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7 benefits to engage Main Automation Contractor (MAC) on mega greenfield project

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Emerson

We help customers in the world’s most essential industries solve the biggest challenges of modern life.

We drive innovation that makes the world healthier, safer, smarter, and more sustainable.

Source: https://www.emerson.com/en-us/about-us

Golden Triangle Polymers Company

Golden Triangle Polymers Company LLC is a joint venture owned indirectly by Chevron Phillips Chemical Company LP (51%) and QatarEnergy U.S. Investments (2) LLC (49%), headquartered in Orange, Texas.

Once operational, the Golden Triangle Polymers facility will manufacture high-density polyethylene, which enables production of everyday products like pipe for water and natural gas delivery and packaging that keeps food fresh and medicine sterile.

Source: https://www.goldentrianglepolymers.com/project-overview/project-faqs

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Session Title: 7 benefits to engage Main Automation Contractor (MAC) on mega greenfield project

Agenda

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Amorn Thunnipath	Challenges and Lessons Learned
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Project Overview

Amorn Thunnipath

Project Overview

- Golden Triangle Polymers will be a world-scale integrated polymers facility. The joint venture between CPChem and QatarEnergy is called Golden Triangle Polymers Company LLC, named for the Golden Triangle region encompassing the city of Orange, Texas.
- 2,080 KTA ethane cracker and two 1,000 KTA high-density polyethylene units.
- Startup planned in 2026
- More than 500 full time jobs and approximately 4,500 construction jobs
- Approximately 25% lower GHG emissions than similar facilities in the U.S. and Europe
- CPChem will manage the engineering, procurement and construction for the project and operate the facility after startup

Source: https://www.goldentrianglepolymers.com/project-overview/project-facts
https://www.goldentrianglepolymers.com/sites/default/files/2023-02/One%20Pager_GTPC_Brand_Final.pdf

Project Overview – Primary Contractors

- CPChem as Construction Manager for GTPC, has contracted companies to oversee the engineering, procurement and construction of the project. They are known as EPCs or primary contractor companies. The companies are:
  - Polyethylene units will be executed through ZDJV, a joint venture between Zachry Industrial Inc. and DL USA, Inc.
  - Furnace Portion of the Ethane Cracker will be executed by T.EN Stone & Webster Process Technology, Inc. with PCL Industrial Construction Co.
  - Ethane Cracker will be executed by JKJV, a joint venture between JGC America, Inc. and Kiewit Energy Group, Inc.
  - Utilities and Infrastructure scope will be executed by BMZ Third Coast Partners, a joint venture between Burns & McDonnell Engineering Company, Inc. and Zachry Industrial, Inc.
  - W.T.Byler Co. Inc. is managing heavy civil work for the entire site as well as EPC for rail and storage-in-transit yard
  - **The Main Automation Contractor (MAC) for the project is Emerson**

Source: https://www.goldentrianglepolymers.com/project-overview/primary-contractors

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MAC Project Scope

Rajesh Ahuja

Emerson Project Scope as a MAC

- Emerson as a Main Automation Contractor was responsible for engineering, procurement, construction of following systems as packages:
  - Package 0 – MAC Technical Coordination
    - Integrate all packages subsystems and systems
    - Interface Management with Company and EPCs
    - Recommend Cost Saving technologies
  - Package 1 - Integrated Control and Safety System (ICSS)
    - Distributed Control System (DCS),
    - Safety Instrumented System (SIS),
    - Gas Detection System (GDS),
    - Fire Alarm System (FAS),
    - Operation Training System (OTS),
    - Alarm Management System (AMS),
    - Asset Management System (AAMS)
    - Interface with Packaged Equipment Control System (PECS)

Emerson Project Scope as a MAC

- Package 1 - Integrated Control and Safety System (ICSS) - Continued
  - Remote Instrument Enclosures (RIEs)
  - Console Furniture in the CCR, OTS, Engineering Room
  - Cabinets in the CCB Rack Room
  - Smart Junction Boxes (SJBs) for IO’s in the Field
  - SIL Calcs to verify Target SILs
  - Safety Requirement Specification (SRS)
  - Function Test Procedures (FTPs) and Proof Test Procedures for SIS, GDS and DCS
- Package 2 – Integrated Analytical System
  - Complex Analyzers
  - Analyzer Racks
  - Stackvision system

Emerson Project Scope as a MAC

- Package 3 – Integrated Telecom System
  - Audio Visual System (AVS)
  - Closed Circuit Television System (CCTV)
  - Access Control System (ACS)
  - Emergency Alarm System (EAS)
  - Structured Cabling system (SCS)
  - Business LAN
- Package 4 – Machine Monitoring System (MMS)
- Package 5 – Site Services

