

# How to Develop a Project Execution Plan

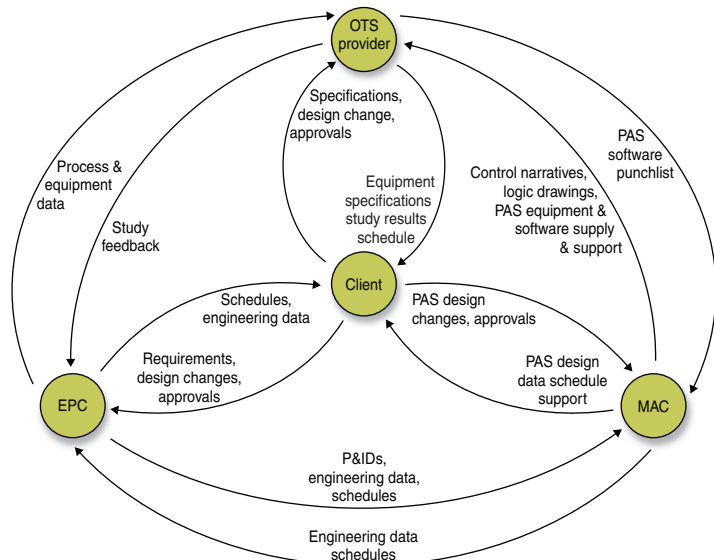
Designing and implementing advanced engineering projects, such as an advanced operator training simulator, requires meticulous planning and communications. Here's a template for success.

**A** trend in major upstream oil & gas projects is the addition of an advanced operator training simulator (OTS). To fully realize the benefits from this technology, the OTS should be developed early enough to complete operator training before facility startup and to support process and operability studies. But there are challenges to early development, particularly when designing and implementing such advanced engineering projects. A detailed project execution plan is essential.

A high fidelity OTS is typically integrated with the same process automation system (PAS) hardware and software used to control the new facility. PAS implementation must therefore be completed sooner, often significantly sooner, than what is required to meet facility engineering and construction schedules. Consequently, the OTS schedule may drive the PAS development schedule with its cascading impact on EPC (engineering procurement construction) schedules. Project success is therefore dependent on the EPC and main automation contractor (MAC) as key stakeholders.

Understanding the elements of a project execution plan from the EPC and MAC perspectives can lessen project challenges and help clearly define

## Example operator training simulator interfaces



Source: Control Engineering with information from Mustang Engineering

the role of the client. Elements include:

- Statement of goals;
- Scope of work;
- Roles and responsibility matrix;
- Technical specifications;
- Contracting plan;
- Organization chart; and
- Integrated schedule.

Here we'll go into each of these in detail.

### OTS project goals

Statement of goals should define the training and engineering study requirements, which may include:

- Pre-startup training and familiarization for new or experienced operators;
- Long-term training or formal re-certification of operators as may be required in some regions;
- Process design validation and throughput optimization studies (new facility and changes);
- Validate basic process controls and safety interlocks (new facility and changes);
- Validate standard operating procedures (SOP)

*Roles and risks associated with OTS stakeholder interactions should be addressed early in the project.*

## Acronym help for engineering project management

- AFD: approved for design
- EPC: engineering procurement construction
- FAT: factory acceptance test
- FEED: front end engineering design
- HMI: human-machine interface
- IEC: International Electrotechnical Commission
- MAC: main automation contractor
- OTS: operator training simulator
- P&ID: process and instrumentation diagram
- PAS: process automation system
- SOP: standard operating procedures

### AT A GLANCE

- Plan ahead
- Develop consensus early
- Validate at agreed-upon points in the process

and changes; and

- Validate PAS alarm system performance (alarm floods, alarm masking).

The statement should define the modeled facilities (new or existing facility or process units), identify key schedule milestones and provide an initial OTS lifecycle plan. The life-cycle plan, covering pre- and post-facility startup, identifies the source of project and long-term support funding and the OTS location, owner and system manager at each phase. A long-term support and software manage-

ment plan also should be included.

Specifications define technical, equipment, and study requirements. The contracting strategy should recognize the unique challenges of the project. A single OTS provider should be employed to reduce interfaces, improve support, reduce schedule risk, and standardize on OTS software. The cumulative costs from all contractors should be considered when selecting the strategy. The OTS execution plan must be prepared early to make it available when the client's project team is ready to issue proposal

requests and contracts to the EPC(s) and MAC. Vendors and contractors should be limited to those with proven technical and execution track records. Risks associated with stakeholder interfaces and accelerated schedules should be addressed early in the project through the process of risk minimization.

