Towards creating concept systems for system domains

IEC SyC Smart Cities WG3 “Reference architecture” convenor
IEC SG 12, JTC 1/AG 8, JTC 1/SC 41/WG6, IEC TC 1
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Different types of viewpoints
(following IEC/IEC/IEEE 42010:2011)

1. **Structure** – Smart Cities are SOMETHING (elements)

2. **Aspect** – Smart Cities exhibit SOMETHING (characteristics)

3. **Perspective** – Smart Cities as only SOMETHING (some artefacts)
   - Smart City as an IoT-centric application

4. **Aggregation** – Smart Cities as a full collection of SOMETHING (all primitive artefacts)
   - Smart City as a cyber-physical system

Towards creating concept systems for system domains
A set of viewpoints (11) and model-types (107)

- VALUE viewpoint
- BIG PICTURE viewpoint
- SYSTEM-SOLUTION ENGINEERING viewpoint
- PLATFORM ENGINEERING viewpoint
- PLATFORM COMPONENT ENGINEERING viewpoint
- SOLUTION ENGINEERING viewpoint
- CROSSCUTTING ASPECTS ENGINEERING viewpoint
- CORPORATE viewpoint
- RISK MANAGEMENT viewpoint
- SOFTWARE FACTORY viewpoint
- STANDARDS viewpoint

TOGAF, DoDAF, BIZBok, BABok, JTC1/SC7, CoBIT, ITSM, ITIL, ISO 20000, ISO 27000, ISO 9000, BPMBoK, PMBoK, DevOps, Agile, SCRUM, RM-ODP, ITU unified security
VALUE viewpoint
(nothing about IT and outside-in viewpoint)

- → Problem-space-overview (see 7.2)
- → Problem-space-terminology (see 7.3)
- → Problem-space-specifics-nomenclature (see 7.4)
- → Problem-space-classifications-nomenclature (see 7.5)
- → Stakeholders-nomenclature (see 7.6)
- → Stakeholders’-concerns-nomenclature (see 7.7)
- → Dependencies between generic system stakeholders, stakeholders’, stakeholders’ concerns and categories of concerns (see 7.8)
- → High-level-requirements-nomenclature (see 7.9)
- → High-level-stories-nomenclature (see 7.10)
- → High-level-use-cases-nomenclature (see 7.11)
- → Problem-space-coverage-by-the-high-level-use-cases (see 7.12)
- → The-mission-statement (see 7.13)
- → The-vision-statement (see 7.14)
- → The-strategic-goals-nomenclature (see 7.15)
The context for IEC SyC “Smart Cities”

• We found many models (including concept ones) for Smart Cities, which can’t be used together

• All system domains from IEC, ISO, JTC1 are developed with different terminologies
Many views from many stakeholders in many disciplines
The problem

• The complexity
  – each **system domain** is multidisciplinary
  – a system domain **concept system** is a composition of many concepts from various concept systems - from other system domains and **subject fields**

• An example – 40 concepts for IEC 60050-831 “Smart Cities”
  – 1 concept (“city”) has to be clarified
  – 1 concept (“smart city”) has to be defined (even derived)
  – 35 concepts to be borrowed from other domains and subject fields
  – 3 concepts are joint two concepts – they need only examples

• The problem – how to create and maintain a system domain (e.g. Smart Cities) concept system efficiently and effectively
Potential solution outline

• Theory
  – Terminology
  – Ontology
  – Graphs (sets of vertices and edges)

• Method
  – Decomposition into a set of concept systems with an explicit ownership
  – Procedure for assembling a new concept system from existing concept systems

• Tooling

• Externalising within the IEC SyCs

• Externalising within the IEC TCs

• Externalising within the international standardisation
Decomposition into a set of concept systems

Commonly agreed decomposition of system domains and subject fields (IEC 60050 is a perfect base)
Understanding of potential conflicts

Potential conflicts:
- same term and different definitions
- same definition and different terms
Procedure to avoid conflicts “by-design”

• Each concept system is made as a planar directed acyclic graph

• Consistency of each concept system is formally validated (we need a tool, ideally, ontology based)

• Several agreed rules are used for assembling a new concept system from existing concept systems
  – adopting an existing concept
  – modifying an existing concept
  – defining a new concept

• All concept systems and their elements are versioned

• IEC terminology rules to be adapted for systems work
Clusters of system domain

- **Level 1 Societal (social-technological) cluster**
  - Smart Manufacturing
  - Smart Cities
  - Digital Healthcare
  - ...

- **Level 2 Verticals cluster**
  - Smart Energy
  - LVDC
  - Smart Buildings
  - Smart Homes
  - Active Assisted Living
  - Intelligent Transportation System
  - ...

- **Level 3 Technology cluster**
  - IoT
  - Cloud computing
  - Blockchain
  - BigData and AI
  - Communication Technologies and Architectures
  - Information Security
  - Trustworthiness
  - Digital Twins
  - ...

- **Level 4 Transversal cluster**
  - Terminology
  - Systems approach
  - Digital Transformation
  - Architecting
  - Organisation of work
  - Organisation of society
  - Urban
  - IT
  - Operations
  - Trustworthiness
  - ...

- **Level 5 Universal cluster**
  - Miscellaneous
Questions?

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