D&D: Innovation for Strategy and Early Scheduling Decision Support Tool

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La force de l'engagement[MD]

Innovation to support Nuclear D&D

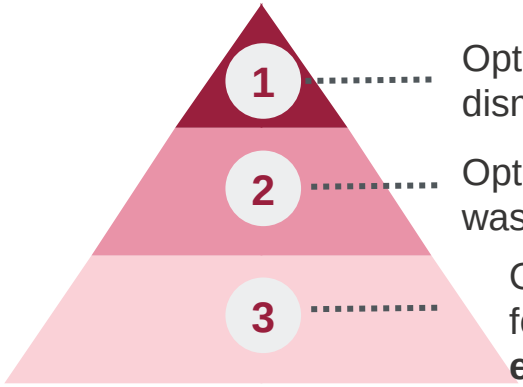
D&D nuclear unit
from 350/500 million € to 1 billion €

Simultaneity of a large number of units
About 110 stopped
200 units added in the next decade

Concertation phase - 5 to 7 years
Several stakeholders: Operator, Nuclear Autority, Main Sub-contractors

Cost reduction
More reliable strategy
Connected to strong early scheduling

Analysis and optimization tools backed by "Big Data" solutions to read operational excellence
Important data volumetric, predictive algorIthm, historical data, constraints, optimization…



Optimization of **investment strategies** for dismantling a reactor – First of a kind

Optimization of pre-planning for dismantling and waste management of a reactor

Optimization of **strategies and pre-planning** for **several units,** to benefit from **the scale effect and cost reduction**

To **assist** in the decision the definition of **immediate, deferred or mixed dismantling** strategies

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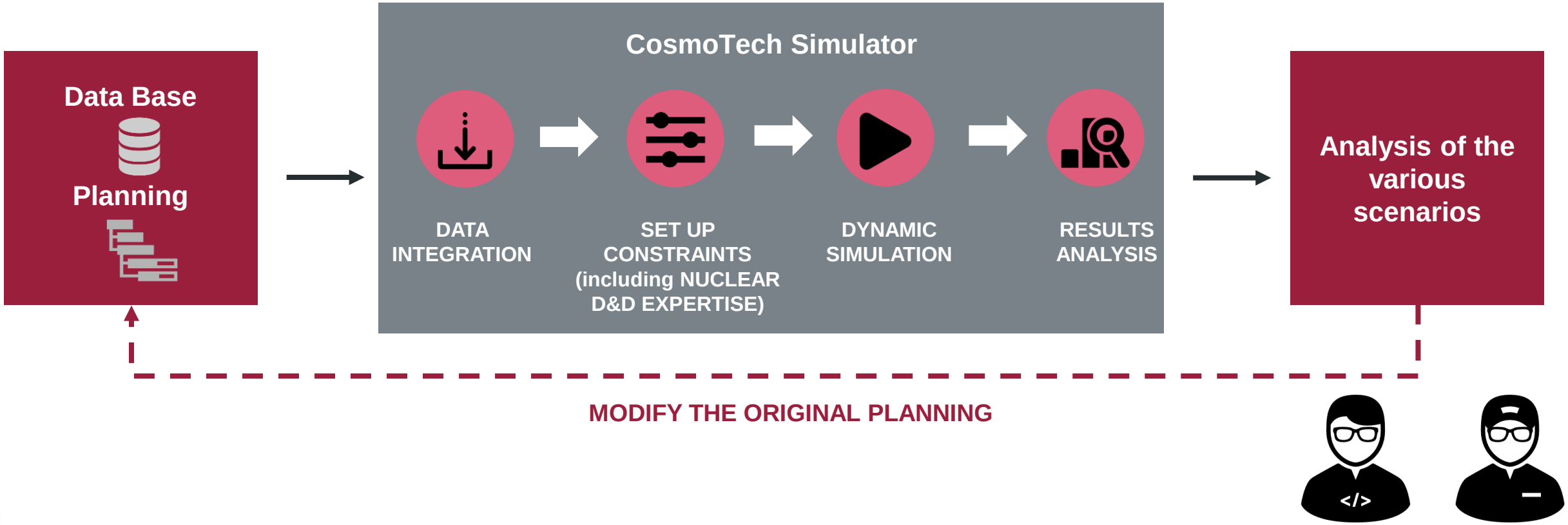
A proven methodology in the industrial sector, responsive to D&D challenges

