The Commission of Inquiry Respecting the Muskrat Falls Project

Analysis of Industry Best Practices

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UNIVERSITY OF CALGARY

Presentation Agenda

- Who am I?
- Acknowledgement
- My mandate
- Objectives of this presentation
- Characteristics of mega projects
- The gated process: industry practices
- The tunnelling concept and decision planes
- Other early warning signs
- Challenges of mega projects
- Risk model & cost estimate
- Contingency, scope contingency and management reserve
- Reshaping governance system
  - Project Sponsor and Project Executive Officer/Project Director
  - Project eco-system and contract strategies
  - Construction productivity
  - Collaborative relationships
- Appendices:
  - Causes for cost and schedule overruns
  - Challenges of mega projects
  - Sponsor and PEO
  - Governance and oversight checklist

Dr. George Jergeas P.Eng.

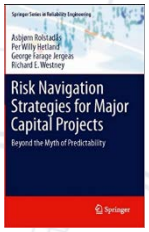
- Professor of Project Management

  Dept. of Civil Engineering, University of Calgary

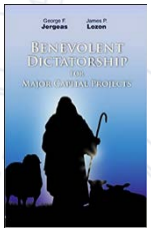
- Interests

  Governance, cost overruns, risks, construction productivity, teambuilding, contract administration, disputes, training and coaching.

- Books:



"Risk Navigation Strategies for Major Capital Projects: Beyond the Myth of Predictability", Springer, 2011



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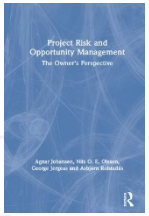

"Project Risk and Opportunity Management, The Owner's Perspective", Routledge, Taylor & Francis Group, 2019

Dr. George Jergeas P.Eng.

- George is a Professor and Director of Project Management in the Schulich School of Engineering at the University of Calgary, where he is involved in both the teaching of and research into project management since 1994. He is a civil engineer from the University of Baghdad with M.Sc. and Ph.D degrees in Project Management from Loughborough University of Technology in the UK. He has over 40 years of academic and industrial experience. Dr. Jergeas joined the university as a full-time academic coming from the industry in 1994. His career in industry was in the delivery of infrastructure projects and consulting in construction and engineering claims and disputes. Dr. Jergeas experience in industry and subsequent research has demonstrated a strong interest in improving the efficiency of construction and engineering projects in the infrastructure and oil and gas sectors with emphasis on mega oil sands projects. Dr. Jergeas' expertise includes team building and partnering, claims preparation and disputes resolution, risk navigation management, productivity improvement, contractual & ethical issues, contract administration and contractual arrangements.
- Dr. Jergeas is also an active project management trainer for both public and private sector organizations. He has provided extensive project management training to many Canadian and international companies such as Husky Energy, CNRL, APEGA, EGBC, Paramount Resources, TC Energy, ConocoPhilps, Gibson Energy, Suncor, EnCana, Nexen, Enbridge, Canfor, Imperial Oil, Lloyd Sadd, District of North Vancouver, City of New Westminster, Flint, PennWest, ATCO, AltaLink, Kvaerner (Norway), CNPC China and EDRC South Korea, Alberta Infrastructure, GNWT, Infrastructure Canada….
- Dr. Jergeas consulting work focuses on improving project alignment and building and sustaining project teams. He has worked with project teams in oil sands development, hospitals, roads and bridges, tunneling, LRT expansions and mining projects. Companies included City of Calgary, City of Edmonton, Alberta Infrastructure, Alberta Transportation, Metro Vancouver, TC Energy.
- As a claims consultant investigating numerous construction projects, Dr. Jergeas gained insight into the fundamental causes of project success and failure. Through his work experience and research, Dr. Jergeas has developed a strong interest in improving project success and predictability founded upon improving the effectiveness of project teams and project delivery system and discipline.
- In addition to his three books, Dr Jergeas has published **more than 100 publications** in project management in journal articles and conference proceedings.

Acknowledgement

- In my previous work, I found:
  - No major problems re quality, safety, and regulatory.
  - Projects running in excess of design capacity.
  - Projects making profits.
  - No unskilled or unprofessional conduct.
  - Proud of industry's achievements.

Acknowledgement

I acknowledge the effort by project participants from all organizations involved in the Muskrat Falls project. These people had to deal with challenges in project planning and execution such as geography, climate, investment, fast completion, and other factors, both internal and external to the project.

George Jergeas

Simplicity!!!


LOCH-RISTI'S
WEATHER FORECASTING STONE
CONDITION
FORECAST
Stone is wet
Rain
Stone is dry
Not raining
Shadow on ground
Sunny
White on top
Snowing
Can't see stone
Foggy
Swinging stone
Windy
Stone jumping up & down
Earthquake
Stone gone
Tornado
2 Stones
Stop drinking

My Mandate

Provide an analysis of industry best practices in delivering mega capital projects based on my research, teaching and work experience.

My presentation is NOT an analysis of the performance of the Muskrat Falls Project.

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Objectives of this Presentation

- Present the big picture and explain the complexity of mega projects.
- Challenge some long-held ideas and best practices.
- Focus on lessons to be learned.

Characteristics of Mega Projects

- Mega projects are complex and not easy to handle despite best effort.
- Mega projects, across the globe experience cost overruns and delays.
- I am not **surprised** by the cost and schedule variances on mega projects.

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Characteristics of Mega Projects

- Billions in capital investment.
- Thousands of workers, engineers, suppliers, contractors and owners support staff.
- Extreme complexity, both technological and size.
- Lack of predictability and increased risks.
  - Some risks are outside the control of the project management team or even the executives level.
- Environmental, regulatory and community impacts.
- Interface management issues.
- Labour availability and labour management issues.
- High visibility, and in most cases, cost overruns that exceed the approved budget.

Oil Sands Project

Oil Sands - Shovel & Truck

Oil Sands -Truck

Characteristics of Mega Projects

- Systematically do not deliver on time and on budget.
  - 50-100% cost overruns in budget is the norm.
- There is not a single actor in control of the vision and implementation.
- Delivered by a network of private and public entities and stakeholders.
- Difficult compromise is needed to achieve consensus between stakeholders.

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Characteristics of Mega Projects

- The scope keeps evolving.
  - Scope changes can affect costs and schedule.
- We tend to be fixated on the original budget and expecting cost won't increase.
- Not easy to explain the new budget isn't an overrun driven by incompetence.
- Success is usually judged on the gap between initial budget and actual performance.

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Characteristics of Mega Projects

- Success has been difficult to achieve despite of industry best efforts.
- Greater challenges to executives.
- Increased risks to investors/clients.
- Investors lose confidence.
- Blame each others & litigation.
- Project manager attrition.
- No difference whether the project is privately or publically funded.

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Characteristics of Mega Projects

- Literature is flowing with papers about repeated global cost overruns and delay cases.
- Causes and factors extend across all phases of a project from development through to execution and completion.

Refer to Appendix 1

Causes of Cost and Schedule Overruns

Reference

Analysis of the Front-end Loading of Alberta Mega Oil Sands Projects", Project Management Journal, Volume 39, Issue 4, December 2008

by

George Jergeas

The Gated Process: Industry Practice

References:

Analysis of the Front-end Loading of Alberta Mega Oil Sands Projects", Project Management Journal, Volume 39, Issue 4, December 2008, George Jergeas.

How to Create Predictable Cost and Schedule Estimates", 58th Western Winter Workshop, San Francisco & Southern CA Sections of AACE International, March 21 – 24, 2019. Dr. Nick J. Lavingia, P.E.

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Chevron
Project Development & Execution Process

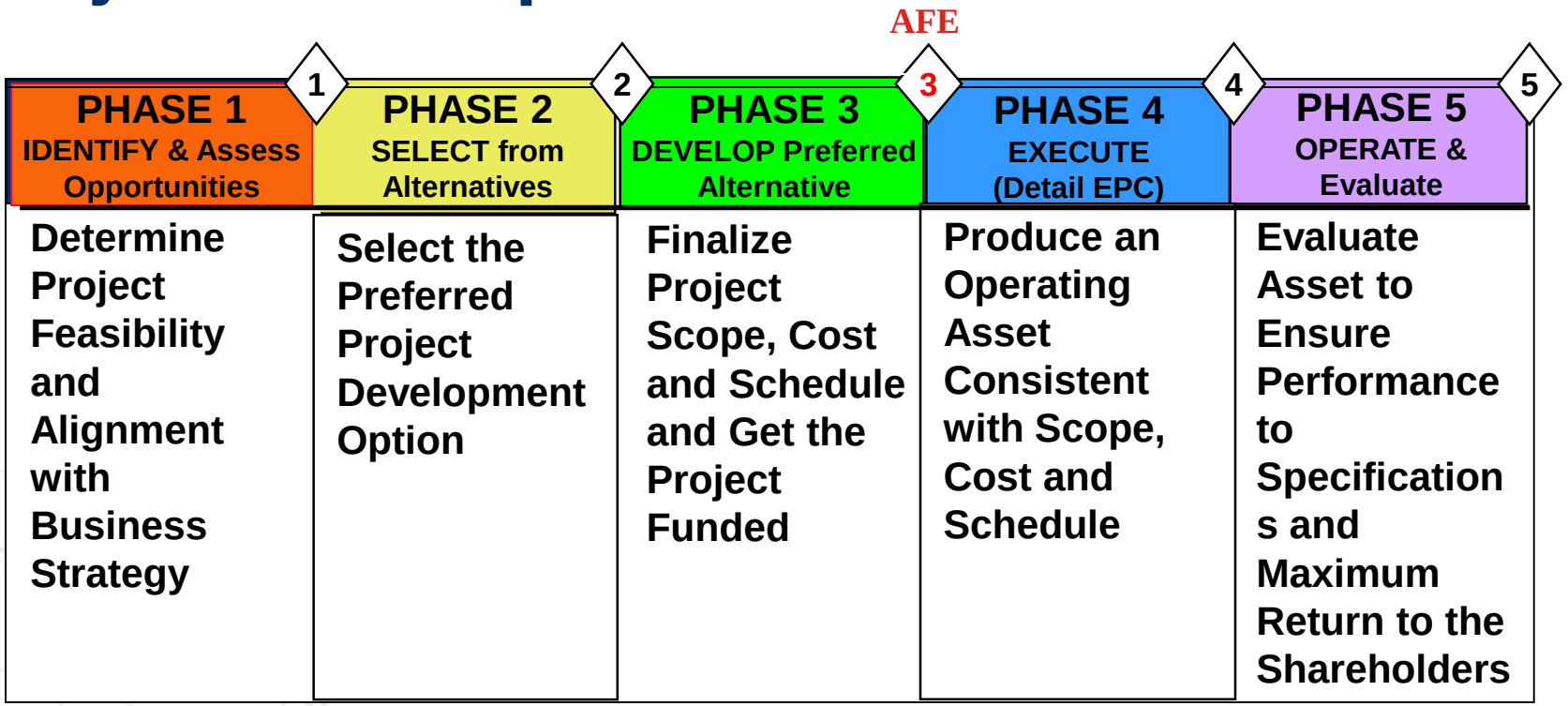
A process that facilitates the optimal use of resources (dollars, people and technology) over the life of an asset or project to maximize value.

Desired outcome

- **Select the right projects by improving decision making.**
- **Improve project outcomes through excellence in execution of decisions.**

Chevron

Project Development & Execution Process



Chevron

Project Development & Execution Process

AFE

1 PHASE 1 IDENTIFY & Assess Opportunities	2 PHASE 2 SELECT from Alternatives	3 PHASE 3 DEVELOP Preferred Alternative	4 PHASE 4 EXECUTE (Detail EPC)	5 PHASE 5 OPERATE & Evaluate
Clearly Frame Goal	Generate Alternatives	Fully Define Scope	Implement Execution Plan	Operate Asset
Test for Strategic Fit	Preliminary Development of Alternatives	**Develop Detailed Execution Plans**	Min. Changes	Monitor & Evaluate Performance
Preliminary Overall Plan	Develop Expected Value	Refine Estimate	Finalize Operating Plan	Identify New Opportunities
Preliminary Assessment	Identify Preferred Alternative	Submit Funding for Approval	Business Plan for Phase 5	
~1 % Engng.	Phase 2 Estimate	~25 % Engng.	Project Review	
Phase 1 Estimate		Phase 3 Estimate (+/- 10 % Accuracy)	Phase 4 Estimate	

AFE = Appropriation For Expenditure

AACE Process Industry Estimate Classification

AACE ESTIMATE CLASS	LEVEL OF PROJECT DEFINITION Expressed as % of Complete Project Definition	END USAGE Typical Purpose of Estimate	METHODOLOGY Typical Estimating Techniques	EXPECTED ACCURACY RANGE At 90% Confidence Level	TYPICAL CONTINGENCY To Achieve 50% Probability of Overrun/Underrun
5	<= 2%	Preliminary Project Screening Estimate, Capital Budget OOM Estimate, Alternate Schemes Evaluation, Strategic Analysis	Capacity Factored, Parametric Models, Judgment, Analogy, Historical Project Comparisons, Gross Unit Cost	Low: -20% to -50% High: +30% to +100%	15% to 40%
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Schedule Level Definitions

SCHEDULE LEVELS

PMP PHASE	OUTPUT DOCUMENT	KEY INPUTS	TYPE OF SCHEDULE (Note 1)	LEVEL OF SCHEDULE (Note 2)
PHASE 1: IDENTIFY OPPORTUNITY	Preliminary Project Milestone Schedule	Start and completion date Duration based on job size	BAR CHART	1
PHASE 2: SELECT ALTERNATIVES	Expanded Project Milestone Schedule	Same as Level 1 plus: Constraints (permit period, long lead-time materials, shutdown dates, etc.)	BAR CHART	2
PHASE 3: DEVELOP ALTERNATIVE	Detailed Integrated Project Schedule	Same as Level 2 plus: Detailed schedules for engineering, procurement, construction and startup (Resource Loaded)	CPM	3
PHASE 4: EXECUTE	Updated Integrated Project Schedule	Expanded detail for design Actual progress, for comparison with planned progress	CPM	4
PHASE 4: EXECUTE	Updated Integrated Project Schedule	Expanded detail for construction & startup Actual progress, for comparison with planned progress	CPM	5

Front- End Loading (FEL)

The front-end period up to the point of official endorsement (project sanction) to proceed, where AFE for full budget funding occurs, and contract ratification with a major contractors for project execution takes place.

Project Documents

- Considerable amount of work to scope the project, select the technologies to be used and present a business case.
- Lots of time and effort:
  - What Owner wanted to do.
  - How much it would cost.
  - What the economics of the investment would be.
  - What the risks might be and much more….

Project Documents

- Project Charter.
  - Is a high level, strategic document for an Owner and Project Team to define a proposed project early, and obtain Stakeholder approval for further development of the opportunity.

- Project Execution Plan (PEP).
  - Clearly defines the components of project implementation including scope and deliverables, methodology, roles and responsibilities, schedule, budget, project background and the internal and external resources required.

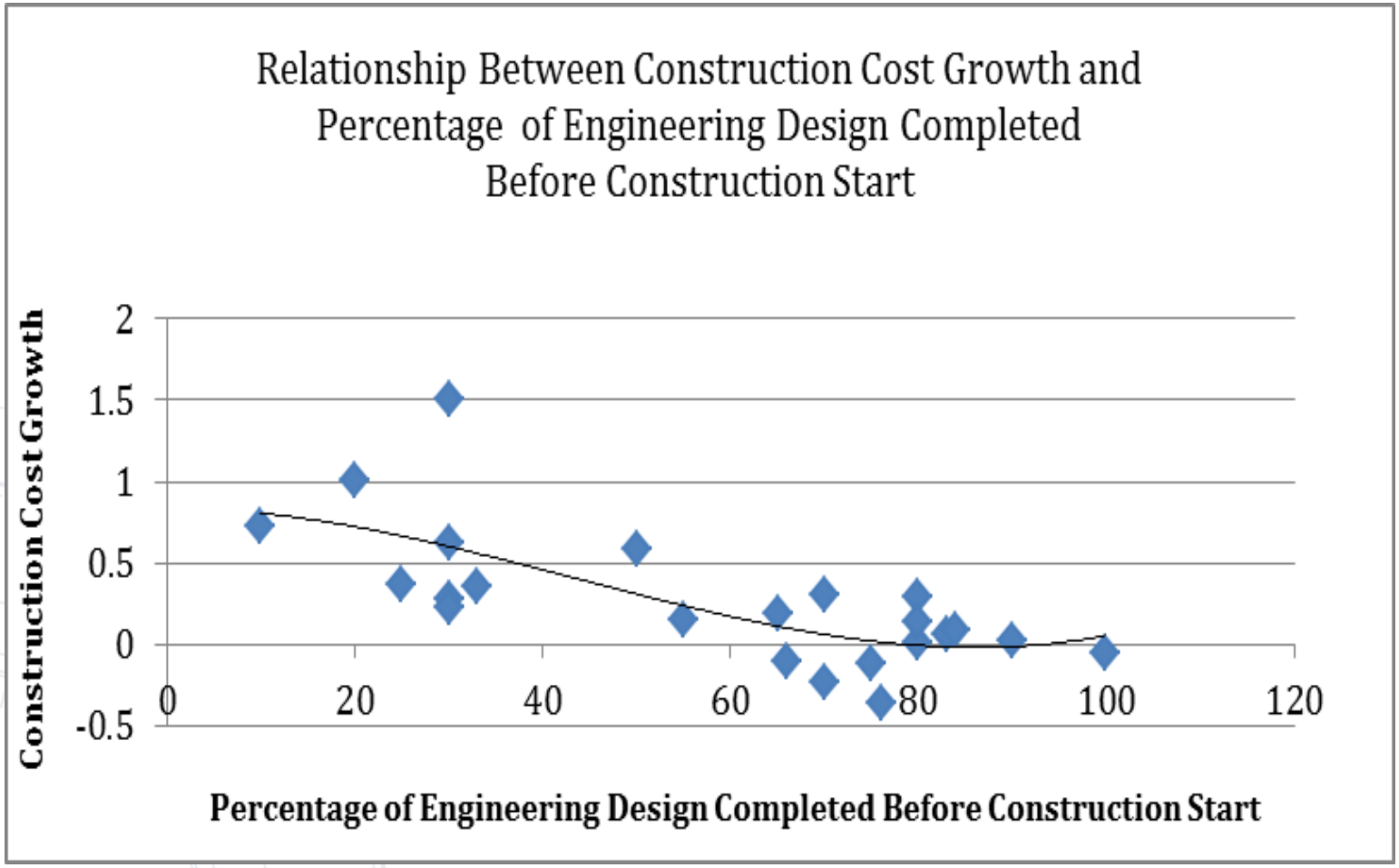
Project Documents

- No sufficient level of detailed engineering done to achieve the level of accuracy and confidence that the owners decision makers place in it when a project is approved.
  - To achieve a level of accuracy of the estimate of (+/-10%) at the end of the project, industry needs more than AACE's 10% to 40% or Chevron's 25% engineering completion.

My Recommendation to Industry

- Strive to have ~80% engineering design completed before mobilizing to site and 100% engineering design completed after site clearing and mobilization is completed but before the start of construction.
- If possible, issue final approval of the project budget after the completion of detailed engineering.
  - The AFE amount should be changed/adjusted; otherwise it will be seen as cost overrun.

