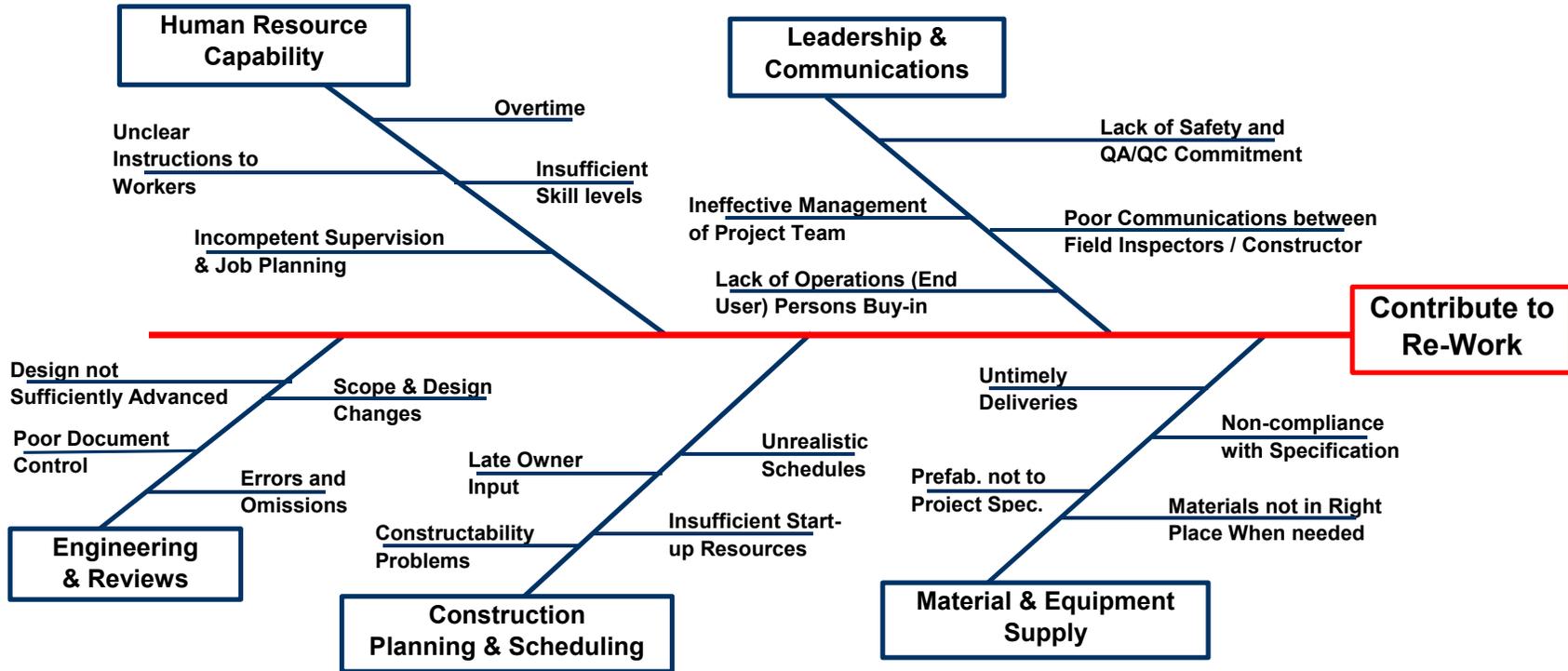


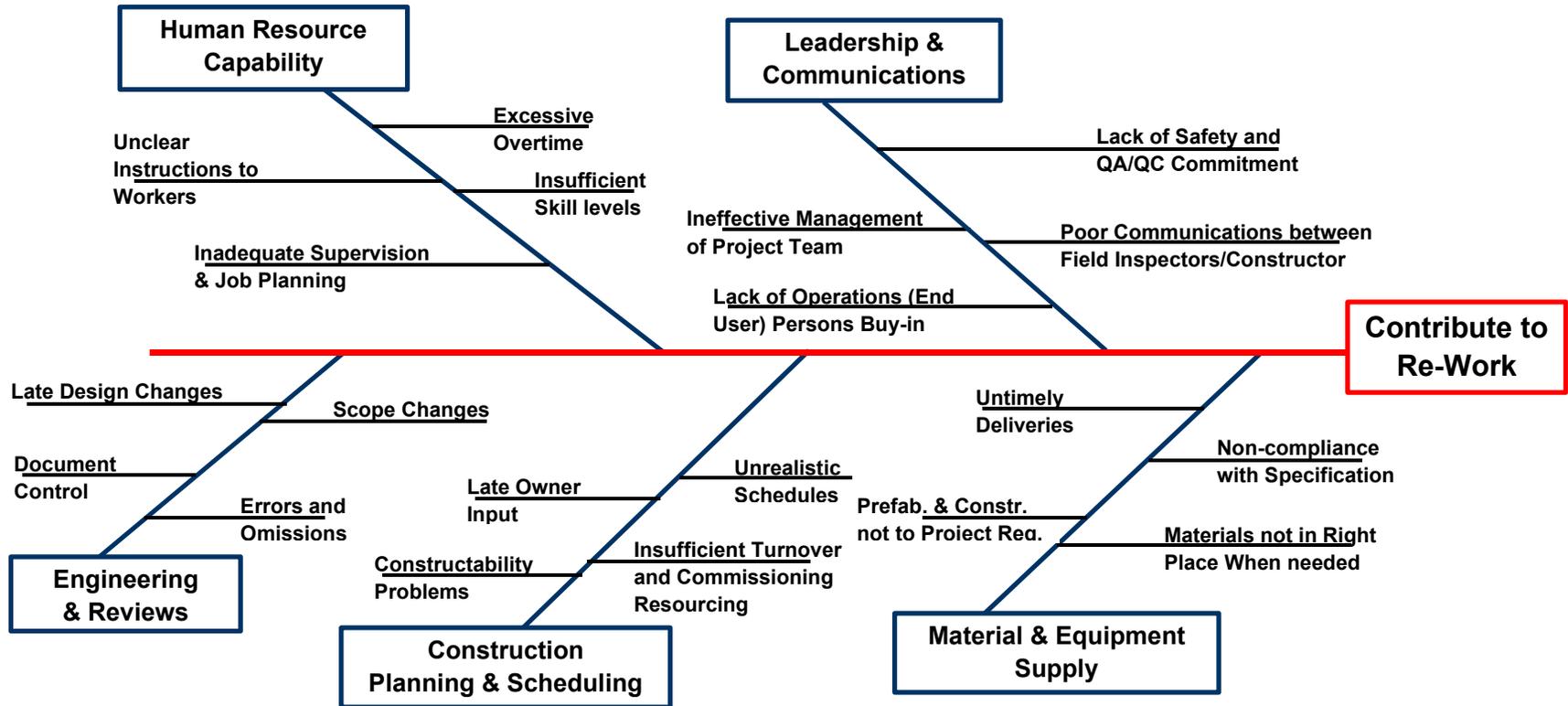
Appendix F

COAA Fishbone Diagrams & Third Level Rework Classification Categories for Pilot Study