**Scope definition**

During scope definition, the client defines the equipment and processes to be modeled and the model fidelity requirements. For oil & gas applications, modeled areas typically include all major oil, gas and subsea production and utility systems. Model fidelity is typically high ( $\pm 2\%$  accuracy from the steady state design) to achieve accurate process responses and dynamics. PAS HMI and controls software is commonly interfaced to these models.

Upstream projects also commonly employ skid-mounted packaged equipment supplied with local embedded control systems provided for compression, subsea, well injection and export systems. This software is also interfaced to OTS models. MAC support may be needed to complete the PAS-OTS interface. This support can be a challenge, since peak OTS support often occurs during peak PAS activity periods.

Early OTS development may be required to support process and design validation studies. Studies may include validating facility throughput,

**Table 1- Roles and responsibility matrix**

Index	Activity	Owner	EPC	MAC	OTS provider
<b>Phase 2 – Concept phase</b>					
1	Define OTS statement of goals	R			
<b>Phase 3 – Front end engineering design (FEED) phase</b>					
2	Develop OTS specification	A		R	C
3	Define engineering study requirements	R	C	C	C
4	Develop initial OTS execution plan & schedule	A/R		R/C	C
5	Define OTS Scope in EPC & MAC Contracts	R	C	C	C
6	Develop OTS cost estimate for OTS equipment and provider services	R			C
7	Develop cost Estimate for PAS Equipment and Support Services (EPC, MAC)	A	R	R	C
<b>Phase 4 – Detailed design, procurement &amp; implementation</b>					
8	OTS procurement / contracting	R	C	C	C
9	OTS kickoff meeting	R	I	I	I
10	Develop integrated schedule	R	C	C	C
11	Update in-house execution plans with agreed OTS milestone dates	A	R	R	R
12	Provide facility engineering & process data	I	R	I	I
13	Provide packaged equipment control system software & data	I	R	I	I
14	Provide PAS equipment & software to OTS provider	A		R	C
15	Model development		C	I	R
16	Develop facility standard operating procedures (SOPs)	R	C	C	I
17	Conduct OTS studies	I	C	C	R
18	Assess/authorize OTS study-initiated changes impacting EPC and MAC.	R	C	C	I
19	OTS-PAS Integration & Testing	A		C	R
20	Implement OTS study-initiated & approve changes to facility and PAS designs	A	R	R	I
21	Train OTS trainers				R
22	Train operators, verify SOPs	R/A	C/R	C	C
<b>Phase 5 – Operations &amp; maintenance phase</b>					
23	Long term OTS management & support	R		C	C

R- Responsible, A – Approve, C – Consult, I – Inform

operability and PAS display and controls performance.

OTS boundaries should be clearly delineated and stakeholder responsibilities clearly defined. Table 1 is an example of a roles and responsibilities matrix. The OTS support plan, pre- and post-delivery, is fully developed here so costs can be assessed and resources and responsibilities defined.

### Schedule development

Developing an integrated schedule begins with the client defining when the OTS must be ready to start operator training and, if applicable, to support OTS studies. Then, the OTS provider, EPC and MAC each identifies when required information and equipment is needed and when deliverables can be provided. The client works with all parties to facilitate a mutually agreed schedule. Schedule risks are shared among parties.

Example timing for EPC, MAC and third-party deliverables is listed in Table 2. Example timing for OTS deliverables are listed in Table 3.

OTS schedule requirements must be included in the main facility project schedule developed during front-end engineering design (FEED). Adding this and the associated new scope to the EPC and MAC schedules after contracts are signed becomes increasingly difficult, and decreases the likelihood of project success.

Schedule acceleration is typically required to meet agreed delivery dates. Common acceleration approaches include working tasks in parallel, and starting OTS and PAS development work before design documents are available. Both approaches result in varying degrees of rework, increasing the EPC's and MAC's scope and therefore cost. Delivering the PAS design six months sooner than is needed to meet the general facility engineering and construction schedule can trigger significant acceleration costs. Controlling these costs is a challenge for all parties.

Project realities that can impact the OTS schedule and completion include:

- Late supply of vendor data and interface requirements;
- Late access to vendor software needed for PAS interface development, testing and OTS integration;
- Effectiveness and timeliness of contractor-to-contractor interfaces;
- Client requirements trigger a major effort to develop new HMI and control software templates and standards;

**Table 2 – Example timing for EPC and MAC deliverables**

EPC & MAC deliverables	Deliverable status	Months from start of detailed design phase
PAS hardware & base software selected		Defined in FEED
P&ID, process & equipment data	Preliminary	3-10
P&ID, process & equipment data	Approved for design (AFD)	6-12
Safety logic drawings and control narratives	AFD	* 6-10
<i>* Up to 22 months if dependant on packaged equipment data</i>		
Vendor data from long lead 3rd party package & equipment vendors	AFD	**13-22
<i>** Earlier dates may be required to meet OTS schedule</i>		
Issue PAS configured I/O, basic controls and HMI.	Fully tested/approved software templates	15-18
	Spot test base HMI and controls software	
Issue PAS complex controls & software update	Full factory acceptance tested (FAT)	16-22
Integration to control system software from long lead, 3rd party vendors	FAT	16-24
Issue PAS balance of plant software	FAT	22-28
Provide PAS equipment and applications support	As needed	Duration