Cost Growth and Percentage of Engineering



COAA, U of C, CII, Alberta Report 1, June 2014

Design % Complete

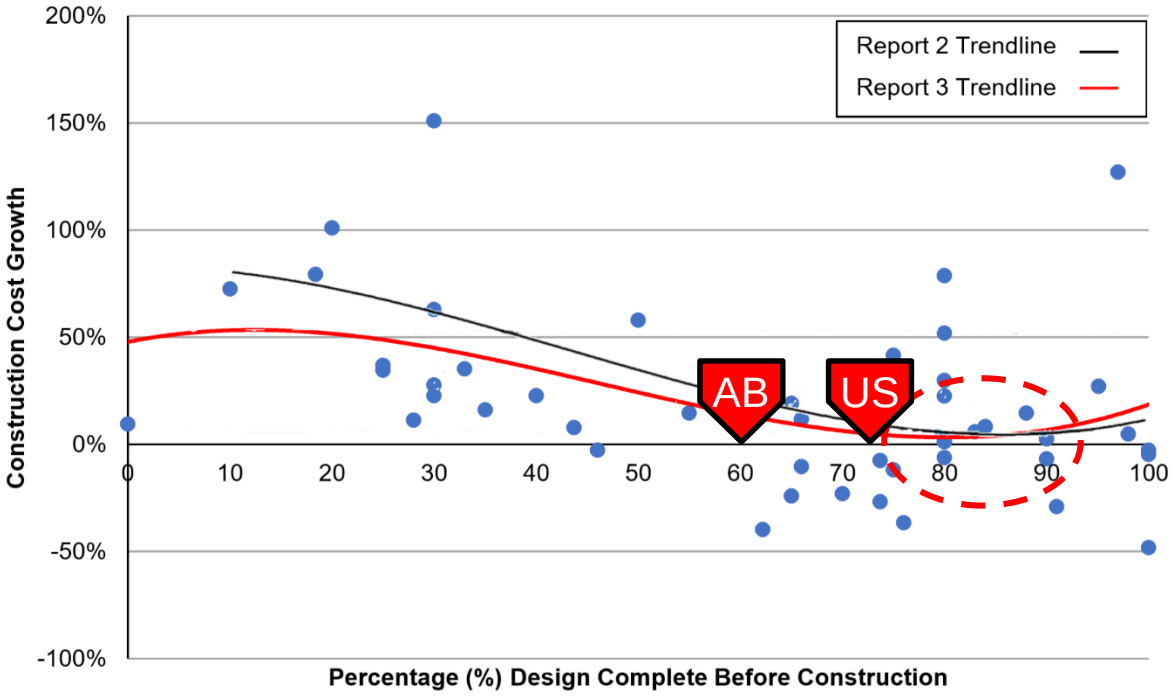


Figure 22: % Design Complete before Construction Start

COAA, U of C, CII, Alberta Report 3, May 2019

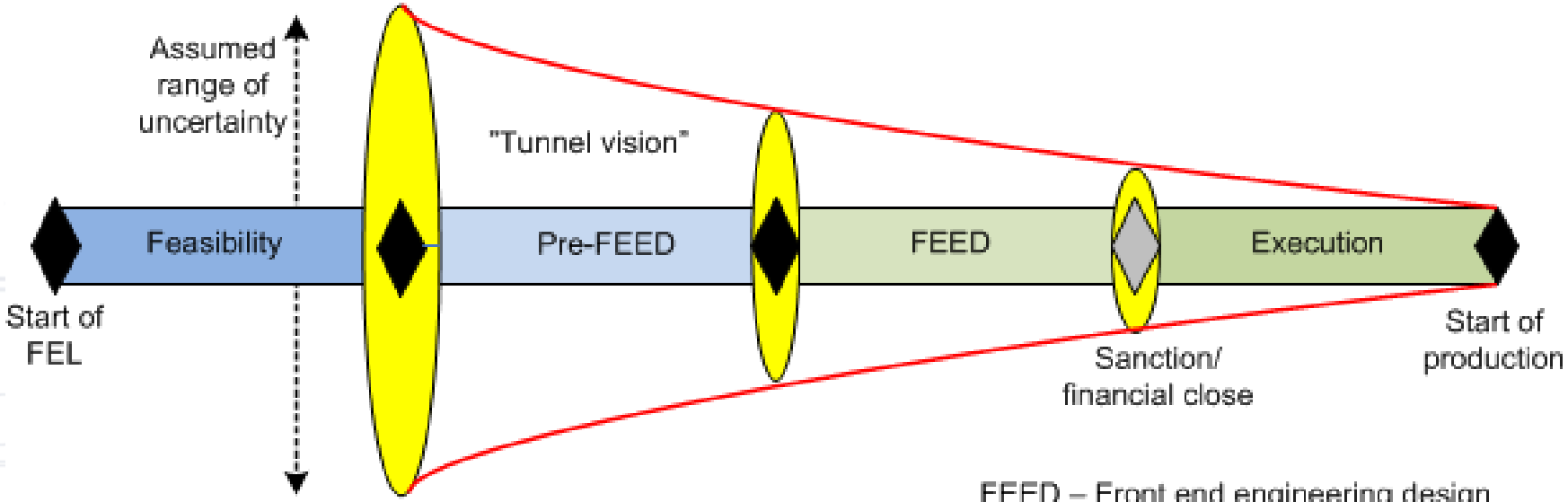
Home Analogy

The Tunneling Concept and Decisions Planes

Reference:

"Risk Navigation Strategies for Major Capital Projects: Beyond the Myth of Predictability", Springer, 2011
by
Per Willy Hetland, George Jergeas, Asbjorn Rolstadas, Dick Westney

Tunneling Concept Neglect of Sources of Uncertainty Outside the Plan Itself



FEED – Front end engineering design

FEL – Front end loading

Tunneling Concept

- Tunneling is the neglect of sources of uncertainty outside the plan itself.
  - Data that supports our proposition is embraced.
  - Data that challenges our proposition is ignored, dismissed, or severely discounted.
- As our investment of time, effort and money in developing and supporting our proposition increases:
  - We are tunneling deeper and more anchored to our solution.
  - Our ability to see outside the boundaries of our assumptions is reduced.
- **Black Swans** are risks that are considered to be outliers and thus ignored until they occur with great impact.

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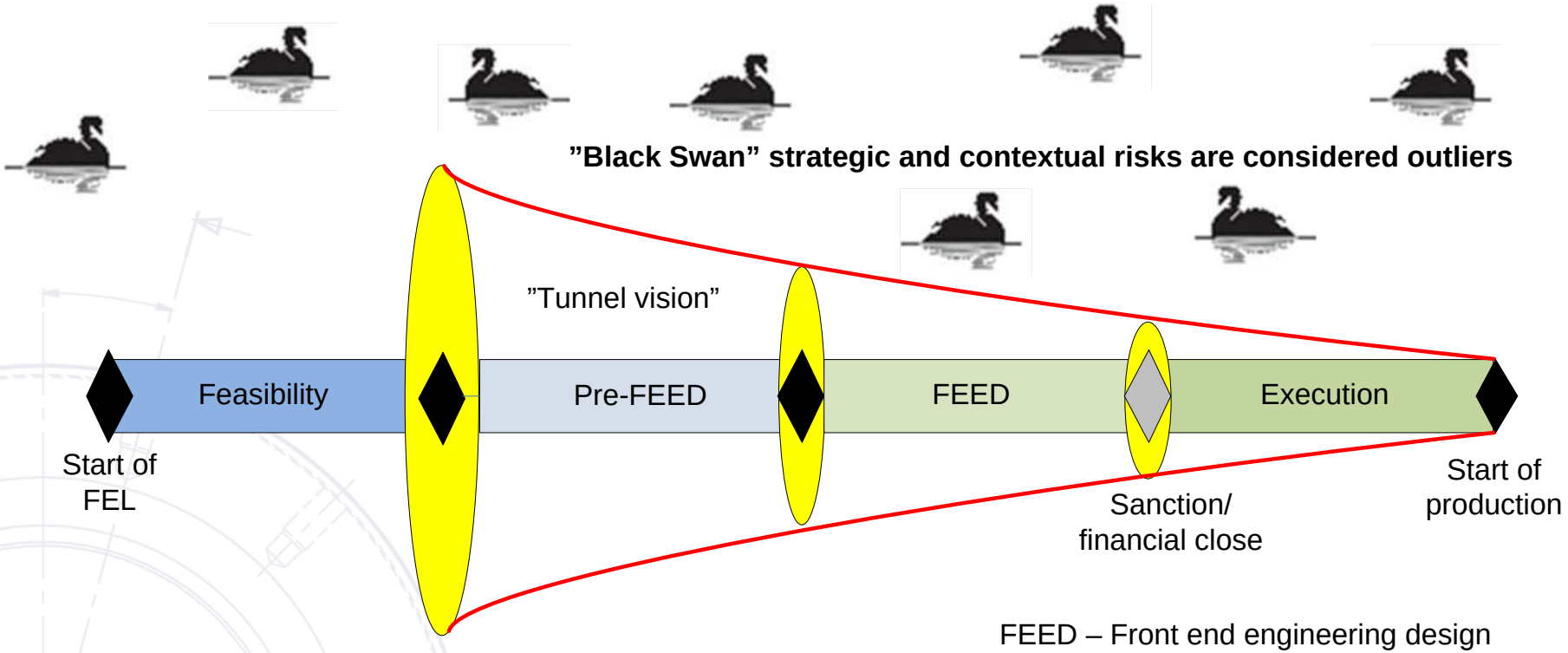
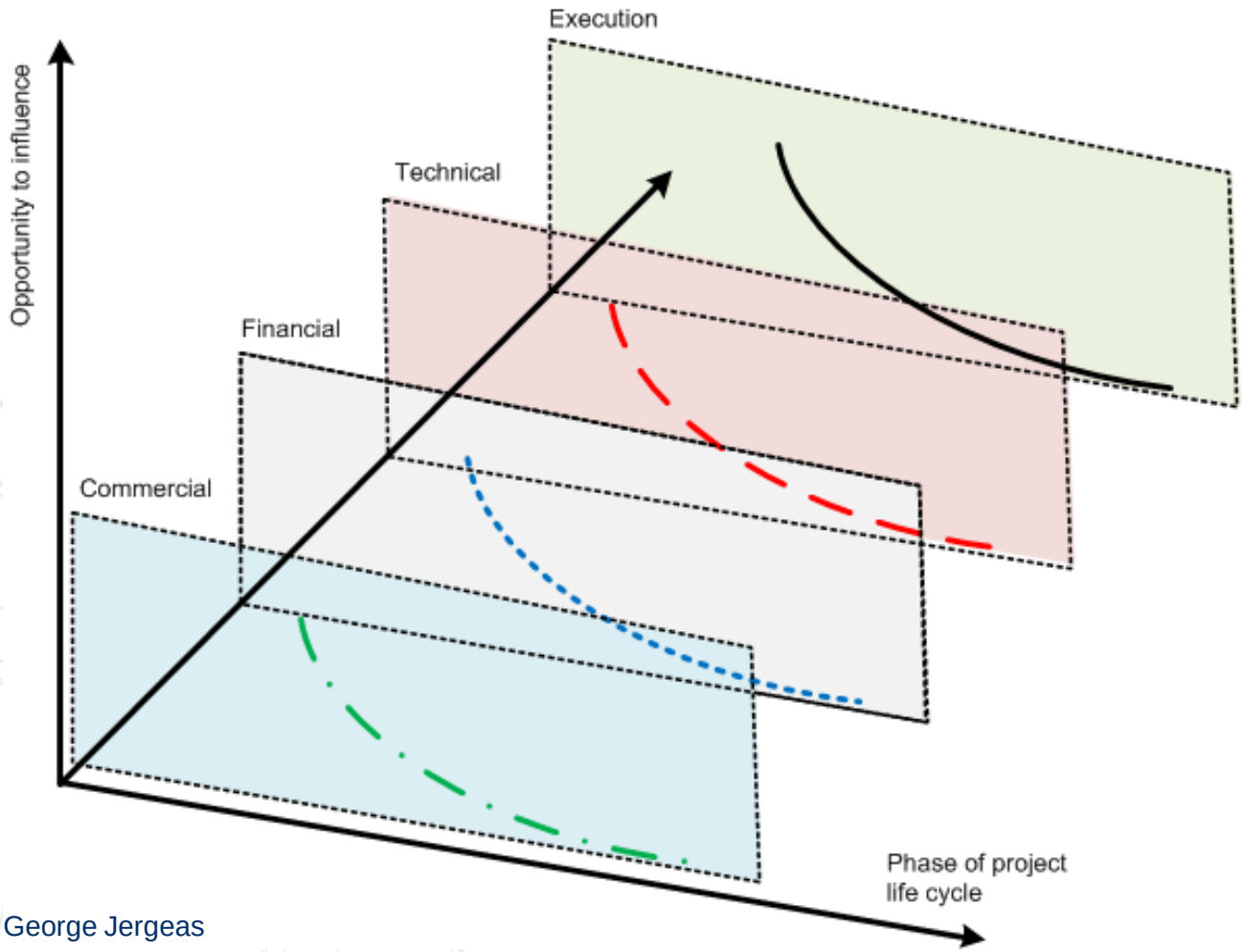
Black Swans and Tunnel Vision



FEED – Front end engineering design

FEL – Front end loading

The Four Decision Planes



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The Four Planes

- People working on each plane tend to make simplifying assumptions about the strategies, decisions, and risks on the other planes.

- Lack of alignment shows up as a major changes in the direction often resulting in significant re-direction or cost overruns and schedule delays.

The Four Planes of Decision Process: Examples

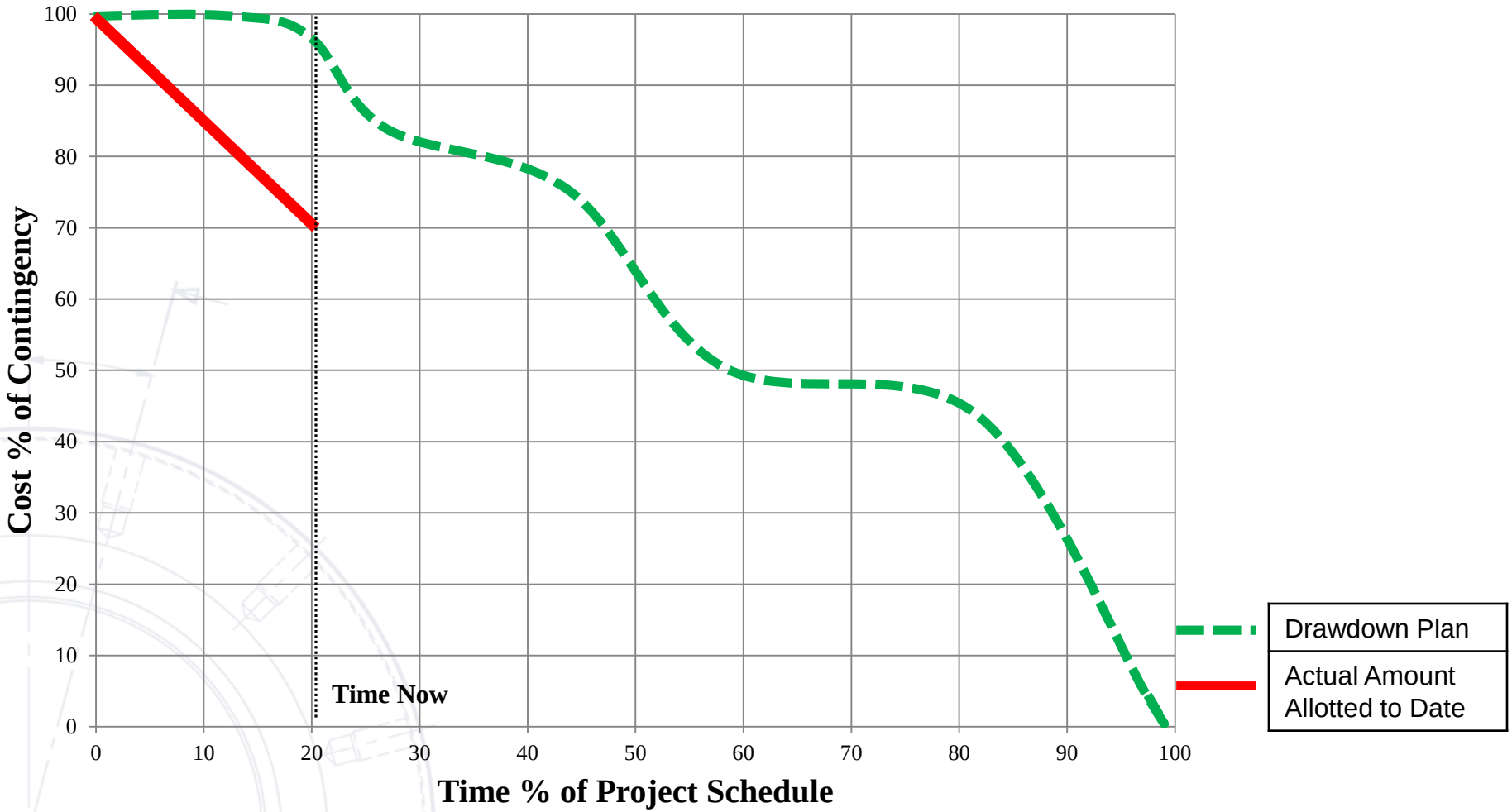
- Decision to fabricate in Korea.
- Company accepts unrealistic completion deadline.
- Business units impose unreasonable budget number or completion date.

Too Many Moving Parts

Other Early Warning Signs

- Warning signals that events are not evolving as expected
  1. Delays in engineering and early milestones.
  2. Huge number of scope changes and project re-estimates.
  3. Contingencies and allowances consumed quickly.
- Delays do not seem to be reflected on final project completion date.
  - Fast-tracking the fast-track!

