

# Quality Management During Design and Construction

Presented by

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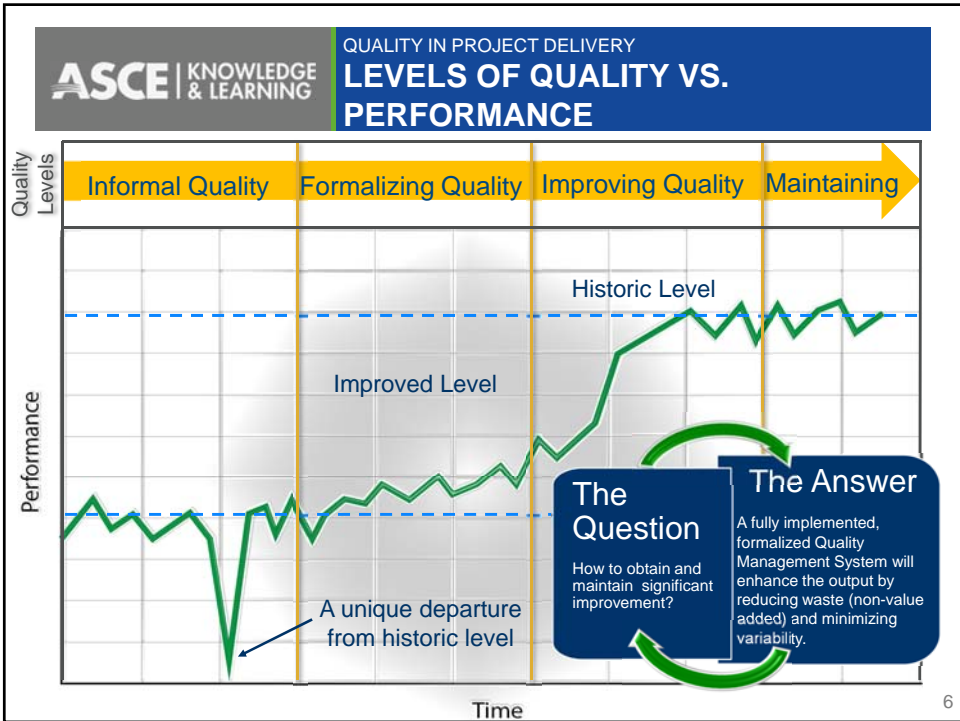
## INTRODUCTION

About the Instructor: Donald G. Archer, P.E.

- Education, Certifications and Training:
  - BSCE, MBA, PM, SSBB, CQA
  - Registered Professional Engineer: CA, TX
- Experience:
  - 30+ yrs in Design and Construction Industry
  - 15 yrs. exclusively in Quality Management
  - Founder of PQM, Inc., 2006
- PQM, Inc. – Quality Management Consultants
  - Public Agencies, AEC Consultants, & Contractors:
    - Quality Management Program Development
    - Quality Program Implementation and Monitoring
    - Root Cause Analysis & Process Improvement
    - Performance Metrics & Statistical Analysis
    - Design & Construction Audits
    - Document Control
    - Training

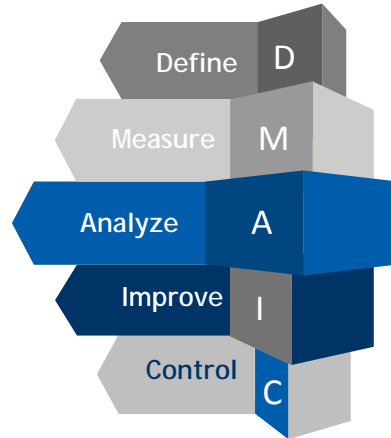
- Climbing the Quality Ladder
- Cost of Quality
- Design & Construction Case Study
- Features of an Adequate Quality Program

