ENABLING SUCCESSFUL NUCLEAR CONSTRUCTION

INTEGRATING DESIGN, SUPPLY CHAIN AND SITE ACTIVITIES THROUGH THE DIGITAL THREAD

DASSAULT SYSTEMES

INTRODUCTION

In our collective journey to Net Zero, the construction of new power generating assets is essential to decarbonise transport, to heat buildings, and to power industry & businesses, as well as provide national energy independence. New civil nuclear power plants are expected to play a key role in the energy transition, alongside other forms of energy generation, storage and demand side management. Recent Nuclear Energy Agency analysis (NEA no. 7628) finds that meeting the average of the International Panel on Climate Change pathways consistent with a 1.5°C scenario will require tripling global installed nuclear capacity by 2050.

New build civil nuclear power plants can be grouped into three main types:

- Gigawatt-scale reactors. Massive infrastructure projects such as Hinkley Point C in the UK. These use existing designs which focus on plant scale to maximise the long-term Levelised Cost Of Electricity[1].
- Small modular reactors (SMRs). Based on evolution of proven Generation III or more novel Generation IV fission technology, where a focus on production rather than plant scale allows design simplicity, standardization, and factory fabrication to lower capital cost.
- Fusion reactors. The fusion energy market is gaining significant investment as governments, private companies and research institutions race to turn decades of research into low cost, lower environmental impact power generation.

All nuclear new build projects face a number of challenges around regulatory compliance, workforce & skills availability, cost of development & construction.

As a technology leader driving innovation across a range of industries, Dassault Systèmes believes now is a critical moment to stimulate digitally transformational conversations in nuclear.

We focus on 3 pillars of business sustainability:

PEOPLE - The required workforce growth & upskilling challenges necessitate solutions that will empower and optimise teams.

BUSINESS MODELS - Following a data-centric approach in new nuclear build is the key to improved efficiency, sustainability, and predictability.

PRODUCTS - Our **3D**EXPERIENCE platform helps reactor vendors, construction companies and supply chain partners collaborate & mitigate risks that have the potential to undermine successful delivery.

[1] Levelised Cost of Electricity: average cost of the lifetime of the plant per megawatt-hour of electricity generated (BEIS Electricity Generation Costs report, Aug 2020)

THE DIGITAL ADVANTAGE

The plant lifecycle can be viewed as a series of connected decisions; the ability to make effective decisions is therefore critical to successful delivery of a plant from concept through to decommissioning. Dassault Systèmes believes effective decisions need to be informed, traceable, timely, and communicated. Data-centric methods such as PLM and BIM Level 3 can play a significant role in all four aspects of effective decisions in the Manufacturing & Construction phase of a project:

Product Lifecycle Management (PLM)

Product Lifecycle Management (PLM) is the process of managing a product, and the data associated with it, through every stage of its lifecycle.

PLM has developed to manage complexity and collaboration across disciplines; it is well established in manufacturing industries where it contributes to significant productivity improvements. PLM compliments the use of Systems Engineering[2] methods to bring innovative products to market quickly.

Building Information Modelling (BIM)

BIM has been the Design & Construction industry's answer to improve the flow of data through the building process, and, therefore, help to create efficiencies.

More and more benefits are gained with each BIM Level of Maturity (Level 0 to 3). The most advanced state, BIM Level 3, is achieved when building data is fully "transactable" across project contributors, not locked in proprietary systems.

Informed: An effective digital strategy democratises data, revealing the right information to empower effective decisions at every level.

Traceable: Robust systems to manage and record change provide a trusted data set to underpin reliable decisions.

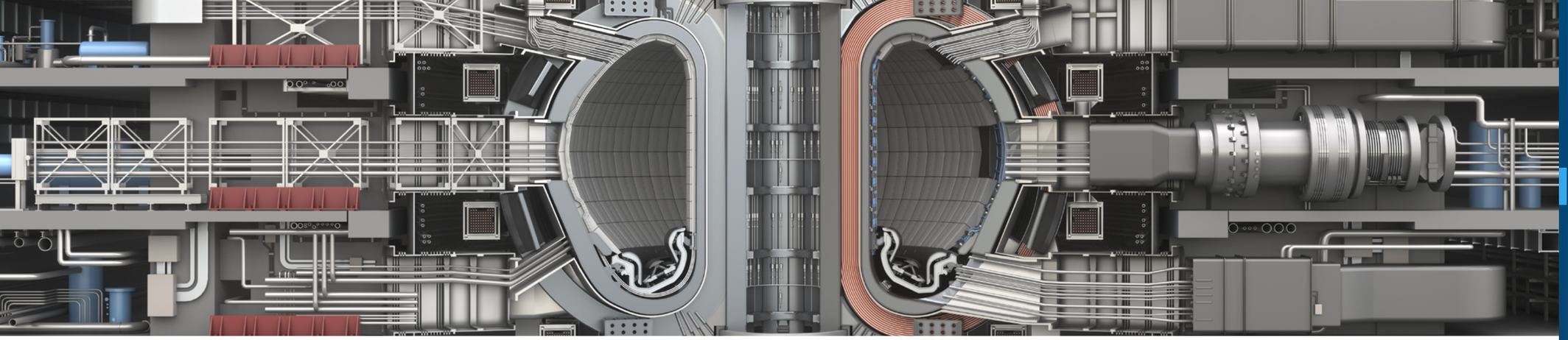
Timely: Less time spent finding and validating information results in faster decisions, reducing the time and cost of change.