Cost Contingency Drawdown Curves



Refer to Appendix 2

Challenges of Mega Projects

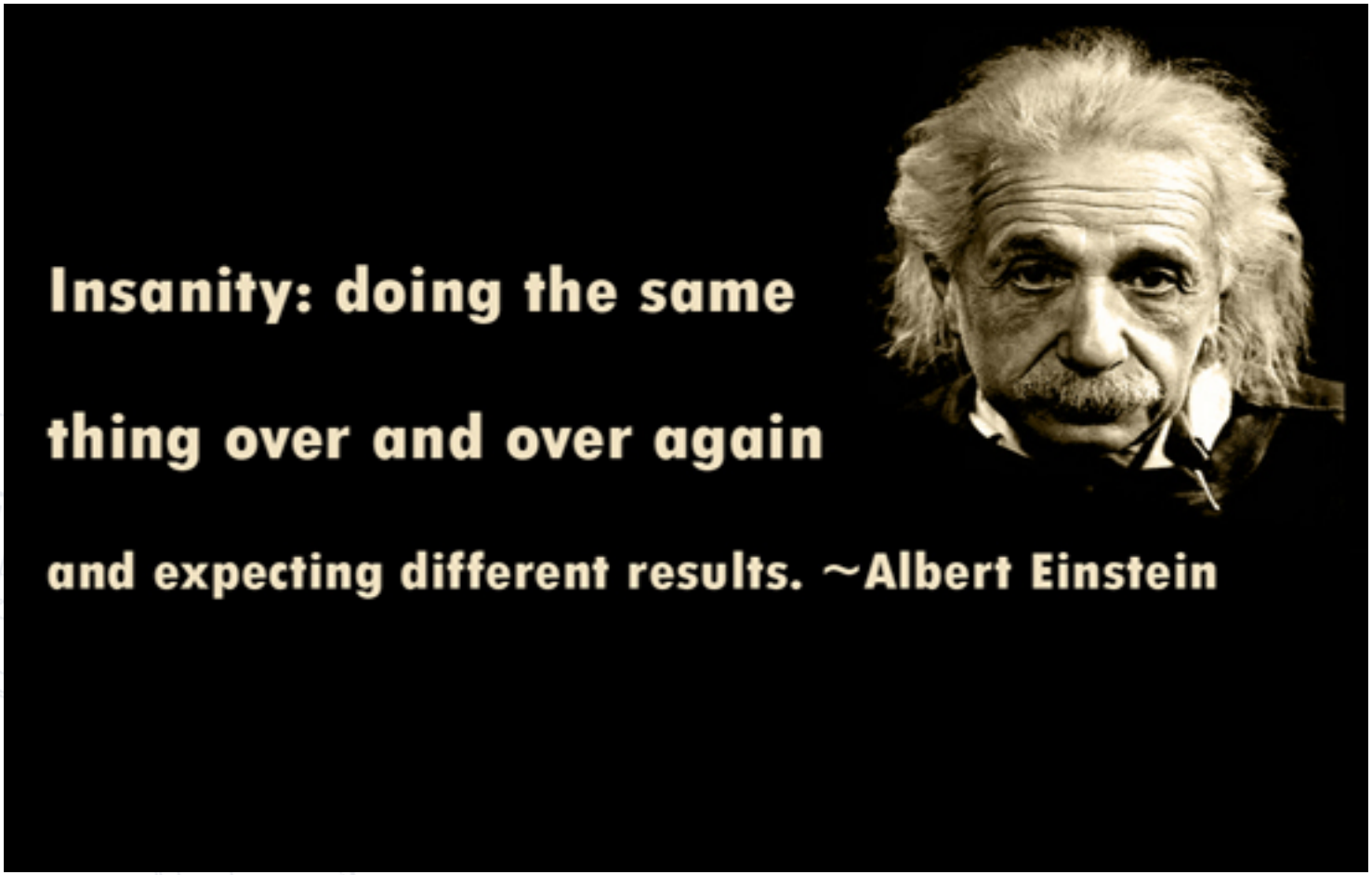
Reference

Performance Challenges of Mega Capital Projects, a report to Productivity Alberta,

George Jergeas and Jim Lozon,

Go Productivity,

November 2014, Alberta.


Insanity: doing the same
thing over and over again
and expecting different results. ~Albert Einstein

Project Risk Model and Cost Estimate

References

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Project Risk and Opportunity Management, The Owner's Perspective, Routledge, Taylor & Francis Group, 2019, by Agnar Johansen, Nils Olsson, George Jergeas and Asbjorn Rolstadas

Project Risk Model

- No project goes exactly as planned.
  - Expect deviations during project execution.

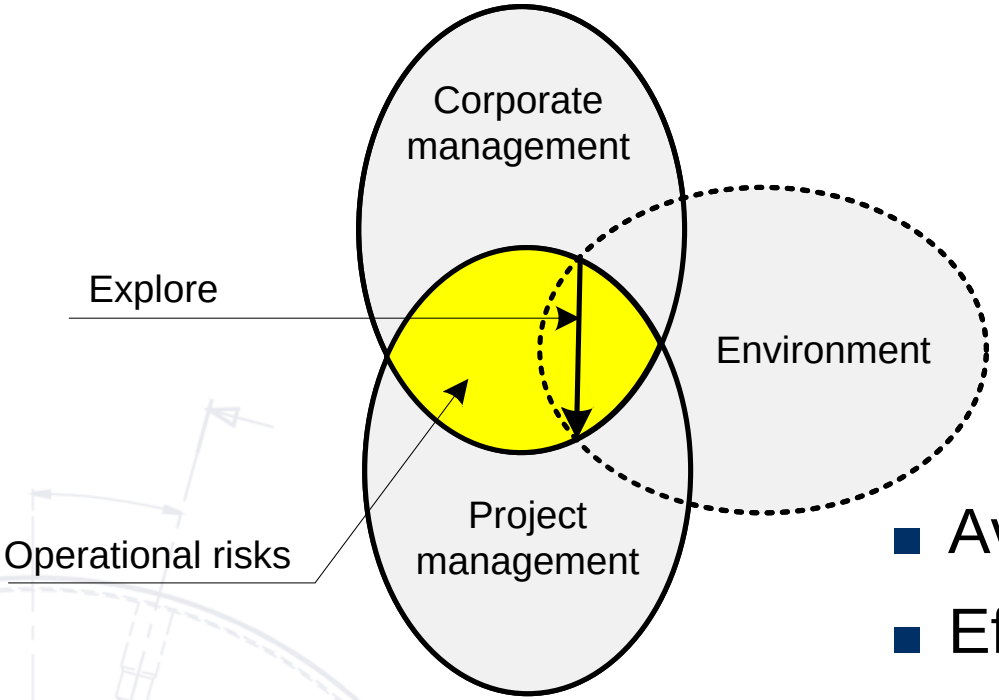
- Not sufficient to just look at Operational risks.
  - Strategic and Contextual risks also important and must be also considered when we develop project contingencies.

Project Risk Model

Types of Risks

- **Operational Risks (Project)**
  - Threats with a potential impact on project objectives resulting from actions that are controlled by the project manager.
- **Strategic Risks (Enterprise)**
  - Threats with a potential impact on business objectives resulting from decisions made by corporate management.
- **Contextual Risks (Global)**
  - Threats with a potential impact on business and project objectives imposed by circumstances outside the project and beyond the control of project and corporate management.

Operational or Project Risks



- Availability of resources
- Efficiency
- Timeliness
- Operability
- HSSE

Strategic or Enterprise Risks

Chapter 6

CIMFP Exhibit P-04102

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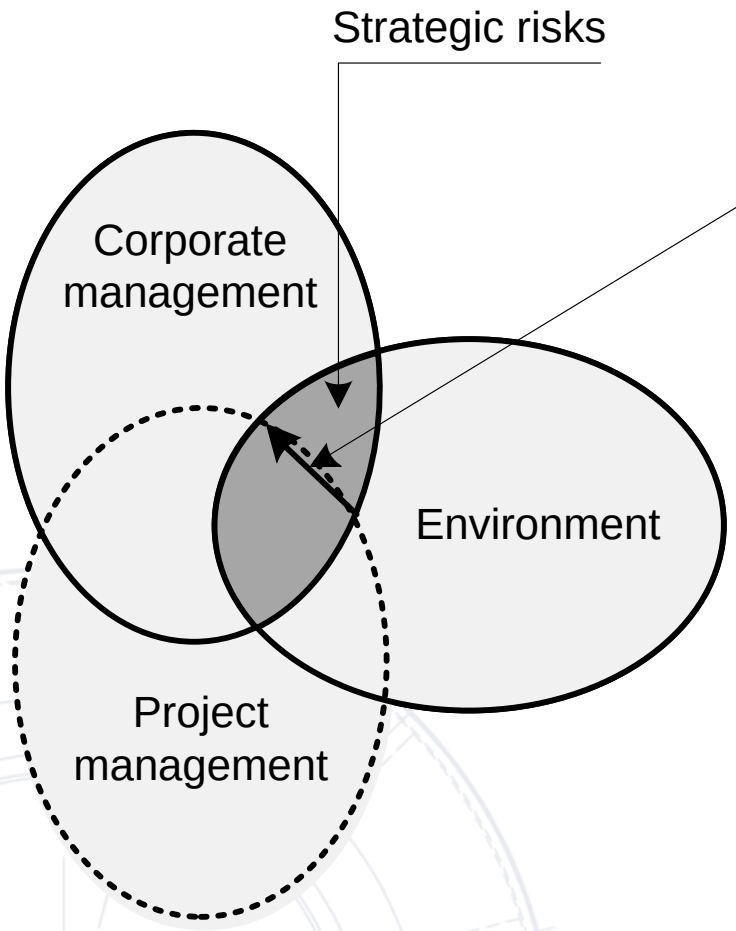

- Maturity at project sanction
- The project execution strategy
- Changes to project objectives
- Acceptance of project business risk exposure

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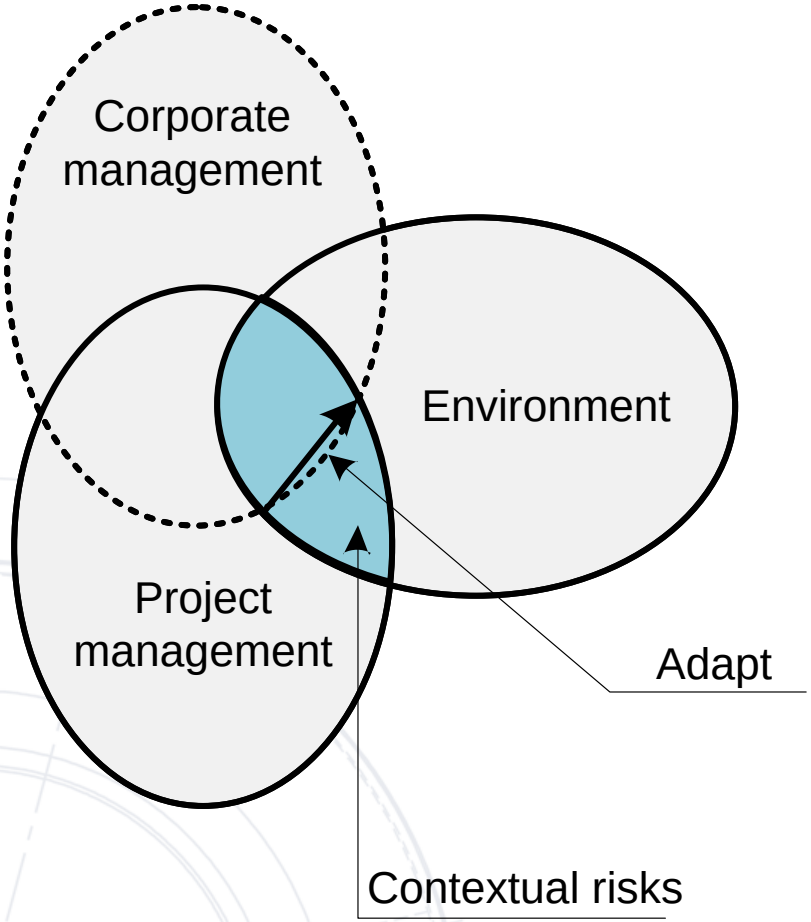
Contextual or Global Risks



- Project location
- Business practices
- Market conditions
- Culture
- Geopolitics

What is a Cost Estimate?

AACE International Definition

- "A compilation of all the costs of the elements of a project or effort included within an agreed upon scope".

To the contractor

- "To forecast cost required to complete a project in accordance with the contract, plans and specifications".

To the owner, cost includes:

- Administering the contract.
- Contractor's charges, consultants and suppliers fees.
- Price of land, financing and operating costs.

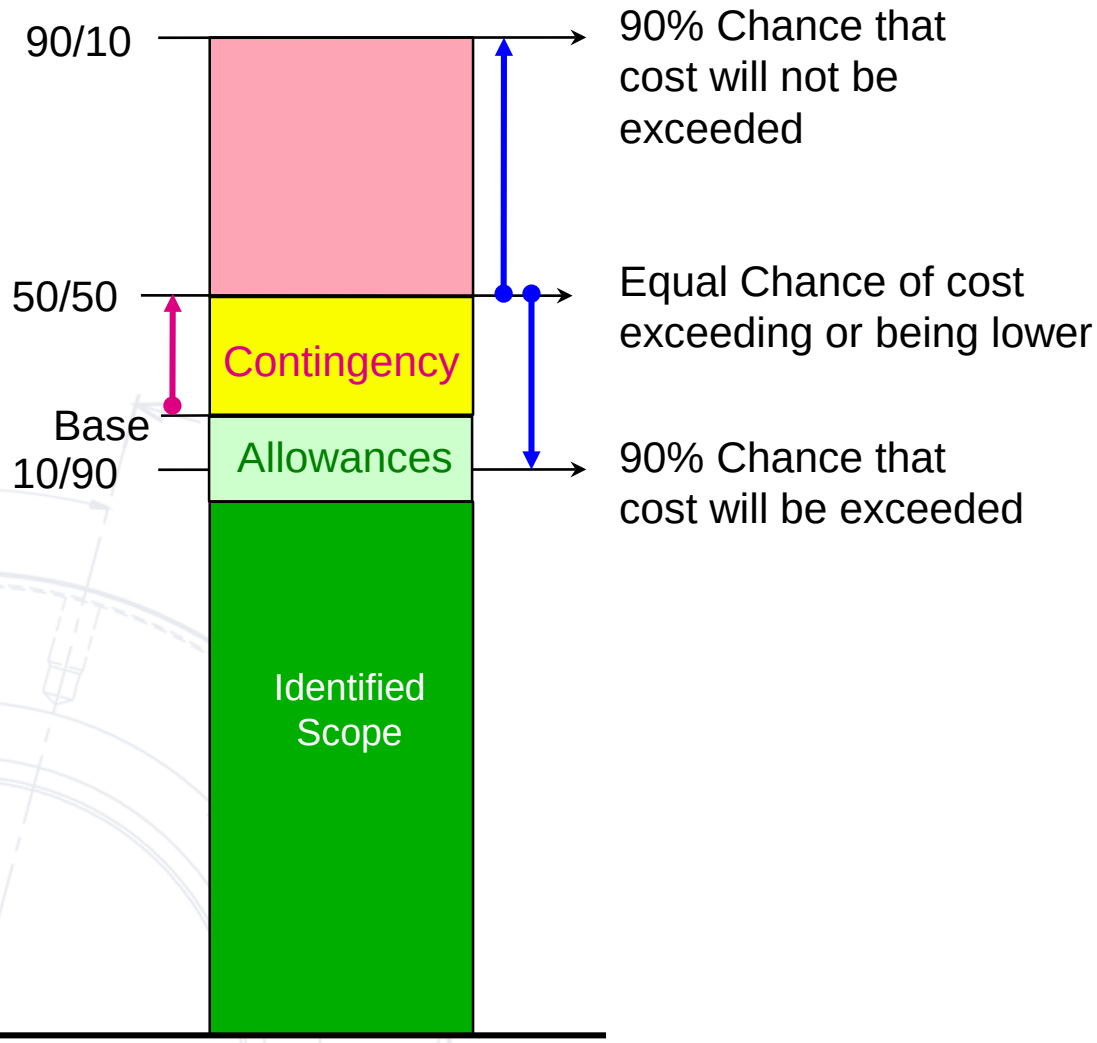
What is a Cost Estimate?

- Realistic representation of final project cost at any stage of project development to meet a specific project objective. (Lavingia, 2019)
- Basic Components:

✧Base Estimate
+
✧Contingency
} Total Cost Estimate

✧Accuracy around the total.

Cost Estimate Confidence



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Recommended Contingency (Karlsen & Lereim, 2005).

Project Stage	Recommended contingency	
	Well-known and mature	Significantly uncertain
Feasibility and idea	25%	40%
Conceptual and planning	15%	25%
Detail engineering	10%	15%
Execution	5%	10%

Three or Two Buckets for Risk Contingency

- Contingency: to cover the Operational Risks.
- Scope Contingency: to cover the Strategic Risks.
- Management Reserve: to cover the Contextual Risks.

Visibility, Accountability, Ability to Manage

- Operational risks are addressed by the project team who have the authority to make the necessary decisions and clear accountability for results.
  - Project Managers are responsible for the **Contingency**.
- Strategic and Contextual risks are addressed by the executives / management.

Management Reserve

- The Project Director / PEO is responsible for the **Scope Contingency**.
- The Sponsor / CEO or Business Unit Vice President is responsible for the **Management Reserve**.

- **Lack of clarity in industry practices.**

My Recommendation

DIRECT COST	
LABOUR	Actual amount paid to personnel – Basic Wage + Benefits
MATERIALS	Essential to constructing and operating an Asset, including equipment permanently installed
EQUIPMENT	Used to perform a Contract
SUBCONTRACTS	

