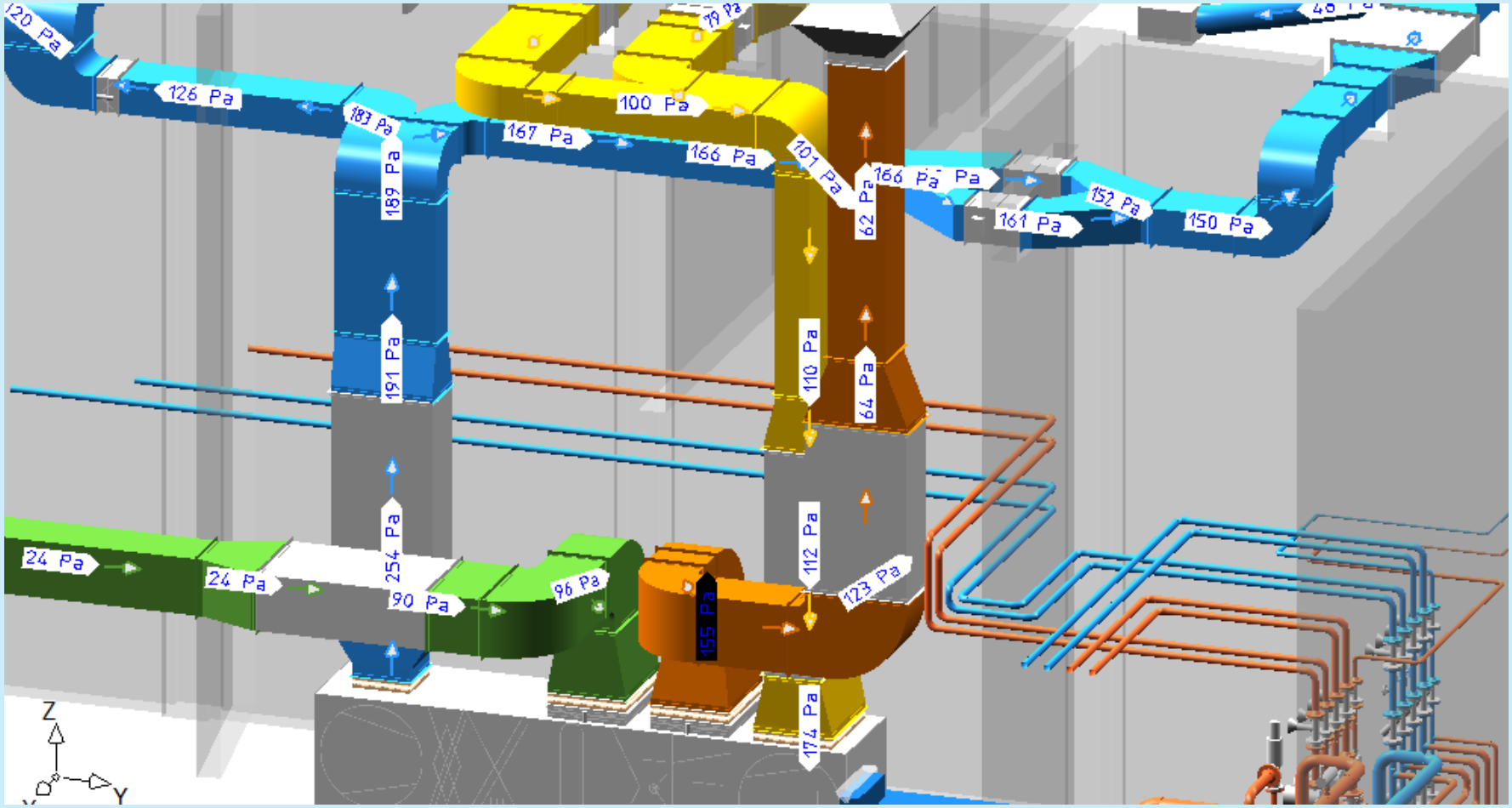
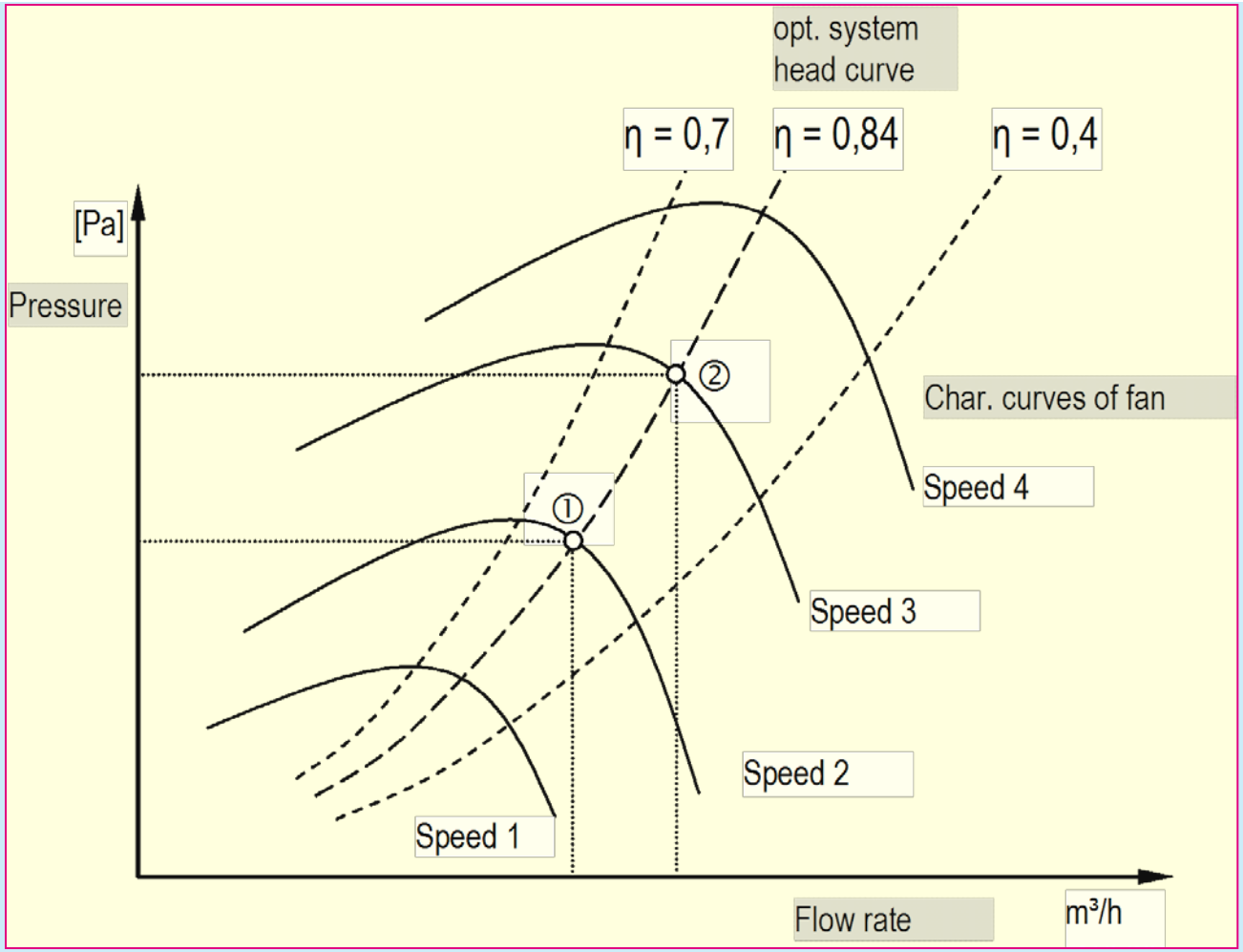


VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

Why VDI 3805 ?

The need of accurate design
Example fan



Fans are operated with degrees of efficiency between 40% and > 90% .

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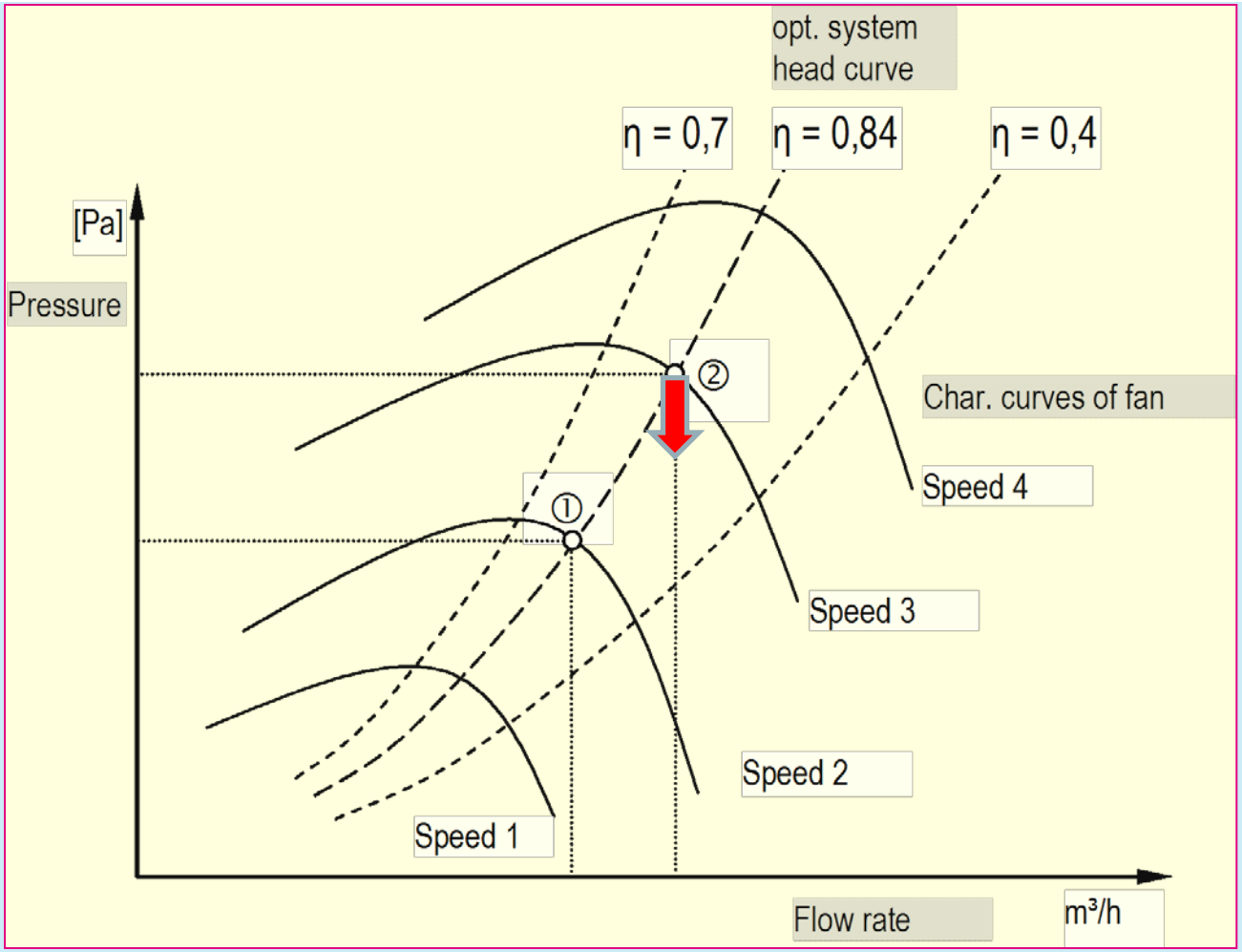
Example fan



