

Technical aspects of digital integrated decommissioning support systems and prospects with ISDC based costing

DigiDecom 2021, March 24th 2021, Halden, Norway
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Virtual conference presentation



This project has received funding from the EURATOM Research & Training Programme 2014-2018 under the Grant Agreement n°899990. The content of this document reflects only the author's view. The European Commission is not responsible for any use that may be made of the information it contains.

What is ISDC?

- International Structure for Decommissioning Costing of Nuclear Installations (IAEA/OECD, 2012)
- Standardised **checklist of decommissioning activities**
- **Benchmarking platform** for nuclear decommissioning costs
- 3-level deep & **extendable WBS** for nuclear decommissioning projects
- Can be used also for project management (not only for costing)

ISDC Top-level activity groups

1. Pre-decommissioning actions
2. Facility shutdown activities
3. Additional activities for safe enclosure or entombment
4. Dismantling activities within the controlled area
5. Waste processing, storage and disposal
6. Site infrastructure and operation
7. Conventional dismantling and demolition and site restoration
8. Project management, engineering and support
9. Research and development
10. Fuel and nuclear material
11. Miscellaneous costs

ISDC Cost categories

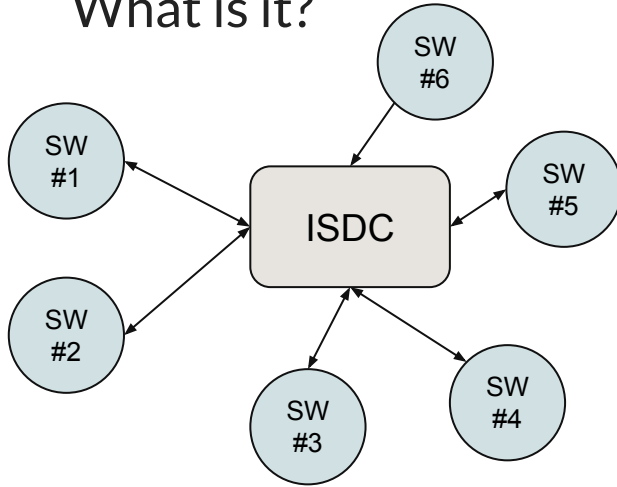
- Labour costs
- Investments
- Expenses
- Contingency

ISDC Costs - the principle in brief

- Activity cost = Labour Costs + Investments + Expenses + Contingency
- Bottom-up approach - costs of lower-leveled activities are aggregated at the upper level
- Costs of top-level activities are the sum of costs all activities below
- The most tricky part of cost estimates = Costs of waste management (Top-level activity #5)

ISDC based integration for support of decommissioning projects

What is it?



Why it is important?

- Common project activity schedule across all decom-support SW tools
- Cost benchmarking and standardised presentation of cost estimations
- Common WBS structure for project management

AquilaCosting - ISDC-based SW for estimating overall decommissioning costs

The screenshot displays the AquilaCosting software interface, which is ISDC-based. It is divided into several panels:

- Left Panel (Navigation):** Contains icons for Costing case overview, Site structure, Inventory database, Cost estim. structure, Waste management, Calculation parameters, Cost calculation, Results and reports, Project schedule, and LiveDecom Demo.
- Top Panel (Costing case overview):** Shows the 'DEMO RESEARCH REACTOR - COPY 1' project. The 'Site structure' is defined as 'Demo Research Reactor facility' with a hierarchy: Reactor building (+0,0) > Reactor hall > Reactor itself (-3,5) > Pool water storage room > Reactor main cooling system room.
- Inventory Database Panel:** A table listing inventory items with columns for Name, Mass [kg], Category, and Site structure object.

