2015 STAMP Conference

MIT Partnership for a Systems Approach to Safety

"Application of STAMP to Project Risk Management: A Workshop Approach"

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Table of Content

Introduction (1/2)

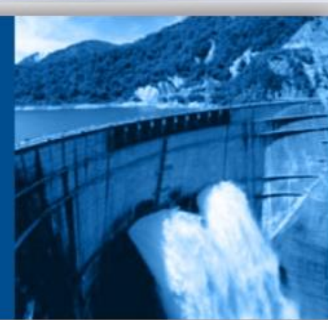
CONSULTING ENGINEERS

ILF Group

Oil & Gas

- Upstream facilities
- Pipeline systems
- Underground storage facilities
- Tank farms & terminals
- Refineries & petrochemical plants

Water & Environment



- Hydropower plants
- Water transmission systems
- Water & wastewater networks
- Water & wastewater treatment plants

Energy & Climate Protection

- Thermal power plants
- Desalination plants
- Renewable energy
- Climate protection
- Power transmission & distribution systems

Transport & Structures

- Airports
- Roads
- Railways
- Urban transport systems
- Tunnels & caverns
- Buildings & structures
- Alpine resorts

Introduction (2/2)

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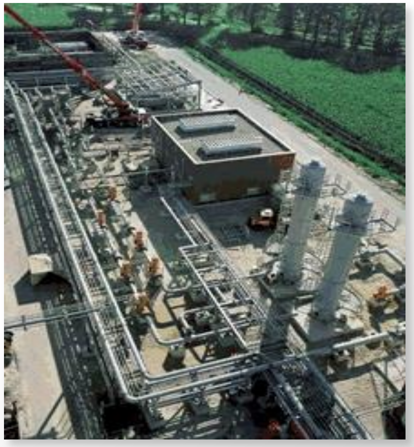
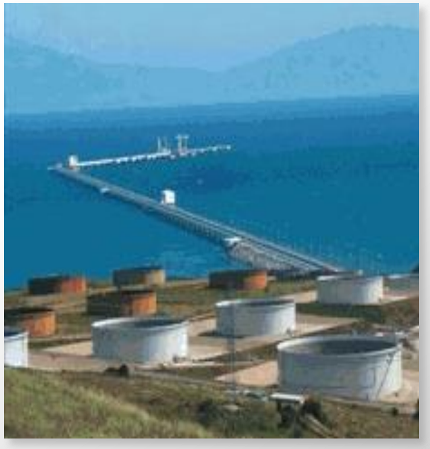
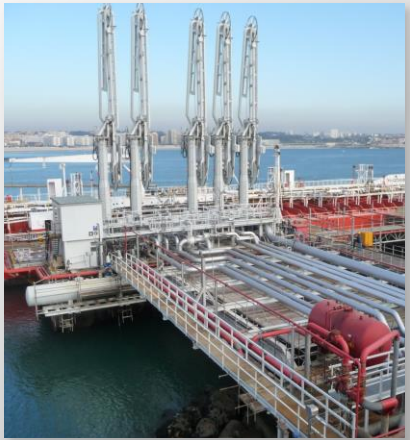
Oil & Gas Projects

Motivation (1/2)

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- **General (1/2)**
- **Previous Master Thesis > Evaluating Project Safety (System Engineering and Safety Management) in an Organization for implementation of STAMP principles**
- **Parallelism Hazard Analysis ↔ Project Risk Analysis**
  - **Resource intensive, benefits questioned**
  - **Impact on actual Project execution?**
- **Transferring techniques might aid in improving established Project Risk Management practice**
  - **e.g. PMI (Project Management Institute)**

Motivation (1/2)

General (2/2)

Regular Risk Management	STAMP-based Risk Management
Risk Management Planning	Goals, Unacceptable Losses, Safety Control Structure
Risk Identification and Analysis	Hazards
Risk Mitigation Strategy	Safety Constraints
Risk Mitigation Action Plans	STPA Step 1 Unsafe Control Actions STPA Step 2 Causes of UCAs