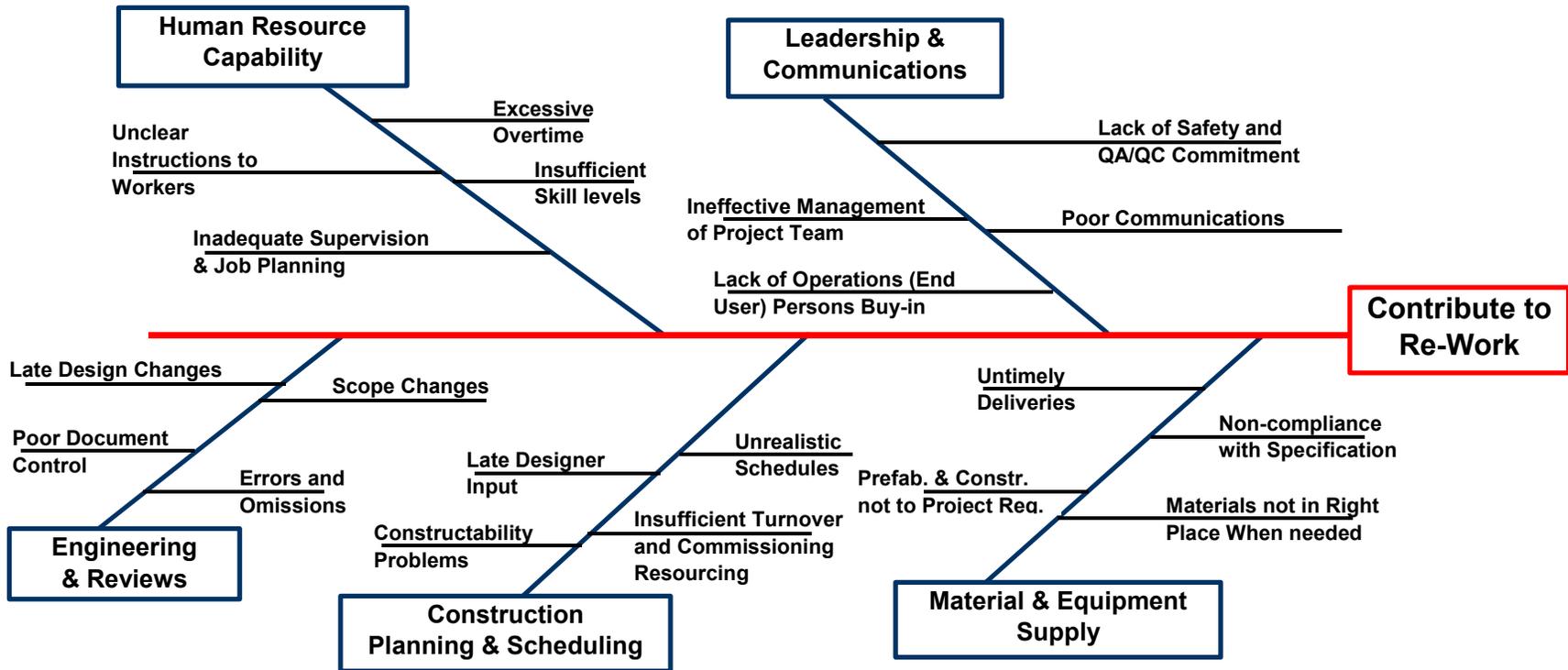
COAA Re-Work Workshop - May 2001



**Revised Fishbone Used in Pilot Study
15-May-02**



**Final Fishbone Used in Pilot Study
2-Oct-02**



SECTION 1 - Engineering & Reviews

A. Late Design Changes	
A1	Insufficient time between engineering and construction activities
A2	Incomplete Client design review
A3	Inadequate constructability reviews
A4	Inadequate execution plan
A5	Process and instrumentation drawings are incomplete
A6	Drawings not issued for construction (incomplete)
A7	Drawings not issued for construction (in review)
A8	Drawings not issued for construction (revisions required)
A9	Document presentation of poor quality (missing details)
A10	Document presentation of poor quality (missing drawings)
A11	Scope changes
A12	Errors & Omissions
A13	Late Owner input

B. Poor Document Control	
B1	Inadequate Revision Control
B2	Document delivery delay
B3	Improper drawing log
B4	Incorrect numbering on drawings
B5	Incorrect work package numbering/contents
B6	Inadequate vendor data control
B7	Inadequate or insufficient resources for document control
B8	Inconsistent treatment/comments on vendor drawings
B9	Inconsistent/conflicting numbering on alliance jobs
B10	Request for Information (RFI's) not responded to in a timely fashion
B11	Incorrect distribution of documents
B12	Drawings not available
B13	Lack of internal document tracking

