SIEMENS Healthineers

Informationsmanagement und Ontologien – Entwicklungsnahe Produktdokumentation In der Medizintechnik

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Methodological Introduction:

The Intelligence Cascade

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Introduction

Levels of Intelligent Content and Data: The Intelligence Cascade

Native Intelligence
Semantic content and semantic metadata for process automization, e.g. PI-Classification

Augmented Intelligence
Additional relations between content objects described e.g. by ontologies

Artificial Intelligence
Automated extraction of metadata and knowledge by mtheods of statistical analysis and training data …

Native Intelligence

Basic CM Concepts in TC

- **CMS principles**
  Controlled reuse of content modules (topics) in multiple documents or media by the use of metadata

- **CMS and metadata offer technologies for …**

– Variant management (product & media variants, configuration)

– Version management (change Management)

– Translation management (internationalization, globalization)

– Cross media & publishing management →

… ***generating Docs***

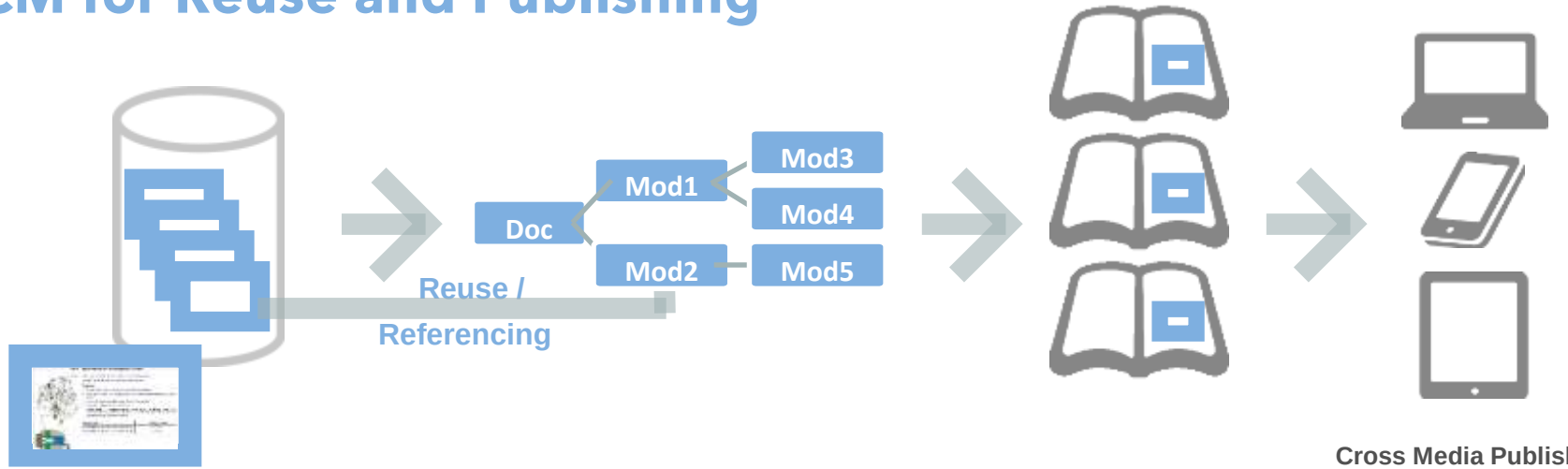
Intelligence Cascade

Native Intelligence

Referencing modules

- permits controlled processes
- avoids uncontrolled redundancies
- defines and populates document structures by topics

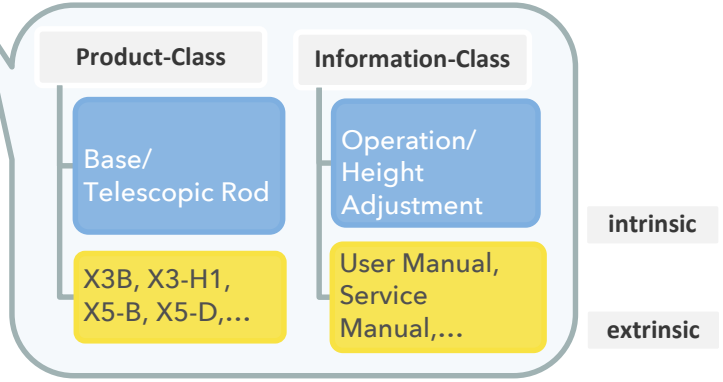
CM for Reuse and Publishing



Cross Media Publishing
(automated)

Native Intelligence

Basic Dimensions of Module Classification (PI-Class®)



www.pi-fan.de

Native Intelligence

Classification of Components (PI-Class)

Product class 1 (Assembly/ Functional group)	Product class 2 (Components/ Functional unit)	Product class 3 Part
Complete device		
Drive	Drive	
	Connection	
	Electric motor	
	Gear box	
Lighting		
	Cover	
	Light fitting	
Heating		
	Heating element	
Rotor		
	Blade	
	Blade mount	
	Impeller	
Protection		
	Safety grille	
Display_operating element		
	Speed controller	
	Swivel control	
	Temperature probe	
	Temperature control	
	Display	
Mounting bracket		
	Base	
		Base plate
		Telescopic rod
	Define mount	

Taxonomy of (intrinsic) Product Component Classes

Analogous procedure of component-based decomposition and classification of software products:

- software components
- software classes/objects
- GUI components
- programming units

- (→ presentation of K. Reinhard, Siemens)

EN Translation provided by RWS Group, Germany

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Native Intelligence

Classification of Information Types (PI-Class)

Information class 1 (Module type)	Information class 2 (Product life cycle)	Information class 3 (Detailed product life cycle)
Procedure	Operation	Blower adjustment Height adjustment Tilt adjustment Swivel activation Temperature adjustment
	Getting started	
	Storage	
	Assembly	
	Maintenance	Check Repair
Description		
	Layout	
	Disposal	
	Function	
	Tech. data	
Plan		
	Diagnostics	Error code Manual
Safety		
	General safety	
	Intended use	
	Specific safety	
	Foreseeable misuse	

EN Translation provided by RWS Group, Germany

Taxonomy of (intrinsic) Information Classes

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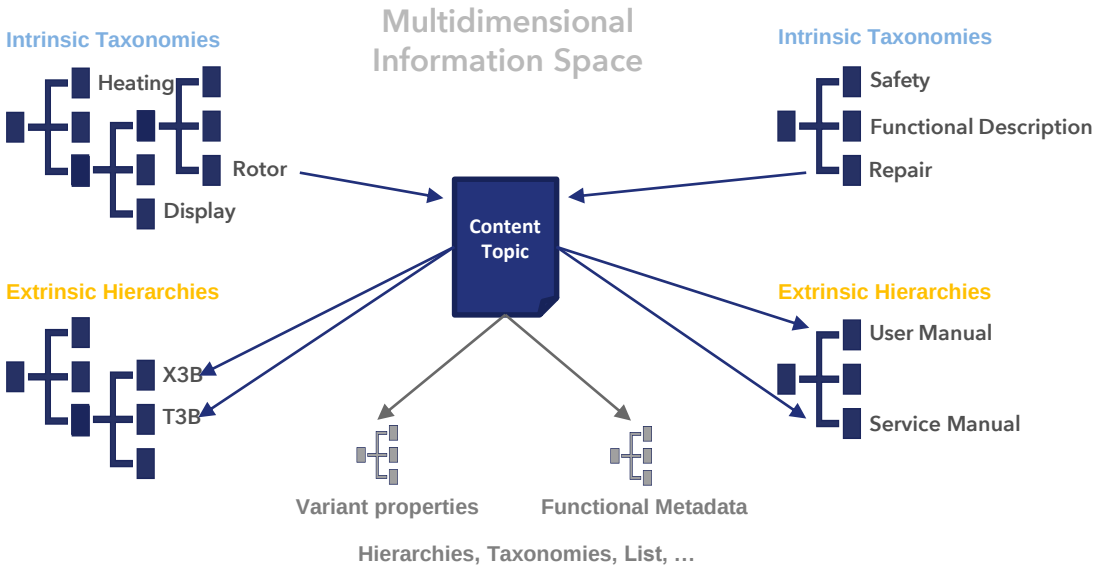
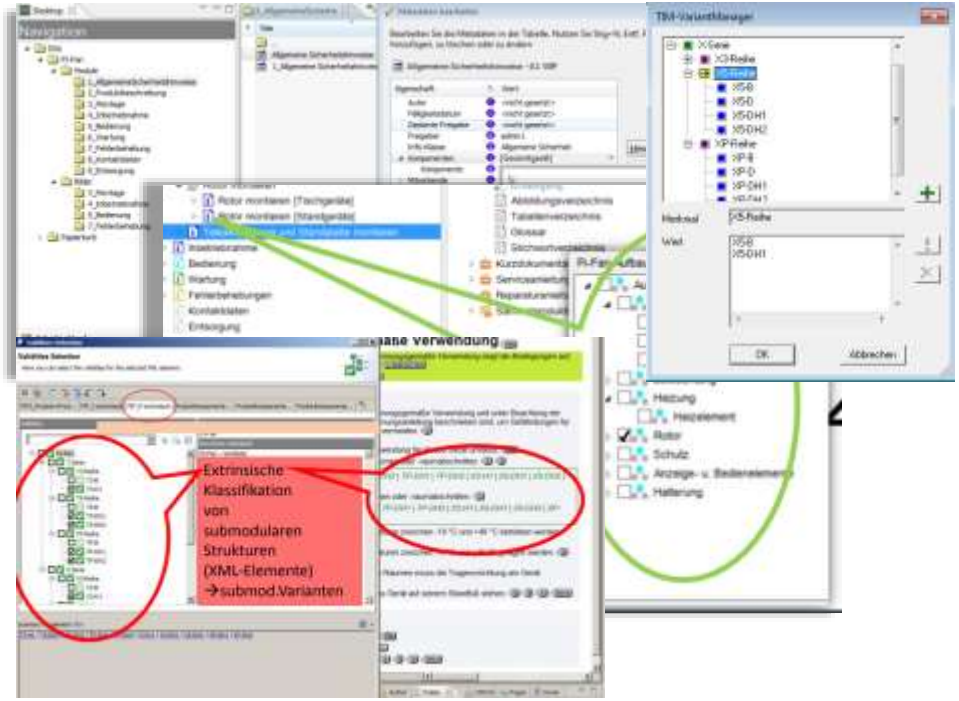
Native Intelligence