Communicated: Effective communication enables efficient action following a decision, reducing re-work and delays when things change.

While the 3DEXPERIENCE platform provides solutions that can support the whole lifecycle, from pre-concept design through to decommissioning, this eBook focusses on the manufacturing and construction phase, and four areas where Dassault Systèmes solutions support the transformation of people, business models and products through effective decision intelligence:

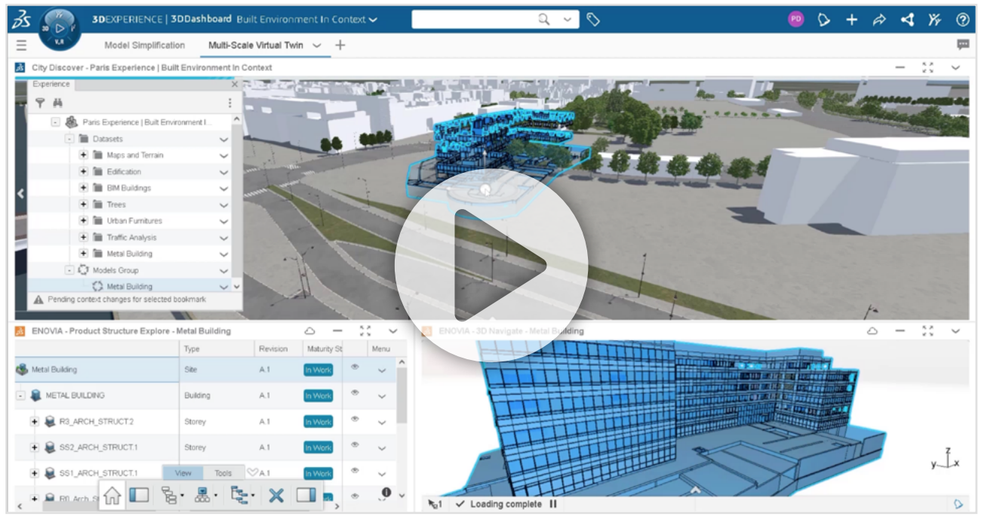
1. Design Coordination: achieving an effective design by applying discipline expertise to an up-to-date common reference.
2. Supply Chain Integration: maintaining the construction pace with timely access to assets and their quality records.
3. Construction Management: building a productive site by putting the right equipment and people in the right place at the right time.
4. Site Connection: providing site access to the latest information and live feedback to support construction management.

[2] **Systems Engineering:** https://www.incose.org/about-systems-engineering/system-and-se-definition/systems-engineering-definition