C. Scope Changes	
C1	Process tinkering (fine tuning of end product)
C2	Client scope changes
C3	Bad process assumptions
C4	Client operating changes
C5	Inadequate design change control
C6	Scope gaps between Contractors/Client
C7	Utilities, off-sites, and site integration
C8	Technology changes
C9	Unknown conditions (undergrounds, field checks)
C10	Licenser changes
C11	Incorrect initial vendor data
C12	Specification changes
C13	Inadequate prototype design
C14	Constructability issues
C15	Request by Fabricator/Supplier

SECTION 1 - Engineering & Reviews (Cont'd)

D. Errors & Omissions	
D1	Inadequate discipline coordination
D2	PM deviates from process
D3	Inadequate field verification by designer
D4	Changes in personnel (small project)
D5	High turnover (resulting in quality issues)
D6	Conflicting project demands
D7	High work load taxing capability
D8	Lack of skills
D9	Incomplete engineering
D10	Complex specifications
D11	Consistency not ensured before Issued For Construction (IFC)
D12	Original design/specification was incorrect
D13	As-built error (for retrofit)
D14	As-built error (for interface)
D15	Lack of attention to (critical) details
D16	Insufficient details
D17	Inexperience
D18	Poor assumption during the design

SECTION 2 - Construction Planning & Scheduling

A. Late Designer Input

A1	Incomplete Client design review
A2	Technology advancements
A3	Inadequate constructability reviews
A4	Inadequate execution plan
A5	Drawings not issued for construction (incomplete)
A6	Drawings not issued for construction (in review)
A7	Drawings not issued for construction (revisions required)
A8	Schedule - not enough float to accommodate change
A9	Errors & Omissions
A10	Scope Changes

B. Constructability Problems

B1	Safety issues
B2	Access to work location
B3	Non-conformance (quality) problems
B4	Trade interferences
B5	Structural interferences
B6	Drawings vs. field construction issues
B7	Technology changes
B8	Poor assumptions during design
B9	Unforeseen ground/site conditions
B10	Adverse weather conditions
B11	Unexpected environmental concerns
B12	Working environment

C. Unrealistic Schedules

C1	Resources used in schedule do not reflect that of actual construction
C2	Budget used in schedule does not reflect that of actual construction
C3	Suppliers/Fabricators not meeting milestones
C4	Sub-trades not meeting milestones
C5	Unforeseen ground/site conditions
C6	Unexpected environmental concerns
C7	Separation between engineering and construction
C8	Unrealistic production factors used
C9	Schedule developed before scope fully defined
C10	Adverse weather conditions
C11	Working environment
C12	Out-of-sequence work
C13	Schedule not up-to-date

SECTION 2 - Construction Planning & Scheduling (Cont'd)

D. Insufficient Turnover & Commissioning Resourcing	
D1	Lack of site visits by operations
D2	Lack of site visits by design engineer
D3	Lack of site visits by owner
D4	Poor definition of project scope and schedule
D5	Poor understanding of project scope and schedule
D6	Lack of owner involvement in early stage of the project
D7	Untimely start date
D8	Unrealistic schedule constraints
D9	Inadequate input from owner or representative
D10	Inadequate input from operations
D11	Process tinkering (fine tuning of end product)
D12	Poor coordination between contractors
D13	Inadequate quality assurance / quality control availability
D14	Poor design assumptions
D15	Implementing new technology - Do not know what is expected
D16	Implementing new technology - Does not work as expected
D17	Inadequate experience with commissioning – owner
D18	Inadequate experience with commissioning – contractor
D19	Unforeseen conditions / circumstances

SECTION 3 - Leadership & Communications

A. Ineffective Management of Project Team	
A1	Poor role definition of key players for authority & responsibility
A2	Frequent structure changes within key team groups
A3	Frequent personnel changes within key team groups
A4	Lack of a sense of ownership within the team
A5	Inadequate project reviews
A6	Inadequate instructions
A7	Inadequate quality systems/audits
A8	Lack of management tools