#1: Optimizing Investments for an Electrical Network Manager
#2: Optimization of nuclear unit outage schedules (for a French nuclear operator)



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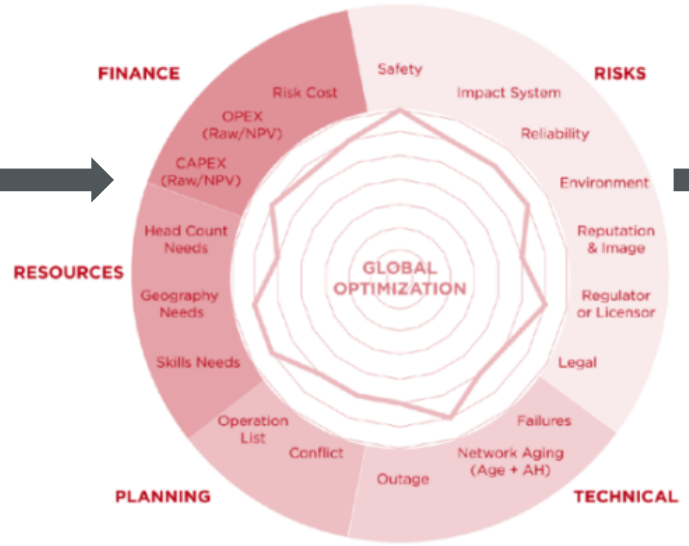
#1 – Optimization of investment strategies

Define a first of a kind dismantling strategy and make the best strategic choices in terms of investment (OPEX, CAPEX), having a holistic vision and keeping track of previously evaluated scenarios

Examples of input data

- Strategy for equipment and spent fuel,
- Strategy for waste management,
- Strategy for the removal and cutting of materials,
- Strategy for the redeployment of support functions,
- Strategy for technical choices,
- Strategy for obtaining authorizations.

Analysis tool



Examples of output

Multiple scenarios to carry out a strategic reflection and to **define the optimal strategies** related to:

- Radiological and chemical characterization, Scope of the work,
- Reconfiguration of support systems, Decontamination
- Removal of hazardous materials, …

Optimization under stress: cost, risk policy and dosimetric assessment

The record of the history of the various strategies (in connection with pre-planning)

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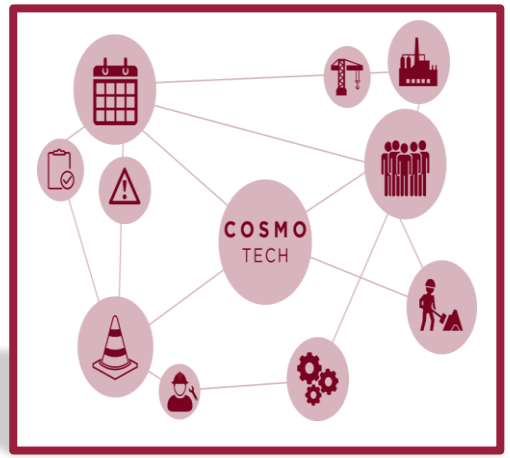
#2 – Support for pre scheduling operations

Optimize the pre-planning of unit D&D and waste management operations during negotiations with Nuclear Authorities, waste facilities and contractors, in line with the defined D&D strategy

Examples of input data

- start date of operations (areas of immediate and differed dismantling)
- Support system configuration (ex “Cold and Dark” situation)
- Level of activity of equipment
- Level of site restoration (brownfield, greenfield)
- packaging, waste treatment and storage solutions (ex “Rip and Ship”),
- Availability of outsourcing (HR issues ...)