CMS „Taxonomies“ from Topic Classification



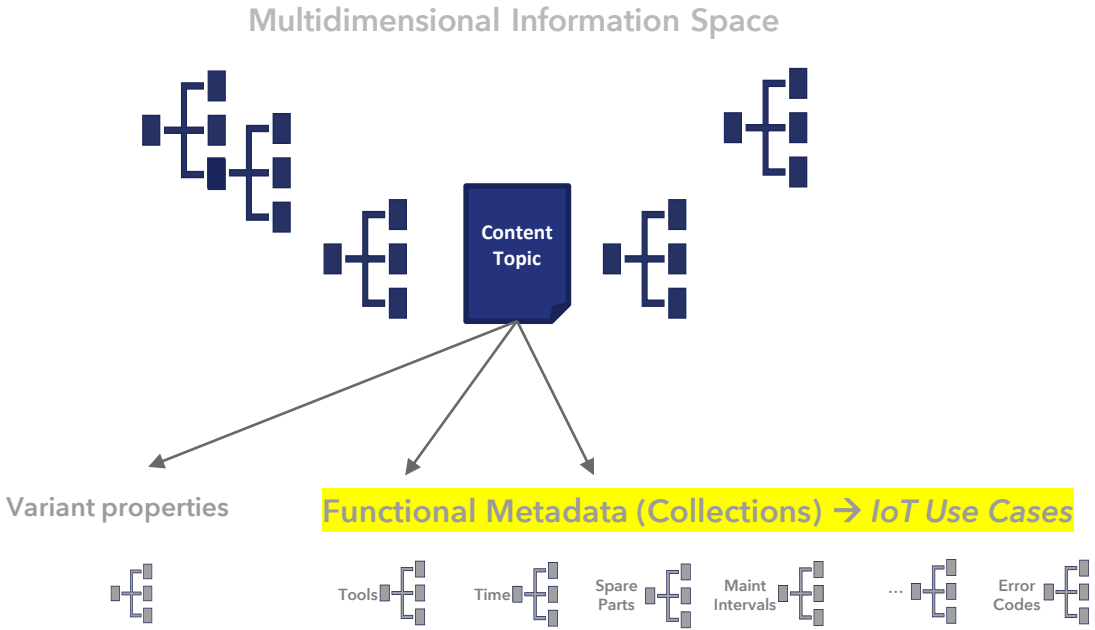
Native Intelligence

Implementation of PI-Classification/ Methodology of Metadata & Variantmgnt.



Native Intelligence

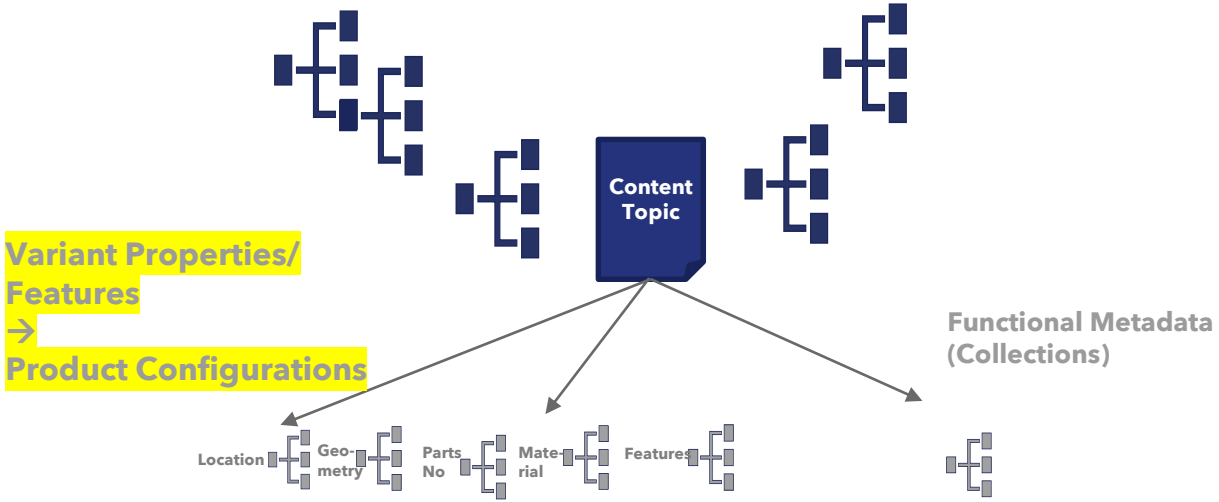
Extending PI-Class by Functional Metadata



Native Intelligence

Extending PI-Class by Variant Properties

Multidimensional information Space using lists, hierarchies and taxonmies



Intelligence Cascade

Native Intelligence

Facetted search/request and topic delivery

Component

- Hydraulic system
  - Oil Pump

Machine

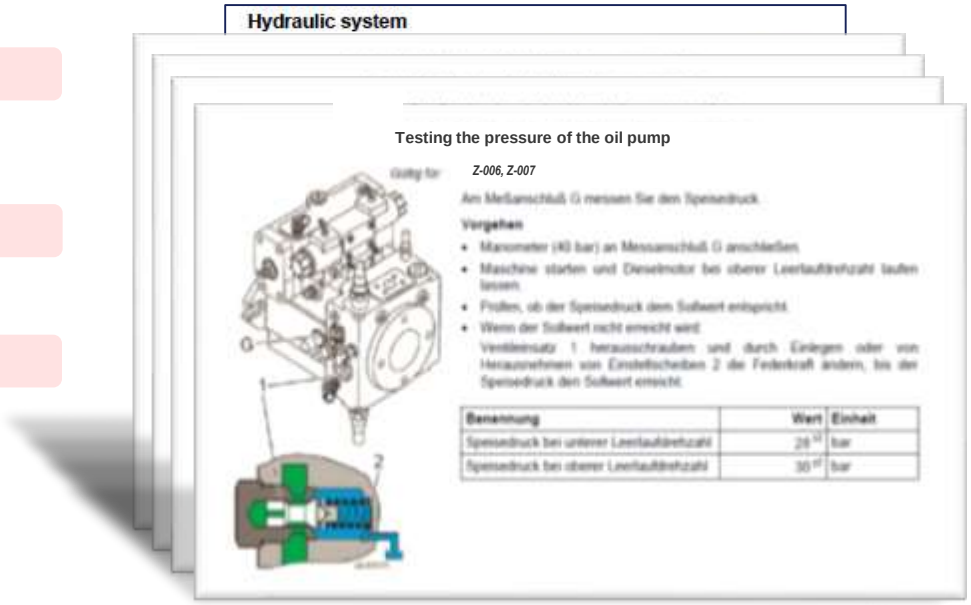
- Z-006

Document

- Service

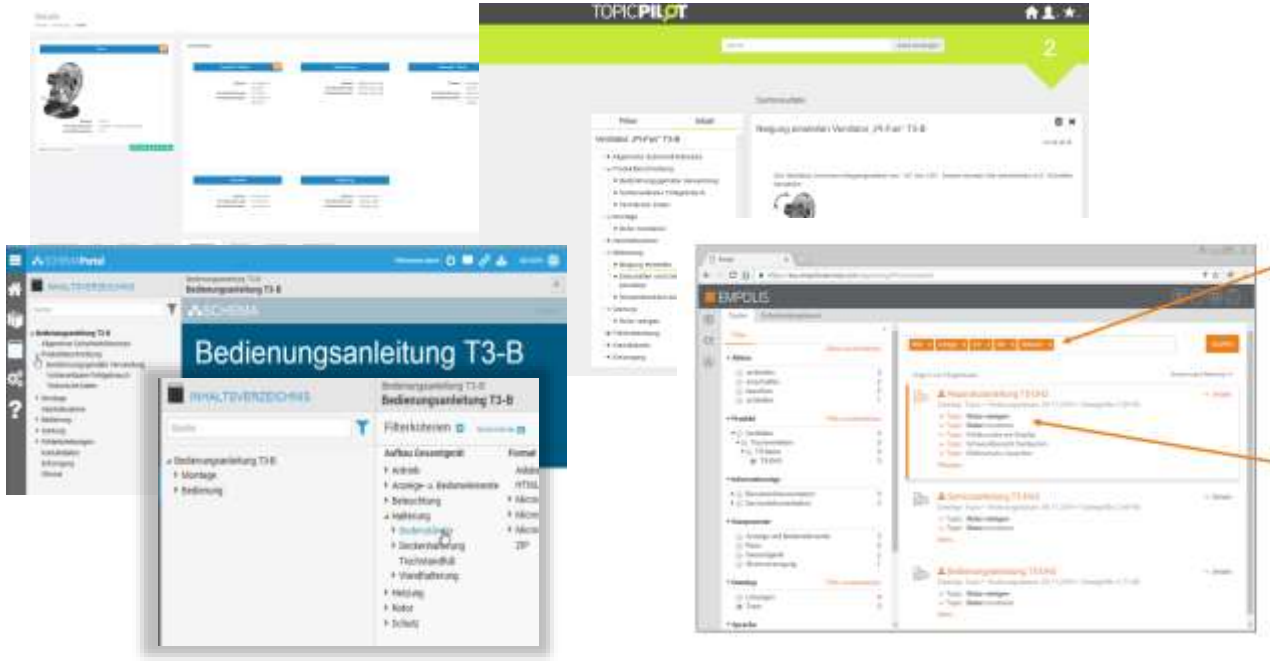
Information

- Procedure
  - Testing



Native Intelligence

Content Delivery Portal (PI-Fan)