## **Climbing the Quality Ladder**



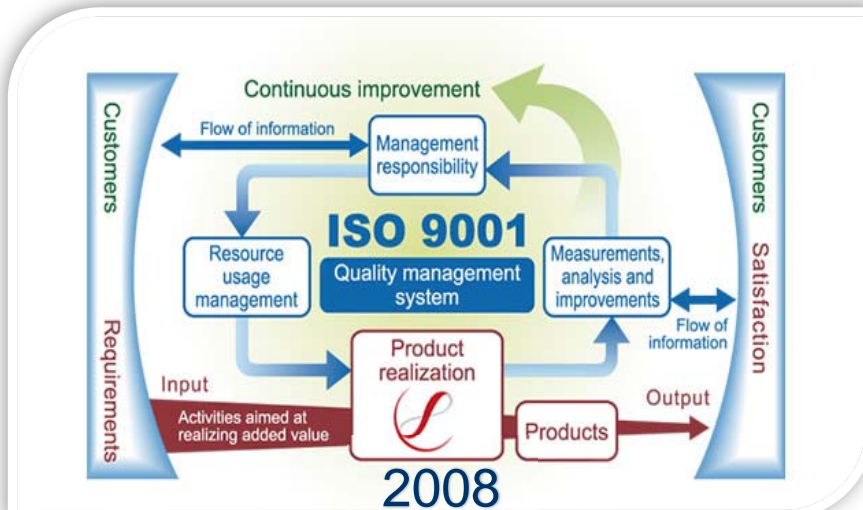
### Six Sigma Approach

- D Define**  
This phase defines the problem or need
- M Measure**  
This phase measures the current process or system
- A Analyze**  
This phase collects and analyzes data to determine critical variables, deficiencies and/or waste
- I Improve**  
This phase focuses on the most important areas to optimize or improve the results of the system
- C Control**  
This phase measures the new process, verifies the improvement and institutes controls to maintain the gains



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### Quality Management System

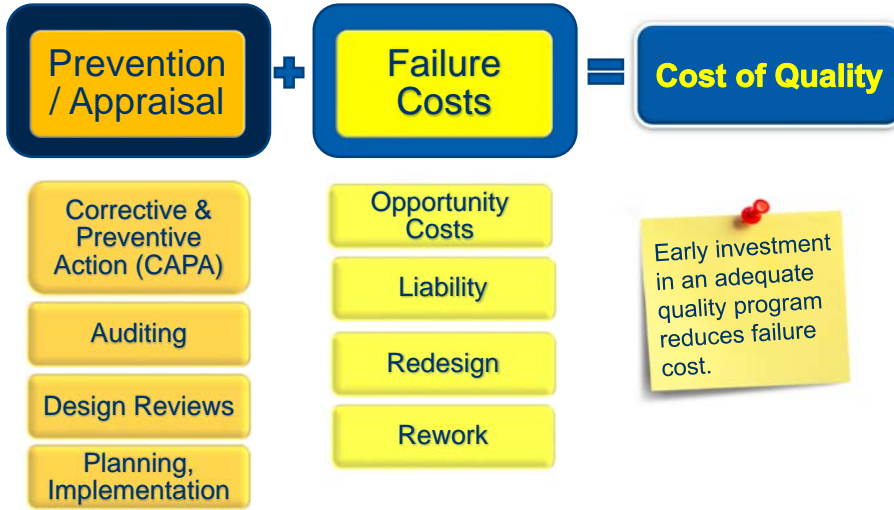


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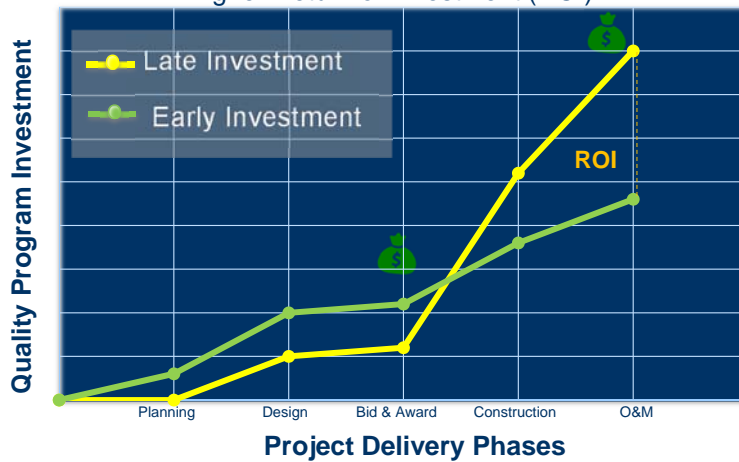
**Quality Management System**