Name	Mass [kg]	Category	Site structure object
Decontamination of building surfaces	0,00	Mechanical decontamination of building surfaces	Reactor hall
Pool water storage tanks - 2 pc	600,00	Tanks - Carbon steel	Pool water
Pipes and valves to empty the reactor tank	100,00		
Monitoring vessel - lead shielding	100,00		
Sump pump	20,00		
Ion exchanger	65,40		
- Cost Estimation Structure Panel:** A hierarchical tree of activities for dismantling the reactor vessel and core components. The selected activity is '04.0502 Dismantling of reactor vessel and core components'. The tree includes: 01 Pre-decommissioning actions, 02 Facility shutdown activities, 03 Additional activities for safe enclosure or entombment, 04 Dismantling activities within the controlled area, 04.0100 Procurement of equipment for decontamination, 04.0200 Preparations and support for dismantling, 04.0300 Pre-dismantling decontamination, 04.0400 Removal of materials requiring specific procedures, 04.0500 Dismantling of main process systems, structures, and components, 04.0501 Dismantling of reactor internals, 04.0502 Dismantling of reactor vessel and core components (selected), 04.0503 Dismantling of other primary loop components, 04.0504 Dismantling of main process systems in other areas, 04.0505 Dismantling of main process systems in other areas, and 04.0506 Dismantling of external thermal/biological systems.
- Activity Characterisation Panel:** Shows the 'ISDC number' as '04.0502' and the 'Name' as 'Dismantling of reactor vessel and core components'. It also displays a warning: 'INVENTORY ITEM NOT SELECTED. This calculation procedure requires an inventory to be selected. Select an inventory or change the calculation procedure.'
- Calculation Parameters Panel:** Shows the 'Start of activity' as '29.08.2042'.

Site structure & inventory database is a "BIM part" of the software

ISDC-based configuration of calculation inputs is linked to the BIM, too

AquilaCosting - ISDC-based SW for estimating overall decommissioning costs

Configuration of waste management streams and cost factors is comprehensive

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PLEIADES

Smarter Plant Decommissioning



- Project aiming to create BIM-based integrated decommissioning support system
- Standardization efforts in terms of decommissioning ontology and software integration principles
- First prototype will validate the idea by simulating small decommissioning activities (e.g. dismantling the valve in the primary circuit or similar)

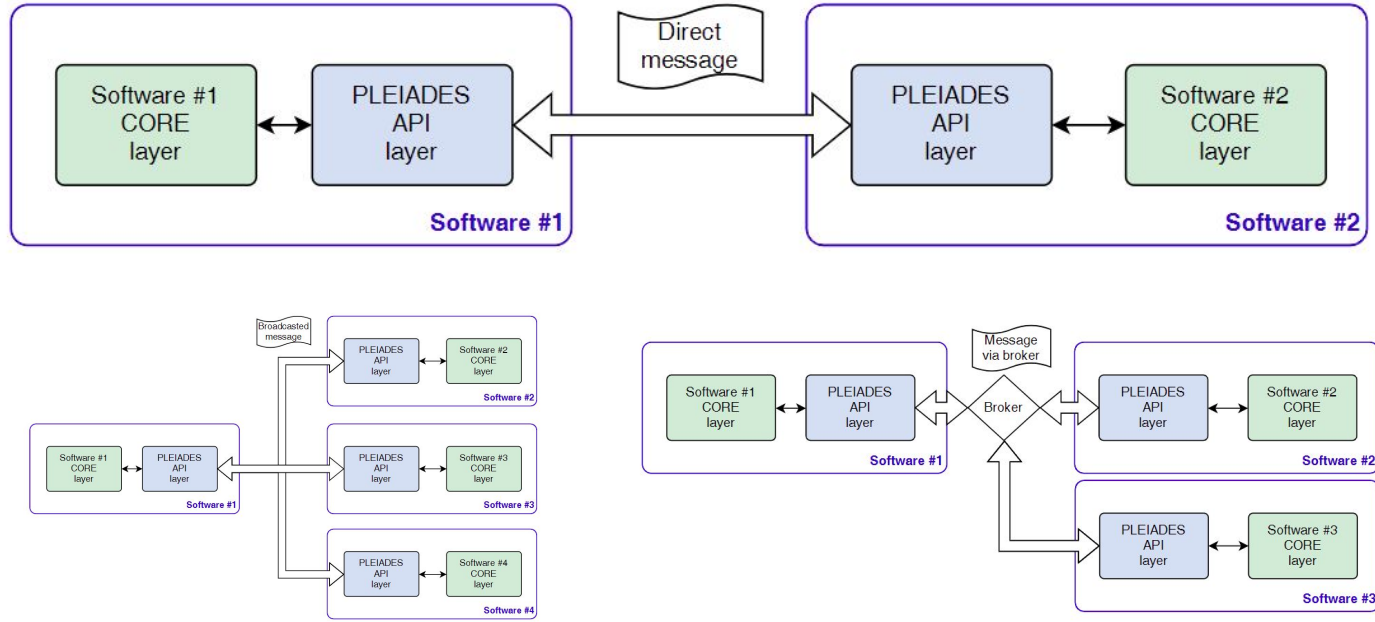
PLEIADES vs. ISDC

PLEIADES	ISDC
First prototype is only for small portion of decom projects	Covers all decom activities
Costing only for simulated work orders / scenarios	Costing covers also project management, waste management, research etc.
Defines standardized API interface for compatible softwares	Defines standardized list of decommissioning activities