Downward regulation of a fan dimensioned too big will reduce its degree of efficiency.

VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

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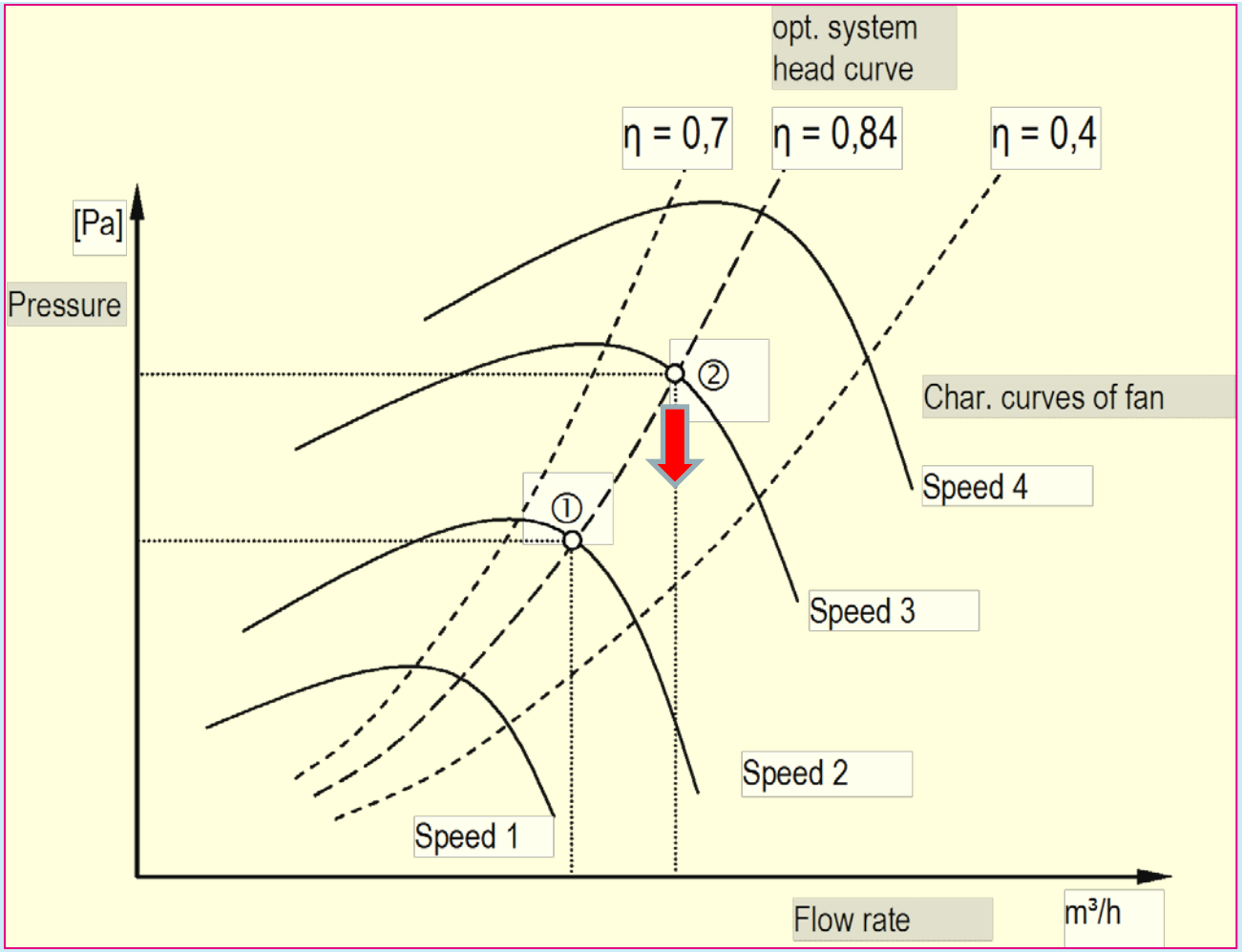

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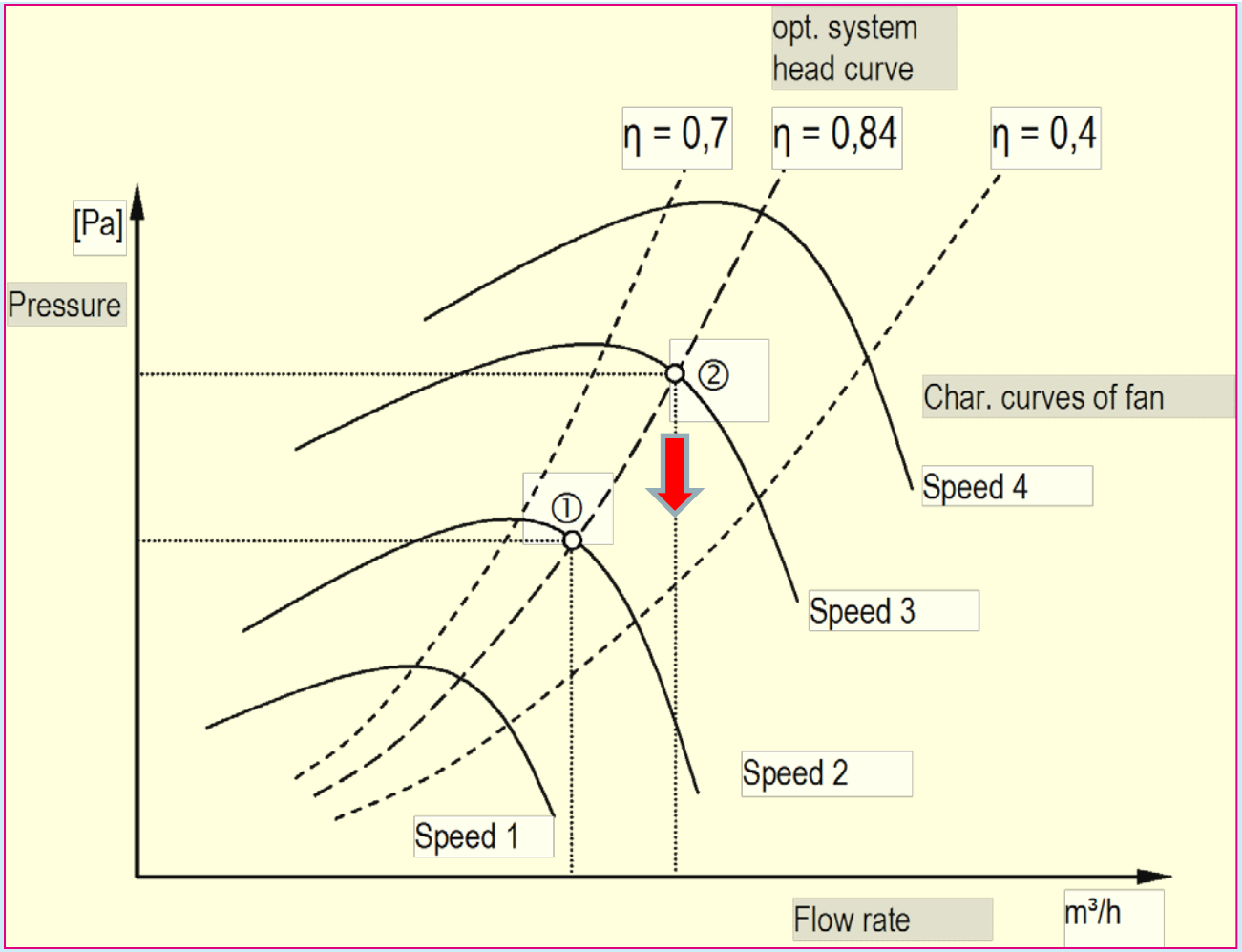