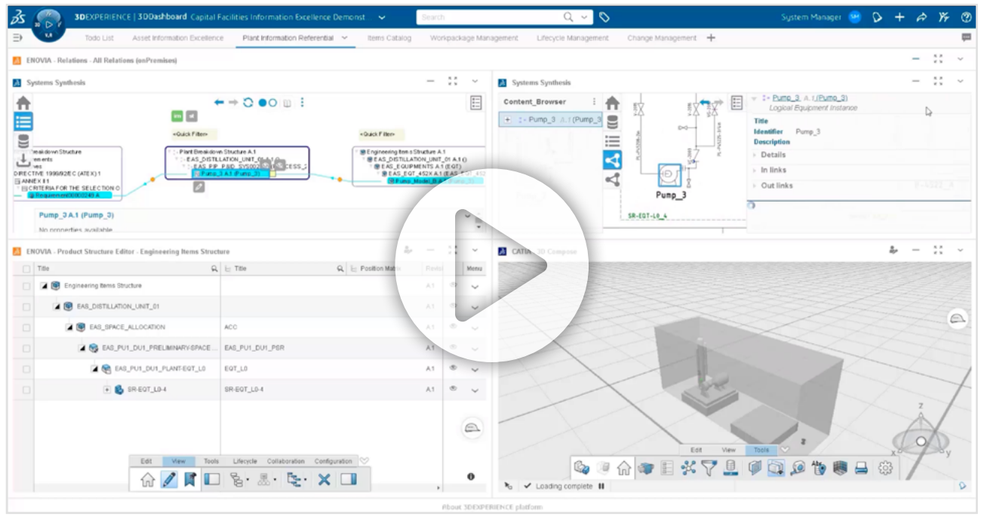
DESIGN COORDINATION

With multiple companies involved in the design of each plant system or sub-system, management of any design changes during construction must be seamlessly coordinated in order to avoid costly rework and schedule delays. Additionally, demonstration of compliance to requirements (including regulatory conditions) is essential. The **3D**EXPERIENCE platform is able to assimilate all project and asset information in a unified environment, integrating with other software providers' solutions, allowing relevant project stakeholders to collaborate. Ultimately, this enables an increase in the speed and effectiveness of decision making.



PLM & BIM working together

- Empower the construction supply chain to leverage their existing investment in BIM tools and processes.
- Take a data-centric approach and connect the BIM models with the Product Breakdown to connect the execution design with everything that came before it.
- Ensure the construction detail is retained against the Product Breakdown to support operations and maintenance.

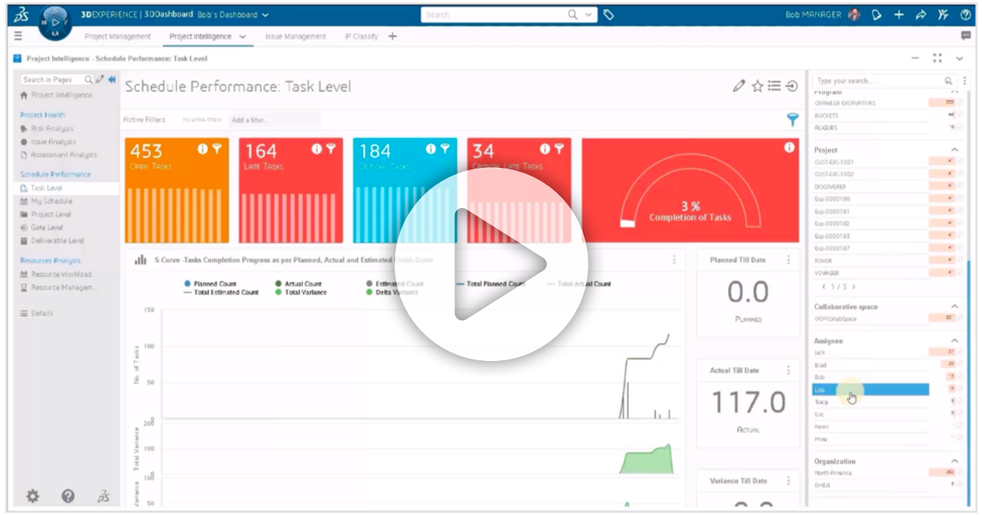


An accessible, up-to-date design reference

- Aggregate engineering, regulatory, commercial, environmental, societal, and governance information into a common referential to make the right information visible to the people who need it.
- Connect and simulate 1D (requirements & functional design) to the 2D (system) and 3D (layout and detail) design to support effective and efficient design decisions, utilising systems engineering tools.