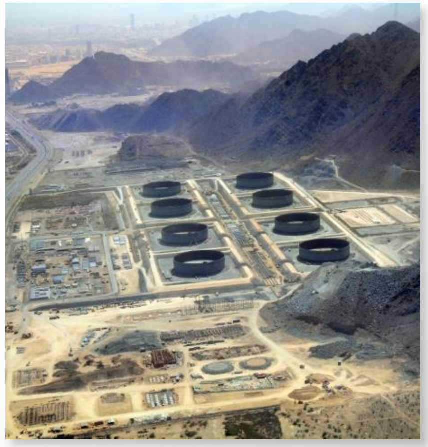
Motivation (2/2)

- **Specific**
- **Attempt to reduce bias in Project Risk Assessments**
- **Increase efficiency of workshop sessions**
  - **Less brainstorming**
  - **More structured framework**
- **Improve communication of results**
  - **Somebody not part of the assessment able to understand results and rationale**

Project Case Study (1/4)

- **Long Distance Pipeline Systems**
- **Several 1,000 km length; Throughputs up to 60 bcma (gas) or 100 MTA (oil)**
- **Pipe Diameters 32”, 48”, 56”; Pressures typically in class ANSI 600 (up to 100 bar)**
- **Typical large Pump Stations up to 50 MW / Compressor Stations up to 200 MW / Metering Stations / Pressure Reduction and Offtake Stations**
- **Interconnecting to other systems/ facilities**
  - **Upstream/ Downstream Pipeline Systems**
  - **Loading Terminals/ Ports**
  - **Production facilities**
  - **Storage and Refining facilities**

Project Case Study (2/4)

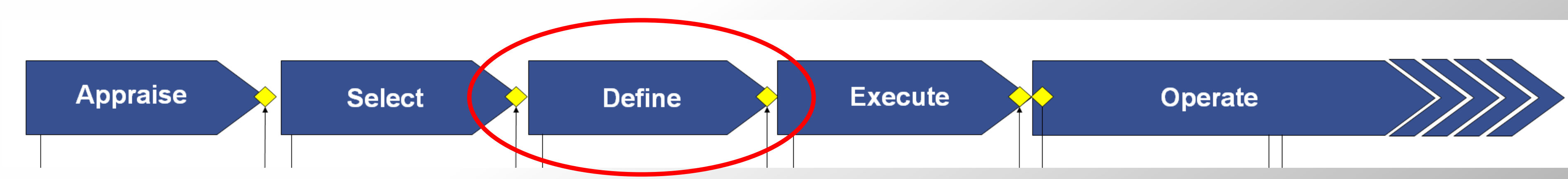








Project Case Study (3/4)

- **Project Risk Management during FEED**
- **Operating Asset Lifecycle**



- **Input to Contracts**
  - **Requirements for Project Execution phase in Scope Of Work documents**
- **Input to CAPEX Estimate**
  - **Recommendation for Project Contingency ($)**

Project Case Study (4/4)

Typical Project Losses to be avoided

- [A1] Pipeline system does not deliver target annual throughput when in Operation
- [A2] Budget is overrun during Project Execution
- [A3] Ready For Operation Target Date not achieved

Example Project Risks

- [H1] Damage to adjacent local infrastructure during Project construction activities
- [H2] Land acquisition is not completed when required to be handed over to construction contractors for start of Project construction activities
- [H3] Authorities do not award permits to the Project when required for start of related Project construction activities
- [H4] LLIs are not available when required to be used by construction contractors in the Project construction activities
- [H5] Major Fire and/ or Explosion during Project commissioning activities

Workshop Sessions (1/9)

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■ Sessions

1. **Agreement of Project Objectives and identification of High-Level Risks**
2. **Validation of identified High-Level Risks**
3. **Risk Analysis and identification of Risk Response Strategies**
4. **Development of Action Plans (Shaping Actions, Hedging Actions)**

Workshop Sessions (2/9)