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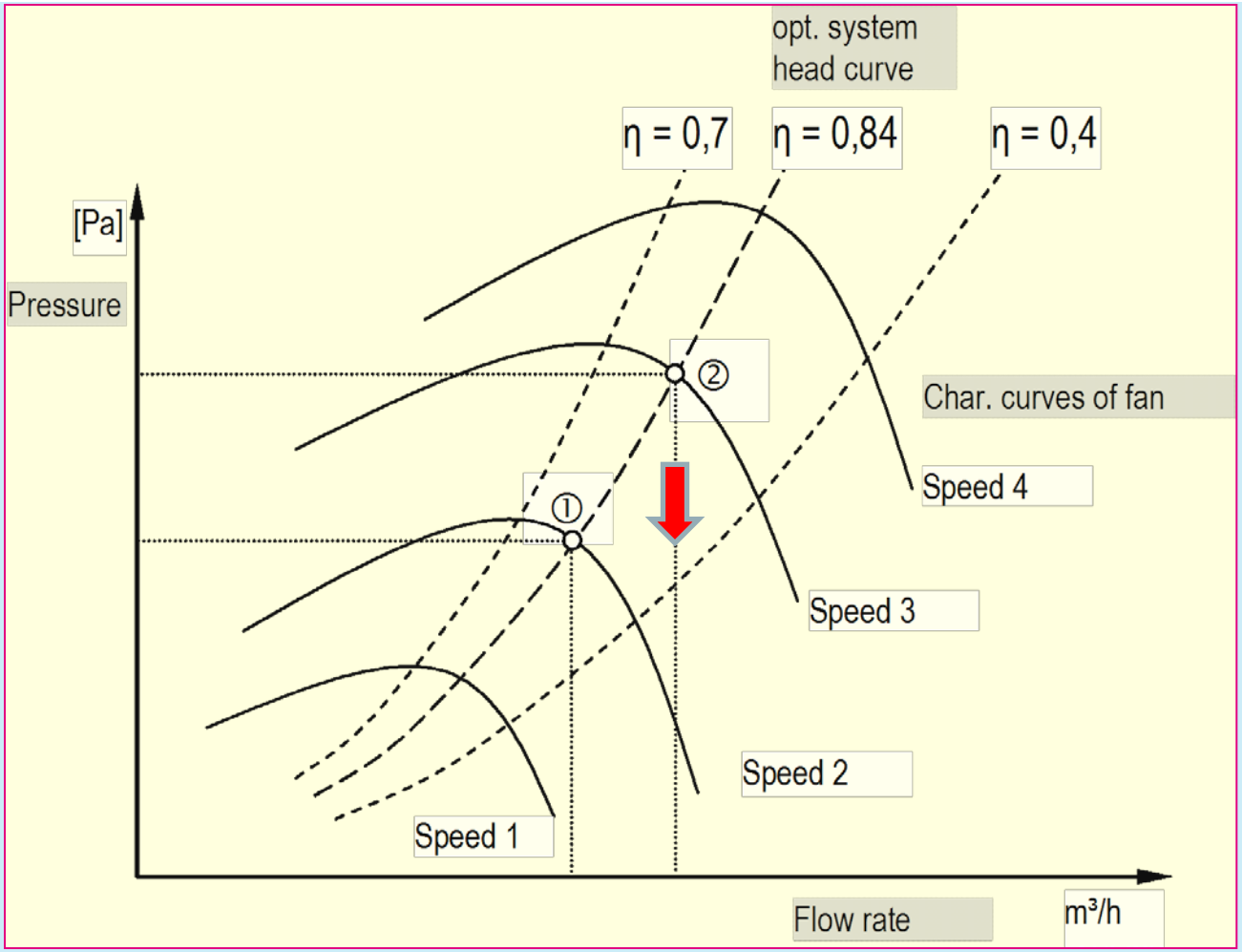

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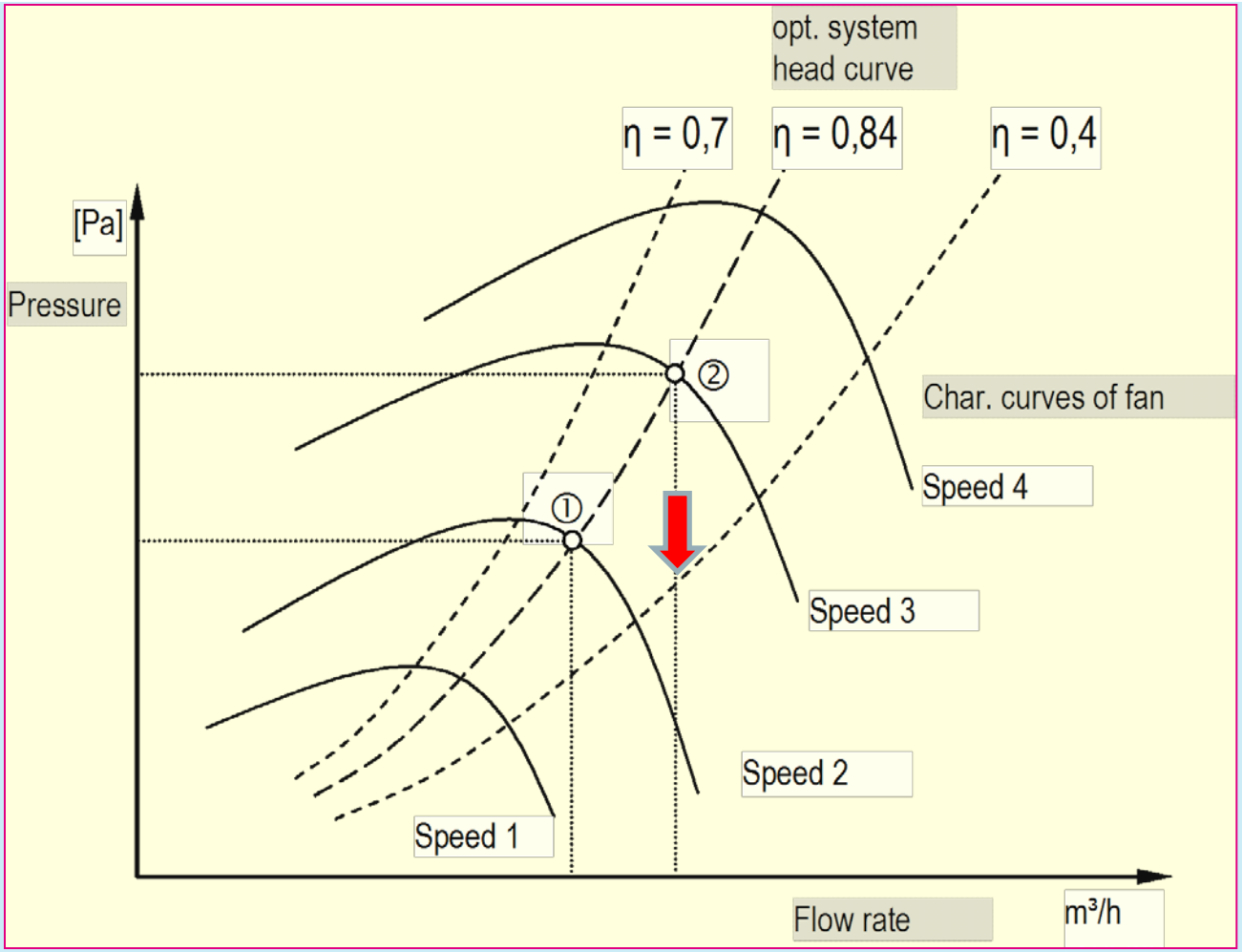

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VDI 3805 and ISO 16757:
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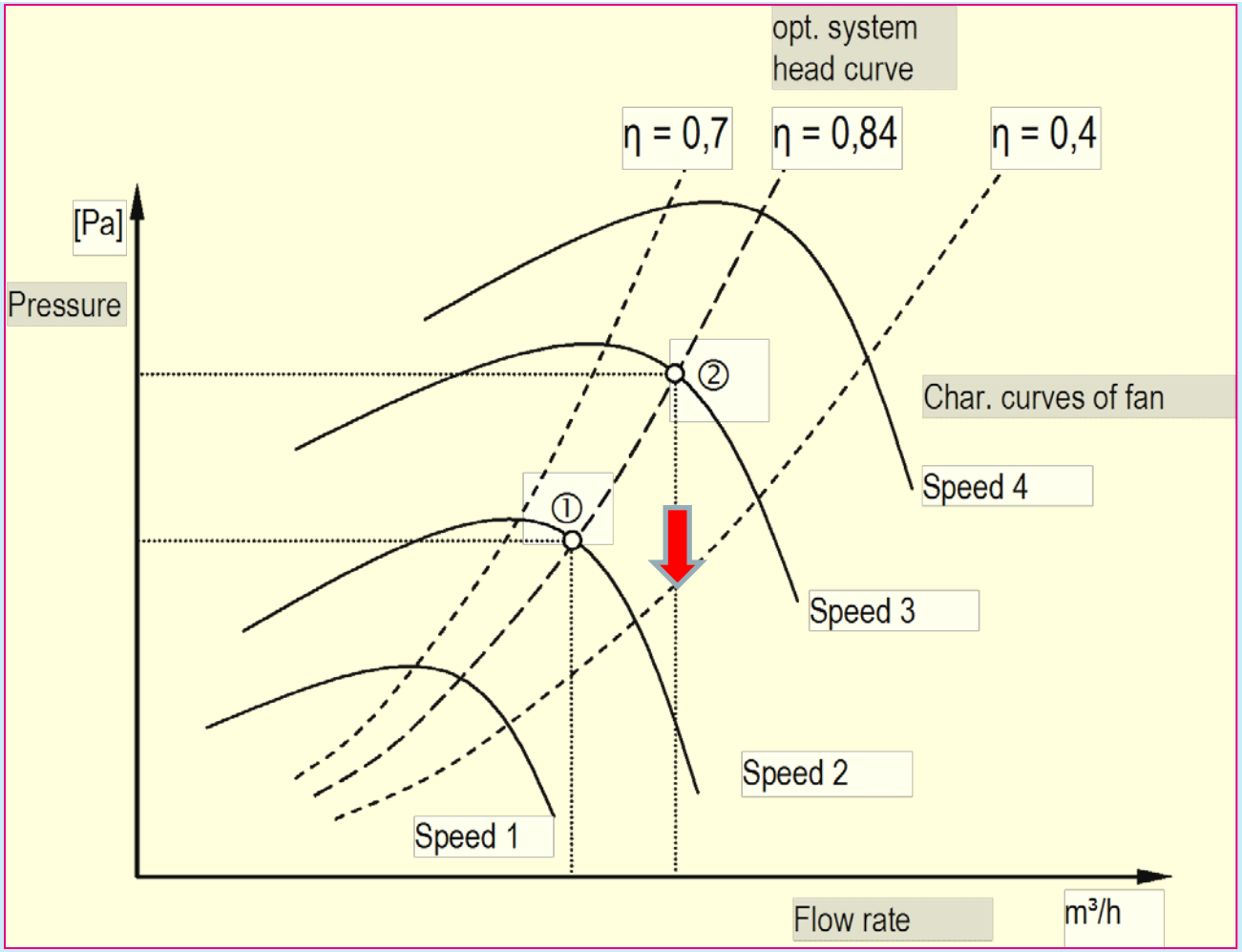