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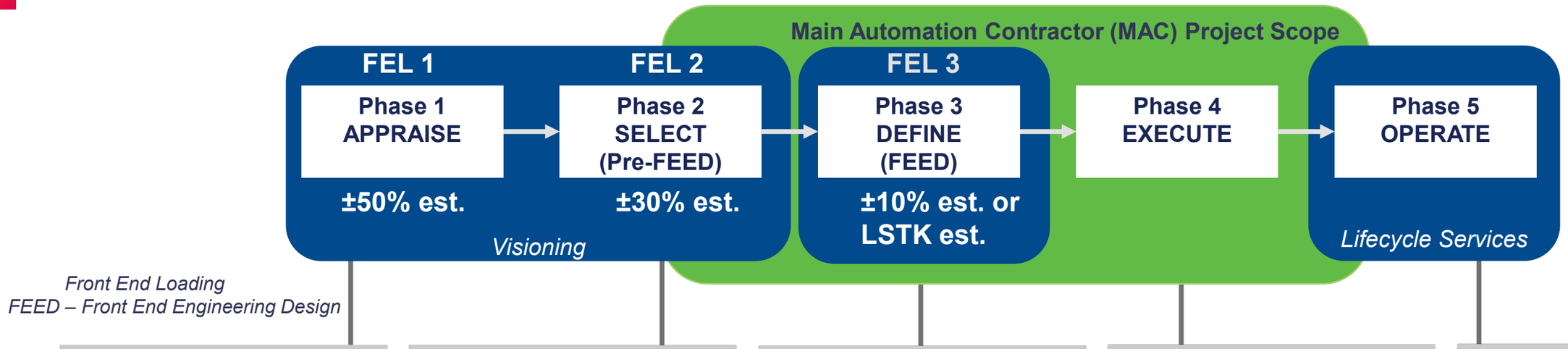
Project Execution Challenges

Amorn Thunnipath

Typical Project Phases and Activities



Front End Loading
FEED – Front End Engineering Design

Phase 1
Assess Business Objectives

- Customer determines whether it is a priority
- Does it align with current business needs and cost constraints?
- Identify any new control system technologies that may fit to project execution and Operation

Phase 2
Assessment and Scope

- Align with operating business objectives
- System deployment strategies
- I/O Sub-system (Busses, wireless, traditional)
- Identify applicable Company, Industry, and/or National Specifications

Phase 3
Preliminary Engineering

- Identify & mitigate risk
- Develop MAC execution strategy and execution plan – align with EPC's design & execution plan
- Develop ICSS and PECS interface functional specifications
- Develop OTS and Process Simulation execution plan – align with Operation's training plan

Phase 4
Design, Implement and Start-up

- Project Management
- Detailed Engineering & Design
- Configuration
- Operator Training Solution
- Factory Acceptance Test
- Install, Commission, Start-up
- Cutover Planning and Execution
- Site Acceptance Test

Phase 5
Commissioning and Lifecycle Care

- Taking care of the assets

Early Engagement of MAC Leads to the Least Risk on the Project and Better Alignment with Customer Goals

Lessons Learned / Challenges – Previous Projects

1. **Inconsistent System Design and Engineering Across Process Units**:
   - Different process units exhibited variability in design and engineering, causing inconsistencies
2. **Non-Uniform System Deliverables Leading to Increased CapEx and OpEx**:
   - While EPCs met project specifications, the lack of uniformity in deliverables resulted in commissioning and startup challenges
3. **Extensive Resource Allocation for Aligning Deliverables**:
   - Significant company resources got engaged due to rework on Operator Graphics and software configuration
4. **Missed / Duplicate Scope between EPCs and MAC Leading to Misalignments:**
   - Ambiguous Division of responsibilities (DOR) between EPCs and MAC caused misalignments and frequent change management issues
5. **Traditional way of Factory Acceptance Test (FAT) for software to be tested on project hardware**
   - All Team members from Company, EPCs and MAC were centrally located for long duration to perform software FAT
6. **Bottleneck in Technical Resource Approval Process Causing Delays:**
   - Limited technical resources slowed down the documentation approval process, this led to schedule delays