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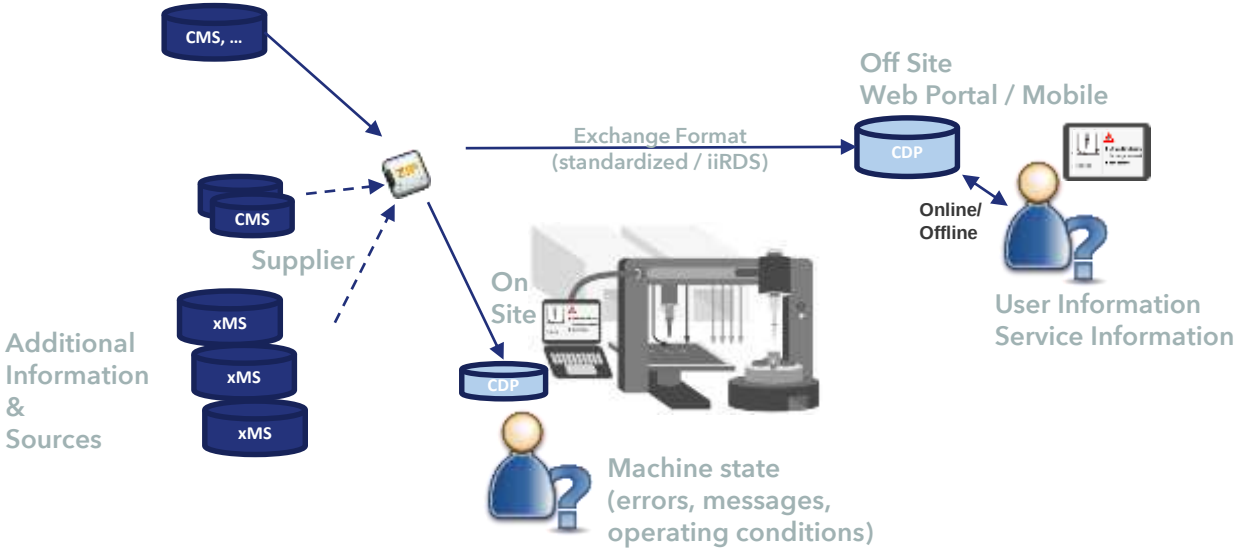
Native Intelligence

CDP environment in industrial applications



Native Intelligence

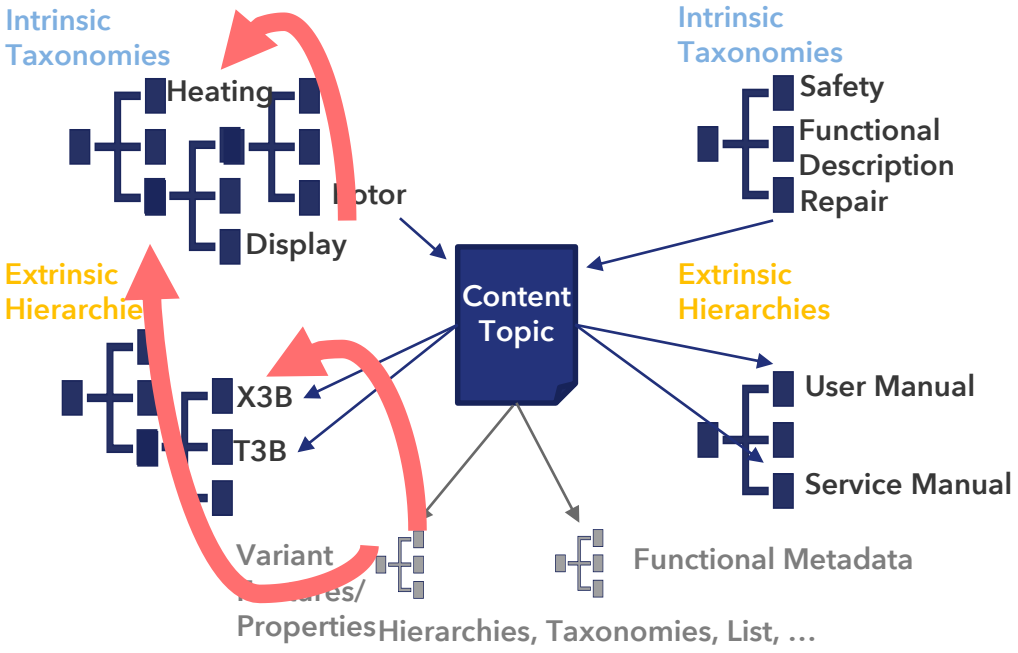
Typical challenges arising from taxonomies

- Multi occurences of product components at different locations (in taxonomy)
- Relations between product components;
  Depencies of topics on combinations of components
- Dependencies of additional variant properties on product components
- Multiple data sources with domain dependant taxonomies
- …

Augmented Intelligence

More Complexity (and Dimensions)

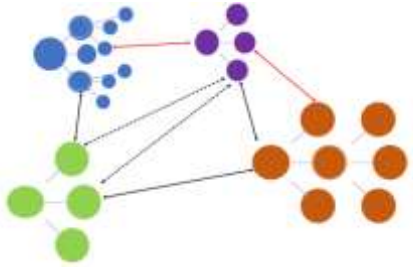
Multidimensional information space including relations, dependencies and rules



Augmented Intelligence

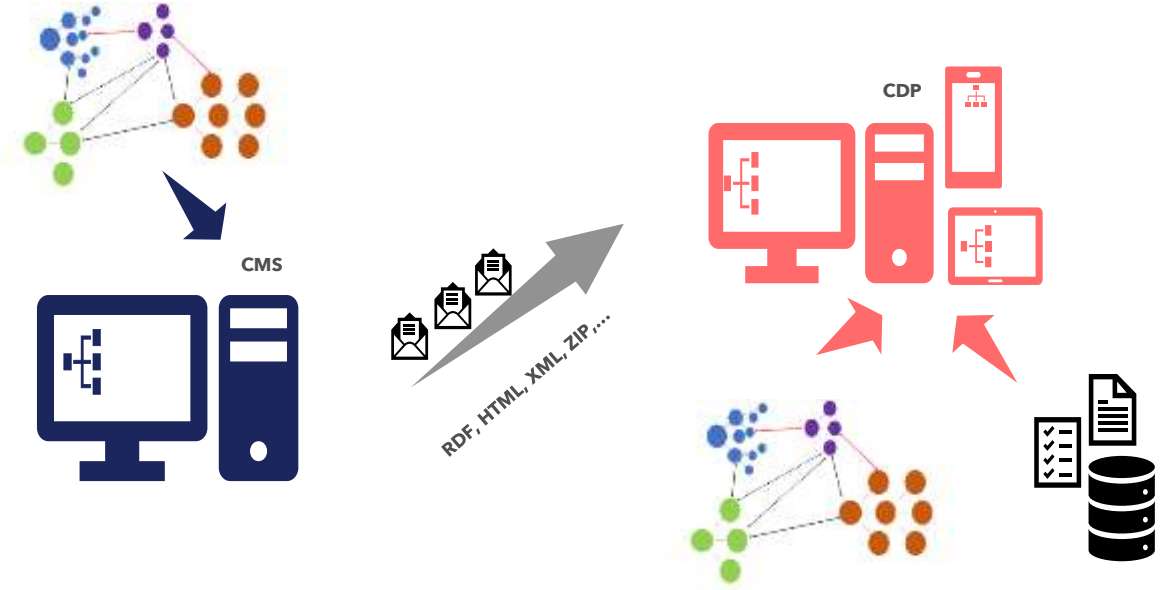
Purpose of Augmented Intelligence

- is to model the complexity of real world products and information
- overcome typical shortcomings of the taxonomic modelling of metadata
- introduce model of objects, their properties and (conditional) relations between each other as semantic network → Ontologies
- support coupling to processes and systems



Augmented Intelligence

Augmenting CMS / CDP by Ontologies

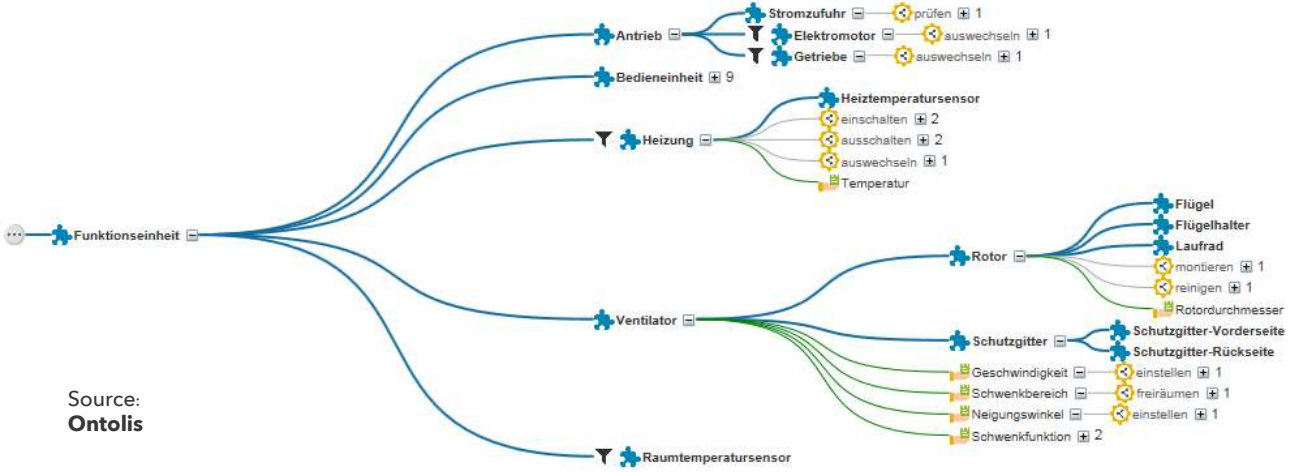


Intelligence Cascade

Augmented Intelligence

Ontology Modelling (of the PI-Fan)