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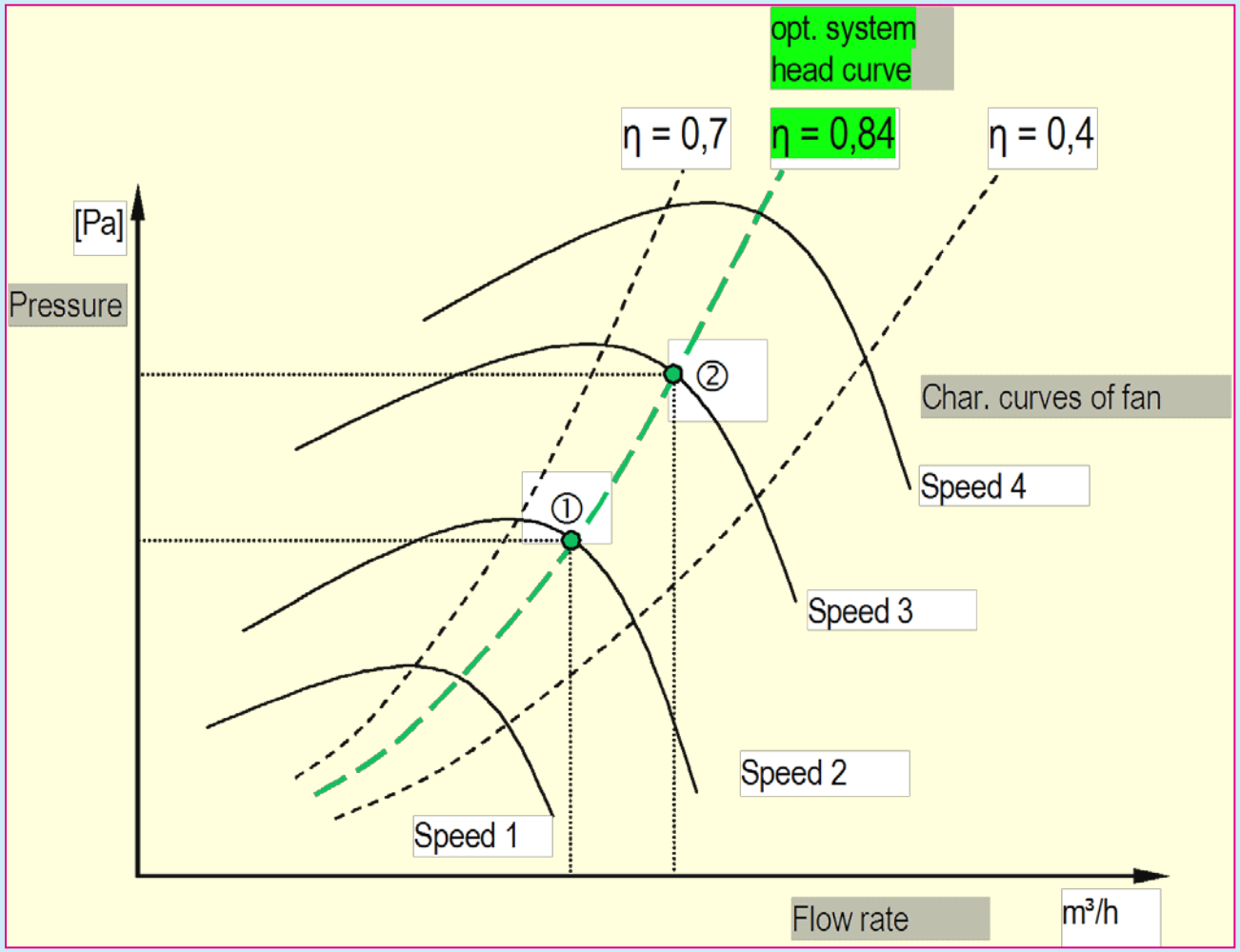

The fan has to be dimensioned for the system it has to supply.

Pressure loss of the system must be calculated before ordering the fan.

The system must be optimized, too!

Why VDI 3805? Influences to a BS system

Performance requirements to a system are dependent of:

- Outdoor temperature, outdoor humidity, rain, snow, ice, wind
- Inner loads (Heat sources/sinks, humidity, air pollution)

→ **Variable load cases and operating points**

Energy consumption of a BS pipe system is dependent of:

- Performance requirements
- Degrees of efficiency of the used devices at variable operating points
- Dimensions of pipe cross sections
- Regularity of pipe cross sections
- Symmetry of piping systems (Avoiding of throttles)
- Roughness of pipes
- Number of bends
- Angles of bends
- Radii of bends
- Inlet pathes before bends

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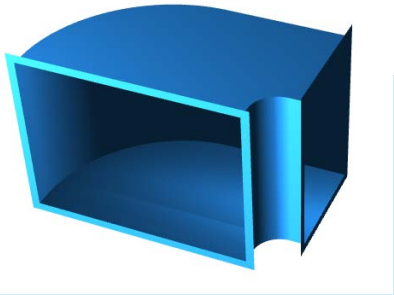
Why VDI 3805?



Influences to a BS system (Example)

$$\Delta p = \zeta * w^2 * \rho / 2$$

Pressure loss of an HVAC transition bend is dependent of:

- Dimension of of pipe cross sections (product property)
- Roughness of bend wall (product property)
- Angles of bend (product property)
- Radius of bend (product property)
- Built in air buffle plates (product property)
- Inlet pathes (BS system property changes **ζ**)
- Air volume flow (BS system property changes **w**)
- Air temperature (BS system property changes **ρ**)
- Absolute air pressure (BS system property changes **ρ**)
- Air humidity (BS system property changes **ρ**)
- Kinematic air viscosity (BS system property changes **ζ**)

Pressure loss = computable property!

VDI 3805: Objectives

- Automatical Integration of catalogue data of **all** manufacturers in **all** CAD/CAE-dimensioning- and calculation system
- Uniform product selection across manufacturers
- Dimensioning of products using manufacturer's algorithms
- Possibility to recalculate and re-simulate the **whole** BS-system with data about **all** BS-components as often as required
- Standardised representation of technical data for data exchange
- Standardised representation of technical data for life-cyle management

VDI 3805: catalogue structure and cataloge data

- **Catalogue meta data**
- **Configuration data**
  - References to properties and their values
  - References to article numbers
- **Selection properties (standardised and manufacturer dependent)**
  - Manufacturer dependent product properties
  - Standardised product properties
  - Product accessory
- **Technical properties**
  - Technical data
  - Computable, derived properties
- **Description data**
  - Article numbers
  - Product description
  - Media data
  - Geometry
  - Surfaces

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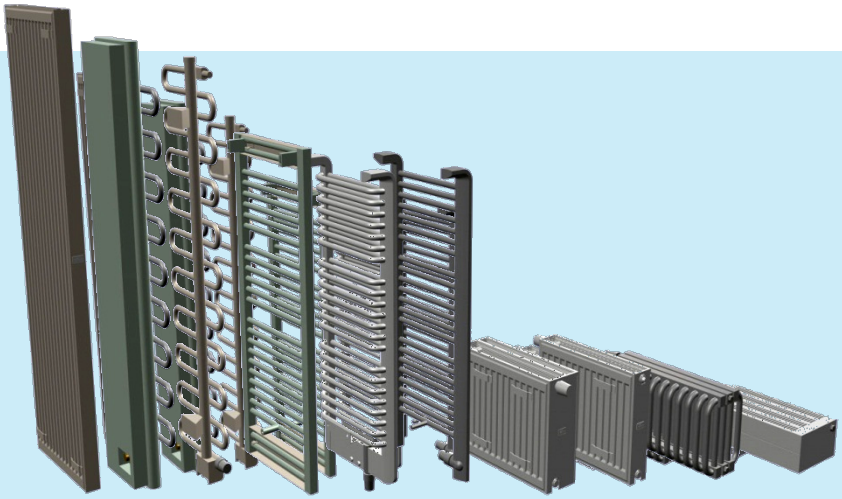
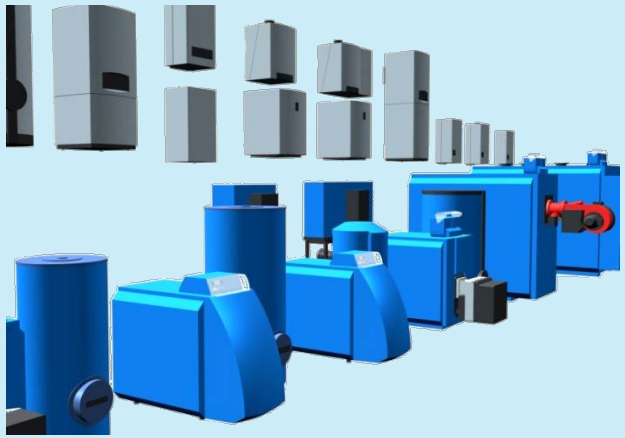
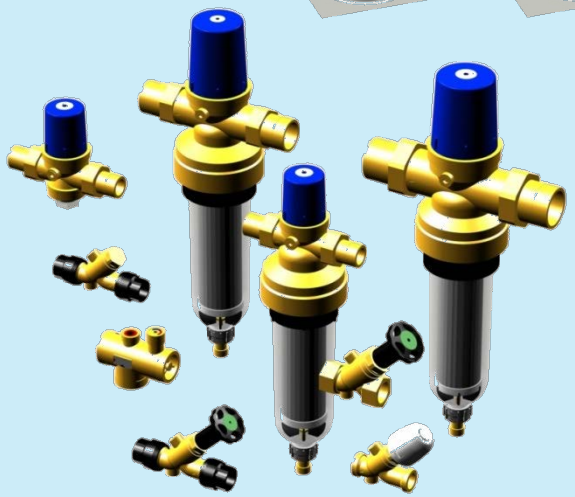
VDI 3805 Examples: Radiators, Air-outlets, Heaters, Valves