B. Lack of Operations (End User) Persons Buy-in	
B1	Lack of client involvement at all stages
B2	Client's PM adopted as 'gatekeeper' to scope change
B3	Lack of dedicated, consistent process personnel/team
B4	Lack of authority/initiative of operators to make decisions
B5	Plan not integrated

C. Lack of Safety and QA/QC Commitment	
C1	Poor definition and communication of project goals
C2	Poor measures & incentive plans
C3	Unclear contract/technical documents
C4	Misalignment of expectations between Contractor and Owner
C5	Misalignment of expectations between Supplier/Contractor
C6	Misalignment of expectations between Contractor and Subcontractor

D. Poor Communications	
D1	Interpersonal difficulties
D2	Barriers to effective communication
D3	Lack of problem solving skills
D4	Lack of standard communication procedures

SECTION 4 - Material & Equipment Supply

A. Untimely Deliveries	
A1	Poor material handling strategy
A2	Lost material/equipment and documents
A3	Error made in method of transportation
A4	Delay in order/inspection
A5	Inadequate specification
A6	Schedule compression
A7	Safety concerns

B. Prefabrication and Construction Not to Project Requirements	
B1	Lack of specifications
B2	Lack of inspection
B3	Special techniques or materials not utilized
B4	Wrong material/equipment
B5	Not-shop tested
B6	Schedule compression
B7	Poor workmanship of the prefab material
B8	Inadequate material/equipment protection for delivery

C. Non-compliance with Specification	
C1	Inadequate vendor quality plans
C2	Inadequate quantity of material
C3	Complex and/or tight specifications
C4	Wrong material/equipment
C5	Lack of experience with material
C6	Poor workmanship of the supplied material/equipment

D. Materials Not in Right Place When Needed	
D1	Poor material/equipment handling strategy
D2	Lost material/equipment and documents
D3	Error made in method of transportation
D4	Delay in order/inspection
D5	Inadequate specification
D6	Schedule compression
D7	Safety concerns
D4	Lack of standard communication procedures

SECTION 5 - Human Resource Capability

A. Unclear Instructions to Workers	
A1	Poor imperative drawings/information
A2	Untimely communication
A3	Misunderstanding of information transferred to individuals
A4	Lack of monitoring of the understanding of transferred information
A5	Inadequate team work
A6	Lack of feedback on clarification of instructions/documentation
A7	Poor information transfer techniques
A8	Lack of clarity of project documentation
A9	Lack of clarity of instructions
A10	Language barrier for technical information
A11	Workers' poor understanding level

B. Inadequate Supervision & Job Planning	
B1	Insufficient leadership talent
B2	Lack of training & experience
B3	Lack of leadership and experience in job planning
B4	Inadequate technical knowledge
B5	Poor information flow
B6	Inadequate Supervisor/Foreman/Tradesmen ratios
B7	Lack of skill development opportunities
B8	Shortage of skilled supervision
B9	Shortage of skilled labour
B10	Excessive labour absenteeism
B11	Excessive labour turnover
B12	Inadequate Field Verification by Contractor

C. Excessive Overtime	
C1	For recovery or advancement
C2	Compressed schedule
C3	Lack of resources
C4	Lack of information
C5	Adverse weather conditions
C6	Design changes
C7	Lack of material
C8	Insufficient manpower
C9	Congestion
C10	Working conditions

SECTION 5 - Human Resource Capability (Cont'd)

D. Insufficient Skill Levels	
D1	Lack of skill development opportunities
D2	Shortage of skilled supervision
D3	Shortage of skilled labour
D4	Excessive labour absenteeism
D5	Excessive labour turnover
D6	Lack of leadership & communication skills
D7	Lack of mentoring & team skill talent transfer
D8	Lack of ongoing training
D9	Restrictive (name hiring) practices
D10	Language barriers
D11	Shortage of experienced workers
D12	Inadequate Journeyman to Apprentice Ratios
D13	Lack of adherence to procedures