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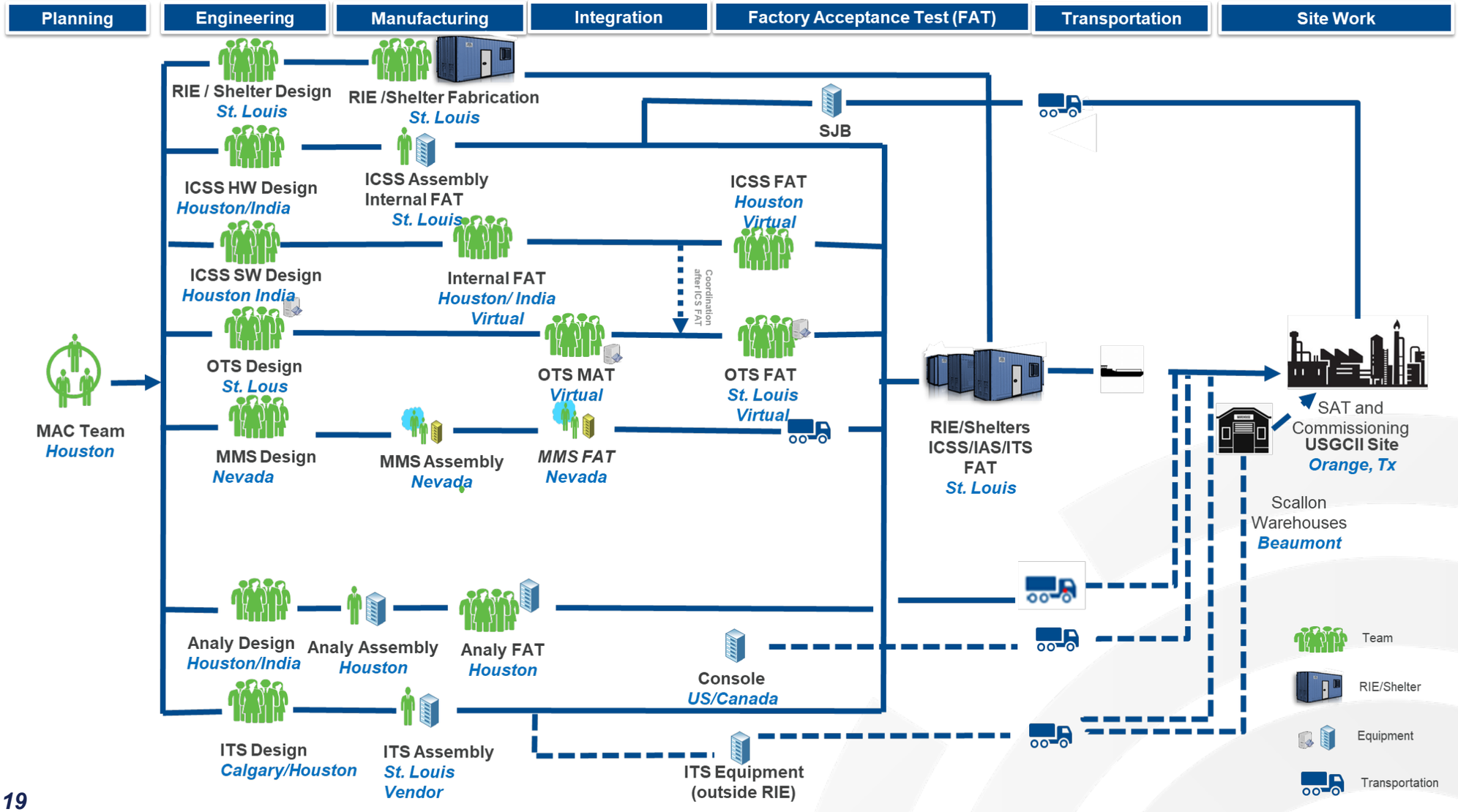
Solution

Rajesh Ahuja

Solution – MAC Execution Model



Solution

1. Early Engagement of Main Automation Contractor (MAC)

- GTPC partnered with Emerson as the MAC during Early Engineering phase of the project
- Reviewed the FEED Deliverables and created / updated a set of project specification documentation as listed below:
  - Technical Specification documents for ICSS, PECS, IAS, ITS and MMS packages
  - Smart Plant Instrumentation (SPI) Data Exchange specification
  - Division of Responsibility (DOR) Matrix
  - Scope Segregation and Interface Diagram
  - Interface Management Plan
  - Project Execution Plan
- All EPCs and their subcontractors were required to adhere to these specification documents
- Any deviations from the specifications must be submitted to GTPC and MAC for approval

Solution

2. Engineering, Procurement and Construction (EPC) Phase

- **Interface Managers** were assigned to the Project by EPCs, MAC and Company
- Interface **Milestone Agreements** were created and monitored on regular cadence call to ensure Inputs with agreed due dates will be provided to MAC and vice versa
- Any **Interface Misalignments** were promptly handled and resolved on priority basis. Mis-alignments were escalated to GTPC Leadership if not resolved by the project team.
- MAC took the lead in the regular **technical, management and leadership meetings** and documenting the same in meeting minutes, action items log and the decision register