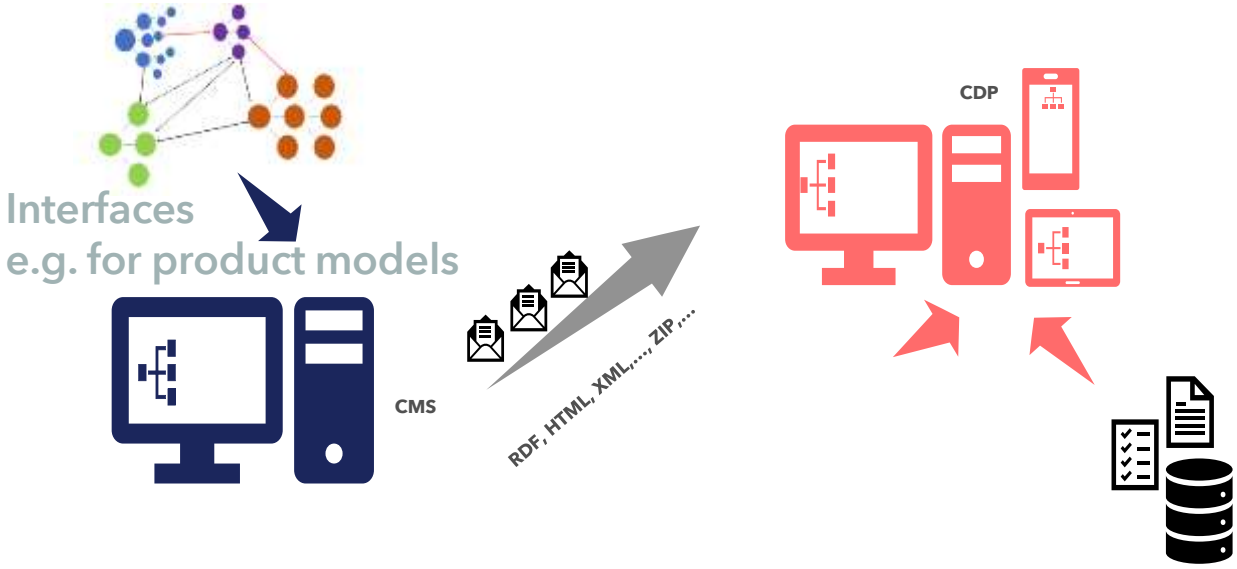
Product model (attached to engineering) as (as far as possible/needed complete) model of components, their relations, functions and properties with respect to variants



Source:
Ontolis

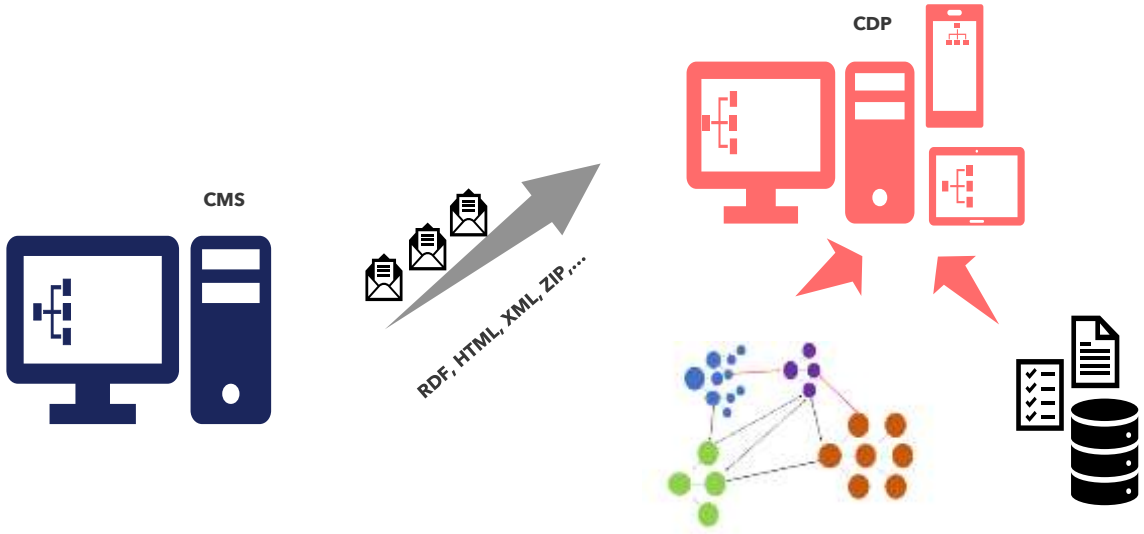
Augmented Intelligence

Augmenting CMS by Ontologies



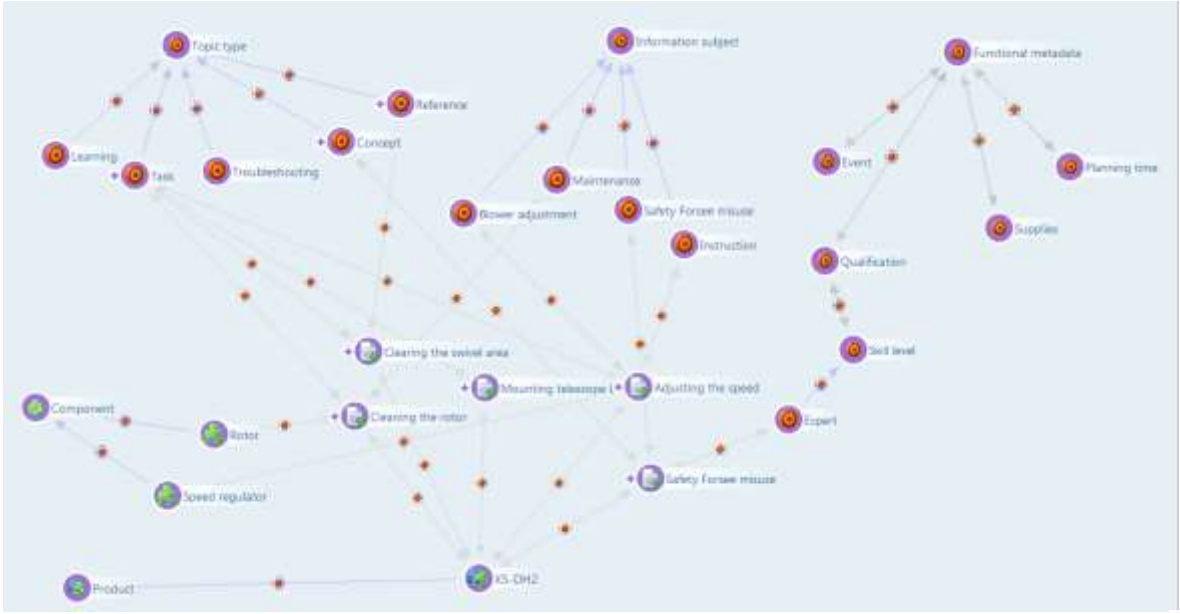
Augmented Intelligence

Augmenting CDP by Ontologies



Augmented Intelligence

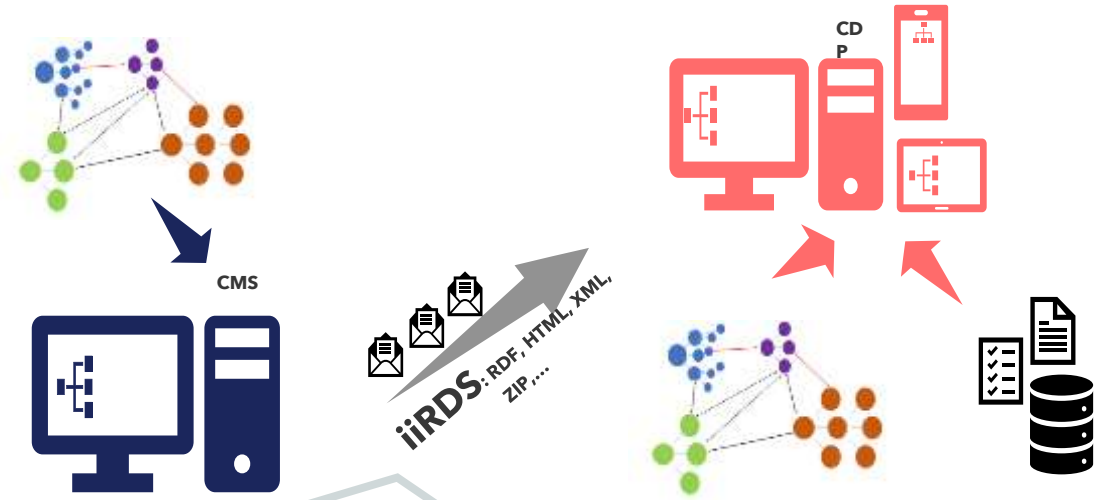
Ontology modelling of PI-Fan



Source: **I-Views**

Augmented Intelligence

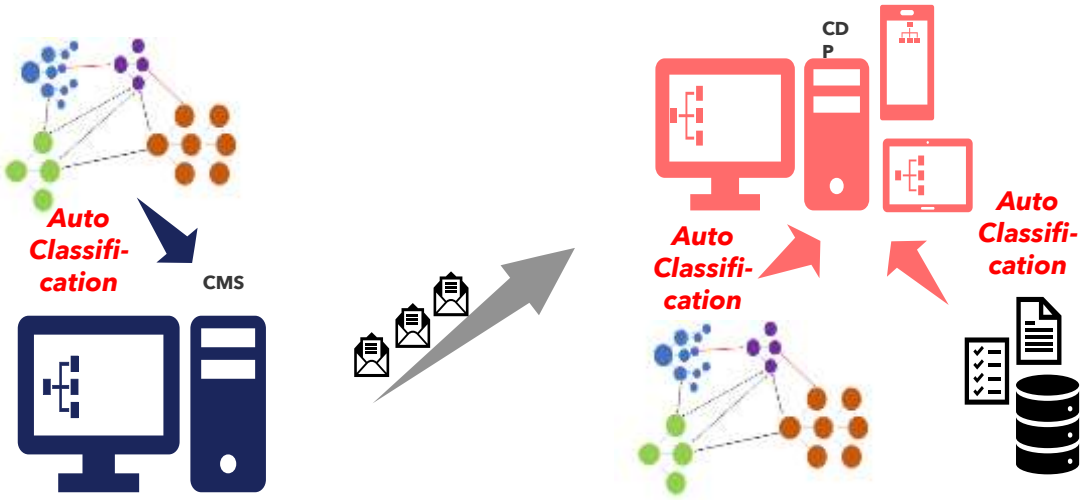
Standardizing Exchange by Ontologies



Standardized description and packaging of metadata and content. Metadata are described by using the formal ontology language RDF and the logic of extended PI-classification.