# Cost of Quality



Early Investment in the Quality Program Results in Higher Return of Investment (ROI)

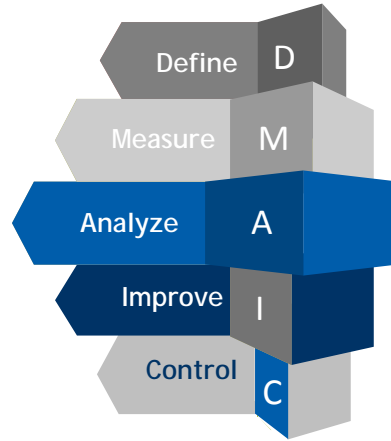




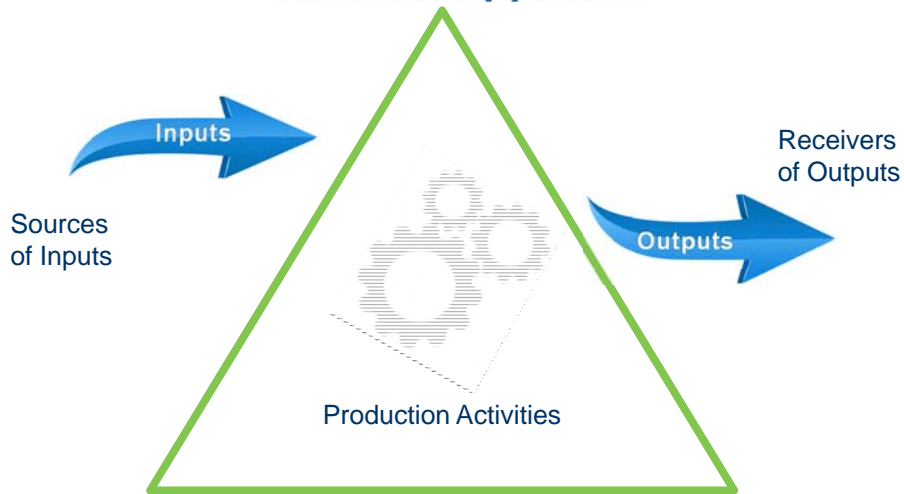
## Design & Construction Case Study DMAIC Approach

### Six Sigma Approach

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### Process Approach





## The Infrastructure Project Delivery Process (DBB) includes Six (6) phases



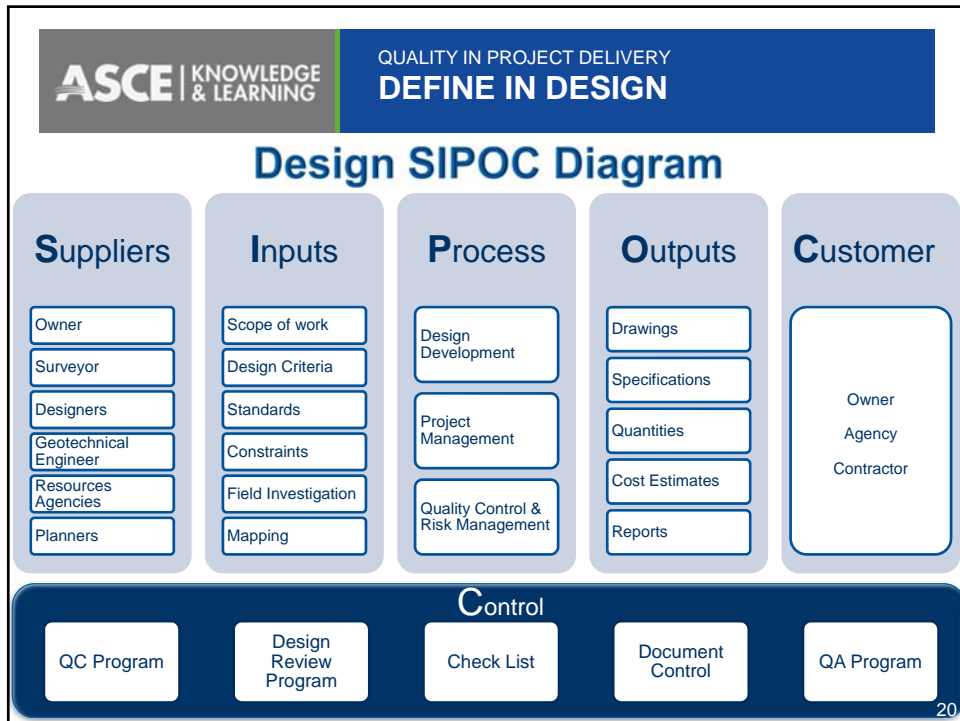
Each phase has policies, procedures and guidelines that are implemented within an organization that define:

- ✓ How **WORK** is produced
- ✓ How work products are **MONITORED**
- ✓ How to **CONTINUOUSLY IMPROVE** production

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## Design Case Study

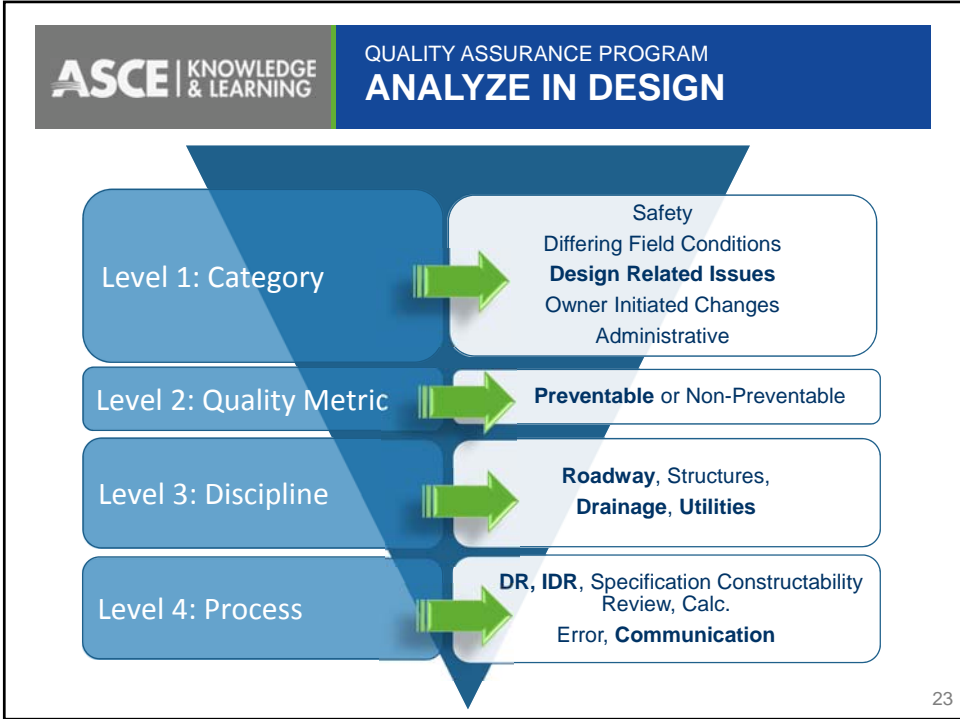
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ASCE   KNOWLEDGE & LEARNING		QUALITY ASSURANCE PROGRAM <b>MEASURE IN DESIGN</b>				
Budgets Were Measured			Construction Change Orders Were Analyzed To Assess Design Quality			
Project	Bid Price	Contingency	Total Project CCOs (#)	Total Project CCOs (\$)	Design Related CCOs (#)	Design Related CCOs (\$)
Project A	\$29M	\$2.2M	60	\$2,394,992	16	\$409,630
Project B	\$28.6M	\$2.1M	56	\$1,500,918	20	\$862,171
Project C	\$65.8M	\$10.3M	86	\$6,050,269	36	\$2,563,444
Project D	\$102M	\$15.1M	199	\$15,111,926	48	\$3,312,160
<b>TOTAL</b>	<b>\$225.4M</b>	<b>\$29.7M</b>	<b>401</b>	<b>\$25,058,105</b>	<b>120</b>	<b>\$7,147,405</b>