VDI 3805 and ISO 16757:

Building Services product catalogue data in BIM

Functions for computable properties, script language VDI 3805
Example silencer: Calculation of sound power level frequency response

```
CHARACTER(256) FUNCTION cLWF(Width,Height,NumberOfSplitters,
                             VolumeFlow,LWA,LWF);
REAL Octave,V,K,VolumeFlow,Strouhal,Thickness;
INTEGER NI,LWA,LWF(8),Width,Height,NumberOfSplitters;
cLWF = ' ';
Thickness = VActualRValue('TechnicalData1',12345);
V = VolumeFlow/NumberOfSplitters*
    (Width/NumberOfSplitters-Thickness)/1000*(Height/1000);
K = -13*LOG10(V)+13.5;
NI = 1;
Octave = 31.25;
DO WHILE (NI<9);
   Octave = Octave*2;
   Strouhal = Octave*ActualRValue('TechnicalData2',23456)/1000/V;
   LWF(NI) = LWA+11.4-14.9*LOG10(Strouhal)-1.4*LOG10(Strouhal)**2;
   LWF(NI) = dLWF(NI)+2.2*LOG(Strouhal)**3-0.5*LOG(Strouhal)**4+K;
   NI = NI+1;
ENDDO;
END FUNCTION cLWF;

CHARACTER(256) FUNCTION dLWF(N);
...
```

VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

Functions for computable properties, language C
Example silencer: Calculation of sound power level frequency response

```
char* cLWF(int Width,int Height,int NumberOfSplitters,float
  VolumeFlow,int LWA,int* LWF,unsigned int NLWF)
  {
   int NI;
   float Octave,V,K,VolumeFlow,Strouhal,Thickness;
   Thickness = VActualRValue("TechnicalData1",12345);
   V = VolumeFlow/NumberOfSplitters*(Width/NumberOfSplitters-
  Thickness)/1000*(Height/1000);
   K = -13*log10(V)+13.5;
   Octave = 31.25;
   for (NI = 0; NI < NLWF; NI++)
   {
     Octave = Octave*2;
     Strouhal = Octave*ActualRValue("TechnicalData2",23456)/1000/V;
     LWF[NI] = LWA+11.4-14.9*log10(Strouhal)-1.4*log10(Strouhal)**2;
     LWF[NI] = dLWF(NI)+2.2*log(Strouhal)**3-0.5*log(Strouhal)**4+K;
   }
   return " ";
  }

  float  dLWF(int N){...}
...
```

VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

Functions for computable properties, language Java
Example silencer: Calculation of sound power level frequency response

```
  public abstract class RValueClass
{
 abstract float VActualRValue(String Data,int Wert);
 abstract float ActualRValue(String Data,int Wert);
 float VActualRValue(String Data,int Wert){...}
 float ActualRValue(String Data,int Wert){...}
}
public class LWFClass
{
      private String  m_LWF;
      private int[]   m_LWF;
      LWFClasse(String LWF, int[] LWF) {...}
      ...
public void cLWF(int Width,int Height,int NumberOfSplitters,float VolumeFlow,int LWA)
      {
       int NI;
       float Octave,V,K,VolumeFlow,Strouhal,Thickness;
       m_szLWF = " ";
       Thickness = VActualRValue("TechnicalData1",12345);
       V = VolumeFlow/NumberOfSplitters*(Width/NumberOfSplitters-Thickness)/1000*(Height/1000);
       K = -13*Math.log10(V)+13.5;
       Octave = 31.25;
       for (NI = 0; NI < m_LWF.length; NI++)
       {
         Octave = Octave*2;
         Strouhal = Octave*ActualRValue("TechnicalData2",23456)/1000/V;
         m_LWF[NI] = LWA+11.4-14.9*Math.log10(Strouhal)-1.4*Math.log10(Strouhal)**2;
         m_LWF[NI] = dLWF(NI)+2.2*Math.log(Strouhal)**3-0.5*Math.log(Strouhal)**4+K;
       }
      }
      private float  dLWF(int N){...}
}...
```

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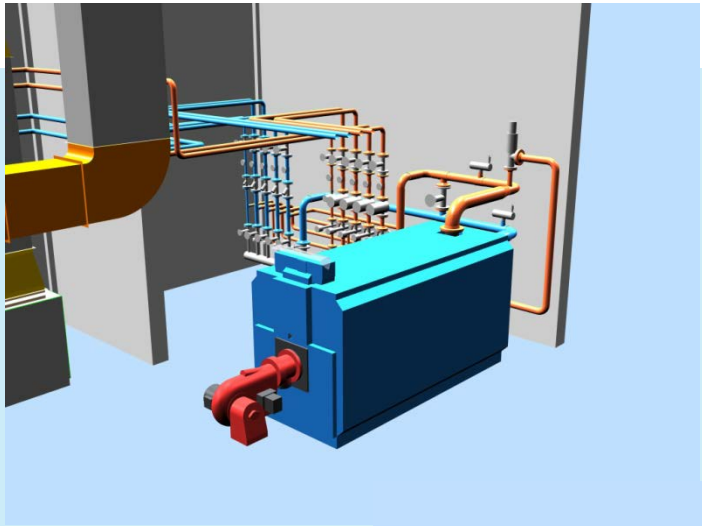
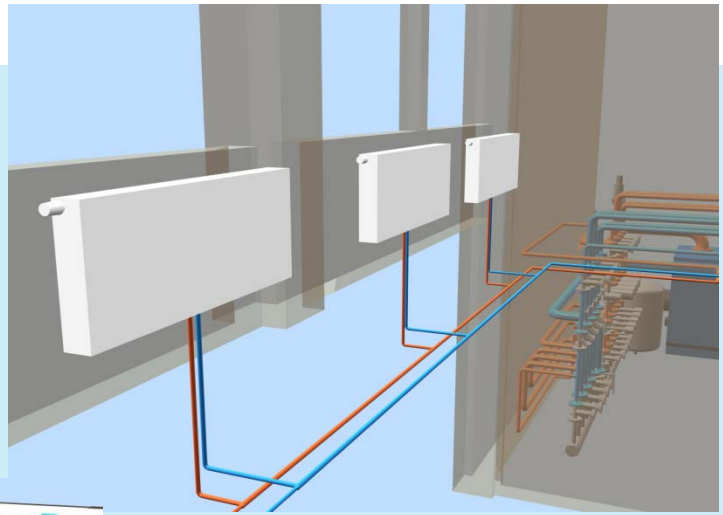
VDI 3805 Examples:

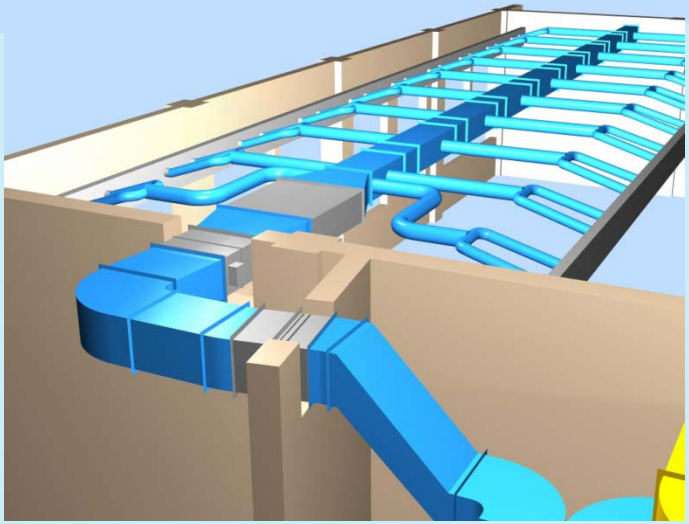
Products in 3D BS system models



Heater



Valve-radiator



Fire damper

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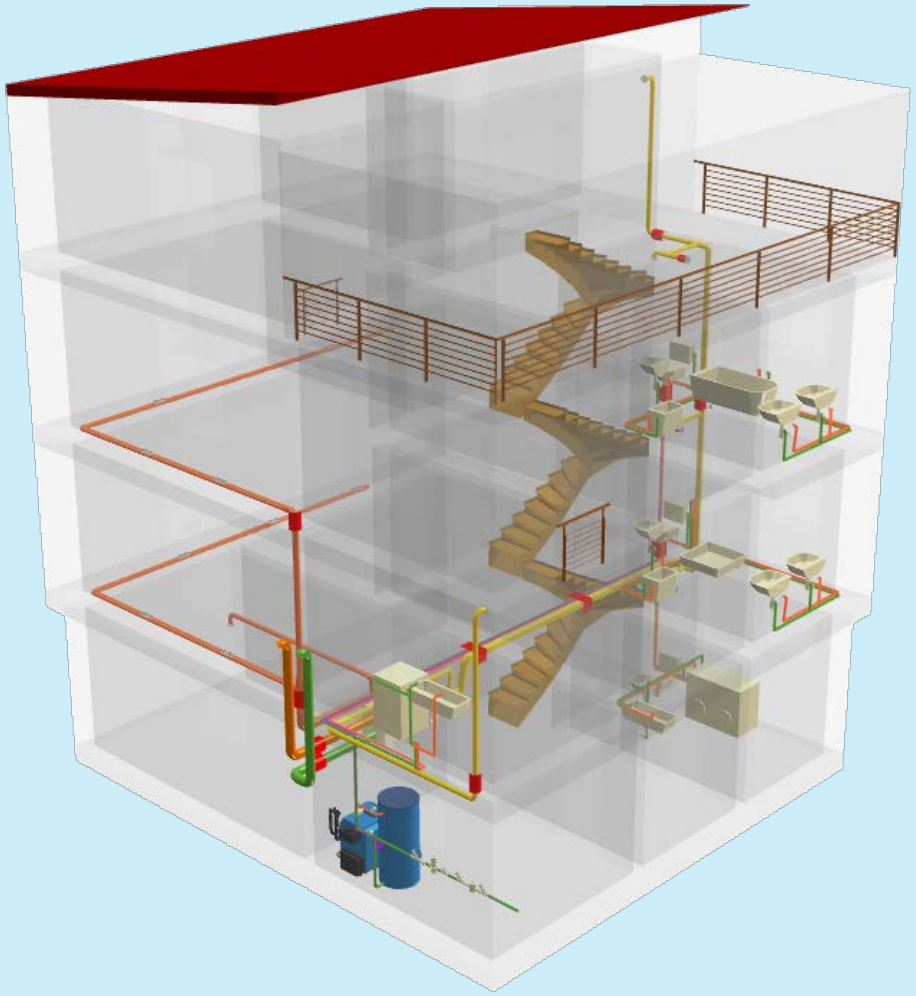
VDI 3805 examples: BS systems in 3D building models

Air-Condition

Heating



Drinking water

Waste water

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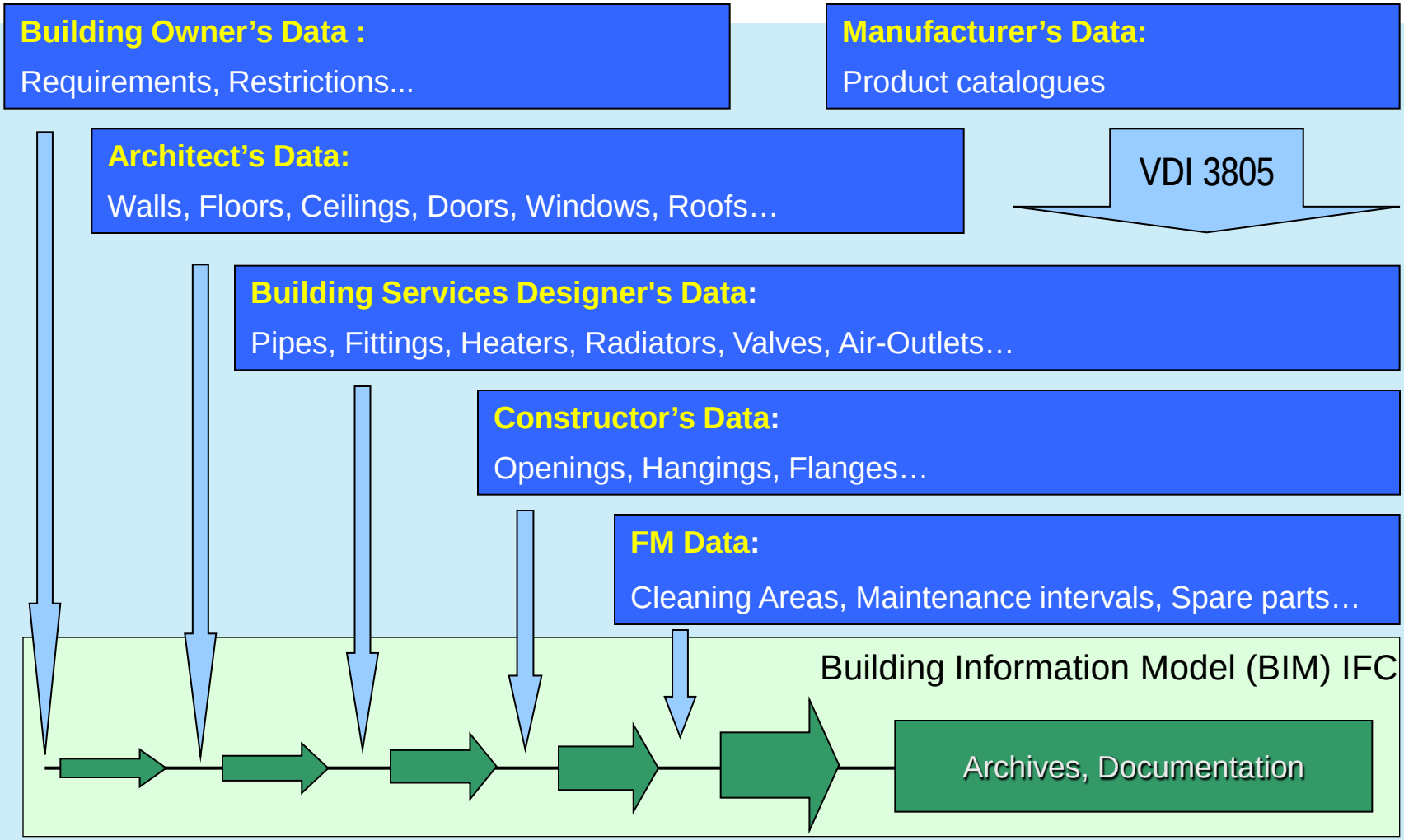
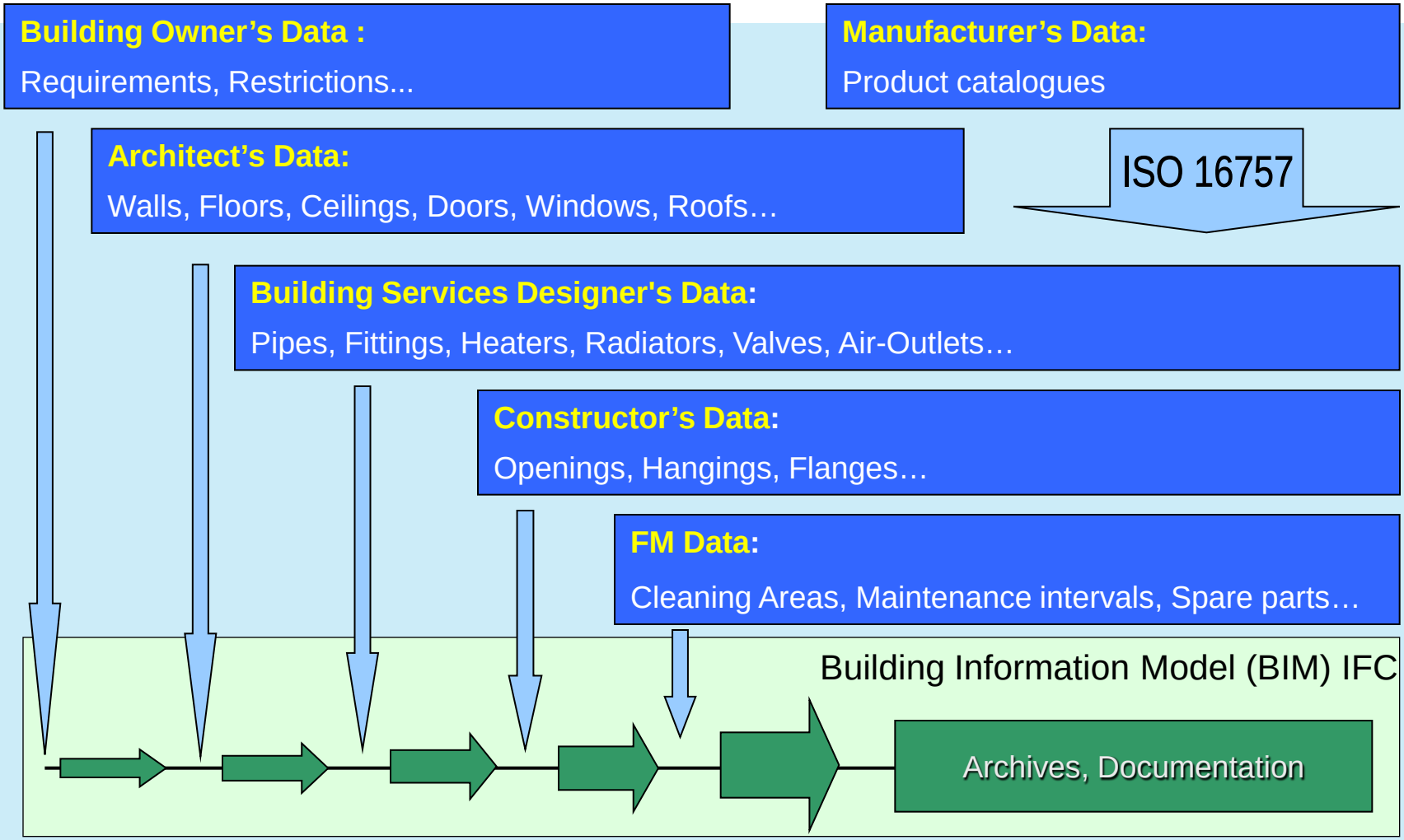
VDI 3805 in building data cycle



VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

ISO 16757 in building data cycle



ISO 16757: new standard in ISO TC 59/SC 13/WG 11 Based on VDI 3805

ISO 16757: Product Data for Building Services System Models

- **Part 1: Concepts, architecture and model**
  This part gives the overview about the standard and the rationale for its elements and organisation.
- **Part 2: Geometry**
  This part defines the geometric elements which are used to represent the products in ISO 16757 catalogues.
- **Part 3: Script language and functions**
  This part defines the script language used in ISO 16757 for various purposes.
- **Part 4: Cooperation with building information modelling standards**
  This part contains IDM descriptions for ISO 16757, including process descriptions for those processes which are to be supported by the standard and it comprises the rules for mapping of product properties and the property descriptions to IFC and for defining properties semantically with IFD.
- **Part 5: Product catalogue exchange format**
  This part defines an exchange format in XML by which electronic catalogues can be exchanged according to the definitions of ISO 16757. The exchange format will be specified as an XML Schema Definition (XSD).
- **Part 10 - XX**
  Product group specific parts of ISO 16757 will define standardized properties for the product groups and the composition of the technical data model. Furthermore they determine the specific programming function- interfaces to layout, calculate and simulate the products.