Analysis tool



Examples of output

- Sensitivity, stress test, domino effects
- KPI planning, durations, costs ...
- Consolidation and feasibility of existing pre-schedules: Optimized prescription, Impacts on activities to plan
- Logistics (supplier delivery reliability, disposal site availability, approvals, and general unexpected delays such as weather)

=> O**perational reflection** on the **methods and technologies** identified for D&D, connected with industrial partners and safety authorities.

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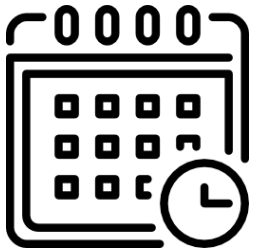
After treatment by our methodology and analysis tool: Provide a Decision Support Tool

SIMULATE STRATEGIC and/ or OPERATIONAL CONSTRAINTS

- Regulatory authorization input (ex level of releases)
- History of the unit
- Installation constraints
- Chemical and radiological characterization
- Chronology of the operation
- Decontamination
- Waste management system
- …



DATA PROCESSING CONFIGURATION

- Default values or custom completion rules in case data is missing.
- Tasks creation for work that is not explicitly scheduled.
- Cross-database incoherence handling.

RUN TIME BEHAVIOR

- Dynamics for equipment state changes.
- Human resources
- On-field contextual reactions:
- Daily priority reviews.
- Daily consignment. conflict resolution

LOOP BETWEEN STRATEGY & PRE SCHEDULING

- Identification of impacts on strategy or pre scheduling if any changes
- Record of historical choices

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Thank you

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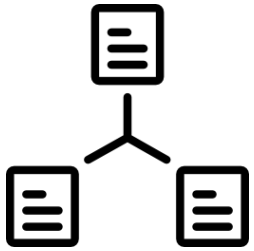
Securing data collection

MODEL-DRIVEN DATA COLLECTION

- Data collection based on model needs.
- Only data contributing to the model has to be collected.

SENSITIVITY ANALYSIS TOOLS

- Quantification of the model sensitivity to specific data.
- Data collection effort can target the most critical data.



AUTOMATED DATA INTEGRATION

- Data uploaded to relational databases through ETL (Extract Transform Load) data integrator.
- Data secured through encryption and authentication protocols.

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The partners

The deploy of this Proof Of Concept will be lead by CGI with its partners – CosmoTech and one expert

CGI

- **CGI will bring a strong knowledge of the EDF context** - including all the aspects related to D&D planning and nuclear waste management. This concerns both business issues and information systems.
- More precisely: **CGI Business Consulting** contributor will bring a "core business" knowledge of decommissioning processes and nuclear waste management. They will ensure the link between the EDF experts and the CoSMo modeling and development teams

COSMOTECH

- **CosmoTech** is a technology company offering simulation platforms for complex systems - combined with constrained optimization algorithms. It has several industrial references (RTE, EDF, ENEDIS, GRTGaz, Alstom, SNCF, Veolia, Sanofi ...).
- The **CosmoTech** solutions aim to analyze and quantify the coupling between systems, to deduce "open" simulation models, and to generate scenarios / define optimization models that fully integrate risk management.

- **Integrated Nuclear Engineering Solutions (including D&D expertise):** Gérard Laurent

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Detailed approach

Methodology

The approach for this PoC will be based on CosmoTech's own methodology, focusing on the following steps :

- Qualification of the requirement - general description of modeling and optimization issues,
- Realization of a "complex system modeling" workshop ("CCTA workshop"),
- Identification of key systems and realization of a design document for the modeling part,
- Development of a first version of the model - including first coupled models,
- First sensitivity analysis (allowing a first quantitative analysis of data and models),
- Realization of a second iteration,
- Development of a graphical interface.