**Root Cause Analysis determined that 46% / \$3.3M of the Design Related CCOs were preventable.**



## Recommendations for Improvement in Design



**Add Independent Review**



**Improve Disposition Log**



**Add Checklists**

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## Recommendations for Improvement in Design

**Constructability Reviews**

**Use Construction Professionals**

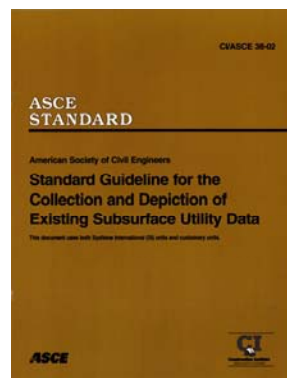
**As-Built Records**

**Treat as an Assumptions**

**Utility Conflicts**

**Implement ASCE Standard 38-02**

ASCE Standard 38-02



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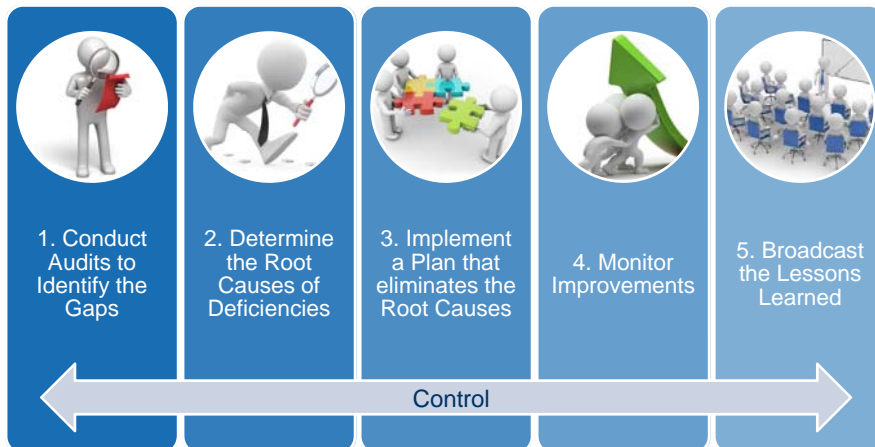
## Recommendations for Improvement in Design

### Disposition Log

Comment	Response	Resolution	Implementation
Design Reviewer	Designer	Designer & Design Reviewer	Designer
Write detail description of comment	Writes detailed description of response	Discuss and agree on resolution of the comment	Verify that the comment is accurately incorporated

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## Continuously Improve your Quality Management System:



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# Construction Case Study

**ASCE** | KNOWLEDGE  
& LEARNING

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Define

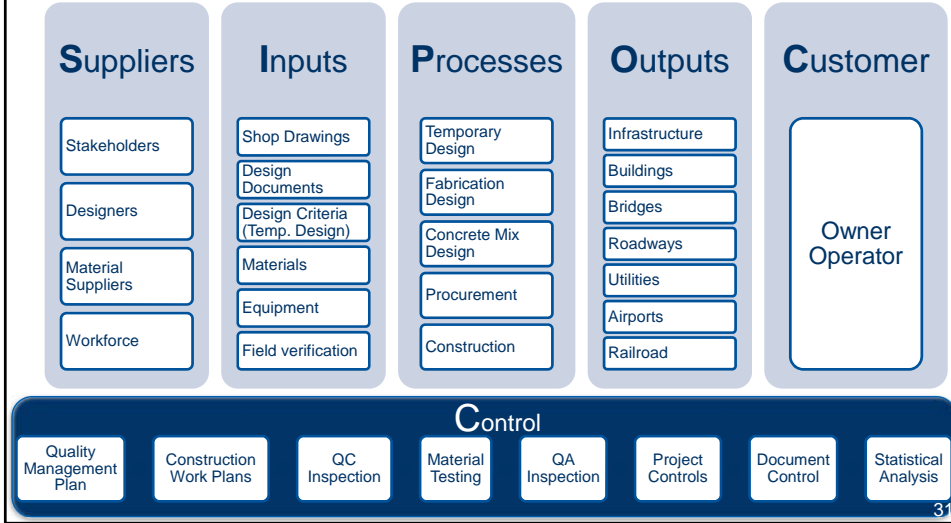
Measure &  
Analyze

Improve &  
Control

**ASCE** | KNOWLEDGE  
& LEARNING

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### Construction SIPOC Diagram



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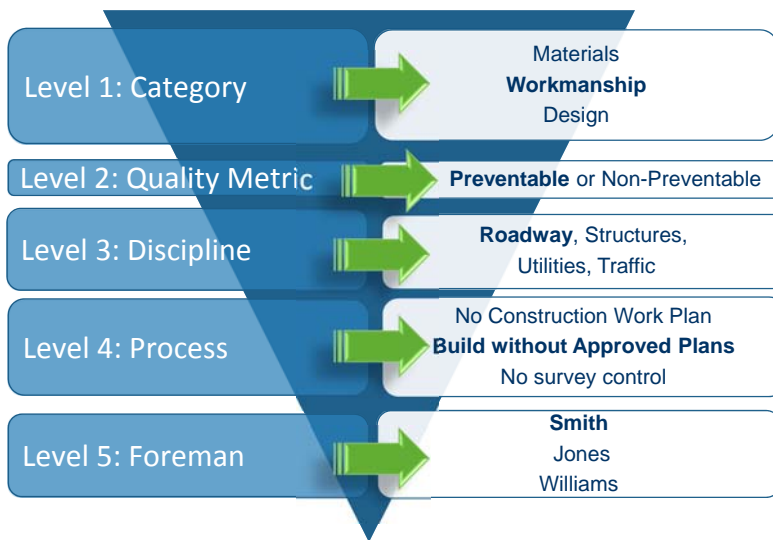


**Construction Parameters**

**Non-Conformances Were Analyzed To Assess Construction Quality**

Project	Schedule	Duration	Total Project NCRs (#)	Workmanship Related NCRs (#)
Project A	18 month	4 months	123	85

**Root Cause Analysis determined that 84% of the Workmanship NCRs were preventable.**





**ASCE** | KNOWLEDGE & LEARNING      QUALITY ASSURANCE PROGRAM  
**IMPROVE IN CONSTRUCTION**

**Recommendations for Improvement in Construction**

**Training**

- The Importance of a CWP
- Only Use Approved Plans
- Always Survey Layout
- Cost of Failure/Rework

**Personnel Performance Meeting**

- Consequences of Non-Compliance
- Implications

Increase frequency of Audits on CWPs, Approved Plans & Survey Control

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**Construction Parameters**

**Non-Conformances Were Analyzed To Assess Construction Quality**

Project	Schedule	Duration	Total Project NCRs (#)	Workmanship Related NCRs (#)
Project A	18 month	Next 4 months	26	6

**A drastic change from the first 4 months!**

**Continuously Improve your Quality Management System:**



1. Increase Inspection of Roadway Workmanship



2. Increase Inspection of Foreman



3. Increase Frequency of Audits on Construction Work Plans



# Conclusion



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QUALITY IN PROJECT DELIVERY

## CONCLUSION

### The Features of an Adequate Quality Program Include:



Implement a Continuous Improvement Quality Program



Use well defined, easy to learn and applicable QC and QA Processes and Procedures



Ensure Quality Best Practices based on Risk Based Thinking



Identify gaps in performance



Improve the Quality Program by Conducting Audits, RCA and applying DMAIC

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**ADDITIONAL THOUGHTS:**

- Project Management → Scope, Schedule and Budget
- Project Controls → Tracks schedules, resources and costs
- Quality Management → ensures work is completed per the requirements

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**“Is more necessary to ensure Successful Project Delivery?”**

**Q&A**