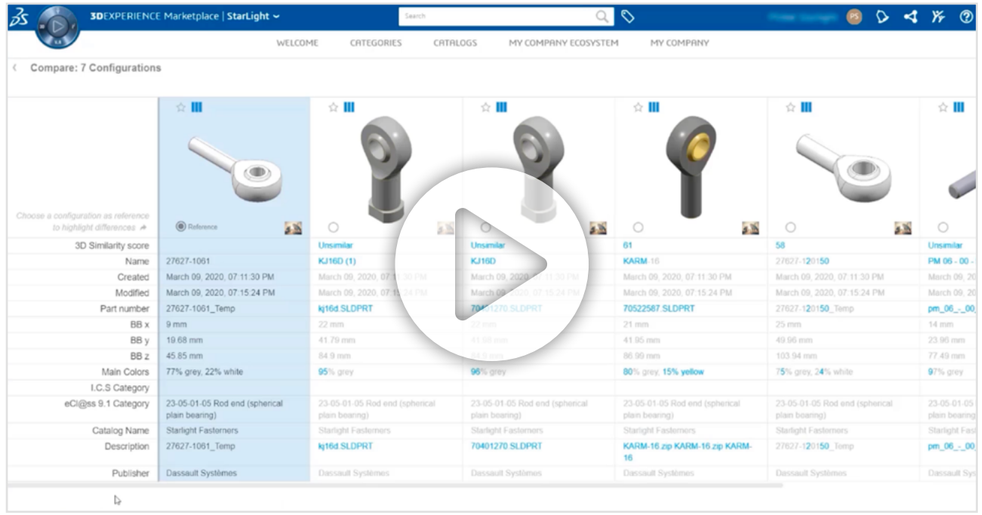
SUPPLY CHAIN INTEGRATION

Supply chains in nuclear construction projects can be vast and complex, which lead to challenges in co-ordinating logistics and site activity, resulting in potential construction delays. Long lead times for manufacturing of certain items, alongside complex logistics for transporting large components, modules & equipment to site, impart risks which must be managed. Components and materials have stringent quality requirements, and compliance must be demonstrated, documented and accessible.



Flexible Work Packages to Manage Interfaces

- Connect site activity to the relevant assets, equipment and documentation, in a collaborative data environment.
- Clear visibility and accountability for risks and issues.
- Easily monitor overall performance and enable pro-active decisions to maintain the schedule.

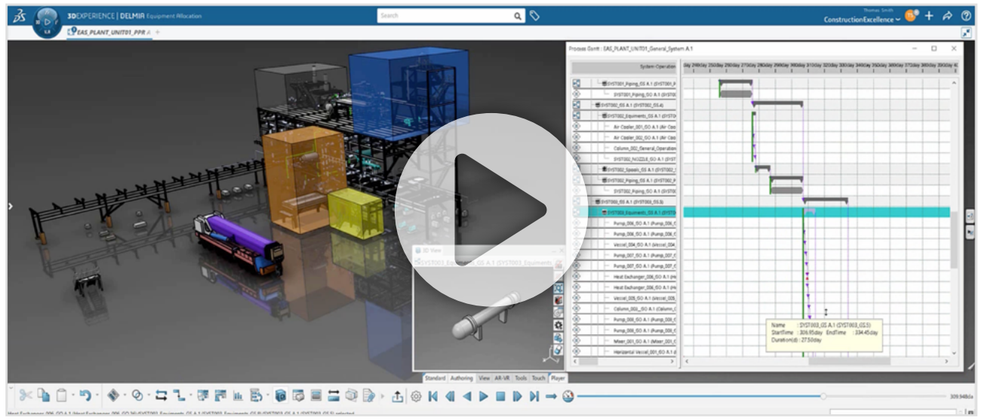


Managed Parts Catalogues

- Drive standardisation to reduce procurement and maintenance cost.
- Manage alternative parts to build resilience and diversity of sourcing.
- Connectivity of related data supports demonstration of compliance with quality requirements.

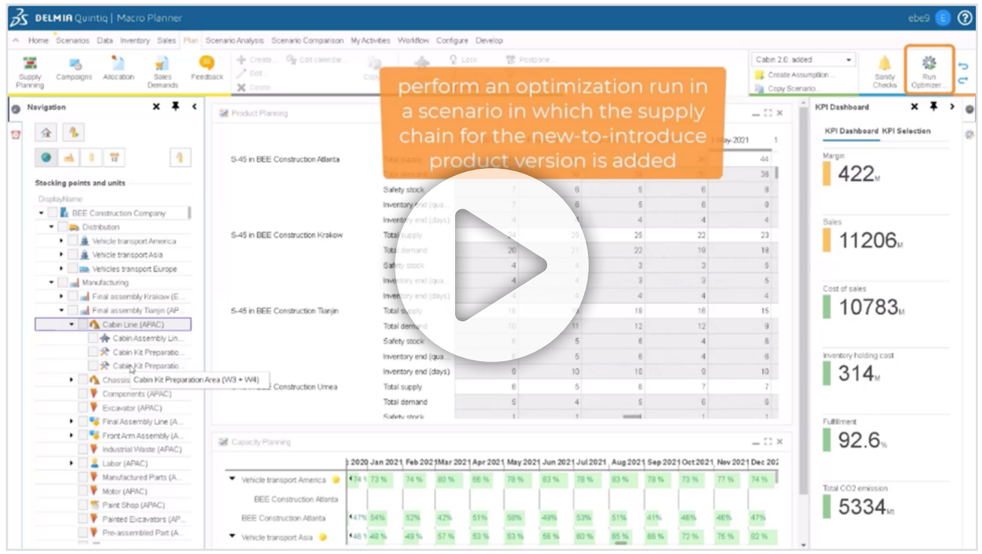
CONSTRUCTION MANAGEMENT

The supply and movement of materials and equipment around large, congested sites requires extensive planning, but also the ability to flexibly change to adapt to emergent conditions. Site safety is of particular importance, which relies on preparation (e.g. lift plans) but also enhanced training and procedural use. In parallel, the scheduling of the specialist workforce on site must be responsive in order to progress construction on schedule.