INDIRECT COST	
OVERHEAD	Home office overhead Job site overhead
TAXES	

PROFIT

ALLOWANCES

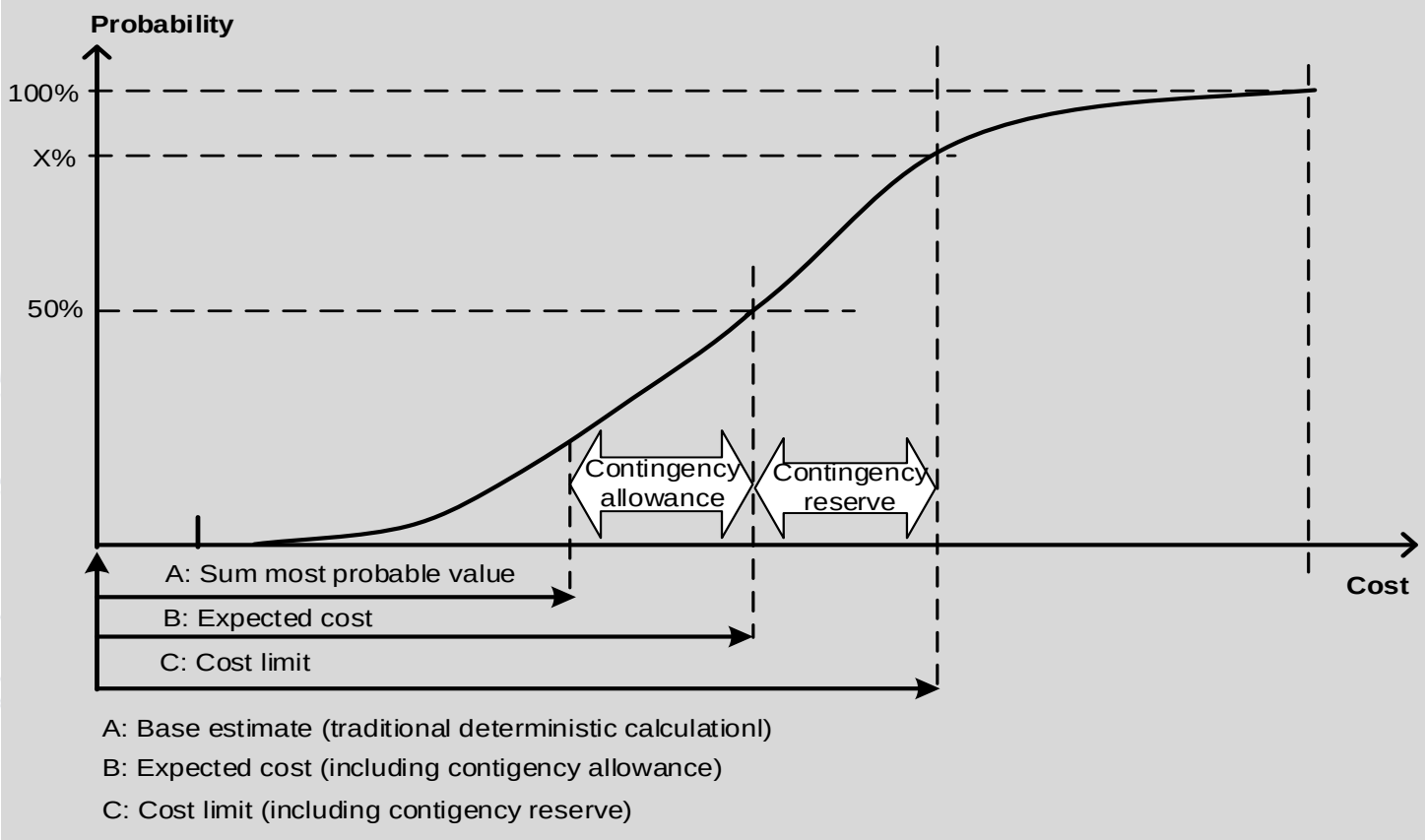
ESCALATION

CONTINEGENCY

MANAGEMENT RESERVE

Watch for assumptions, exclusions and duplications

My Recommendation



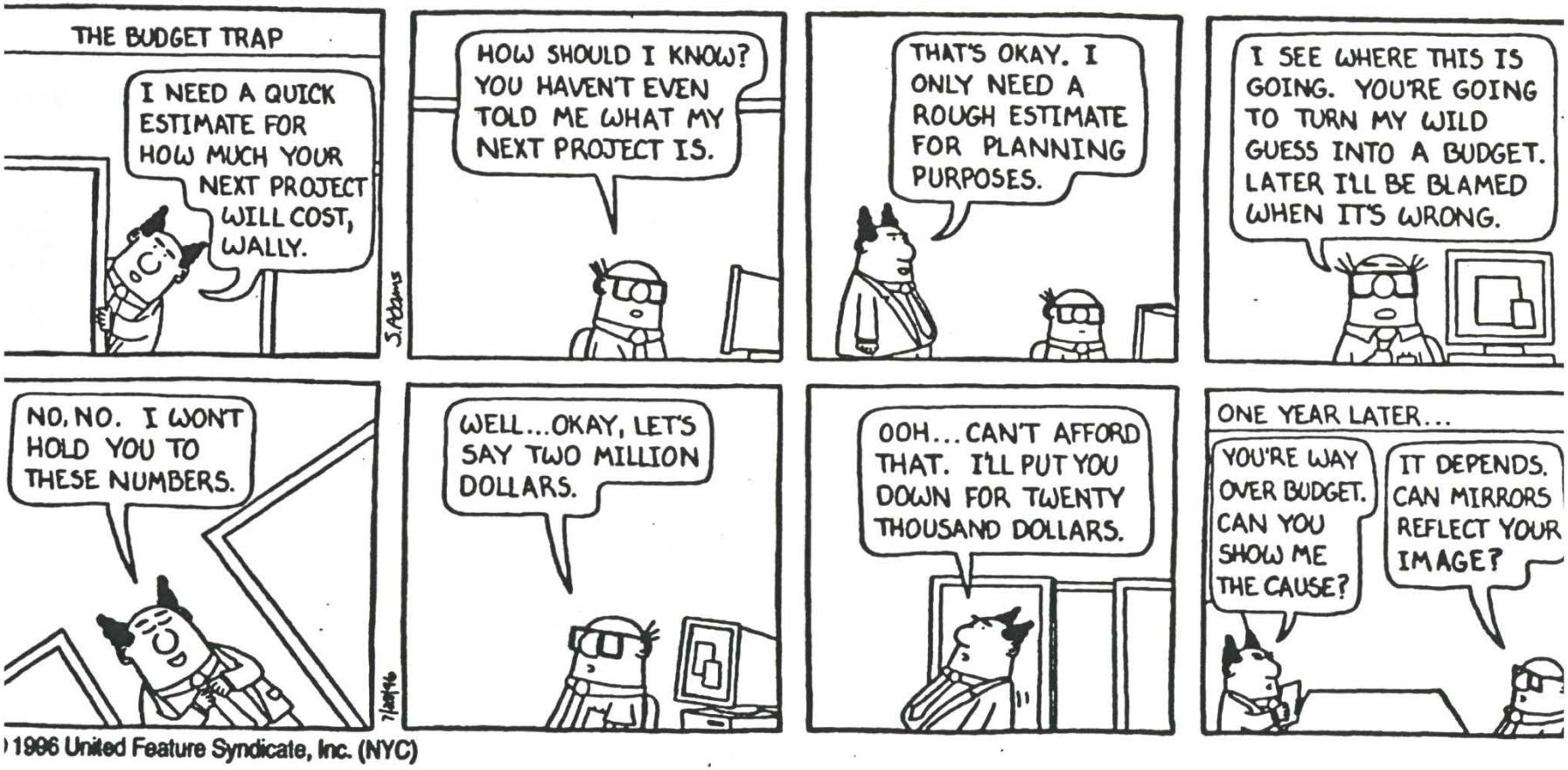
"Project Risk and Opportunity Management, The Owner's Perspective", Routledge, Taylor & Francis Group, 2019

Cost Estimate Confidence

- What should be the probability point for a cost estimate:
  - Presented to management for funding?
  - Used as a performance target for a project team?
  - Used for cost control of/by a contractor?

There is only one thing certain about a cost estimate:

It will be wrong!!!


THE BUDGET TRAP
I NEED A QUICK ESTIMATE FOR HOW MUCH YOUR NEXT PROJECT WILL COST, WALLY.
HOW SHOULD I KNOW? YOU HAVEN'T EVEN TOLD ME WHAT MY NEXT PROJECT IS.
THAT'S OKAY. I ONLY NEED A ROUGH ESTIMATE FOR PLANNING PURPOSES.
I SEE WHERE THIS IS GOING. YOU'RE GOING TO TURN MY WILD GUESS INTO A BUDGET. LATER I'LL BE BLAMED WHEN IT'S WRONG.
NO, NO. I WON'T HOLD YOU TO THESE NUMBERS.
WELL...OKAY, LET'S SAY TWO MILLION DOLLARS.
OOH...CAN'T AFFORD THAT. I'LL PUT YOU DOWN FOR TWENTY THOUSAND DOLLARS.
ONE YEAR LATER...
YOU'RE WAY OVER BUDGET. CAN YOU SHOW ME THE CAUSE?
IT DEPENDS. CAN MIRRORS REFLECT YOUR IMAGE?
S. Adams
1996 United Feature Syndicate, Inc. (NYC)

Reshaping Governance System

References

Benevolent Dictatorship for Major Capital Projects: A guide for Executives who want to enhance their major project delivery experience. LearnAcademy, 2017, Amazon.ca, by George Jergeas & Jim Lozon.

GAPPS. (2011). *A Framework for Performance Based Competency Standards for Program Managers*, Sydney: Global Alliance for Project Performance Standards.

GAPPS. (2015). *A Guiding Framework for Project Sponsors*, Sydney: Global Alliance for Project Performance Standards.

"Strategic systems" problem,

NOT a

"fix the broken parts" problem

Our Future is at Stake

- We can do something.
  - We can easily fix problems if we have a mind to.
  - We must attack the real sources of poor performance.

No single actor in control

Fresh Thinking is Required

- Apply a Benevolent Dictatorship approach!!
  - It is all about Leadership, Governance and Communication

Benevolent Dictatorship

A Leader exercises absolute authority over the delivery of a project

but

does so for the benefit of all members of the project

in full compliance with

legal, ethical and moral requirements and values

Benevolent Dictatorship

1. Understand the project delivery process.
2. Embrace uncertainty.
3. Recognize and engage stakeholders.
4. **Establish governance and conduct oversight**
5. **Improve productivity**
6. Fulfill ethical and legal obligations.
7. **Build collaborative relationships**

George Jergeas

4. Establish Governance and Conduct Oversight

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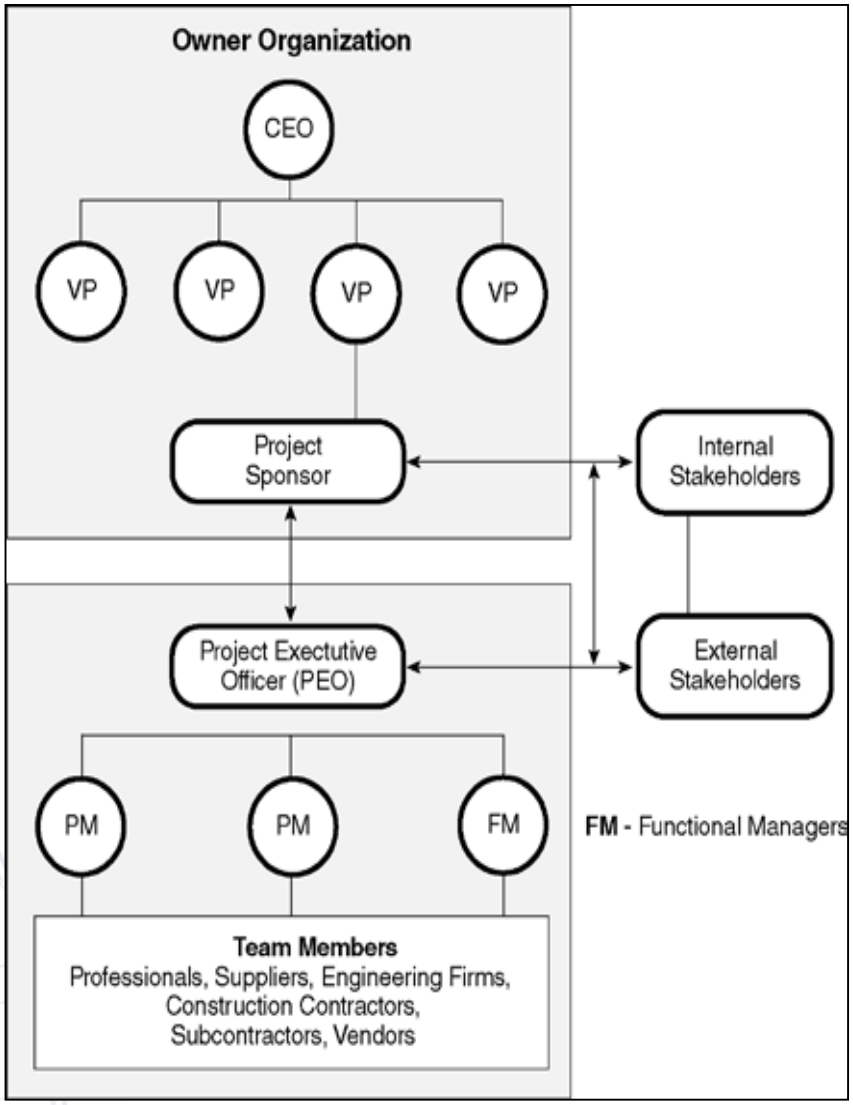


Project Governance

… ***Governance determines who has power, who makes decisions, how other players make their voice heard, and how account is rendered.***

the Institute on Governance (IOG)

The objective of Project Governance is to enable efficient and effective project decision making:

- Steer: Show direction.
- Supervision: Close to the team.
- Support: Provide experience and influence.
- Assurance: Provide confidence to stakeholders.

Project Sponsor

The Project Sponsor, must direct, dictate and influence the organization and the project to enable appropriate decision-making and provide control mechanisms to ensure that strategies, directions and instructions from management are carried out systematically and effectively.

Key Functions of Project Sponsor

- Selects the Project Director or PEO.
- Makes sure project economics and assumptions are consistent with Business Unit plans and strategies.
- Agrees on key milestones for review.
- Responsible for assessing the level of risk analysis to be done.
- Approves major scope/budget changes and estimates for the project.
- Assures that the project definition and cost estimate for AFE are consistent with the Process.
- Responsible for ensuring project meets AFE objectives including cost, schedule and economic projection.
- Reports to a high level in Business Unit or Corporate Management.

The Project Executive Officer (PEO) / Project Director

- The size and complexity and financial exposure of a major capital project make such an endeavour similar to the operation of the corporation.
- Managing major capital project cannot solely be reduced to a manager leading a project team.
- In a project there are many leaders and at the top is the PEO.
- PEO is accountable for the results of what the organization produces.
- Reporting to the PEO are managers accountable for the physical parts of the project (project managers) and managers for project functions (functional managers).

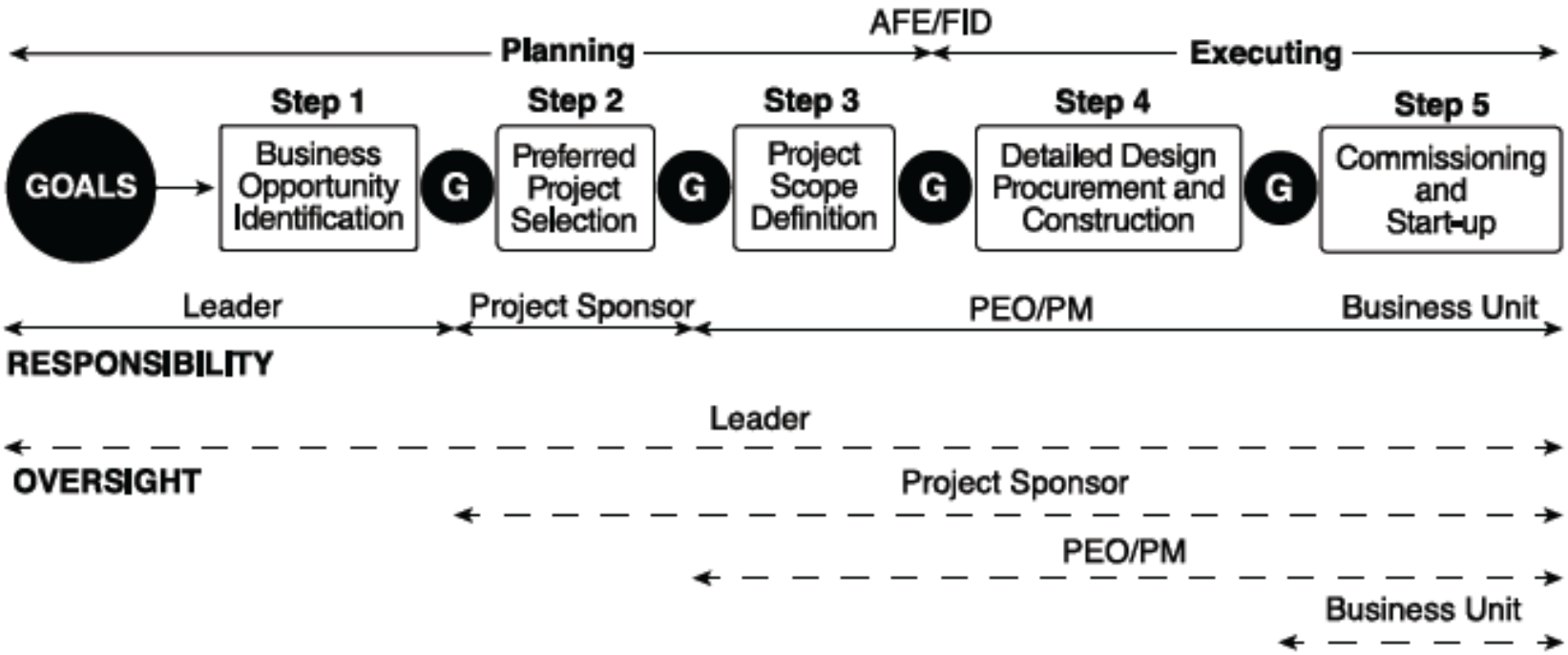
The Management Role of the Project Executive Officer

- PEO reports to the Sponsor and represents senior management.
- Possesses the skills and experience needed to manage the owner's role in the project.
- Maintains direct access to the people making key decisions.
- Authorized to take day-to-day executive action in the face of unforeseen events.
- Selects the right project managers.

Refer to Appendix 3: The Sponsor and the PEO

George Jergeas

4. Establish Governance and Conduct Oversight



4. Establish Governance and Conduct Oversight

- Governance
  - Executive (Leader)
  - Sponsor
  - PEO/PMs
- Oversight on:
  - Issues – Risks, budget and schedule estimates, stakeholder engagement, selection of contractors and consultants
  - Gates
- Refer to Appendix 4

Chapter 8

The Project ECO-System

Reference

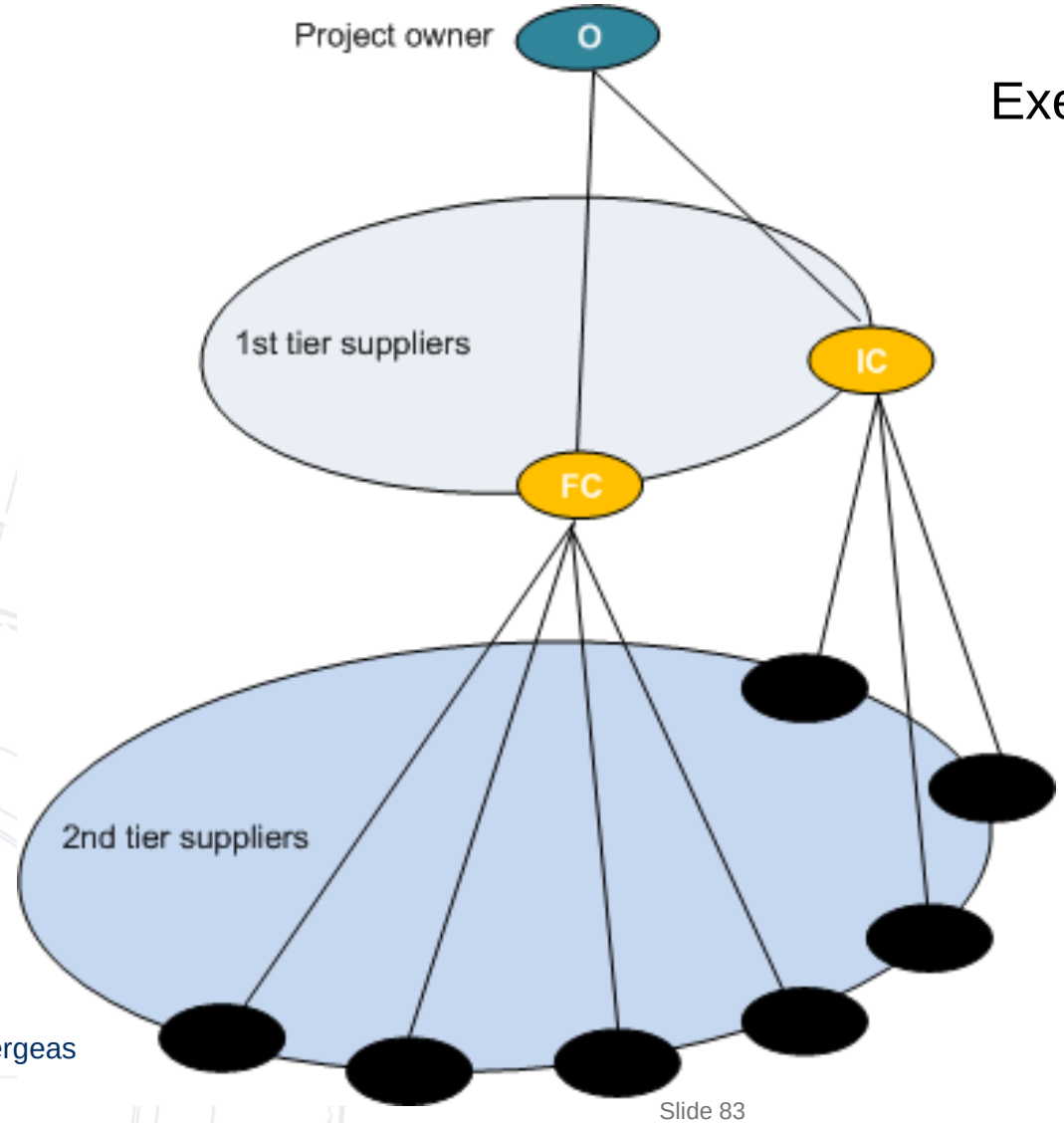
Risk Navigation Strategies for Major Capital Projects: Beyond the Myth of Predictability", Springer, 2011 by Per Willy Hetland, George Jergeas, Asbjorn Rolstadas, Dick Westney.