Artificial Intelligence

Where AI can help and is used



Let's look at the use case …

- …at Siemens Healthineers
- …including native and augmented intelligence
- …coupled to product development, product modelling and PLM
- …for process enhancement of CMS

Project Scope and Problem Definition

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Project scope

Interventional angiography

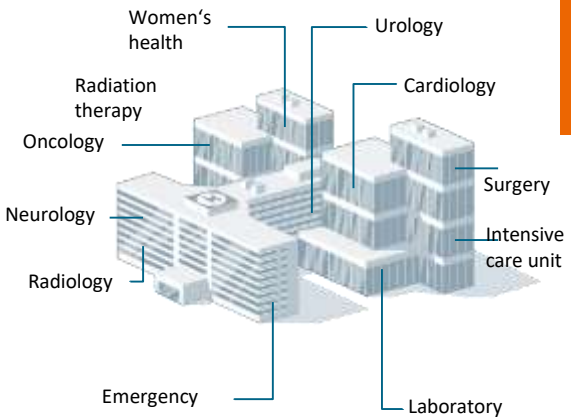

Mammography


Computed tomography

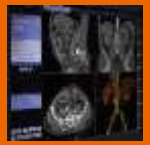

Magnetic resonance imaging


X-ray imaging


Molecular imaging

Imaging Software




Ultrasound imaging


Molecular testing


Point of care testing


Hemostasis & hematology testing


Clinical chemistry & immunoassay testing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Software and hardware

?

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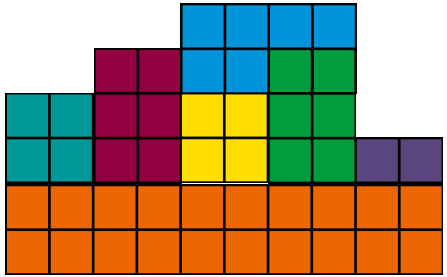
Software platform for imaging devices

Basic idea



Software platform

One software platform for different products

- CT, MR, MI scanners
- Angiography systems
- Advanced visualization software, etc.

- Software is provided centrally
- Software is configured and complemented at product level

- Platform consists of several modules for several feature domains
- Modules and their features may be valid for certain product types only
- Relationships between modules, features, and feature variants are pre-defined

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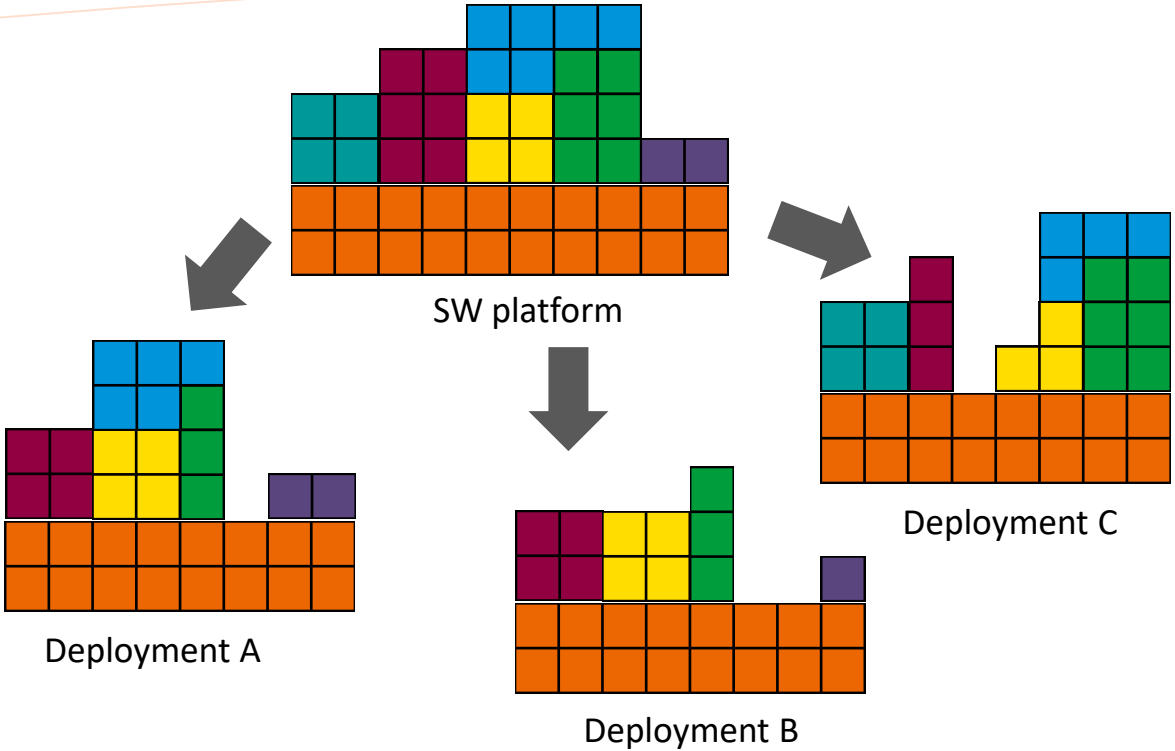
Software platform for imaging devices

Deployment sets



Platform software bundled and deployed for different product types

- MR, CT, MI scanners
- Angiography systems
- Advanced visualization software

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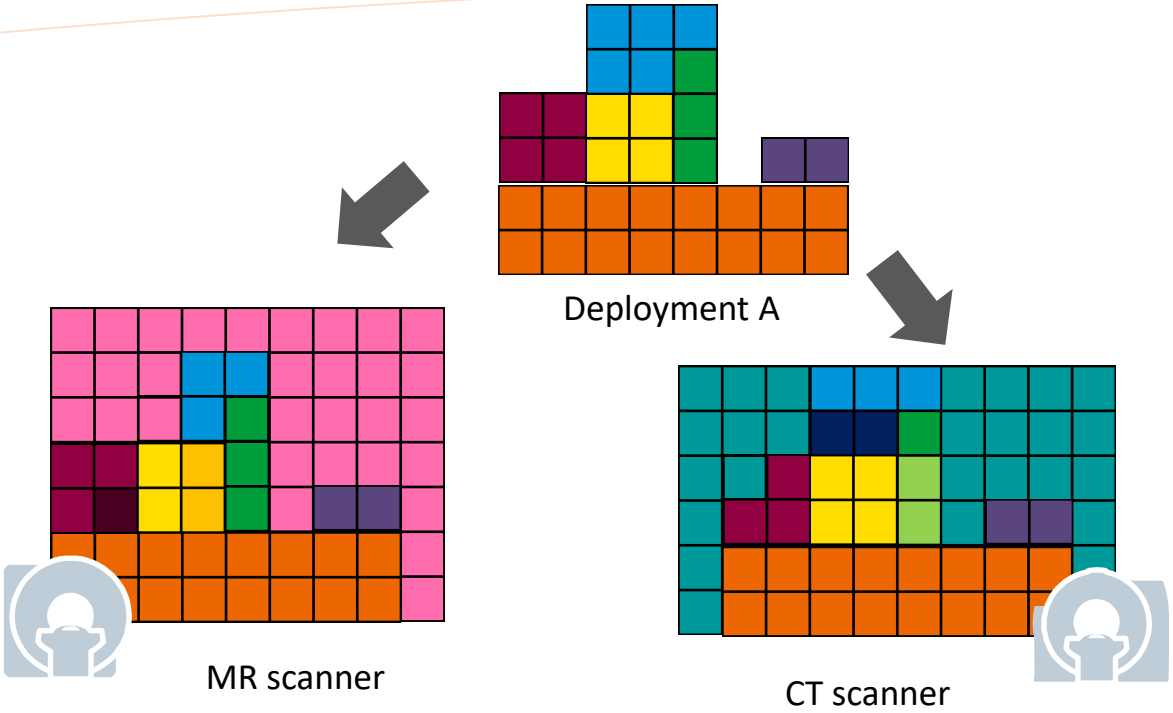
Software platform for imaging devices

Deployment sets



Deployment sets integrated to different products (and complemented by product-specific software parts)

- Different subsets for different CT and MR scanners
- Additional software features added for specific products and product types
- Different configuration of platform and product family features for different products

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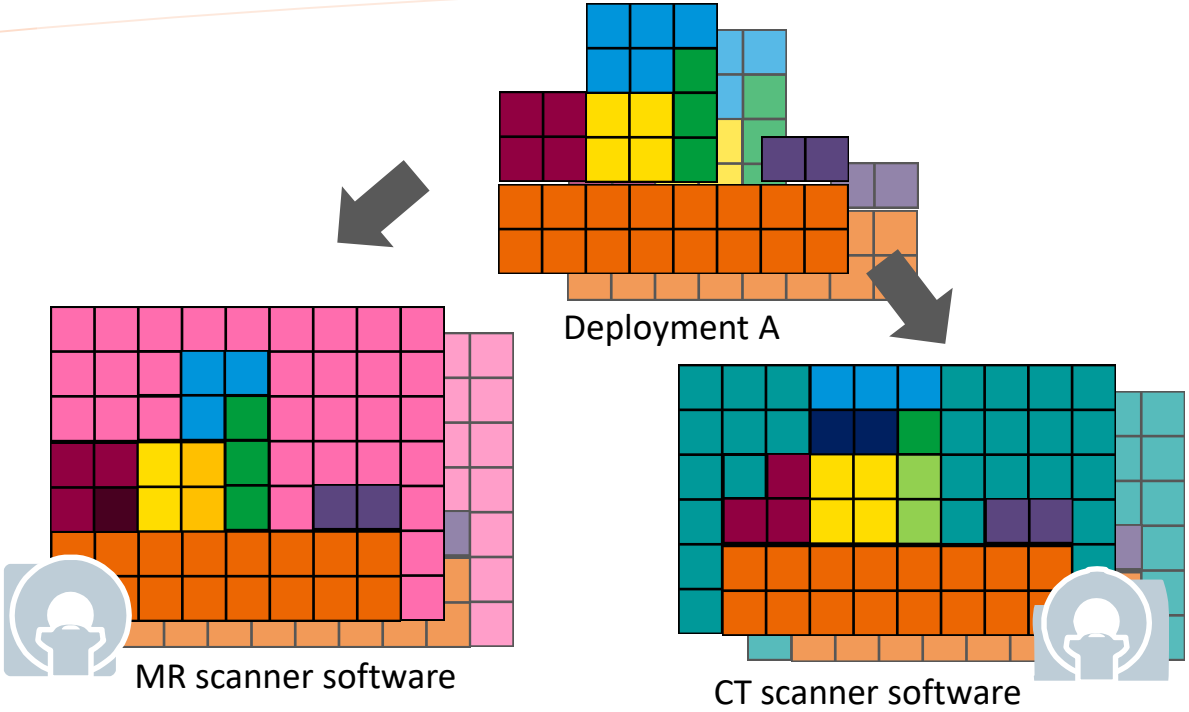
Software platform for imaging devices

Development setup



Platform-based products developed independently

Platform based products are to be developed and updated

- Asynchronously
- Independently from the platform
- At different locations in different countries

And the same applies to hardware

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Software platform for imaging devices

User documentation

User documentation structure follows product structure

- Reflects variance of platform and related products
- Artifacts follow breakdown of platform and product software
- User documentation must follow the product update scenarios
- Platform user documentation will be extended at product level
- Content variants needed at platform, product family, and product levels
- Provided at platform level as reusable artifacts (Lean approach)
- Created off-site and asynchronously at product level

Consequence: User documentation is a **PLM process discipline** and is faced with the same challenges as any other PLM discipline!