- **Agreement of Project Objectives and identification of High-Level Risks**
- **Preparation by review of contract documentation**
- **Agree Project Objectives and Project Losses to be avoided with main stakeholders in session**
- **Identify High-Level Risks (Delphi method)**

- **Lessons:**
  - **Contracts quality (formulation of objectives might be vague)**
  - **Agreeing on objectives and losses might take more time than expected**

Workshop Sessions (3/9)

■ Validation of identified High-Level Risks

Project Risk Validation Criteria	Reason
High-level Project Risks are such that directly lead to defined unacceptable losses (i.e. The Project Risk is a direct cause of one or more unacceptable losses defined).	Causal factors such as e.g. ineffective interface coordination or lack of resources are causes of Project Risks and shall not be accepted as high-level Project Risks. This type of causal factors will be identified later on.
The Project Risk formulation is sufficiently precise (not vague) for a non-participant of the Project Risk Workshop to clearly understand the issue and for development of Risk Mitigation strategies.	Project Risk formulations should, whenever possible, include a subject, a verb and some information about the context. Formulations such as “line pipe late” or “bad weather” shall not be accepted.
Project Risks can be controlled by the Pipeline Project (both by preventive or contingency measures).	Project Risks for which the Pipeline Project has no control are not worth of consideration, e.g. related to Project financing, steel and fuel cost fluctuations, currency exchange rate fluctuations, oil prices lower than predicted, war or political developments.

■ Lesson:

- **Initial long list significantly reduced: 35 items → 15 items**

Workshop Sessions (4/9)

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■ Risk Analysis (Alternative to Risk Probability – 1/2)

■ Risk Plausibility as a function of

Factor	Definition
Experience	Determines if such or similar risks have materialized in past pipeline projects for the Oil&Gas industries, considering the experience and knowledge of the Project Risk Workshop panel members.
Proximity	Determines the timing when a risk might start impacting the Project. In other words, it determines when the Project will migrate to a state of higher risk caused by the identified matter.
Manageability	Determines how easy a Risk can be managed. Assumes a risk is manageable by Project Execution.

■ Data collected in workshop vs. selected Probability in a scale

- **70% of Risk Plausibility yielded by data matched Probabilities selected by panel**

Risk (Threat / Opportunity)	Plausibility				Probability		
	Experi-ence	Proxi-mity	Manage-ability	Rate	Proba-bility	Prob Low	Prob High
Land acquisition delays Experience: Very frequent Proximity: Risk impacting from start of construction Manageability: Land acquisition process is ongoing (if there are delays, only related to small pockets that have been identified by route verification)	5	3	1	0.60	High	0.51	0.7

Workshop Sessions (5/9)

Risk Analysis (Alternative to Risk Probability – 2/2)

- **30% of Risk Plausibility yielded by data did not match Probabilities selected by panel**
  - **In all instances panel selected a lower probability than what the data collected suggested**

Risk (Threat / Opportunity)	Plausibility				Probability		
	Experi-ence	Proxi-mity	Manage-ability	Rate	Proba-bility	Prob Low	Prob High
Damage to pipeline material during construction Experience: It has happened in several projects Proximity: Risk impacting during construction Manageability: PQ process in place	3	3	1	0.47	Low	0.11	0.3

Lesson:

- **Risk Plausibility framework provides a more robust scheme than Probability scales**

Workshop Sessions (6/9)

Risk Analysis (Risk Impact on Project Objectives)