The Project ECO-System

- The complete structure of the project owner and contracted suppliers.

- Eco-system must be taken into account when we consider uncertainty and risk in a project.

Vertical Dependencies



Exertion of governance

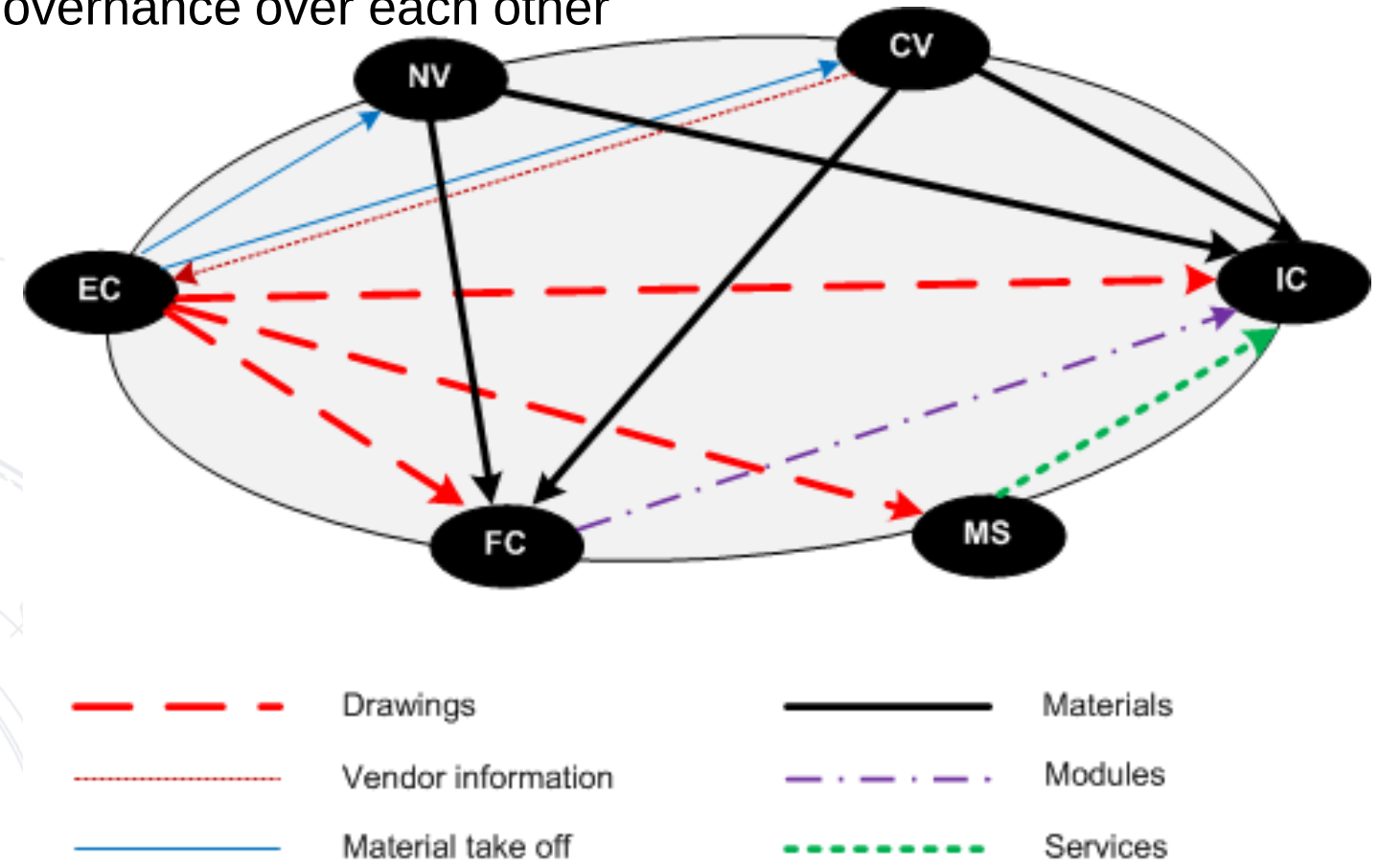
Key Players in Major Projects

- Engineering Contractor (EC)
- Fabrication Contractor (FC)
- Installation Contractor (IC)
- Miscellaneous Services (MS)
- Vendor of Non-critical Material (NV)
- Vendor of Critical Materials (CV)

Chapter 8

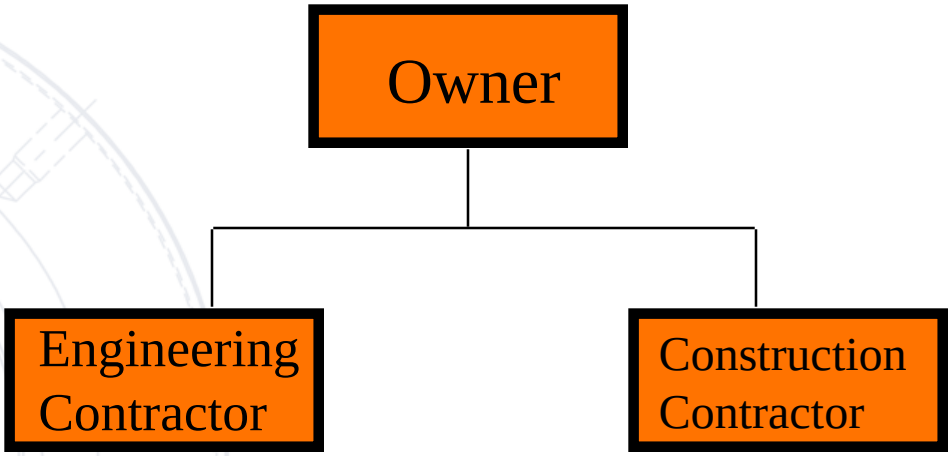
Horizontal Dependencies

Chain of Contracts
Workflow related
No formal governance over each other



General Contractor Concept (Design-Bid-Build)

- **Features:**
  - Owner manages two contractors with two separate contracts.
  - Owner manages the interface.
  - Owner retains the risk for project completion.
  - No direct contractual relationship between E and C organizations.
- **Where found:**
  - Government, infrastructure projects.

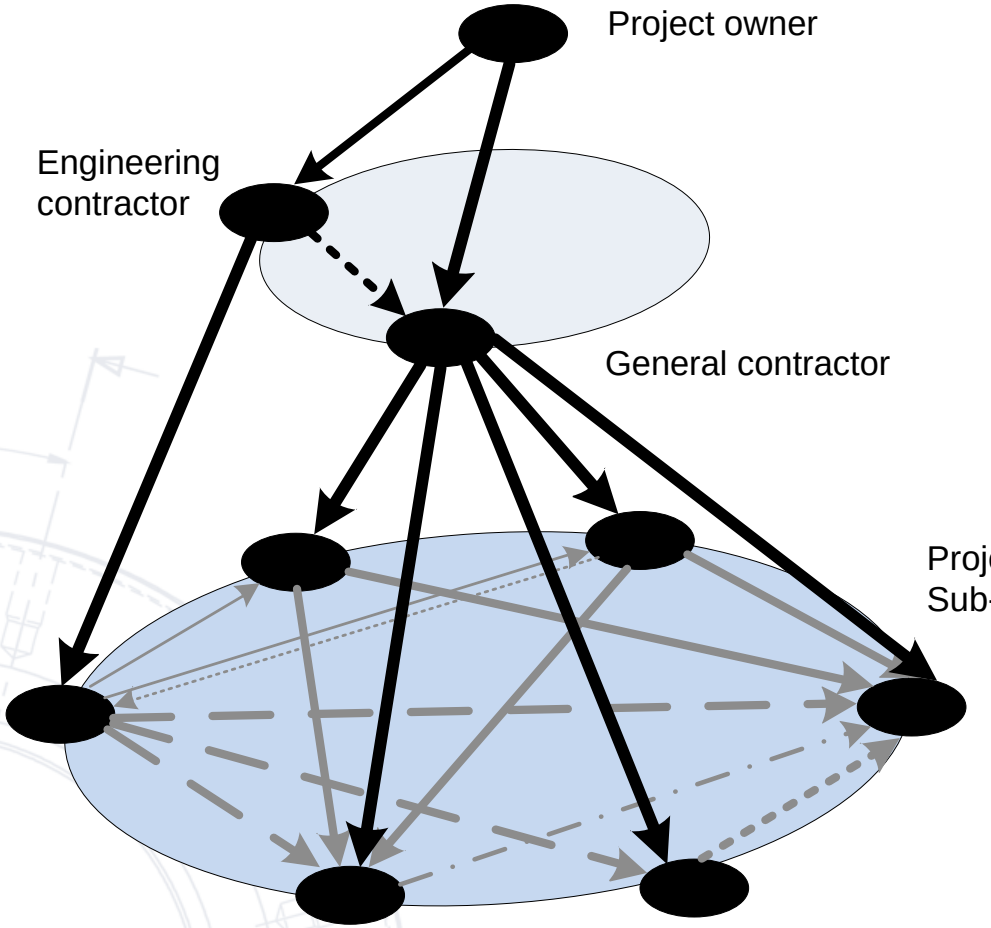


Vertical and Horizontal Ties in a General Contractor Concept

Chapter 8

CIMFP Exhibit P-04102

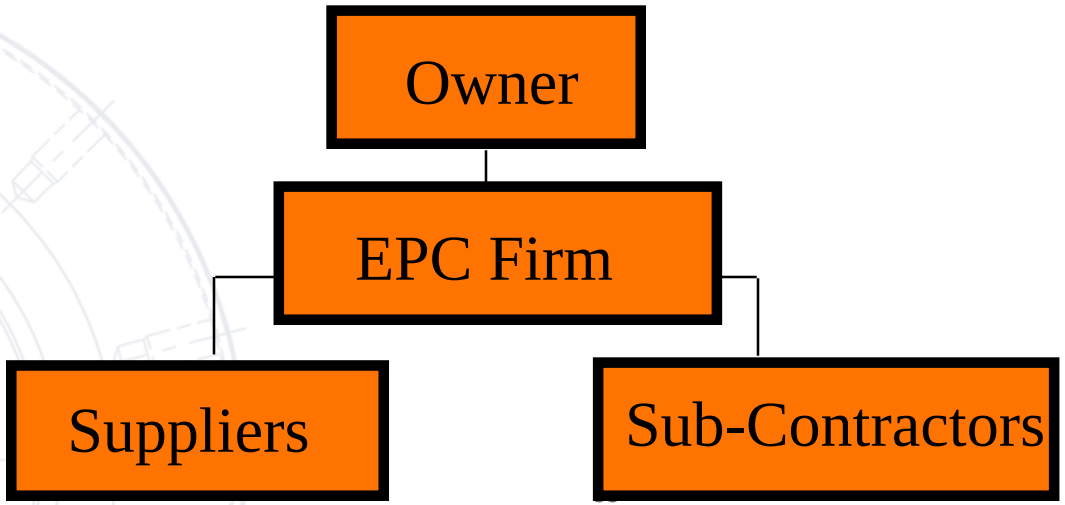
Page 87



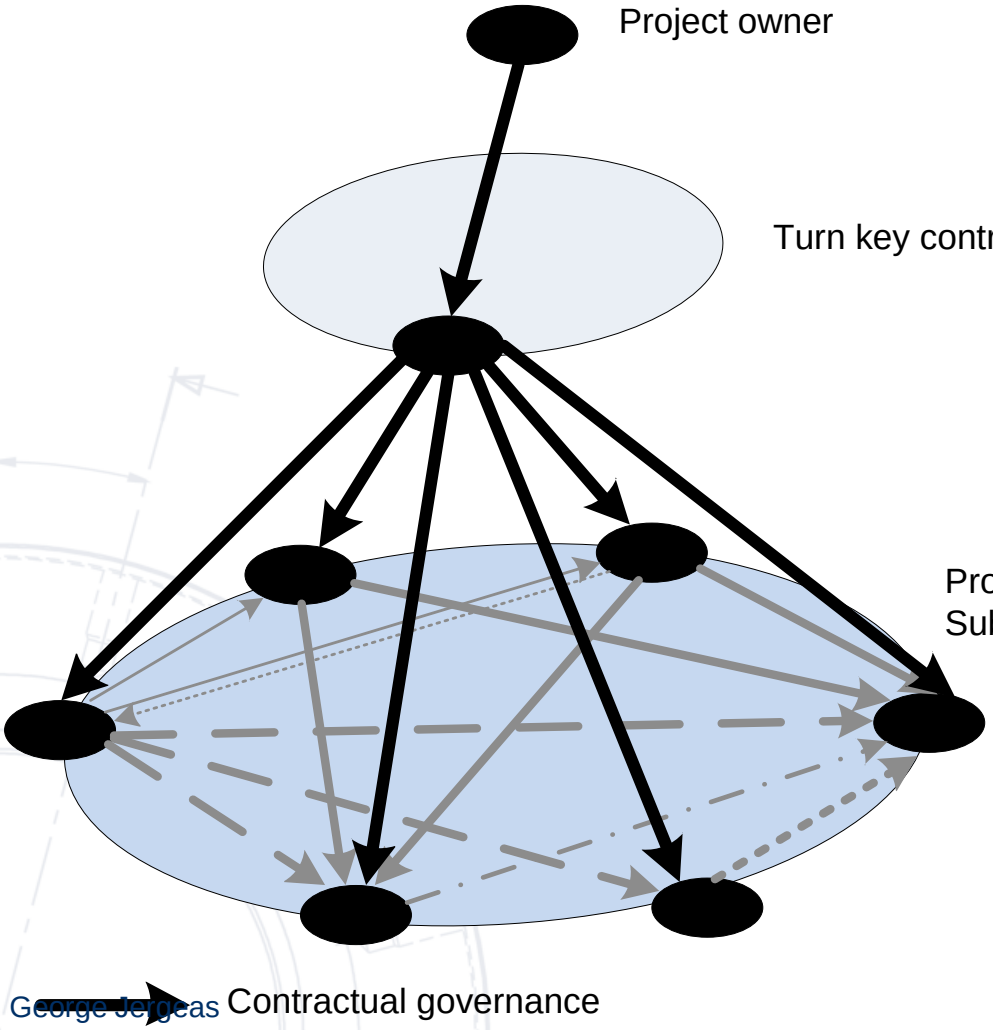
- Owner Exerts governance Engineering and General contractors
- Engineering and General contractors exert governance over respective internal units and subs

Design/build, EPC Contracts

- **Features:**
  - Single point accountability.
  - One single organization executes E, P, C phases of the project.
  - EPC contractor assumes more risks.
- **Where found:**
  - Complex projects, common in petrochemical and oil and gas industry.

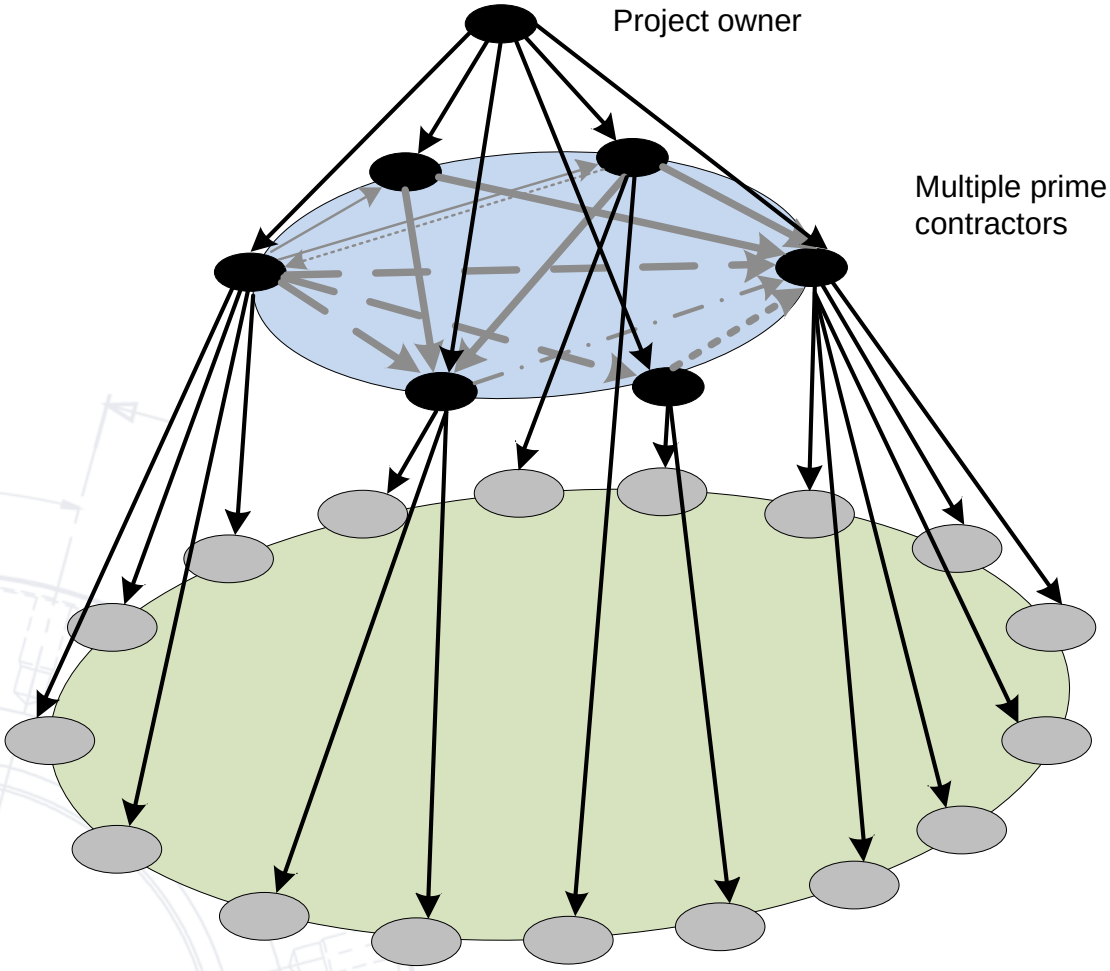


Vertical and Horizontal Ties in a EPC Concept



- Owner exerts governance over the contractor
- Contractor exerts governance over internal units and sub-supplier

Vertical and Horizontal Ties in a Multiple Contracts



- Owner exerts governance over 1st tier contractors
- Interfaces between contractors managed by Owner
- Need for Management Contractor

George Jergeas

Preferred Contracting Strategy

Work / Services	Player
Project Management	Owner
Management Support	Consultants or Contractors
Proprietary Technology Basic Engineering Package	Owner / Licensor
Detailed **E**ngineering **P**rocurement **C**onstruction Management	Contractors Reimbursable Cost
Construction	Construction Contractors-Lump Sum
Commissioning/Start-up	Owner

Packaging of Contracts

Packaging of Contracts	Advantages	Disadvantages	When Best to Use
Engineering Only	• Many Contractors Available • Specialization of Expertise	• Large potential for design errors found in construction phase for which engineering contractor not accountable	• Conceptual Designs • Developing Alternatives • For specialized technology
Engineering and Procurement	• Many Contractors Available • Engineering contractors specialize in procurement of technical items	• Large potential for design errors found in construction phase for which engineering contractor not accountable	• Limited in-house project team personnel
Procurement and Construction	• Control of Equipment Deliveries • Likely constructibility review	• No accountability for accuracy of drawings and specifications • Limited technical ability for purchase of some equipment	• Only after significant portion of engineering work completed and reviewed for accuracy and completeness
Construction Only	• Many Contractors Available • More flexibility - Can take advantage of various contractors' strengths	• No accountability for accuracy of drawings and specifications • Limited and difficult coordination of equipment deliveries	• Only after significant portion of engineering work completed and reviewed for accuracy and completeness
Engineering, Procurement and Construction	• Contractor accountable for all phases of work • Ease of coordination of resources (manpower, materials, machinery, and equipment) • Allows more efficient overlapping of engineering with construction (faster schedule) • Everyone familiar with work processes • More likely to incorporate constructibility reviews seamlessly	• Fewer contractors with this ability • Large contingency if Lump Sum • Inflexible: Forced long term relationship with one contractor • Difficult to define and manage reimbursable and lump sum contract	• On large projects (>$100 million US Dollars) • After concept selection

George Jergeas

Contractual Obligations In Design-Bid-Build

- **Owners:**
  - Site access / availability.
  - Owner-supplied materials and facilities.
  - Design responsibility - owners impliedly warrant own design.
  - Timely approvals.
  - Not to interfere with the contractor's method of execution.
  - Quantity variations.
    - The accuracy of estimates depends on adequate front-end planning, and the level of design performed on behalf of the owner.
  - Issue change orders.
  - Duty to disclose superior knowledge.