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Software platform for imaging devices

User documentation

New challenges for documentation…

- Creating monolithic documentation for an entire turnkey-ready product isn't possible any more
- Documentation has to be created for different products and product types instead of variants of similar products only
- Components of the products are supplied "Just-in-Time"

…and what is necessary to manage it

- Information about feature models, component structures, and product assembly must be available
- Complexity for product tech writers must be reduced
- Variants must be traceable
- Reliable system-based update mechanisms required
- Assembly of user documentation must be rule-based

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Content Management for platform based products

Benefits and limitations of content Metadata

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PI-Class® Metadata can be used to define Digital Twins of content objects

- For **identification** of relevant content and variants…
- For **sorting and shelfing** topics...

…with **pre-defined** document **structures** for variants of similar products which can‘t be set-up and maintained **systematically**…

…because of **missing information** about **product/components configurations** and **relationships**

Digital Twins of entire products and components instead of topics only!

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Content Management for platform based products

Why and how to use engineering information in a CMS?

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With complex platform based products

- Scope of a product and it‘s documentation can‘t be conceived at once
- Product and component information is widespread
- There aren‘t any overarching master document structures

How to manage these challenges?

- Definition, assembly, and update must follow PLM information (Product component models)
- Shared product component models needs to be linked to content objects

What does it mean to the CMS environment?

- CMS can‘t manage these complex, multidimensional information structures
- A system for maintaining and filtering product component models needs to be linked to the CMS

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Working with PI-Ontology

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Working with PI-Ontology

Why do we need it?

Common concepts and methods are limited

- PI classification supports variant management and validity for content objects
- ? It does not consider functional dependencies between and within products and components

- PI based tools in a CMS (publication configurator, project configurator) help to manage documentation for similar products (master structures)
- ? Platform based products are structured differently and not already known (no master structures)

- Variant management works properly if all variants are known while documentation is planned
- ? Platform based products are planned and developed independently, off-site, and asynchronously

Documentation content shall follow product component models and be assembled automatically by explicit rules

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Working with PI-Ontology

Basic ideas

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How to describe a product model

- PLM-based product component models with all relevant dependencies, relations, configuration items are set up and maintained as ontologies
- Components of these models need to be linked to content objects in CMS by P(int)
- PI metadata are based on
  - configuration items
  - component relations
  - cross-dependencies

  and maintained with product and component models

- Selection, assembly, and update of product documentation must follow product configuration like a filter on the full set of products and components

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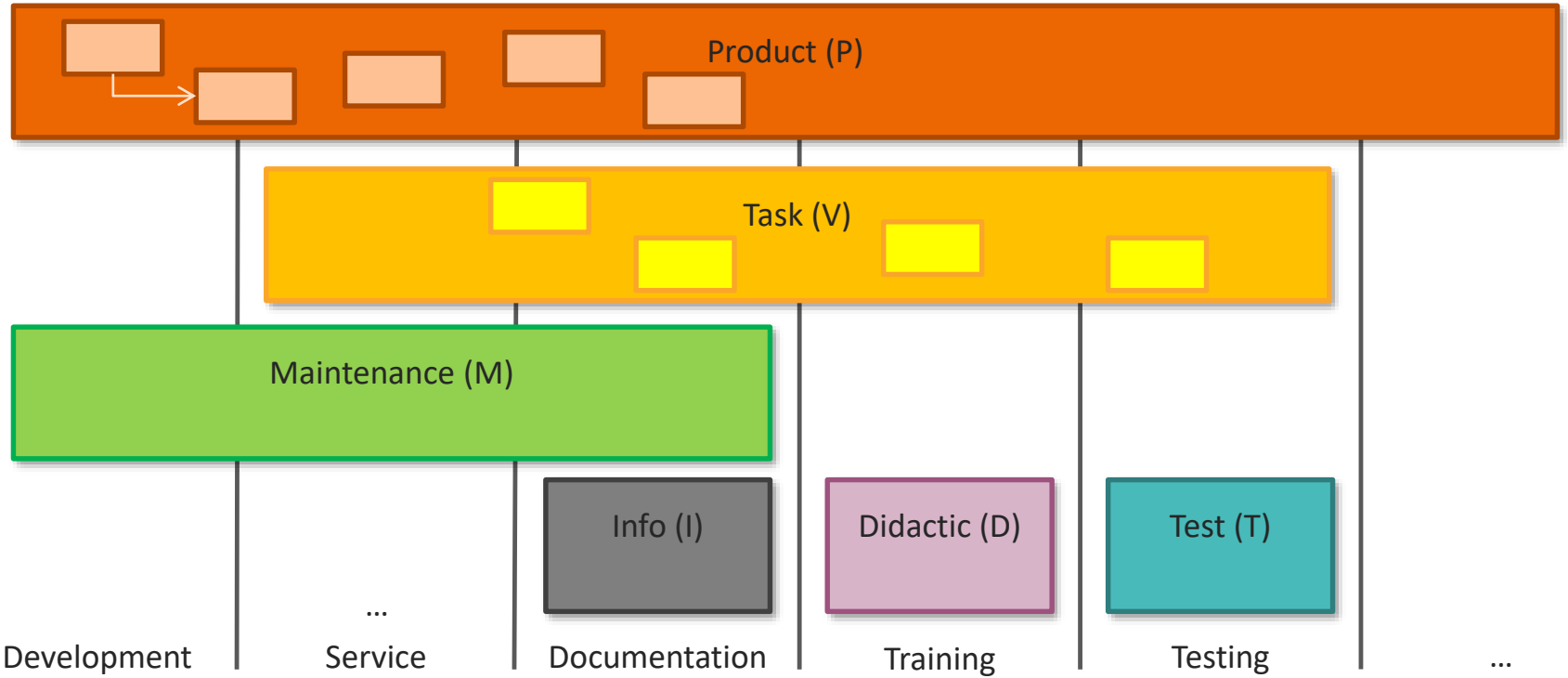
Extended PI©-Classification and it‘s PLM relevance



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How does it work?

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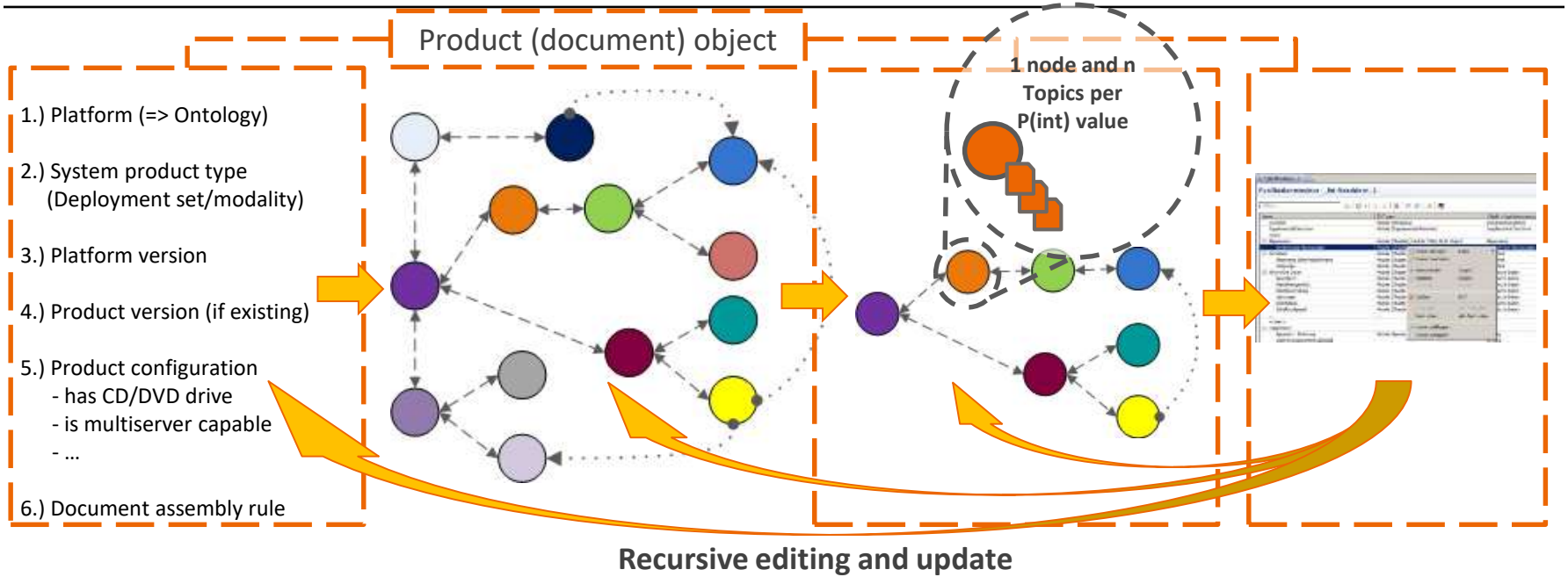
Step 1: Create/update product document profile	Step 2: Retrieval on comprehensive FuncStructure (Ontology)	Step 3: Extract specific product FuncStructure	Step 4: Edit document in PubConf



