Digital Twin and AI in Control Rooms: Where They Create Real Value

Intelligent Operations · 5 September 2026 · 7 min read

Digital Twin and AI can strengthen control-room decision support, but only when built on reliable operations, contextualized data, defined use cases, human authority and credible models. The objective is appropriate operational intelligence — not technology for its own sake.

Digital Twin and artificial intelligence are becoming prominent themes in control room modernization. They can help organizations integrate information, understand relationships, explore scenarios, detect unusual conditions and anticipate what may happen next.

They can also create additional complexity if they are introduced without a clear operational purpose.

The most useful starting question is therefore not "How do we add AI?" It is:

Which operational decision or workflow needs to improve, and what evidence would demonstrate that improvement?

A Digital Twin is more than a 3D model

A visually impressive model may help people understand geography or asset location, but visualization alone does not establish an operational Digital Twin.

For control-room use, the twin should represent relevant assets, systems, processes and relationships. It should connect them to sufficiently current operational information and make the resulting state understandable to the people who need it.

Depending on the use case, a twin may include:

- ? Asset identity and condition
- ? Location and connectivity
- ? Current operating state
- ? Dependencies between systems
- ? Historical behavior
- ? Operating limits
- ? Maintenance information
- ? Events and alarms
- ? Environmental or external factors
- ? Simulation or prediction models

Not every use case requires a photorealistic 3D environment. Sometimes a map, network model, process representation or relationship graph communicates the operational context more effectively.

Context is the bridge between data and decisions

Control rooms already receive information from many sources: SCADA or DCS, GIS, CCTV, maintenance systems, asset databases, weather services, incident platforms and enterprise applications — the layers described in Situational Awareness.

Connecting these sources does not automatically create understanding. Data needs context.

The system must establish which information refers to the same asset or event, how elements are

related, when information was updated, whether it is trustworthy and who should see it.

This contextual layer is what allows an operator to move from isolated signals toward a coherent operational picture, as described further under Common Operating Picture.

Start with bounded, valuable use cases

The first AI and Digital Twin applications should be selected according to operational value, data readiness, risk and the organization's ability to maintain them.

Potential applications include:

- ? Correlating alarms and related events
- ? Identifying abnormal combinations before traditional thresholds are crossed
- ? Presenting relevant procedures and historical incidents
- ? Forecasting demand, load, congestion or resource requirements
- ? Supporting predictive maintenance
- ? Simulating possible consequences of an operational decision
- ? Comparing response options
- ? Building incident timelines
- ? Supporting shift handover
- ? Training and rehearsing rare scenarios

A small number of well-defined use cases is generally more valuable than a broad platform deployment with unclear operational ownership.

Keep the operator inside the decision process

AI can detect patterns, rank options and make recommendations, but operational accountability must remain clear.

For each function, the organization should define:

- ? What the system observes
- ? What it predicts or recommends
- ? How confidence and uncertainty are communicated
- ? Who reviews the result
- ? Who is authorized to act
- ? What happens when the recommendation conflicts with operator judgement
- ? What is recorded for later review
- ? How the function behaves when data or models are unavailable

Early implementations will often be most appropriate in an advisory role. The system supports the operator, while the operator retains authority.

Automatic action may be considered only within carefully defined boundaries, supported by appropriate engineering, specialist assurance, validation, override, logging and recovery arrangements.

Data readiness comes before intelligence

AI and Digital Twin initiatives often reveal weaknesses that already exist in the information environment.

Common issues include inconsistent asset naming, incomplete data, poor time synchronization, undocumented interfaces, uncertain ownership, unreliable sensors and separate systems that describe

the same asset differently.

These are not minor implementation details. They determine whether the resulting operational picture can be trusted.

A readiness assessment should therefore examine:

- ? Data ownership
- ? Data quality
- ? Asset identity
- ? Time alignment
- ? Update frequency and latency
- ? Availability
- ? Provenance
- ? Access permissions
- ? Configuration control
- ? Interface stability
- ? Maintenance responsibility

Where cybersecurity, facility networks or enterprise infrastructure are involved, requirements and interfaces must be coordinated with the customer's appointed qualified specialists.

Validate the model, not only the interface

A Digital Twin or AI dashboard can look convincing while producing unreliable conclusions.

Validation needs to consider the complete chain from source data to operational use. This may include:

- ? Correctness of data mapping
- ? Representation of assets and relationships
- ? Synchronization behavior
- ? Model assumptions
- ? Performance under normal and abnormal conditions
- ? False positives and false negatives
- ? Communication of uncertainty
- ? Behavior outside the model's intended operating range
- ? Failure and degraded modes
- ? Suitability of the human-machine presentation

Validation should use representative historical events, controlled test scenarios and operational feedback. The level of evidence should reflect the consequence of relying on the output.

Integrate intelligence into the workflow

An additional dashboard is not automatically an improvement.

Digital Twin and AI outputs should appear where they support the operator's existing or intended workflow. This may be within the HMI, Common Operating Picture, alarm-investigation process, incident-management environment, maintenance workflow or shared overview display — the integration approach described in Advanced Visualization.

The design should determine:

- ? Who needs the information
- ? When they need it

- What level of detail is appropriate
- How it relates to existing alarms and procedures
- How the operator moves from insight to authorized action
- How other teams receive and interpret the same context

The objective is to reduce fragmentation rather than create another isolated interface.

Plan for lifecycle ownership

Models, data and operational environments change. Assets are replaced, configurations evolve, procedures are updated and operating conditions shift.

The organization needs clear ownership for:

- Data-source changes
- Model updates
- Validation after change
- Performance monitoring
- Detection of model drift
- User access
- Incident review
- Backup and recovery
- Retirement or replacement

Without lifecycle ownership, an initially useful capability can gradually become misleading.

Progress through maturity, not hype

A responsible progression can be described as:

- Observable: Reliable integrated operational data is available.
- Contextual: Assets, events and relationships form a coherent operational picture.
- Predictive: Validated models support forecasting, simulation and recommendations.
- Supervised action: Operators authorize actions prepared or recommended by the system.
- Bounded autonomy: Specific automatic actions occur inside a validated operating envelope with override and auditability.

Not every organization or use case needs to reach the final level. The appropriate target depends on operational benefit, maturity, risk and assurance.

The objective is appropriate operational intelligence

Digital Twin and AI create value when they improve a defined operational outcome and remain understandable, supportable and governed.

The foundation remains the same:

Operational requirement -> Use case -> Data and context -> Model or analytic capability -> Human interaction -> Risk controls -> Validation -> Lifecycle ownership

TechniHub integrates Digital Twin and AI into the wider control-room design approach so that technology supports the operation rather than becoming an isolated demonstration.