Contractual Obligations In Design-Bid-Build

- **Engineer:**
  - Prepare design, specifications and drawings.
  - May prepare bid documents and assist in procurement.
  - Oversee execution and maybe inspection.
  - They may be expected to make decisions regarding:
    - Measurement of quantities.
    - Contractor's right to payment.
    - What to be paid for "extra work".
    - Degree of satisfaction for completion of the work.
    - Interpretation of plans and specifications.
    - Ordering any additional work.
    - What to do in the case of differing conditions.
    - Project delays (and justification).
    - he determination of disputes.

Contractual Obligations

- **Contractor:**
  - Deliver the project in accordance with the drawings and technical specifications.
    - Within the agreed-upon timeframe and budget.
    - In compliance with relevant codes, laws and regulations of the land.
- The contract documents with the owner outline the contractor's obligations clearly and in detail.
    - Expected quality, timeframe, contract administration issues and compliance with statuary obligations.

5. Improve Productivity

Reference

Improving Construction Productivity on Alberta Oil and Gas Capital Projects,

A report submitted to:

Alberta Finance and Enterprise

May 2009

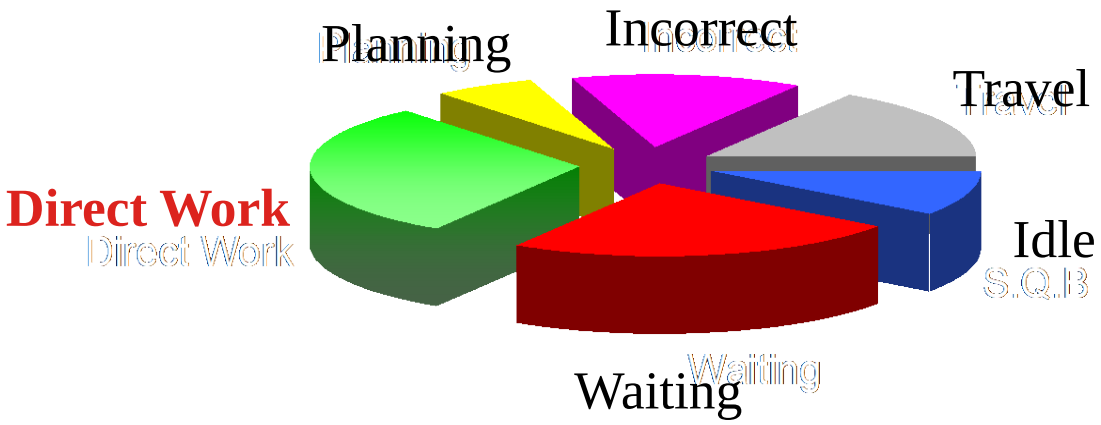
George Jergeas

Productivity

- Construction productivity is a complex issue because of the interaction of labour, capital, materials and equipment…
- Productivity is affected by many issues:
  - Technical issues.
  - Management issues.
  - Human/labour issues.
  - External issues/factors.
  - Market conditions.

Labour Productivity

30% of work day in direct work
… or 3 hrs / 10 are on real stuff



Blame unfairly placed on workers

Improve Productivity

1. Improve project Front-End Planning.
2. Enhance design/engineering quality:
   - Consider constructability during design.
   - Standardize designs and vendors on repetitive installations.
   - Maximize modularization and pre-build in shops to reduce fieldwork.
   - Apply the 80-100 rule.
   - Reduce the practice of fast tracking.

Improve Productivity

3. Proper management of construction operations:
   - Tools, equipment, ……..
   - Implement Workface Planning (detailed schedules)
4. Better management of labour:
   - Incentive programs.
   - Access to job sites.
   - Remote locations.
   - Labour relations.
   - Resource scheduling (shifts and overtime).
   - Look after your workers and their well being.

Improve Productivity

5. Enhance communication:
   - Clarify roles, responsibilities and authority
   - Follow effective systems and procedures.
   - Provide clear and direct instructions to workforce.
   - Communicate the big picture of the project.

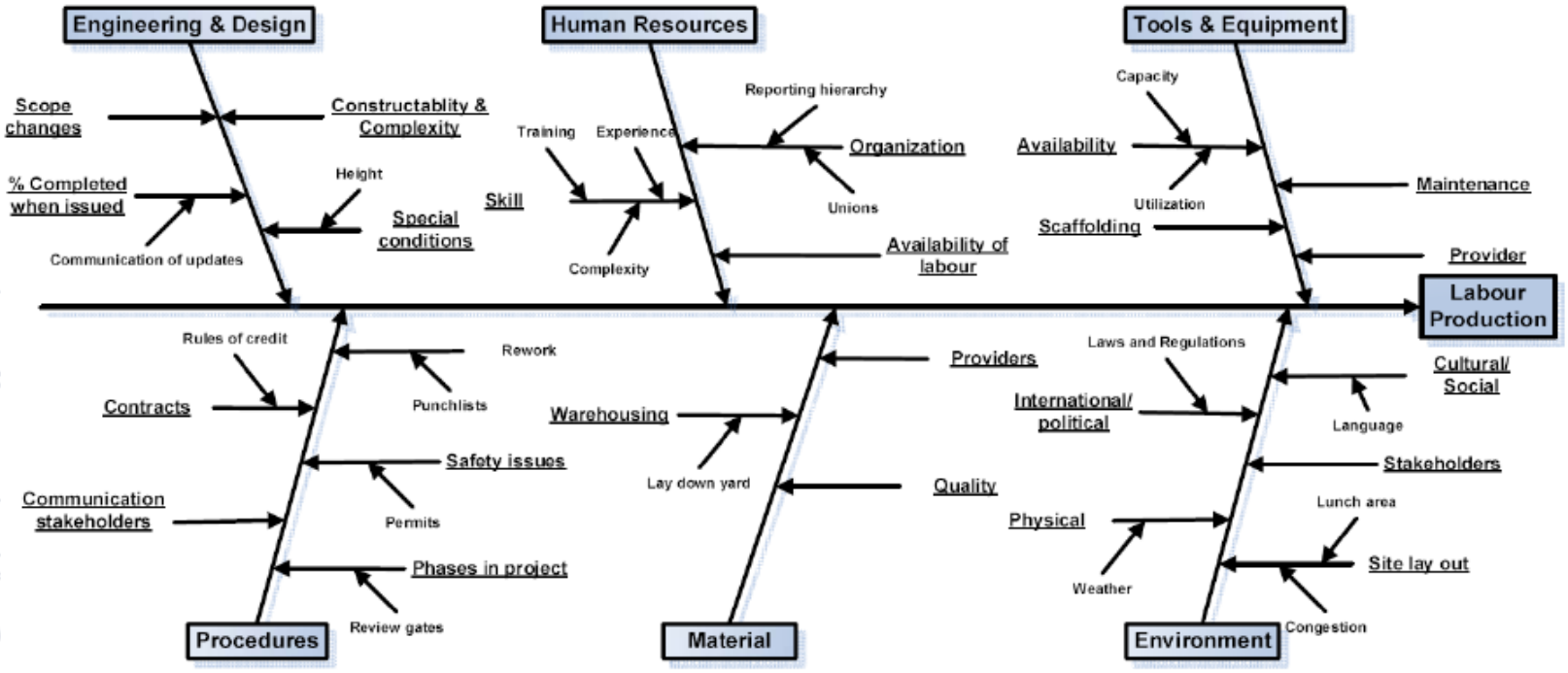
6. Select appropriate contracting strategies.

Improve Productivity

7. Apply effective supervision and leadership:
   - Increase supervision to labour ratio.
   - Provide adequate labour workforce.
   - Oversee with experience and authority.
   - Be accountable for scope, time and cost.

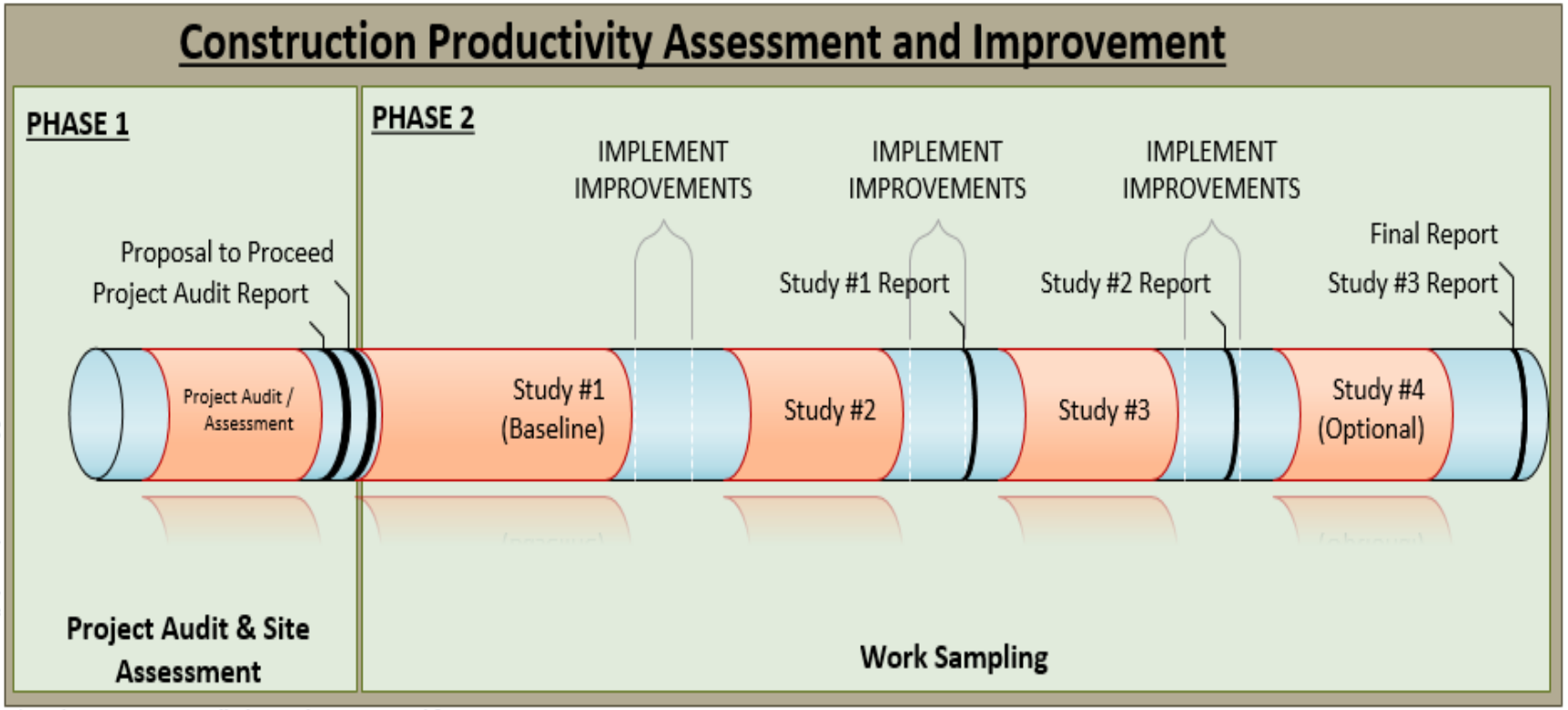
8. Government agencies can also help:
   - Grant timely approvals.
   - Remove barriers including labour mobility.
   - Improve infrastructure.

Improve Productivity



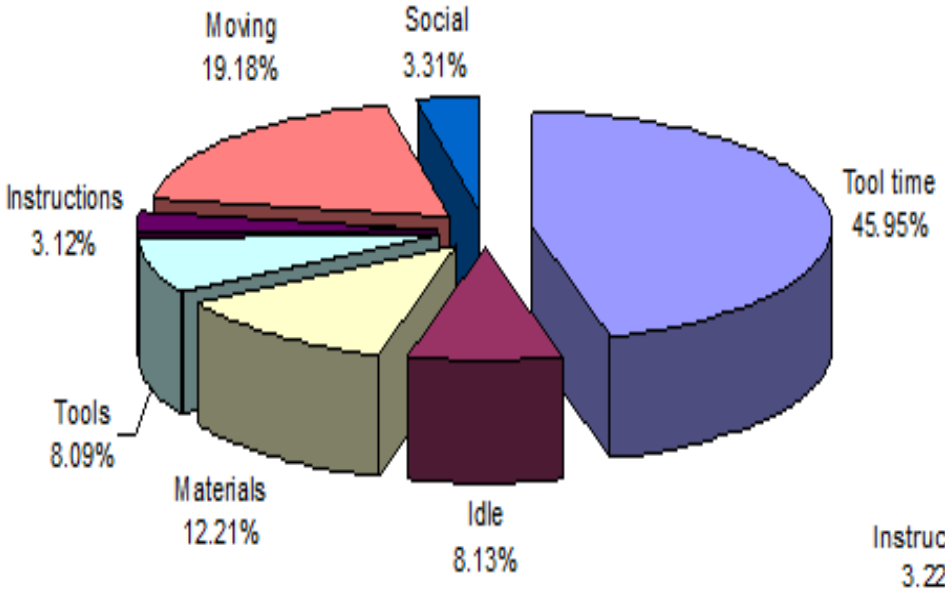
Construction Productivity Assessment and Improvement

CIMFP Exhibit P-04102 Page 104

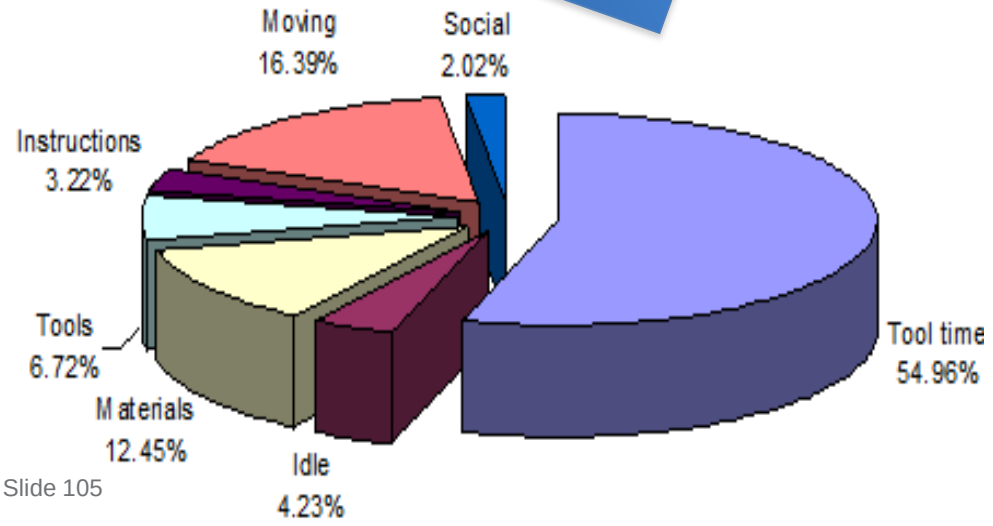


Tool Time Analysis

Weekly measure “Tool Time”



Apply Best Practices



7. Build Collaborative Relationships

A structured management approach to build a cohesive, co-operative relationship with common goals and established procedures for open and honest communication and issue resolution in a timely manner based on:

- Trust
- Respect

Refer to Chapter 13 of Risk Navigation Strategies for Major Capital Projects: Beyond the Myth of Predictability, Springer, 2011 by Per Willy Hetland, George Jergeas, Asbjorn Rolstadas, Dick Westney.

Prerequisites

- Equity
- Commitment
- Trust
- Open and honest communication
- Mutual goals and objectives
- Ongoing project performance evaluation
- Timely issue resolution

My Model for Building and Sustaining Project Teams

Applied on 156 projects with great success.