ISO 16757: new standard in ISO TC 59/SC 13/WG 11 Based on VDI 3805

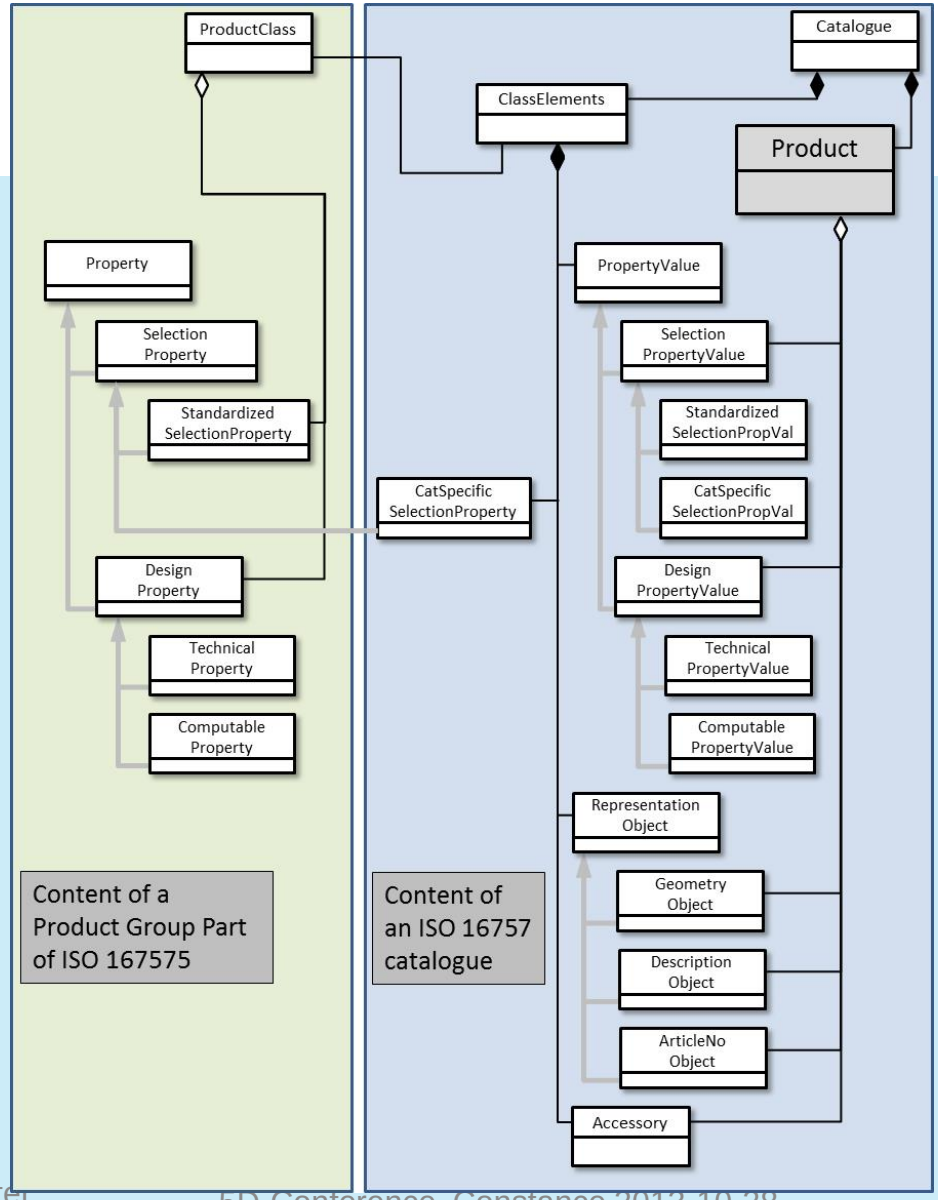
- **January 2011:** **New Work Item Proposal Ballot**
  13 votes in favour, no vote against, 2 abstentions. Official participants of working group from:
  Austria, China, Denmark, Germany, Japan, Canada, Netherlands, Norway, United Kingdom
  Guest: **Finland**
- **March 2011:** **Kick-Off-Meeting in London**
  12 attendants
- **October 2011:** **Presentation of new draft standard during buildingSMART-conference in Singapore**
  15 attendants including **Australia** and **France**
- **July 2012:** **Committee draft of ISO 16757 Part 1**
  10 votes in favour, no vote against, 8 abstentions, 48 comments
- **October 2012:** **Presentation of new draft standard of ISO 16757 Part 2 on ISO-conference in Tokyo**
  6 active attendants – adaptation of draft
- **October 2013:** **Presentation of draft standards of ISO 16757 on ISO-conference in Munich (10** attendants)
  DIS ballot for Part 1 started – comments arriving by January 9th
  Part 2: WG internal review by 2013-10-20
- **November 2013:** **planned: Comment Resolution, then finalization of FDIS (or IS) version**
  In parallel: work on the editorial improvement of both Parts
  Part 2: Start with CD ballot in mid-November
- **Begin 2014:** **planned: Completion of ISO 16757 Part 1 to 5**
  Exemplary application on Part 11 (radiators) and Part 12 (air openings)
- **2014:** **planned: Publication**

VDI-Society
Civil Engineering and
Building Services

VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

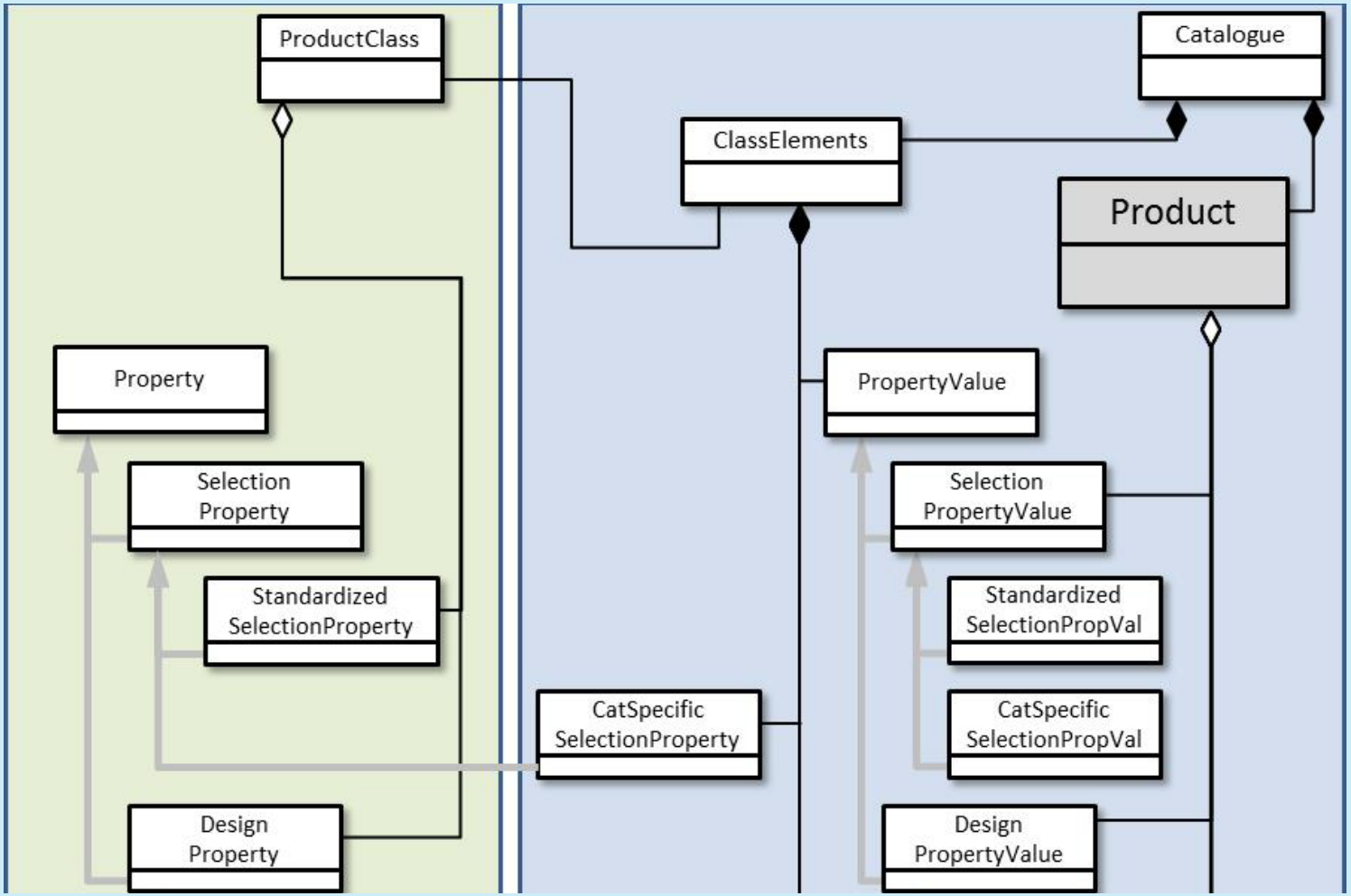
ISO 16757

- **Transparency**
  - Selectable properties
  - Standardised properties
  - Representing properties
- **Flexibility**
  - Unlimited number of properties
  - Any number of levels
- **Performance**
  - Non redundant
  - Algorithmic generable
- **Open for extensions**
  - Any kinds of product groups