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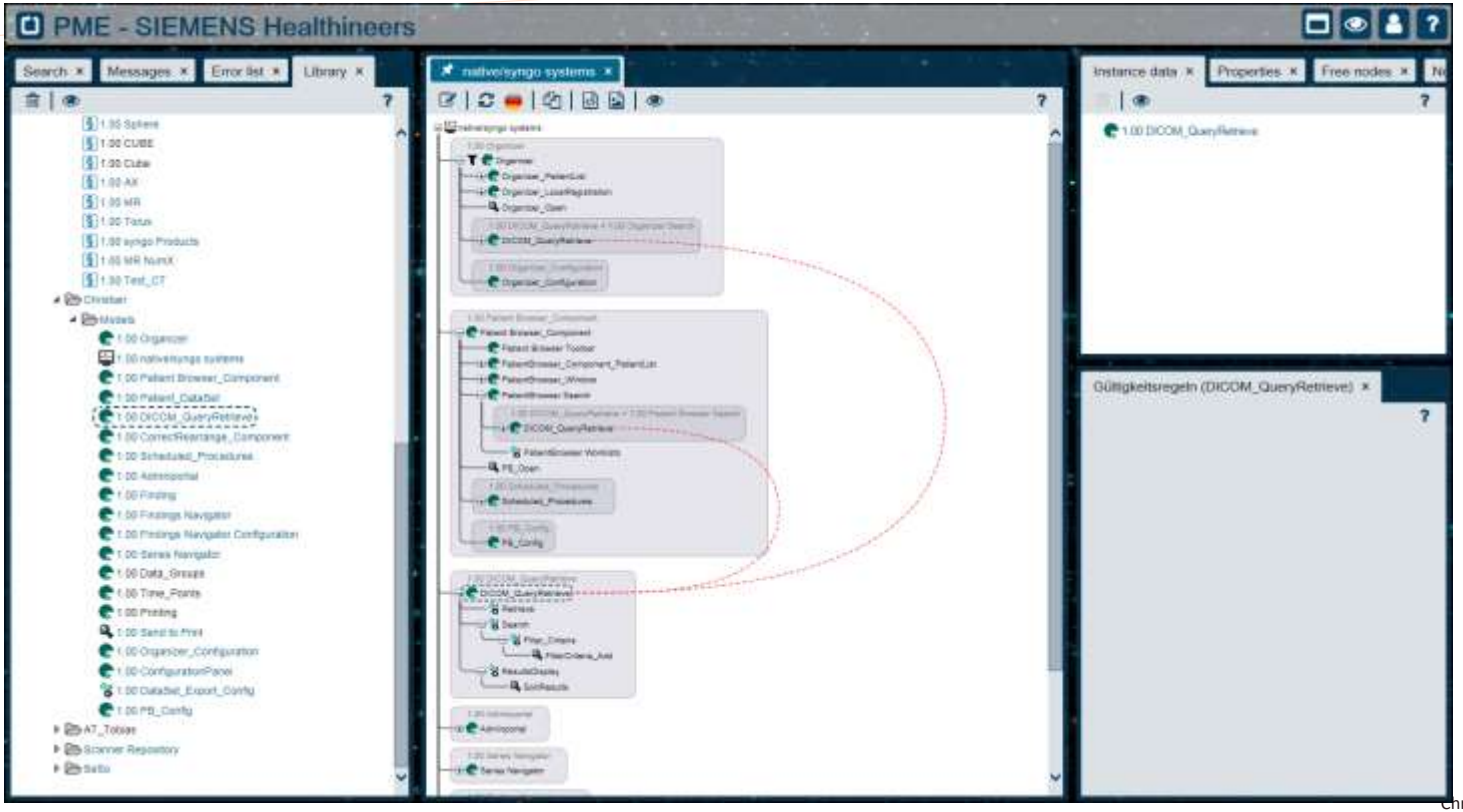
Managing metadata and component models



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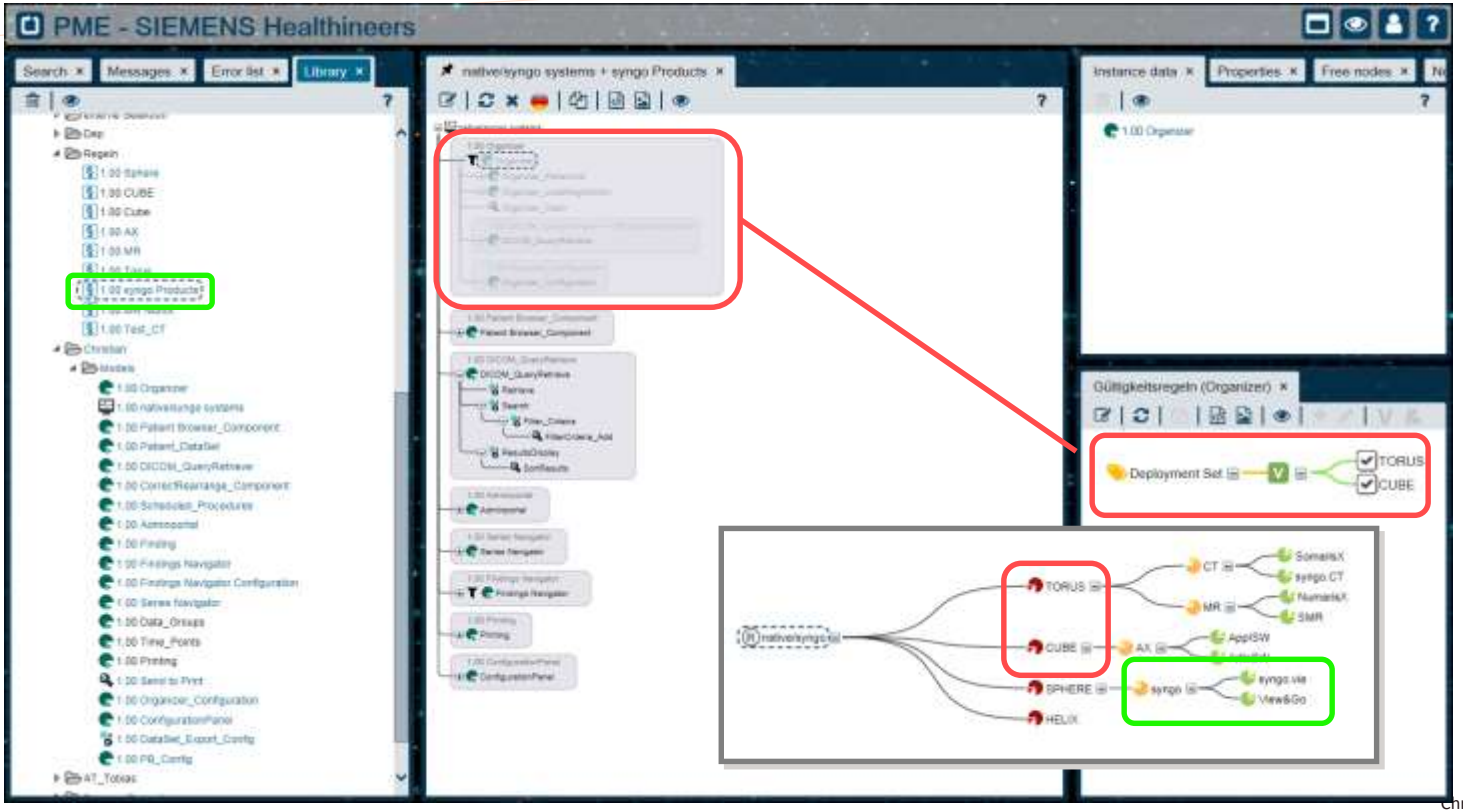
Filtering component models for specific products



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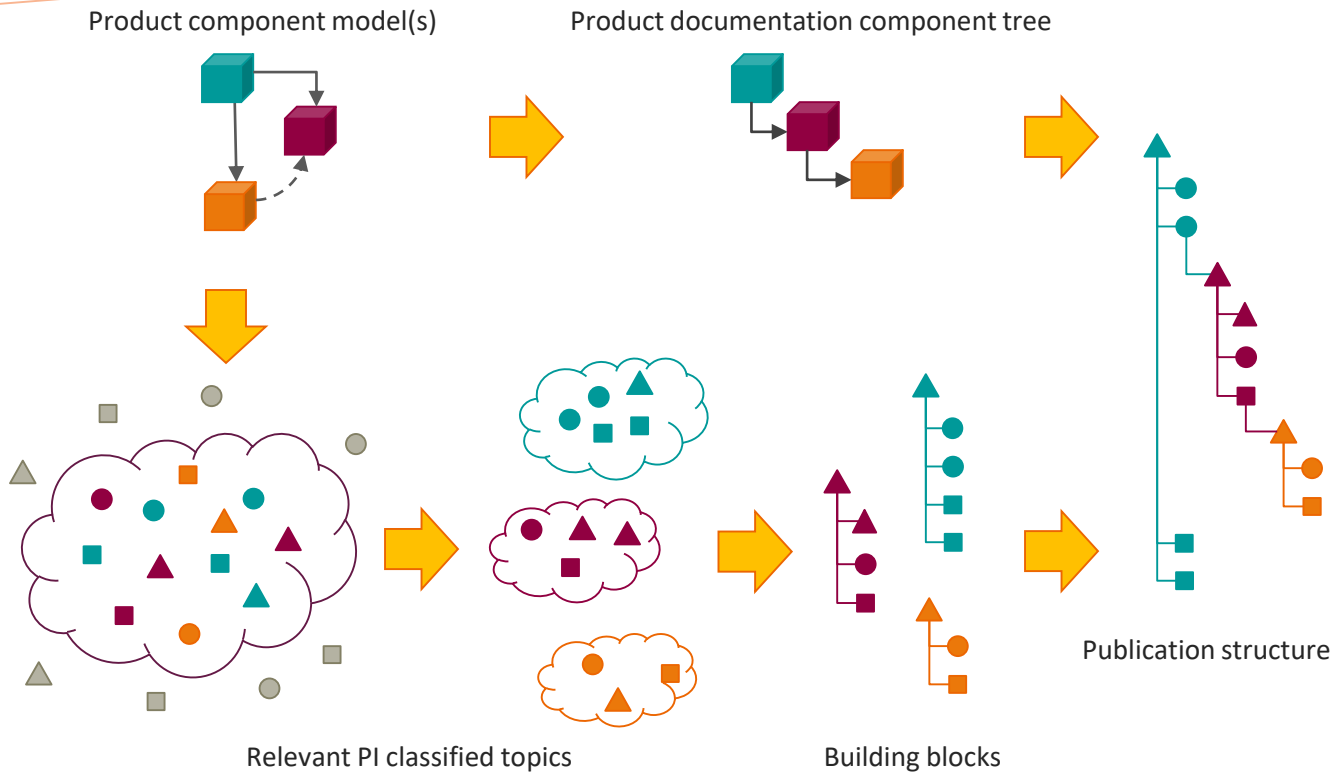
Working with PI-Ontology

Publication assembly based on product models and PI class



Step 1:
Rule based creation of **product documentation component tree**

Step 2:
Selection and clustering of all relevant **topics by P(int)**

Step 3:
Rule based creation of **Building Blocks by I(int)**

Step 4:
Rule based assembly of building blocks and component tree to **Publication Structure**

I(int) domain and Ontology Schema must remain stable!!!