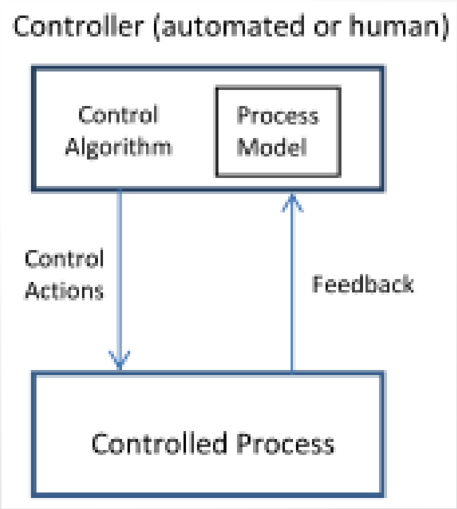
Objective	Risk Impact
Environmental Impact	Whether or not long term environmental impacts can be minimized: • It can be reasonably expected that long term environmental impacts will be minimized • It cannot be reasonably expected that long term environmental impacts will be minimized If not, which environmental factors may be affected and which design features and operations and maintenance controls are expected to contribute to long term environmental impacts as a result of the Project Risk? Why?

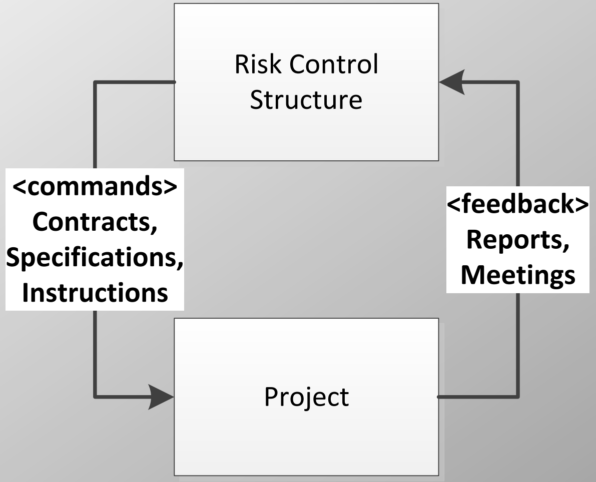
Lesson:

- **Asking why certain Project objectives might be affected or not yields more useful information for subsequent development of Risk Response Strategies than rating the severity of the Project Risk in the frame of a traditional Impact scale**

Workshop Sessions (7/9)

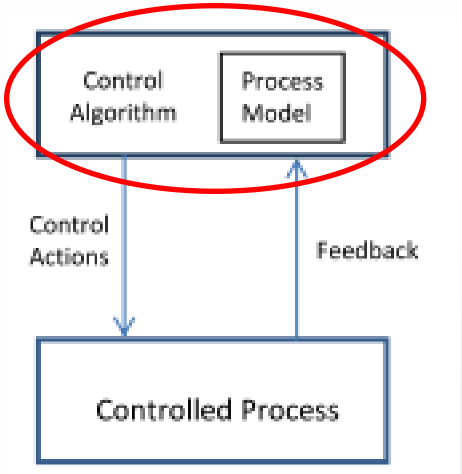
- Development of Action Plans
- Based on Risk Response Strategies
- Shaping and Hedging Actions





Workshop Sessions (8/9)

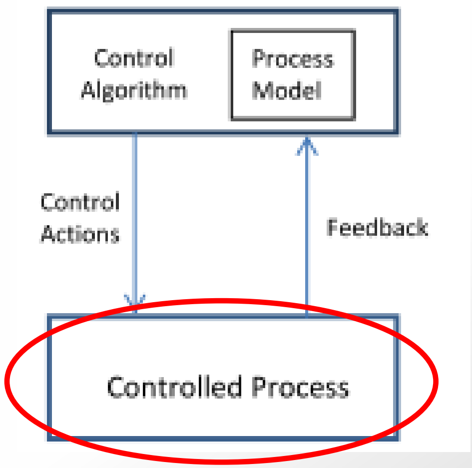
Quality of Action Plan (Example Controller)



Risk Control Structure Elements		Parameters bases on causes of Inadequate Risk Control	
Systems-theory terminology	Project Risk Management terminology	Systems-theory terminology	Project Risk Management terminology
Controller	Responsible person or organization that ensures an action is carried out. Action Owner (in RACI terminology "Accountable"), sometimes also Risk Owner	1- Control input or external information wrong or missing	1.1- Define allocation of resources needed for implementation of risk mitigation action 1.2- Schedule start of risk mitigation action implementation
		2- Inadequate control algorithm (flaws in creation, process changes, incorrect modifications or adaption)	2.1- Define the purpose, scope and extent of risk mitigation action, e.g. issue a risk mitigation action implementation sheet 2.2- Define line managers of responsible personnel to approve the resource estimate performed by Action Owner 2.3- Define ways to verify the Action Owner is competent for the risk mitigation action