The duration for the realization of this model would be **4 months**. The PoC will mobilize modeling teams (CosmoTech) and nuclear consulting competencies (CGI and experts) - but also client experts, to identify most relevant investment choices in the framework for decommissioning projects.

The mobilization of client contributors will focus on: the initial workshop (1d); functional workshops involving sectoral expertise (5 * 0.5d); frequent exchanges related to project monitoring; methodological validations concerning the modeling ...

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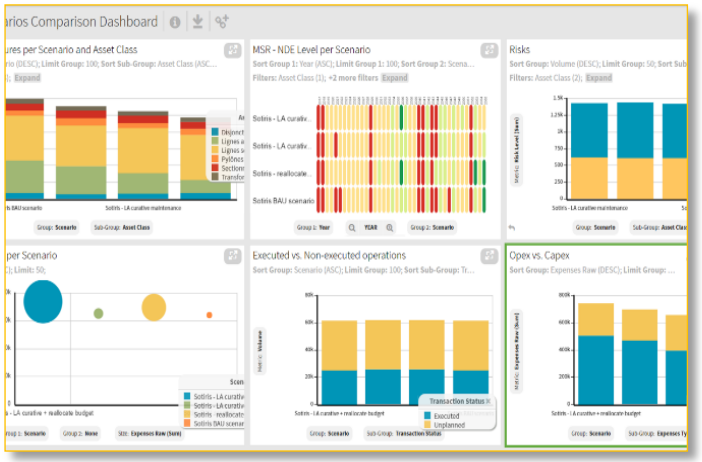
Optimizing Investments for an Electrical Network Manager

Targets:

Develop a decision support tool on optimization of maintenance and investment strategies for the utilities sector

Enable utilities **to simulate maintenance,** component replacement and **optimization programs** for these programs; study of the impacts on the electricity network and the organization of the performance of the output products

Deliver a **method** that can **be audited and replicated** to internal teams, but also **justify investment** to decision makers



Benefits:

Improve visibility on risks in the short and long term

Justify the CAPEX and OPEX strategies according to the quality of the maintenance operations and not only their frequency

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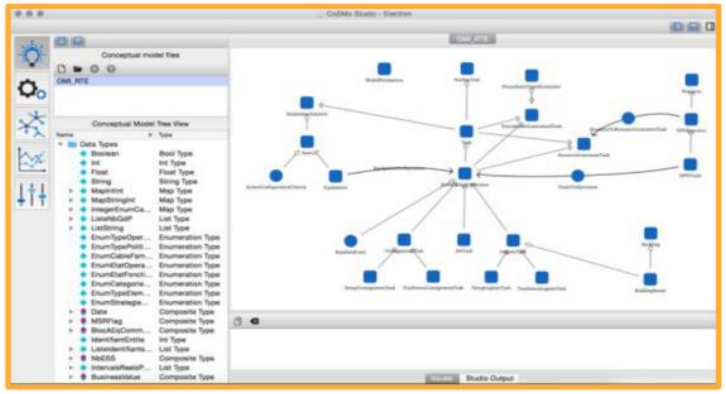
Optimization of nuclear unit outage schedules

Targets:

Resolve operational conflicts taking into account various types of constraints (small premises, availability of several equipments, human resources, co-activity ...**)**

Improve schedule reliability by simulating a nuclear unit outage, including:
- Modeling cascading effects for unplanned events
- The proposition of what-if scenarios, based on probabilities



Benefits:

Properly planned tasks according to all the **constraints** of the outage

Optimization of project management, including the allocation of human and material resources, as well as the prioritization of specific tasks

A nuclear unit outage project **team mobilized** around the joint construction of the planning and sharing a **common vision** on the on issues and objectives

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Our engagement

We carry out each mandate for one purpose:
to contribute to the success of our clients