Integrated 4D Planning & Simulation

- Create and share sequencing models to make a de-conflicted plan available to all.
- Simulate activities and changes to ensure smooth execution of critical tasks.
- Monitor schedule plan and progress against 3D representation to enhance execution and remove bottlenecks.



Schedule and Workforce Optimisation

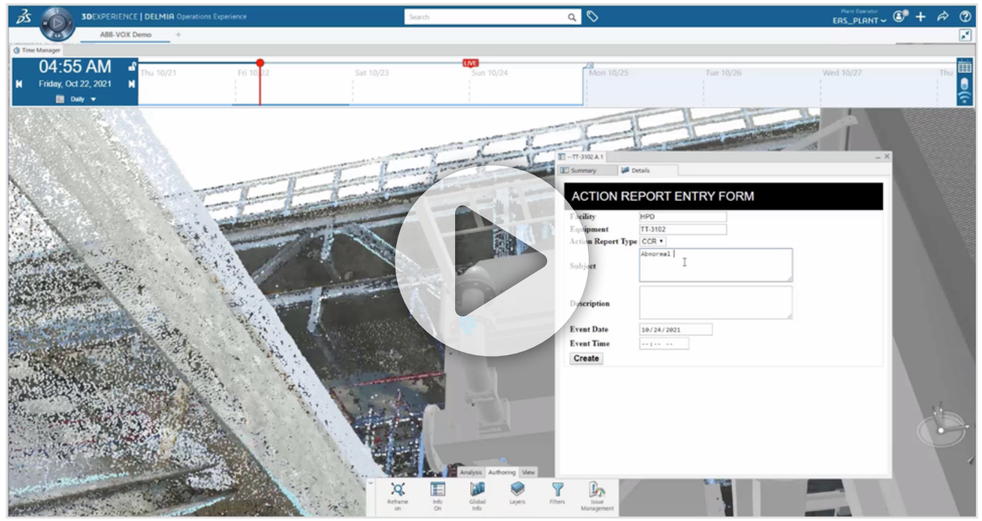
- Driven from Work Packages, optimise & balance supply network strategically to meet project metrics.
- Quickly respond to volatility in supply & demand of skills and resources.

SITE CONNECTION

Construction sites endeavor to produce a safe, efficient, up-to-date physical representation of their digital plans. Connected data empowers users and stakeholders to visualise installation and issues, enabling coordination of timely remedial action. Furthermore, by understanding the differences between the 'as-built' and 'as-designed' sites, construction programme managers can account for variance in subsequent construction phases to reduce costs, delays and rework.

Digital to site

- Design and site reference information available at the point of work.
- Use Augmented Reality to visualise issues and de-risk installation of equipment.
- Up-to-date work instructions visible in context, enhancing training and execution.
- Records of installation can be stored and recalled for traceability.



Capture the As-Built

- Manage scans of the site alongside the design models to quickly identify and interrogate differences.
- Use Augmented Reality to support inspections and assess conformity, documenting relevant data and raising comments.

INTEGRATE DIFFERENT ACTIVITIES AND STAKEHOLDERS ACROSS ALL STAGES OF CONSTRUCTION

It is expected that nuclear power plants in the form of gigawatt-scale fission, SMRs, and fusion reactors will make a significant contribution to expand, diversify & decarbonise worldwide energy supplies.

These complex construction projects face many challenges, which threaten to delay construction and increase costs.

Backed by scientific capabilities and experience with today's industry leaders, Dassault Systèmes is uniquely positioned to help deliver safe and reliable nuclear power plants. The challenges are real. But so are the opportunities.

Click here to learn about our expertise in the Infrastructure, Energy & Materials industry.

Digitise the nuclear **decommissioning** journey

Download the eBook

Decarbonize energy with Nuclear – **Small Modular Reactors**

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Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating virtual twin experiences of the real world with our **3D**EXPERIENCE platform and applications, our customers can redefine the creation, production and life-cycle-management processes of their offer and thus have a meaningful impact to make the world more sustainable. The beauty of the Experience Economy is that it is a human-centered economy for the benefit of all –consumers, patients and citizens.

Dassault Systèmes brings value to more than 300,000 customers of all sizes, in all industries, in more than 150 countries. For more information, visit **www.3ds.com**.

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