Workshop Sessions (9/9)

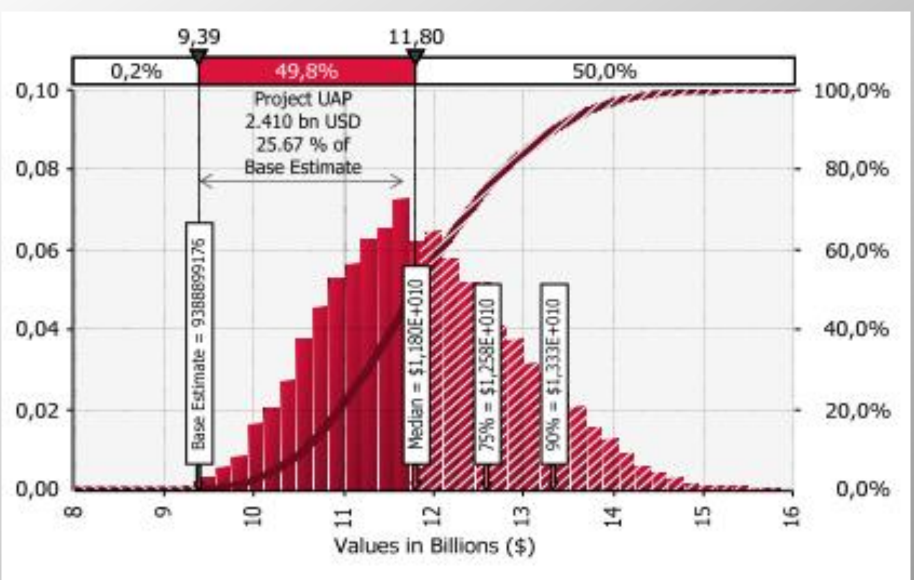
Quality of Action Plan (Example Controlled Process)



Risk Control Structure Elements		Parameters bases on causes of Inadequate Risk Control	
Systems-theory terminology	Project Risk Management terminology	Systems-theory terminology	Project Risk Management terminology
Controlled Process	Responsible person for implementation of action (in RACI terminology "Responsible") Responsible person for coordination of an action (in RACI terminology "Coordinate") Responsible person to be informed of an action (in RACI terminology "Inform")	4- Component failures, changes over time 5- Conflictive control actions 6- Unintended or out-of-range disturbance 7- process output contributes to system hazard	4, 5, 6- Define line managers of responsible personnel to approve the time schedule of risk mitigation action implementation (i.e. to ensure that the responsible persons are available when they shall be) 7.1- Establish a schedule of checks (i.e. to ensure that the responsible persons execute the risk mitigation actions as intended) 7.2- Set a target completion dates (i.e. to ensure that the responsible persons execute the risk mitigation actions timely)

Challenges

- <u>Recommendation for Project Contingency</u>
- **Established practice is based on probabilistic risk analysis**
  - **Project Risk Exposure**
  - **Estimate ranges (quantities and prices)**
  - **Aggregation aided by Monte Carlo Sim.**
  - **Decision based on level of confidence**



- **Alternative?**
  - **Back to deterministic risk analysis**
    - **Different estimates for different scenarios**
    - **Each scenario reflects a certain level of risk in which sets of assumptions hold or not (Assumption-based scenarios)**

More Information

MIT Partnership for a Systems Approach to Safety

- Papers, Masters Theses and Ph.D. Dissertations
- 2014 STAMP Conf. “Using STAMP Principles in Risk Management of Large Scale Pipeline Projects”

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3rd European STAMP Conference

- 5-6 October 2015 @ Amsterdam University of Applied Sciences