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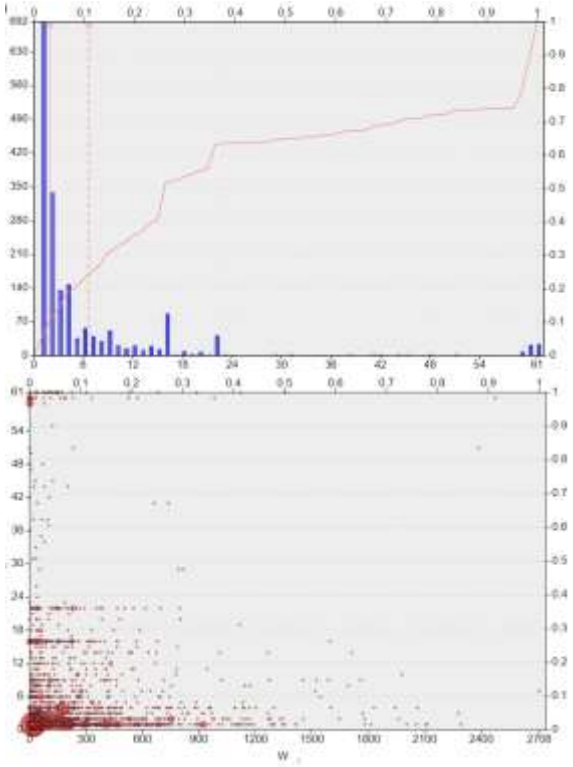
Working with PI-Ontology

Content Intelligence & (REx) Analytics for Quality Assurance

Decentralized and modularized editing and management requires highly automated QA routines.

- Tool-based monitoring, controlling and platform scoping
- Monitored data:
  - Usage of platform content
  - Detection/identification of potentially needed platform topics
  - Reuse of content
  - Quantification of reuse, copies, target publications, translations



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Challenges and outlook

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Challenges and outlook

What will change?

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Basic changes

- Technical documentation will become a product integrating PLM process discipline
- Assembly and update of product documentation will be done automatically based on engineering information
- Use of metadata model over the full PLM lifecycle
- New role profiles, skill sets and tasks in Product Documentation

Process and workflow

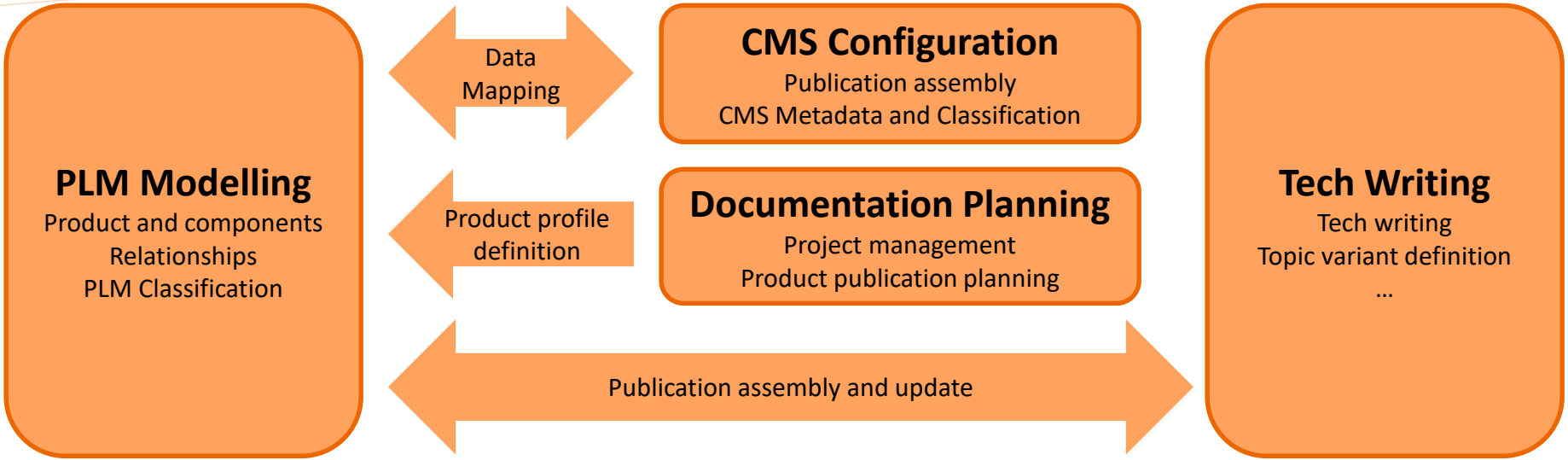
- Products documentation can‘t be planned with only the outer view
- Product documentation will be created with shared responsibilities
- Aligned product documentation processes, quality management and regulations

Tooling

- Metadata maintenance will be coordinated centrally across all „platform customers“
- Documentation data storage and assembly in the CMS
- Better utilization of enriched data in content delivery

Challenges and outlook

Tasks and Skills



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Challenges and outlook
Role profiles

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Product planning

Tasks:

- Modelling components and products in PLM tooling
- Analyzing relationships between (sub-)components
- Defining and maintaining Product Classifiaction data

Skills:

- Deep component and product knowledge
- Analytical skills

Documentation planning

Tasks:

- Documentation product definition
- Documentation project management

Skills:

- Deep understanding of documentation concepts
- Component and product knowledge

CMS Configuration

Tasks:

- Rule based implementation of documentation concepts
- Defining and maintaining documentation classification

Skills:

- Deep understanding of documentation concepts
- Deep understanding of classification and metadata modelling

Technical Writing

Tasks:

- Creating/updating documentation for pre-defined publication
- Variant management on documentation level

Skills:

- Modular writing (topic based)
- Deep understanding of metadata and classification models
- Deep understanding of variant management

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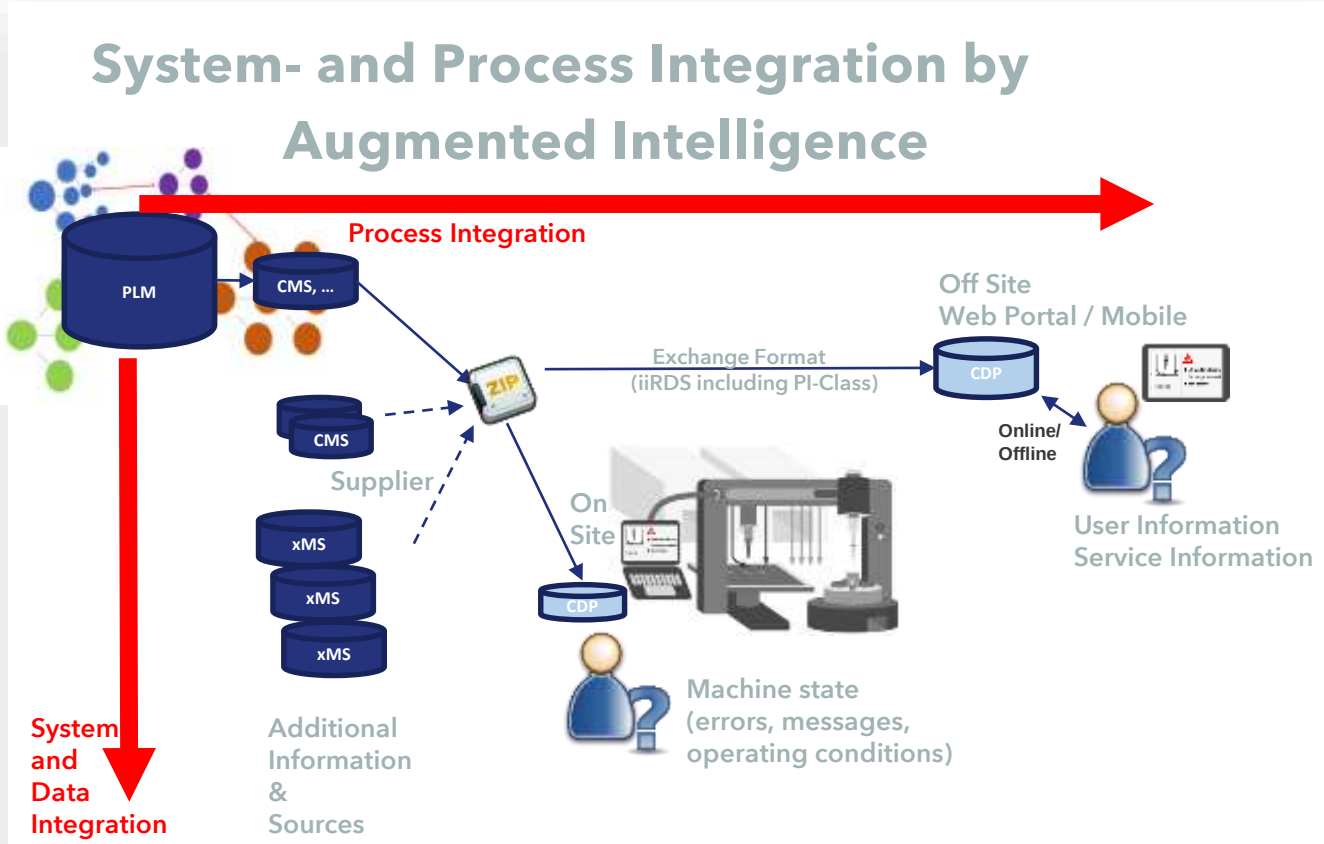
Summary



Semantic metadata in content management for medical imaging devices

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?

I4I CM

ONTOLIS

COSIMA enterprise

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Informationsmanagement und Ontologien

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