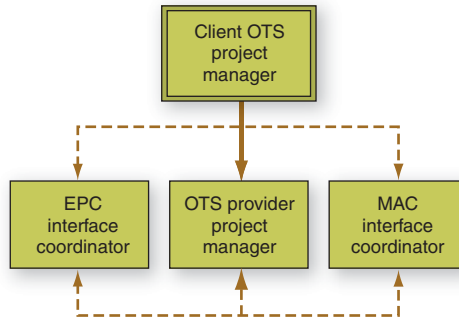
- Significant changes in the PAS design basis or scope during the detailed design phase;
- Project adds new work processes or design requirements (for example, IEC 61511 adds steps that can lengthen the safety system design and software development duration); and
- Unplanned custom emulations are needed, such as when vendors will not provide proprietary software or algorithms.

### Organizational considerations

Project success requires sound organizational and staffing decisions. Selecting the right person for the client project manager role is critical. Recommended skills include basic contract management, an understanding of interface and schedule management, good organization and communication skills and sufficient technical knowledge and authority to respond to queries and make timely decisions. The EPC and MAC should provide an OTS interface coordinator to manage information exchange requests, attend interface meetings and coordinate schedules and activities within their respective organizations.

Risks associated with OTS stakeholder interfaces should be addressed early in the project. The "Example interfaces" illustration (on p. 9) shows some possibilities. The client is typically at the center of this challenging, multi-organization, interface-intensive effort. Employing the right people in

### Sample organizational chart



Source: Control Engineering with information from Mustang Engineering

Project managers for the client and provider interact with the engineering procurement construction (EPC) interface coordinator and with the main automation contractor (MAC) coordinator.

SOP's may need to be written earlier to allow time for verification using the OTS.

A challenge when designing safety systems to IEC 61511 is acquiring process response times for a new facility. This data is used to set safety interlock speed of response requirements. Response data from the OTS may prove to be more accurate than data derived through other means and should be explored.

### Plan, realities, requirements

Early supply of a high fidelity and PAS-integrated OTS is possible, but requires the right execution plan and

aggressive plan execution by all parties. The client OTS project manager and EPC and MAC coordinators are key positions that directly impact project success. Risks should be identified, managed and, to the extent possible, thoughtfully distributed among OTS contributors. How early the OTS can be delivered depends on project specific realities and requirements. **ce**

Author: Tom Shephard, PMP, CAP, Mustang Engineering, is a main automation contractor program manager and automation project manager.

### For more information, visit:

[www.mustangeng.com](http://www.mustangeng.com)

Table 3 – Example OTS timeline

Event or EPC and MAC supplied engineering data	OTS provider activity	Months from first oil
OTS award		30
P&ID, process and equipment data – preliminary	Planning, specifications	29
	Model build	28
P&IDs, process and equipment data – AFD	Model validation, FEED studies	26
	Detailed engineering data for model update	23
	Engineering studies	21
PAS delivery	Model update	17
	PAS integration	16
OTS design & integration completed	Integrated PAS and operating procedure checkout	14
	OTS acceptance test	8
First oil	Instructor training, SOP verification	7
	Operator training	6
		0

key roles provides a means to improve the timeliness and effectiveness of an interface. Opportunities to simplify or streamline an interface also should be considered to reduce project risk.

### Feedback, acceptance tests

Feedback from OTS studies will generate PAS and facility design changes to consider. The client will need a process to manage this work and its potential impact on cost and schedule. A rigorous management of change process must be in place. The change process must include review, approval, implement, test, and document work status as it progresses.

Dividing PAS acceptance tests into multiple test periods to support staged software deliveries can increase PAS scope and cost. Frequent changes and incremental testing provides the opportunity for software errors to creep in. Both should be addressed in the MAC's change management and quality plans.

The client may need to exercise corporate agreements to ensure third-party vendors release proprietary software, algorithms or functional design information to the OTS provider.

**COMPACT CABINET COOLER**  
for sealed electrical enclosures

**REMOVE WASTE HEAT WHILE KEEPING CONTAMINANTS OUT**

Replaces air conditioning | Replaces compressed air | Easy installation | Energy efficient | NEMA 12, 4, 4x | Stainless Steel | Washdown

**GREAT FOR food processing**

**NOREN**  
norenproducts.com/ccc  
650.322.9500