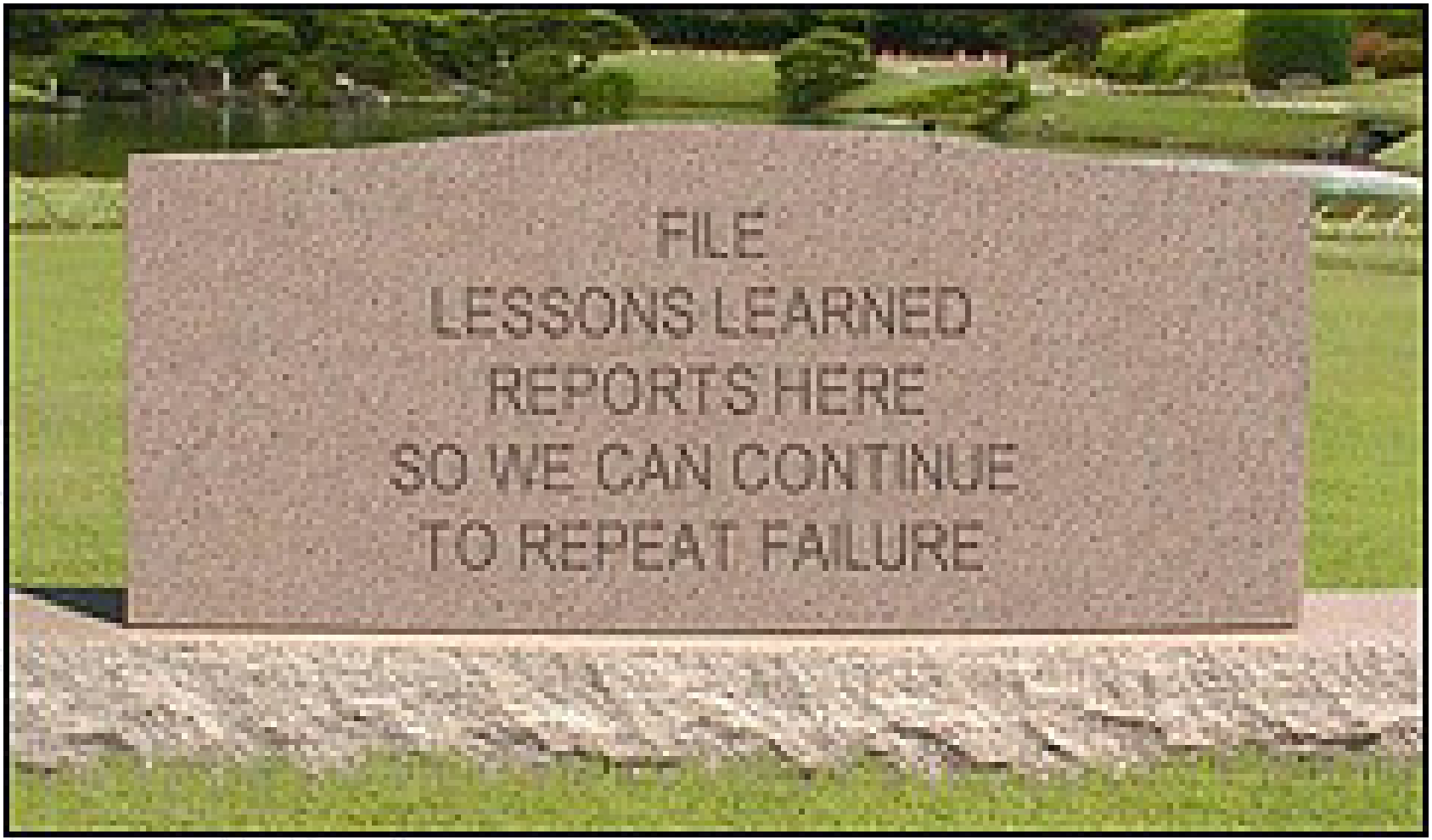
1. Common Vision
2. Health Check
3. Issue Resolution Mechanism
4. Ground Rules
5. Roles and Responsibilities

One More Thought

- What is more important objectives for a project to reach?
  - Is it delivering a facility on time and budget?
  - Or maximizing business value creation in a longer term perspective?
  - How should we define project success and failure?
    - Should one look at the Project Charter?
    - Did the team achieve the business objectives and goals?

My Conclusion

- Mega projects are very complex engineering and construction undertakings.
- Mega projects, across the globe experience cost overruns and delays.
- Lessons repeated NOT learned.



George Jergeas

My Conclusion

- Project promotors, engineering contractors and construction contractors, other industry professionals and academia must continue to search for better techniques and methodologies for delivering future mega projects in a more predictable environment.

References

- A Framework for Performance Based Competency Standards for Program Managers, Sydney: Global Alliance for Project Performance Standards, GAPPS, 2011.
- A Guiding Framework for Project Sponsors, Sydney: Global Alliance for Project Performance Standards, GAPPS, 2015.
- Alberta Report II, COAA Major Projects Performance Assessment System, Project Performance Engineering Productivity Construction Productivity, June 2014.
- Alberta Report III, COAA Major Projects Performance Assessment System, Project Performance Engineering Productivity Construction Productivity: A Best Practice of the Construction Owners Association of Alberta, May 2019.
- Analysis of the Front-end Loading of Alberta Mega Oil Sands Projects", Project Management Journal, Volume 39, Issue 4, December 2008, George Jergeas.
- Benevolent Dictatorship for Major Capital Projects, LearnAcademy, 2017, Amazon.ca, George Jergeas and Jim Lozon.
- Challenges of Mega Projects Performance Challenges of Mega Capital Projects, a report to Productivity Alberta, Go Productivity, November 2014, Alberta, George Jergeas and Jim Lozon.
- How to Create Predictable Cost and Schedule Estimates, 58th Western Winter Workshop, San Francisco & Southern CA Sections of AACE International, March 21 – 24, 2019. Dr. Nick J. Lavingia.
- Project Risk and Opportunity Management, The Owner's Perspective, Routledge, Taylor & Francis Group, 2019.
- Risk Navigation Strategies for Major Capital Projects: Beyond the Myth of Predictability, Springer, 2011 by Per Willy Hetland, George Jergeas, Asbjorn Rolstadas, Dick Westney.
- The Fast Track Manual: A Guide to Schedule Reduction for Clients and Contractors on Engineering and Construction Projects. Loughborough, UK: European Construction Institute, 2002, Eastham, G.

Project Documents Reviewed

1. Grant Thoronton Audit report, Sanctioning Phase.
2. Grant Thoronton Audit report, Construction Phase.
3. EY Review of project cost, schedule and related risks.
4. Nalcor Risk Management Plan.
5. Bent Flyvbjerg report.
6. Nalcor Change Management Plan.
7. Overarching Contracting Strategy.
8. Project Execution Plan of March 11, 2014.
9. Project Execution Plan of September 22, 2011.
10. Project Controls Plan March 11, 2011.


THANK YOU!

Appendix 1
Causes of Cost and Schedule Overruns

Reference

Analysis of the Front-end Loading of Alberta Mega Oil Sands Projects", Project Management Journal, Volume 39, Issue 4, December 2008

by

George Jergeas

Causes of Cost and Schedule Overruns

- **Unrealistic or overly optimistic original (AFE) cost estimate and schedules**.
  - Under appreciation of project complexity, interfaces, interdependencies, and risks associated with the mega project environment. Some of the risks are outside the control of the project management team.
  - Underestimating the cost to attract and maintain the labour (including camp development and operations cost and costs to transport personnel into and out of the region).
  - Underestimating the direct and indirect costs of overtime including additional premium and loss of productivity costs.

Causes of Cost and Schedule Overruns

- Craft wage increases to attract personnel to the location.
- Regional and national demands on labour, including that from other mega projects.
- Underestimation of the labour productivity loss associated with working in cold weather climates and locations with severely shorter daylight hours in northern regions. (Weather conditions such as low temperatures, high winds, precipitation, and reduced daylight hours can significantly reduce labour efficiency).
- Shortages of skilled labour and lower than anticipated labour productivity due to mismanagement of the construction phase.

Causes of Cost and Schedule Overruns

- High labour turnover mainly due to the harsh working environment and competition between employers attracting labour.
- Transportation costs are generally underestimated for permanent materials, construction equipment, personal, staff, etc.
- Environmental and regulatory compliance costs are not given sufficient consideration during the contract negotiation period by both the client and engineering firms.

Causes of Cost and Schedule Overruns

- Material cost for both permanent facilities and temporary facilities are not sufficiently escalated during the project budget development phase. These escalation costs are often qualified or limited by the EPC contractor or passed along to the client.
- Requirements for local content can add inefficiency and additional training cost to staff a project. These requirements can also eliminate lower-cost vendors and fabrication facilities in order to meet the “local content” requirements.

Causes of Cost and Schedule Overruns

- **Incomplete scope definition or inadequate front-end loading and poorly completed front-end deliverables including milestone schedule slippage in front end.**
  - Mainly due to the fast-tracking nature of mega projects.
  - The ongoing changing customer requirements resulting in scope changes.
  - Lack of understanding of the cumulative impact of scope changes on project cost and schedule.
  - The clients' and engineering firms' practice of pushing work to the field early puts construction under an unrealistic compressed schedule with increased overtime requirements and often with little or no consideration for the field cost.
  - Issues with late or incomplete vendor data are having a substantial negative effect on engineering progress.

Causes of Cost and Schedule Overruns

- **Inappropriate project strategies for the mega environment.**
  - Some project strategies deployed do not properly consider the level of scope definition, the fast-track nature of the mega project environment, market condition, owner participation, owner control, and owner risk.
  - Improper or late consideration of the following project strategies adds to cost overruns:
    - **Project management strategies** such as risk management, project control, change control, communications, organization, and responsibilities.
    - Some senior executives and project managers in both client and EPC firms attend project reviews and do not understand what they are looking at. They do not recognize the early warning signs that are self evident to someone with real experience and knowledge.

Causes of Cost and Schedule Overruns

- **Contract strategies** relating to management, design, construction, and commissioning services. These strategies are driven by time rather than cost, assuming safety and quality are given requirements.

- **Design strategies** such as contributions from client business, operation, project team, contractors, and suppliers.

- **Procurement strategies** including preferred suppliers (supplier of choice), progressing, inspection and expediting, receipt, storage and management, spares, and documentation.

Causes of Cost and Schedule Overruns

- **Construction strategies** including site management and organization, site layout, power, utilities and drainage, work breakdown structure, construction method, off-site prefabrication and assembly, schedule and milestones, industrial relations, and pre-commissioning.

- **Commissioning strategies** including responsibilities, schedule and integration with construction, resources, training and validation, engineering and trade support, and provision of operating materials.

Causes of Cost and Schedule Overruns

- **Mismanagement of the construction phase.**
  - Inadequate field experience in most home office engineering and procurement personnel, especially in project managers, project controls, and key design leads.
  - Later-than-anticipated engineering, vendor data, equipment, and material deliveries.
  - Poor project controls. Nobody on the project has single-point responsibility except the client, who does not control much of the work. Even if there is one point head for this, most time is spent on reporting after the fact rather than analyzing and forecasting.
  - Inadequate plan of execution and poorly defined tasks and division of responsibility.

Causes of Cost and Schedule Overruns

- Lack of knowledgeable leadership in the engineering, procurement, construction, and start-up of major facilities.
- Inexperienced or poorly equipped project management personnel and supervisors coupled with the inability to understand, plan, adapt, and implement project management procedures or systems.
- Lack of standardization and fit-for purpose including inadequate use of shop fabrication, modularization strategy, and constructability reviews.

Causes of Cost and Schedule Overruns

- Poor communication, teamwork, and alignment between the players, leading to adversarial relationships and protracted disputes.
- Poor site organization and layout leading to excessive time wastage and productivity loss during construction.
- Joint venture (JV) of project partners, contractors, and engineering firms that are not aligned or not set up to work effectively due to different cultures, internal JV conflicts, and diverging visions of the way that the project should be structured and managed.

Causes of Cost and Schedule Overruns

We need to consider the following questions:

- If the full cost was known and understood at the inception of the project, would the proposed project be funded?
- What is the purpose of the cost estimate developed at the AFE gate? Is it developed to ensure the project receives sanction or to provide a realistic goal for the project team?
- Why, when the EPC firms provide a qualified cost for a limited scope of work, does the client take it to be for a broader scope of work?
- Why, during negotiations with EPC firms, does the owner insist on bringing the contract amount below the AFE numbers? Why do EPC firms accept the owner's position?
- BACK

Appendix 2

Challenges of Mega Projects

Reference

Performance Challenges of Mega Capital Projects, a report to Productivity Alberta,

George Jergeas and Jim Lozon,

Go Productivity,

November 2014, Alberta.

Table 9: Factors that affect Project Performance (references)

Factors that affect project performance	Reference
1. Insufficient/incomplete front end planning, cutting corners	1, 2, 5, 19, 28, 33, 50, 52, 57, 59, 61
2. Inaccurate/unreal estimates/economics, optimistic bias, aggressive targets	2, 16, 19, 25, 39, 50, 55, 57, 61, 79, 86
3. Poor risk assessment/management, uncertainty, poor risk sharing	2, 6, 25, 42, 50, 52, 57, 61, 78, 79
4. Poor governance, oversight, support, business/project/strategy management	2, 5, 9, 28, 36, 37, 55, 57, 86
5. Team conflict, turnover, lack of integration, lack of continuity, poor interface management	
6. Unclear scope/objectives, late scope changes, scope creep	
7. Changes, slow/poor decision making	
8. Contract strategy, responsibilities, slow payment, lump sum barriers	
9. Unmet stakeholder requirements, poor stakeholder/user engagement	
10. Poor monitoring/control, lack of control	
11. Incomplete contingency plan, low contingencies	
12. Inexperienced, lack of project management skills	
13. Underestimating complexity and magnitude of the project	
14. Incomplete engineering design before construction start	
15. Compressed and aggressive schedule, fast tracking	
16. Poor communication	
17. Procurement strategy (global/local), late material/equipment delivery	
18. People (limited resources), labour, engineering, construction management	
19. Engineering/construction productivity	
20. Technology	
21. Insufficient modularization, pre-fabrication	

Table 10: Categories of Factors that affect Project Performance

Project Planning	AFE	Project Implementation
• Large project size		• Poor project management skills
• Lessons learned ignored		• Slow decision making
• Unclear scope/objectives		• Uncontrolled scope creep
• Poor scope management		• Incomplete engineering design
• Incomplete front end planning		• Complex new technology
• Inaccurate/unreal estimates		• Low contingencies
• Compressed/aggressive schedule		• Rework and changes
• Incomplete contracting strategy		• Risk averse behaviour
• Inadequate procurement strategy		• Lack of innovation
• Inadequate risk assessment		• Poor monitoring and control
• Incomplete project execution plan		• Mishandled claims and disputes
• Poor governance, oversight, support		• Team conflict
• Inadequate staffing		• Insufficient modularization
• Unsatisfactory contractor selection		• Unsatisfactory productivity
• Onerous legal contracts		• Unmet stakeholder requirements
• Poor communication		• Poor communication
• Deceptive low bidding		• Poor construction management
• Biased risk management		• Late material delivery
• Incomplete contingency plan		• High worker turnover
• Distrustful project culture		• Poor monitoring and control
• Incomplete transfer of information		• Undefined lines of authority
• Poor stakeholder engagement		• Poor interface management

3) What can we do tomorrow?

The researchers and professional organizations offered many ideas as to what we could do to improve our capital projects including: (a) actions to improve project performance, (b) executive oversight, (c) systems thinking, (d) leading indicators (early warnings) and (e) benchmarking programs.

(a) Actions to Improve Project Performance

Table 11: Actions to improve Project Performance (refere

Actions to improve Project Performance	Reference
1. Leadership, governance (see Executive Oversight questions below)	16, 33, 36, 38, 39, 42, 86
2. Stakeholder input/communication/ alignment	17, 21, 30, 38, 43, 57,
3. Strong risk management program (share risks)	14, 18, 42, 43, 52, 54,
4. Comprehensive front end planning (get it right)	15, 33, 45, 46, 57, 58
5. Clear roles and responsibilities	18, 21, 41, 42, 52, 54
6. Strong cost and schedule monitoring and control (stick to the plan)	41, 43, 46, 49, 52, 66
7. Interface management	18, 19, 21, 40, 80
8. Manage engineering (do not fast track engineering)	16, 33, 49, 52, 57
9. Clear scope definition	21, 55, 57, 72
10. Assign project team early (adequate staffing)	42, 55, 57, 58
11. Restrict changes (e.g. after constructability review)	4, 7, 9, 72
12. Manage changes	21, 41, 43, 52
13. Higher modularization and offsite fabrication	7, 19, 33, 49
14. Develop contracting strategy early	9, 21, 33, 52
15. Realistic cost and schedule estimates	14, 42, 43, 66
16. Strong construction contract management	15, 19, 33, 52
17. Standardize designs and work processes	18, 55, 57, 78
18. Integrated project team	46, 58, 63
19. Reduce project complexity/size	41, 49, 61
20. Manage key suppliers/logistics	18, 19, 41
21. Align expectations/team	28, 57, 72
22. Strong construction labour relations (incentives, schedules, site, size)	33, 49, 52
23. Board of Directors oversight (see Executive Oversight questions below)	57, 86
24. Cost driven not schedule driven	55, 66
25. Risk assessment before estimates	27, 66
26. Use Best Practices (CII and others)	7, 72
27. Develop dispute avoidance/resolution model	13, 52
28. Focus on Project Management best practices (skills training)	14, 52
29. Apply lessons learned	14, 72
30. Early focus on supply and contract optimization	18, 52
31. Clear communications	18, 33
32. Complete constructability reviews	20, 33
33. Develop long term relationships	52, 78
34. Optimize scarce talent	52, 82
35. Select appropriate project delivery system	42
36. Less fast tracking	66
37. Near term thinking	36
38. Early contractor involvement	4
39. 10-4 construction site work schedule	7
40. High quality FEED	9
41. Complete the project execution plan	9
42. Incremental design optimization	78
43. Develop construction plan early	9
44. Local versus global sourcing	49
45. Monitor and control global sourcing	11
46. Select better projects	14
47. Manage cash flow	14
48. Trim project portfolio (less projects simultaneously)	16
49. Independent peer reviews	17
50. Benchmark projects	17
51. Capture risk history	27
52. Review risks at 30% review	27
53. Manage political influence	33
54. Continuous improvement culture	72
55. Accelerate operational readiness	82

3) What can we do tomorrow?

The researchers and professional organizations offered many ideas as to what we could do to improve our capital projects including: (a) actions to improve project performance, (b) executive oversight, (c) systems thinking, (d) leading indicators (early warnings) and (e) benchmarking programs.

(a) Actions to Improve Project Performance

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21. Align expectations/team	28, 57, 72
22. Strong construction labour relations (incentives, schedules, site, size)	33, 49, 52

Authorization for Expenditure (AFE). These categories of suggested actions allow us to focus our resources to achieve the best results for the two parts of a project.

Table 12: Categories of Actions to Improve Project Performance

Project Planning	AFE	Project Implementation
• Reduce project size/complexity • Clear scope definition • Apply lessons learned • Comprehensive front end planning • Strong risk management plan • Early contracting strategy • Realistic estimates • High quality FEED • Complete project execution plan • Strong leadership/governance • Stakeholder input • Assign project team early • Clear communications • Early contractor involvement • Optimize scarce talent		• Clear roles and responsibilities • Strong cost/schedule monitoring and control • Manage engineering • Manage/restrict changes • Standardize designs • Local versus global sourcing Integrated project team • Strong construction management • Manage key suppliers • Strong interface management • Ongoing dispute avoidance and resolution

23. Board of Directors oversight (see Executive Oversight questions below)	57, 86
24. Cost driven not schedule driven	55, 66
	66
	72
	52
	52
	72
	52
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54. Continuous improvement culture	72
55. Accelerate operational readiness	82

Recommendations

1) Recommendations from Industry Survey Group

The industry executives that participated in the survey identified a number of actions that they recommend be taken to improve project performance. These recommended actions include the following:

- Complete front-end planning including the Project Execution Plan (PEP)
- Align all project teams to follow the Project Execution Plan (PEP) and remove those who are not aligned
- Get the project scope right and don't make changes
- Provide sufficient time to complete the engineering design
- Spend more time with key Suppliers and Fabricators – expedite well and continually - since they can make or break a project
- Increase standardization and modularization
- Develop a workable contracting strategy
- Conduct a serious analysis of all types of risks including global risks that are outside the control of the Project Manager and the Executives
- Include the right levels of contingencies in the budget
- Exhibit leadership that is empowered to make decisions without fear of blame
- Assign project leaders and project teams early and maintain continuity
- Develop strong teamwork and collaborative relationships
- Be open about your capabilities - do not be afraid to ask for help
- Assign experienced and competent professionals to all project teams
- Maintain the continuity of all project teams

Table 14: Categories of Leading Indicators as Early Warnings

Project Planning	AFE	Project Implementation
• Changes to scope during FEED • Delays in engineering • Contingencies used quickly • Late permits • Late decision making • Pilot facility not completed • Long lead items not ordered • Low staffing levels • Contractor not accepting contract • Changes from stakeholders • Onerous local content requirements • Environmental, political, social interruptions • Vendor information late		• Changes in approved cons and engineering plans • Material delays • Multiple change orders • Changes to long lead item orders placed • Delays without schedule c • Vendors provide target da • Late mobilization • Disputes between contract • Low engineering and cons productivity • Incomplete design before construction

BACK

Appendix 3
The Sponsor and the PEO

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Project Sponsor

- An instrumental senior management role undertaken on behalf of an organization with responsibility for seeing a major capital project delivered from inception to completion.
- Project Sponsor is accountable for the realization of a project's benefits by providing leadership and oversight of project execution.
- Project Sponsor is responsible for defining the scope of a project and then turning the project over to others to 'make it happen'.
- Project Sponsor to lead the project team to improved performance and a more predictable project outcome.