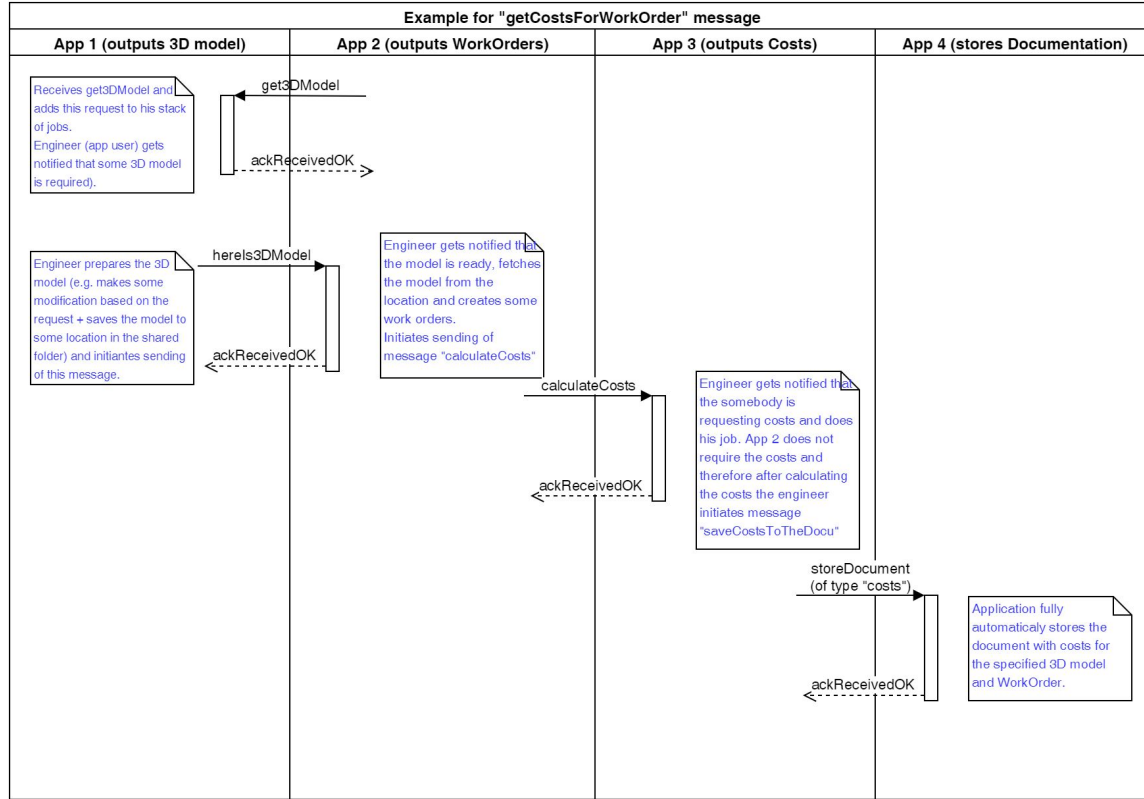
Messages - a way to communicate

- 1) A “message” is a basic communication entity with relatively small payload. Analogy: an email without any attachment.
- 2) Messages are of different types, are transferred using API (potentially REST API) and can link to a file in a Shared Folder (e.g. to a point cloud file) for accessing large payloads.
- 3) Message has its structure defined by its type.
- 4) Each message has a sender and
 - a) one recipient (= app),
 - b) can be broadcasted to all apps.
- 5) Asynchronous communication is necessary while not all actions can be done automatically (require human interaction)

Messaging network alternatives



Example of message flow



Technical aspects

Barriers

- Hard to specify the common API
- Variety of software tools
- End-user adoption
- ...

Enablers

- Common ontology
- More efficient planning
- Single source of truth (both for inputs and for documentation)
- ...

✓ **Barriers and Enablers will be discussed at the discussion Group #2.**

Thank you

Let's meet at the discussion Group #2.

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