Solution

2. Engineering, Procurement and Construction (EPC) Phase - Continued

- MAC contributed to various meetings near site hosted by GTPCs and its subcontractors
  - Quarterly **Construction Summits**
  - **Incident and Injury Free (IIF)** workshops
  - **SPI Administrator** meetings to ensure data entry by EPCs are consistent across units
  - **Functional Safety Audits** to support Safety Instrumented Systems (SIS)
  - **PHA / LOPA** meetings to answer Emerson product related questions
- Early Engagement with GTPC Operations for each unit on following designs and approvals
  - Console furniture
  - Operator Graphics
  - Operator Training System (OTS)
  - Complex Logic, SIS and Sequence demo workshops to align with EPC Input documents
  - Proof Test Procedures(PTPs) and Function Test Procedures(FTPs) for DCS, SIS and GDS

Solution

2. Engineering, Procurement and Construction (EPC) Phase - Continued

- Systems Software Engineering and Design
  - MAC ensured **consistent system design** and software engineering across units
  - Software Configuration was done in MAC's remote virtual office (RVO) **cloud environment** - No project hardware needed
  - **Design review meetings** were held with each EPCs and Company to get alignment on the software design before starting software configuration
- Systems Hardware Engineering and Design
  - MAC ensured **standard hardware design** for cabinets, Smart Junction boxes (SJBs), MCC IO Cabinets, Remote Instrument Enclosures (RIEs) and Analyzer racks across units
  - Decision made that all field I/O's will be terminated in the 96 I/O SJBs **across units**
  - **Power Requirements** were communicated early to EPCs based on the standard design
  - **Design Review Meetings** were held with each EPCs and Company to get alignment and approvals on the hardware design before mass production

Solution

2. Engineering, Procurement and Construction (EPC) Phase - Continued

- Factory Acceptance Test (FATs)
  - **Inspection and Test Plan (ITP)** developed in early engineering was used to identify FATs on the project
  - **Prototype hardware** Cabinet and SJBs were fabricated and tested to align EPCs on the cabinet design
  - RIE FAT punch items were implemented in all unit RIEs to **ensure consistency** in design
  - Software FATs were conducted in the **cloud (RVO) environment** across units
  - PECS FATs were done at vendor location across the globe using **global Emerson resources**

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Benefits Realized

Amorn Thunnipath

Benefits Realized

1. **Standardized system engineering and design across multiple process units involving multiple EPCs**
   - ✓ Ease of operations
   - ✓ Ease of maintenance
   - ✓ Common approval of RIEs from Texas department of licensing and regulations (TDLR)
2. **Standardize Emerson technology and expertise to optimize capex and opex cost**
   - ✓ Common spares across units
   - ✓ Lower capital and operational expense
   - ✓ Lower training expense
3. **Single Integrated MAC Project schedule instead of multiple project schedule with each EPCs**
   - ✓ Interface milestones identified with date based on the dependencies of input and output required between MAC and EPCs
   - ✓ These Interface milestones added to the Integrated Project schedule and were tracked and updated by MAC on bi-weekly basis. Any delays were addressed on priority

Benefits Realized

4. **Common Division of Responsibility (DOR) to avoid any scope gaps**
   - ✓ Better Control on Change Management as Common RASCI Matrix between EPCs, MAC and Company helped ensure no scope is missed during Engineering, Procurement and Construction (EPC) Phase of the Project
   - ✓ Faster resolution to any mis-alignments between stakeholders
   - ✓ Avoiding double dip of one scope between parties
5. **Common Document Management system between Company and EPCs**
   - ✓ EPCs and MAC following the same terminology on Document revision, Document numbering and approval status
   - ✓ Consistent Document Approval durations and Approval cycles
   - ✓ Company role is minimal to consolidate comments and not be the bottleneck in the approval process avoiding delays
6. **Common Progress reporting, Procurement and Invoicing**
   - ✓ Standard Engineering Earned Value Tracking
   - ✓ Standard Hardware Earned Value Tracking
   - ✓ Project Invoicing based on above progress and project milestones

Benefits Realized

7. One Team – One Goal Approach

- ✓ Clear Scope definition across all EPCs and MAC
- ✓ Clear Schedule definition across all EPCs and MAC
- ✓ Target Completion dates definition for EPC phase across all EPCs and MAC

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Thank You