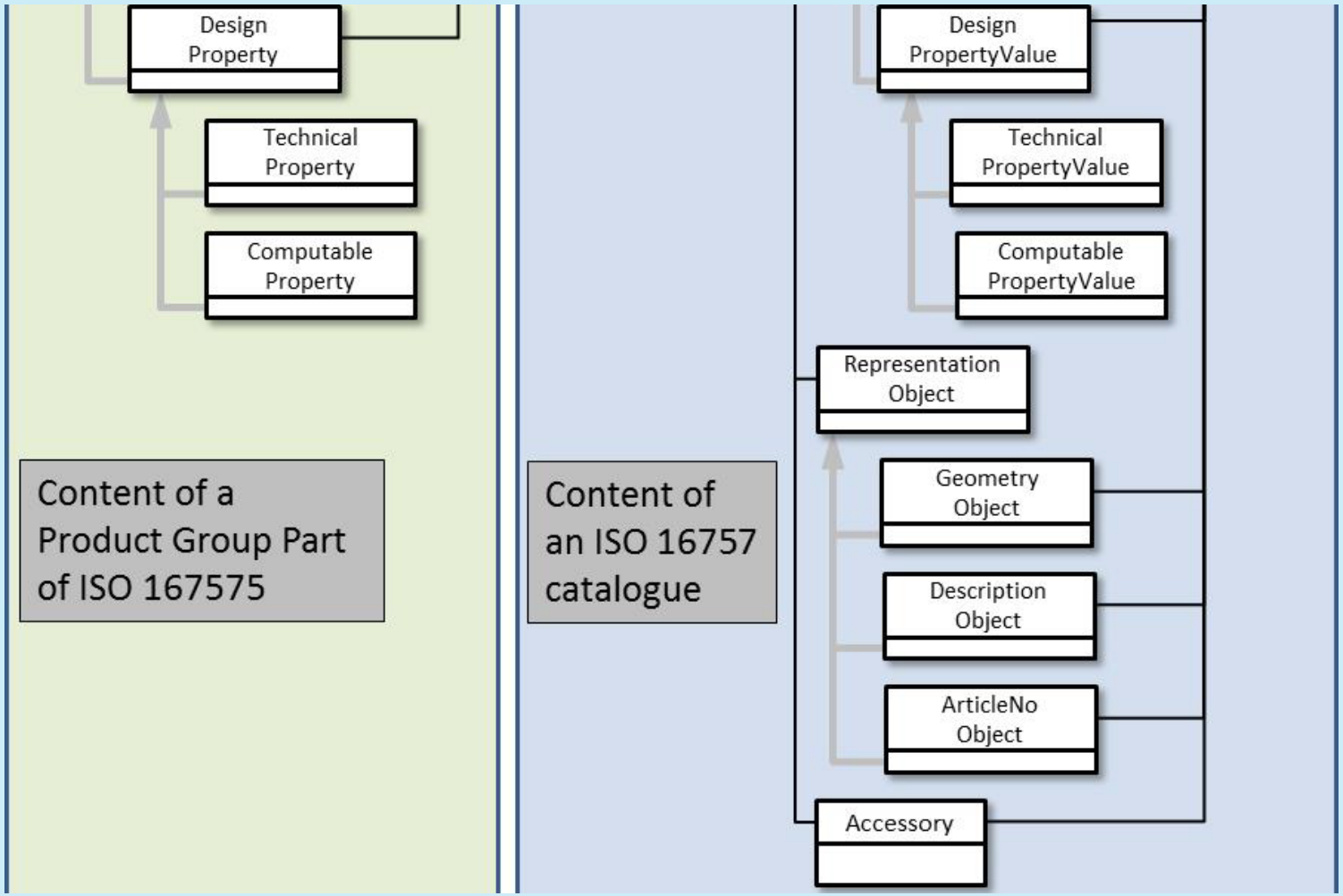
VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

ISO 16757

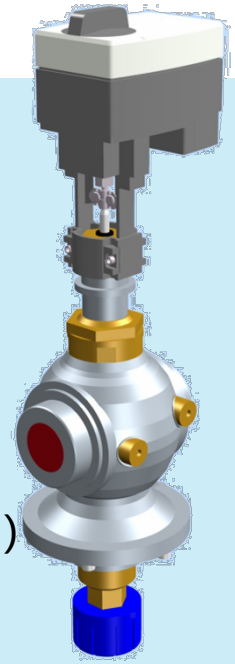


VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

ISO 16757



ISO 16757: new standard in ISO TC 59/SC 13/WG 11 Based on VDI 3805



- **Description of processes:**
  - **ISO 29481 → IDM (Information Delivery Manual)**
- **Formal definition of product classes, properties and function parameters according to different standards:**
  - **ISO 13584 → DIN property server**
  - **ISO 12006-3 → bSDD property server**
    (IFD: International Framework for Dictionaries)
  - **ISO/PAS 16739 → IFC (Industry Foundation Classes)**
- **Definition of geometry, functions, function implementing and function codes:**
  - **In new parts of standard ISO 16757**
  - **According to existing, available standards**
- **Definition of an XML-format as exchange base for millions of variants**

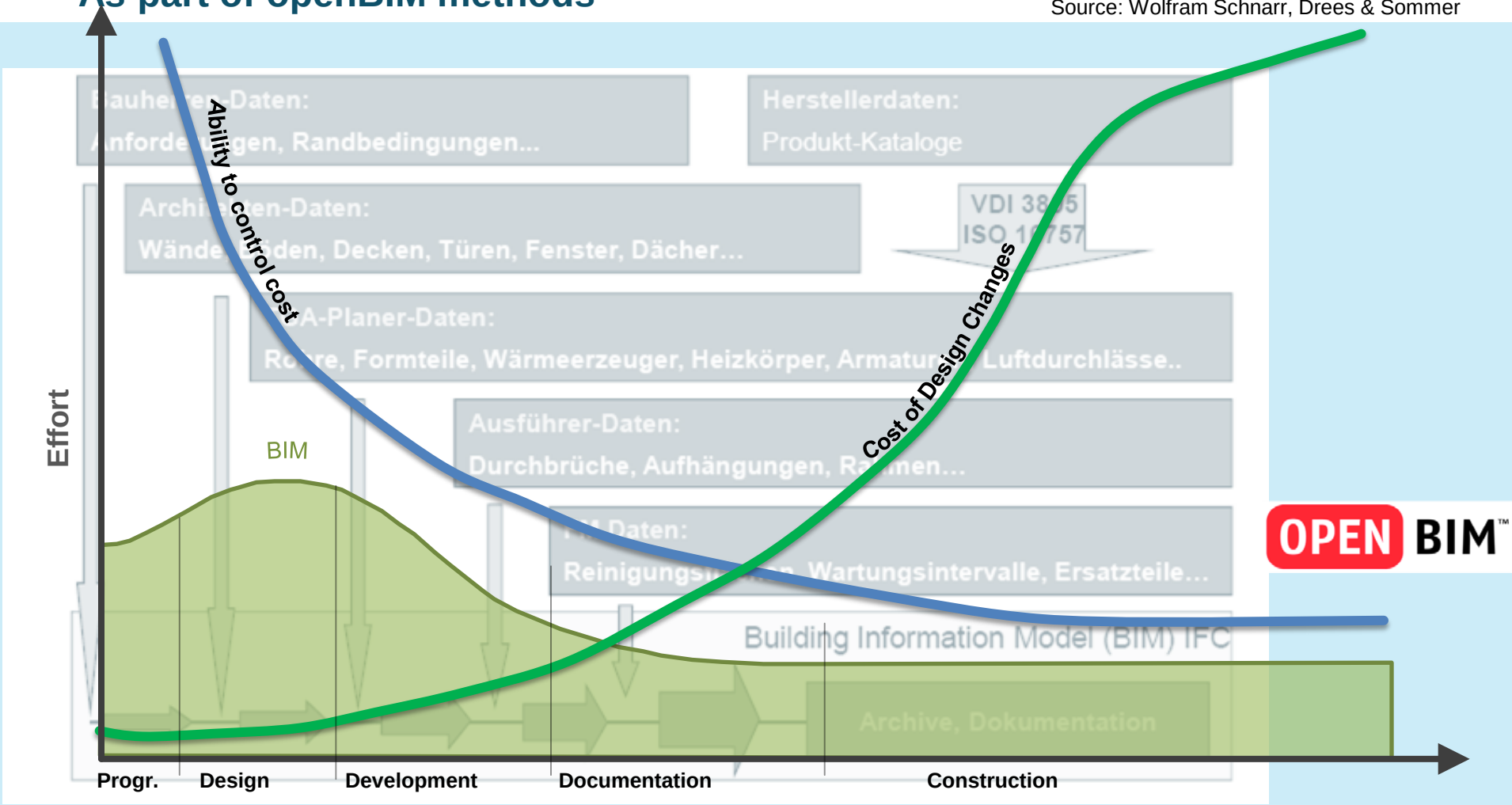
ISO 16757 Integration in BIM (IFC)

- **BIM: Descripton of a building**
  - **Single products**
  - **No product catalogue**
- **Product data in direct relationship to BIM (Mapping to IFC)**
  - **Manufacturer dependent properties**
  - **Standardised properties**
  - **Accessory**
  - **Product description**
  - **Article numbers**
  - **Geometry**
- **Product data in devious relationship to BIM (Embedding in IFC)**
  - **Technical data**
  - **Functions to generate computable properties**

VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM

Apply of product data according to ISO 16757
As part of openBIM methods

Source: Wolfram Schnarr, Drees & Sommer



VDI 3805 and ISO 16757:
Building Services product catalogue data in BIM