Project Sponsor

- Aligns the project with corporate goals.
- Understands and maintains corporate culture and values.
- Has the drive and skills necessary to guide a project through its life cycle including operation.
- Knows the organization's operations.
- knows his/her way around the organization and commands trust and respect.
- Coordinate the needs of all Business Units and integrate the project into the organization by resolving any issues and conflicts outside the control of the Project Team.

Project Sponsor

- Project Sponsor is ultimately answerable for how the project is managed, for the success or failure of the product of the project and the realization of benefits.
- Project Sponsor demonstrates competency in:
  - Maintaining the alignment of the project with the defined direction of organization by resolving competing or conflicting interests within organization.
  - Justifying project based on a feasibility study or other analysis that pre-dates the start of the project.
  - Defining, communicating and implementing authority levels, approval processes, decision making protocols and reporting mechanisms.
  - Supporting the lessons learned process to ensure lessons and insights are captured and shared across the organization and the project.

Project Sponsor

- Project Sponsor supports the Director/PEO and Project Managers by:
  - Planning and keeping commitments including how everyone works together, how matters are escalated for resolution and how communication and interactions will be conducted.
  - Sharing relevant information and addressing requests from the PEO and Project Managers in a timely manner.
  - Anticipating and managing potential conflicts in a timely manner.
  - Assessing the performance of PEO and Project Managers and taking action to ensure that best practices are applied.

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Project Sponsor

- Project Sponsor supports the project by providing resources, making timely decisions, cultivating stakeholder commitment and completing project reviews. Actions include:
  - Addressing the resource needs of both the organization and the project at a high level including managing organizational realities, competing needs and political aspects.
  - Establishing resource requirements, constraints to availability and resolving conflicts between the organization and the project regarding demand for resources.
  - Securing funding for the project including the original allocation, unexpected events and the management reserve for baseline changes including any scope changes caused by changing requirements or business conditions that can impact the project.

Project Sponsor

- Defining and supporting approaches to sustaining stakeholder commitment including building relationships, alliances and coalitions, sharing information and resources, shaping stakeholder interests and ensuring project team wellness.
- Monitoring and reconciling differences in stakeholder interests and expectations.
- Planning and conducting project reviews in a timely manner including taking action to ensure personal readiness for these reviews and providing constructive feedback.
- Making decisions in a timely manner and taking action for delayed decisions by others that can impact the project.
- Managing expectations upward to senior management.
- Protecting the Project Team from reckless misinformation or demands from senior management.

Key Functions of PEO

- Participates in selection of Project Manager and Operating Representative.
- Provides interface with Operating Organization.
- Manages project definition including selection of best technology.
- Responsible for permitting process.
- Responsible for coordination of preliminary AFE and AFE
- Responsible for project reviews at agreed upon milestones, including post project review.
- Approves contracting plan.
- Provides leadership for the startup organization.
- Reports to Operating Organization.

PEO Sets Project Vision and Follow Through

- Projects are different, hence need for different strategies.
- Question project context, its objectives and execution strategies, to test their relevance based on the overall vision of the corporation.
- Set performance goals.
- Set performance metrics.
- Manage contextual risks.
- Manage strategic risks.
- Manage operational risks.
- Monitor performance volatility and compensation.

PEO

- PEO is accountable for the successful completion of the project with many consultation issues, contractual and relational interfaces, uncontrollable risks and a network of stakeholders as well as financial exposure similar to that of major corporations.
- PEO has significant experience in major projects with a similar degree of size and complexity and has the right mix of qualifications, skills and technical and non-technical experience, particularly leadership and communication.

PEO

- Major capital project can be described as a portfolio of multiple and related projects managed and coordinated as one project, as one unit, with the objective of achieving outcomes and benefits for the organization.
- The PEO is equivalent to the Program Manager heading a temporary flexible organization structure created specifically to coordinate, direct and oversee the implementation of a set of related projects.
- PEO has responsibility to lead upwards, lead downwards and lead outwards.

PEO

- PEO must provide leadership that motivates and inspires the Project Team to work collaboratively to attain project benefits. Actions include:
  - Promoting the vision of the project by being involved in developing the vision or adopting an established vision as well as aligning the project with this vision.
  - Defining, communicating and implementing authority levels, approval processes, decision making protocols and reporting mechanisms.
  - Building an environment of confidence and trust within the project:
    - Demonstration of openness, trust, goodwill, integrity and appreciation of the contribution of others.

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PEO

- Embedding social responsibility and respect into the project by practicing ethical and equitable behaviours including developing and implementing policies and procedures to safely report breaches of socially responsible practices and identifying and addressing threats to these practices.
- Developing the potential of project team members by establishing behavioural expectations, responding to conflicts or dealing with differences in skill, background, culture or other personal characteristics.
- Supporting a learning environment by viewing project planning and execution as a learning process that treats errors and mistakes as learning opportunities and identifies, captures, disseminates and exchanges knowledge.

PEO

- PEO facilitates stakeholder engagement with effective communication and behaviours that cultivate commitment from all stakeholders including:
  - Identifying and documenting stakeholders and their communication needs.
  - Developing appropriate communication approaches with each stakeholder.
  - Sharing information and addressing variances.
  - Investigating, documenting and addressing stakeholder interests and expectations.
  - Taking actions to accommodate differing stakeholder expectations and interests including mediation, reconciliation, arbitration, facilitation or collaboration.

PEO

- The PEO crafts the project by envisioning the desired future state based on a feasibility or Project Execution Plan (PEP). Actions include:
  - Describing, defining and agreeing to the desired future state.
  - Monitoring and evaluating internal and external project contexts for circumstances that may require changes to the desired future state.
  - Shaping and sustaining the initial development, refinement and substantial revisions to the execution approach for the project.
  - Shaping and sustaining the project's business case by monitoring and evaluating any changes needed to move from the current state to the desired future state.

PEO

- The PEO orchestrates the attainment of project benefits for the organization. Actions include:
  - Monitoring and evaluating internal and external project contexts for circumstances that may require changes or trade-offs of benefits.
  - Periodically reviewing, confirming and updating benefits and trade-offs.
  - Shaping and sustaining project benefits by delivering benefits gradually or incrementally.
  - Measuring and reporting the delivery of expected project benefits to your Project Sponsor.

PEO

- The PEO sustains project progress by securing resources and funding to complete the project. Some of these actions may be delegated to a Project Manager:
  - Developing and updating forecasts of funding and timing requirements as the project progresses.
  - Securing initial funding commitments and additional amounts as needed.
  - Adjusting budgets and related scope, delivering fewer benefits, modifying approaches, delaying delivery of benefits or allocating contingencies or reserve amounts.
  - Monitoring, evaluating and coordinating project progress by various tools including trend analysis, forecasting, strategic alignment reviews and monitoring internal and external project contexts.
  - Addressing, in a timely manner, all relevant legal and regulatory requirements including legislation and regulation, authority approvals, contract and subcontract provisions, health and safety, discrimination, labour relations, internal business controls and environmental regulatory issues.

PEO

- The PEO must manage change by monitoring internal and external project contexts and evaluating alterations within the organization and the project such as structure, operations, roles and responsibilities, funding, timing, resources, processes, behaviours, infrastructure, culture or other areas. Actions include:
  - Monitoring alterations within the organization and project.
  - Revising project delivery approaches and stakeholder engagements to accommodate any alterations.
  - Communicating and monitoring changes with the Project Team.
  - Evaluating and addressing feedback on alterations and changes.

PEO

- The PEO manages contracts and workflow related interactions by developing and maintaining policies, processes, procedures and practices. Actions include:
  - Developing terms, conditions and procedures for contracts and workflows.
  - Developing and managing contracts and workflows.
  - Overseeing and verifying contract and workflow performance.
  - Managing contract and workflow interfaces.
  - Documenting, resolving and verifying contract and workflow variations including significant compliance issues, contract non-performance, changes, disputes, claims or complaints.

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PEO

- PEO engages in collaborative relationships with shared interests and a high degree of joint decision-making to involve departments, business units, external partners and others internal and external to the organization and the project. Actions include:
  - Identifying and evaluating opportunities for collaborative relationships.
  - Initiating and shaping collaborative relationships through progressive engagement, open and honest communications and common understanding of processes and procedures that build trust and respect.
  - Communicating and maintaining a shared vision and desired outcome.
  - Aligning the interests of all partners to the benefits of the project
  - Encouraging information sharing.
  - Mutually identifying roles and responsibilities and expected results
  - Monitoring, nurturing and sustaining collaborative relationships
  - Ensuring all partners benefit from the project commensurate with their contribution and performance. BACK

Appendix 4

Governance and Oversight Checklist

George Jergeas

Governance

Executive Governance Level

- Address corporate goals, strategy, ownership and accountability. Responsibilities include:
  - Establishing corporate goals.
  - Producing a strategy to meet these goals including operating and maintaining installed assets and developing new projects to create additional assets.
  - Appointing the dedicated Project Sponsor (Benevolent Dictator #1) and PEO (Benevolent Dictator #2) for the major capital project.
  - Delivering oversight to identify the business opportunity and strategic/enterprise and contextual/global risks (Step 1 of the Major Capital Project Delivery Process).

Governance

Sponsor Governance Level

- The Sponsor is to align your major capital project with corporate goals. Responsibilities include:
  - Developing a project strategy to meet corporate goals.
  - Securing and providing resources to the project including human (Project Teams) and financial (budget).
  - Engaging stakeholders and managing their expectations
  - Overseeing strategic/enterprise and contextual/global risks and opportunities.
  - Overseeing the project and providing personal support.
  - Reporting project progress and results to executive team.

Governance

Project Executive Officer (PEO) Governance Level

- The PEO is to interpret corporate and project strategy and scope.
- Manage Project Managers and Project and contractors and suppliers. Responsibilities include:
  - Translating corporate goals into a project.
  - Engaging stakeholders and managing their expectations.
  - Determining project strategy and scope.
  - Monitoring project delivery including design, procurement, construction, commissioning and start-up.
  - Managing project, enterprise and global risks and opportunities.
  - Ensuring compliance with legal, ethical, regulatory and environmental requirements.
  - Making decisions to adjust the project plan as needed.
  - Overseeing and providing leadership to the project.
  - Implementing an effective labour management strategy.
  - Reporting project progress and results to Project Sponsor.

Governance

Project Manager Governance Level.

- The Project Manager is to deliver the project. Responsibilities include:
  - Planning and scheduling the project.
  - Executing the project plan.
  - Identify changes to the project plan.
  - Managing operational/project risks and opportunities.
  - Overseeing contractors' performance.
  - Reporting project progress and results to the PEO.

Oversight

- Oversight is the watchful care and supervision. You can be watchful by overseeing issues in the project such as risks, estimates, stakeholders and external concerns.

Oversight On Issues

1. **Risks**

   You ask: was our risk management process followed; were risks categorized; were contingency and reserve amounts adequate; were particular risks assigned to parties best suited to address them?

Oversight on Issues

2. Budget and Schedule Estimates

You ask: did we evaluate various probabilities; are our budget and schedule estimates optimistic or conservative; does our project have an equal chance of meeting or exceeding these estimates; are the assumptions that support these estimates clearly detailed and understood; have we identified the risks associated with these assumptions?

Oversight on Issues

3. Stakeholder Engagement

You ask: what have we done to engage all stakeholders; have we resolved their issues and concerns; how will we address unresolved issues?

4. Selecting Engineering Firms and Construction Contractors

You ask: what criteria did you use to select engineering firms and construction contractors; how did you evaluate engineering firms and construction contractors; what assurances have you received that they have the resources and skills to work on our project; what mechanisms are in place to ensure they will engage the promised resources on the project in a cost-effective manner?

Oversight of Decision Gates

Step 1: Business Opportunity Identification

- What are the details of the preferred potential business opportunity?
- Which corporate goals are being met by this opportunity?
- Does this preferred business opportunity fit with our corporate strategy?
- Have you incorporated lessons learned from similar business opportunities?
- Do economic analysis and market feasibility strongly support this opportunity?
- What percentage of engineering design did you complete for Step 1?
- Who are the stakeholders and what are their concerns?
- What top ten risks are included for the Step 1 risk assessment?
- What does the Step 1 schedule include?
- What is included in the Step 1 cost estimate?
- What contingencies and reserve amounts are included in these estimates?

- Did you develop a work plan, budget, resource requirements and preliminary schedule for Step 2?

Oversight of Decision Gates

Step 2: Preferred Project Selection

- What project alternatives are being developed?
- What is the expected value of these project alternatives?
- How will you identify the preferred project alternative?
- What percentage of engineering design did you complete for Step 2?
- How did you estimate the key quantities?
- What are the needs of the stakeholders?
- Have you identified long lead items and planned for their procurement?
- Have you incorporated lessons learned from similar project alternatives?
- Did an independent Peer Team conduct a review of the project?
- Have all the critical observations identified by the Peer Team been resolved?
- Are there any outstanding items to be resolved before Step 3?
- What top ten risks are included for the Step 2 risk assessment?
- What is included in the Step 2 cost and schedule estimates?
- What contingencies and reserve amounts are included in these estimates?
- Did you develop a work plan, budget, resource requirements and preliminary schedule for Step 3?

Oversight of Decision Gates

Step 3: Project Scope Definition

- Who is involved in completing Step 3?
- Does everyone involved understand the goals of the project?
- How are the engineering firms and construction contractors involved?
- What is included in the fully defined project scope and what is excluded?
- Does the project comply with all regulatory requirements?
- Who was involved in preparing the project execution plan?
- Does the project execution plan support the project goals?
- Does the team work effectively or are there unresolved issues?
- Did you involve the Operations Group and Business Unit in Step 3?
- Is preassembly and modularization incorporated into the project?
- What percentage of engineering design was completed prior to this funding request? (For example, 40% engineering design completed for a Class 3 estimate) (AACEI 2016)
- Are there any outstanding items to be resolved before Step 4?

Oversight of Decision Gates

Step 3: Project Scope Definition

- How did you engage stakeholders and what are their issues and concerns?
- Have all stakeholders bought into and/or provided their approvals for the project?
- Have you incorporated lessons learned from similar projects?
- Did you capture new lessons?
- Did you order long lead items?
- Did an independent Peer Team conduct a project audit or cold eyes review?
- Have all the critical observations identified by the Peer Team been resolved?
- Have you conducted a health check of the Project Team?
- What top ten risks and mitigations are included in the budget and schedule?
- What contingencies and reserve amounts are included in these estimates?
- What is included in the request for funding approval (AFE/FID)?
- Did you develop a detailed work plan, budget, resource requirements and preliminary schedule for Step 4?
- Have you assigned the project team members for Step 4?
- How did you select the team members for Step 4?
- How was the project execution plan communicated to the Step 4 team?

Oversight of Decision Gates

Step 4: Detailed Design, Procurement And Construction

- How are you progressing against the project execution plan?
- How effectively has the change control system been applied?
- What tools do you have in place to facilitate communication?
- How are you managing the interfaces between the parties?
- Have the regulatory requirements been met?
- Are engineering deliverables on time for construction?
- What is the actual progress of engineering design compared to the plan?
- What is the actual level of engineering quality versus that planned?
- Has the procurement plan addressed local content requirements?
- Are there any significant procurement or logistical issues?
- Is a supplier quantity and quality surveillance program being implemented?

Oversight of Decision Gates

Step 4: Detailed Design, Procurement And Construction

- Are safety toolbox meetings being held daily?
- Is the required level of competent craft labour available?
- Do you anticipate any labour disruptions for any reason?
- What is the actual progress of site construction versus that planned?
- What is the site labour productivity compared to planned and why?
- How is cash flow being managed during construction and what is the actual versus planned?
- What is the level of trust and respect among the parties?
- Are team members recognized and rewarded for outstanding performance?
- Are resources allocated according to project priorities?
- Does the project team have the authority necessary to do its work?
- Have there been any significant communication issues encountered during either the engineering, procurement or construction work?

Oversight of Decision Gates

Step 4: Detailed Design, Procurement And Construction

- Was the construction contractor involved in the detailed engineering design?
- Did an independent Peer Team conduct a project audit or cold eyes review ?
- Have all the critical observations identified by the Peer Team been resolved?
- Have you conducted a health check of the Project Team?
- Are you preparing the commissioning and start-up plan, budget and resource requirements?
- Are you finalizing the operating plan?
- How are you tracking progress and performance?
- Are construction sequences as required by the commissioning and start-up sequences?
- Have you incorporated lessons learned from similar projects?
- How are stakeholders being engaged and are their issues resolved?
- Are there any new stakeholders or new stakeholder issues?
- Is construction aligned with the commissioning and start-up schedule?
- What are the top ten risks and how are these being mitigated?
- Have you developed a work plan, budget and preliminary schedule for Step 5?
- Did you capture new lessons?

Oversight of Decision Gates

Step 5: Commissioning and Start-up

- Is system turnover proceeding according to plan?
- How well are commissioning and start-up progressing?
- Are there any significant commissioning issues?
- How ready is the Operations Group to operate the asset?
- Have all Operators received adequate training?
- Are all the operating manuals and data books available for start-up?
- Was the start-up plan complete or are there unresolved issues?
- Were there any changes to be made during commissioning and start-up?

Oversight of Decision Gates

Step 5: Commissioning And Start-up

- How were changes communicated to all parties?
- Were resources allocated according to project priorities?
- What is the level of trust and respect among the parties?
- Does the commissioning and start-up team have sufficient resources?
- Are there any significant communications issues encountered during commissioning or start-up?
- Were all regulatory requirements met or are there outstanding issues?
- What tools do you have in place to monitor and evaluate the facility?
- How did you engage stakeholders and communicate project results?

Oversight of Decision Gates

Step 5: Commissioning And Start-up

- Were lessons learned captured for all project steps?
- Were lessons learned posted to company archives?
- What type of project data was archived?
- Are you actively identifying new opportunities?
- What is the Post Project Assessment compared to what was approved in the AFE/FID at the end of Step 3 with respect to safety, cost and schedule targets?
- When is the Business Evaluation scheduled? (typically about 1-2 years after start-up when the asset has achieved normal operation)

Back

Additional Slides for reference, if needed

George Jergeas

Failure as an Industry

98%

Of projects over $1 Billion exhibiting cost overruns of 80%.

(Source: Brenden Bechtel, CII, Annual Conference 2016)

65%

Of large scale industrial projects FAIL to meet business objectives.

(Source: Merrow 2011)

73%

Of mega-projects experience schedule overruns.

(Source: Ernst & Young 2014)

UP TO 57%

Of resources are wasted in construction, compared with 26% waste in manufacturing.

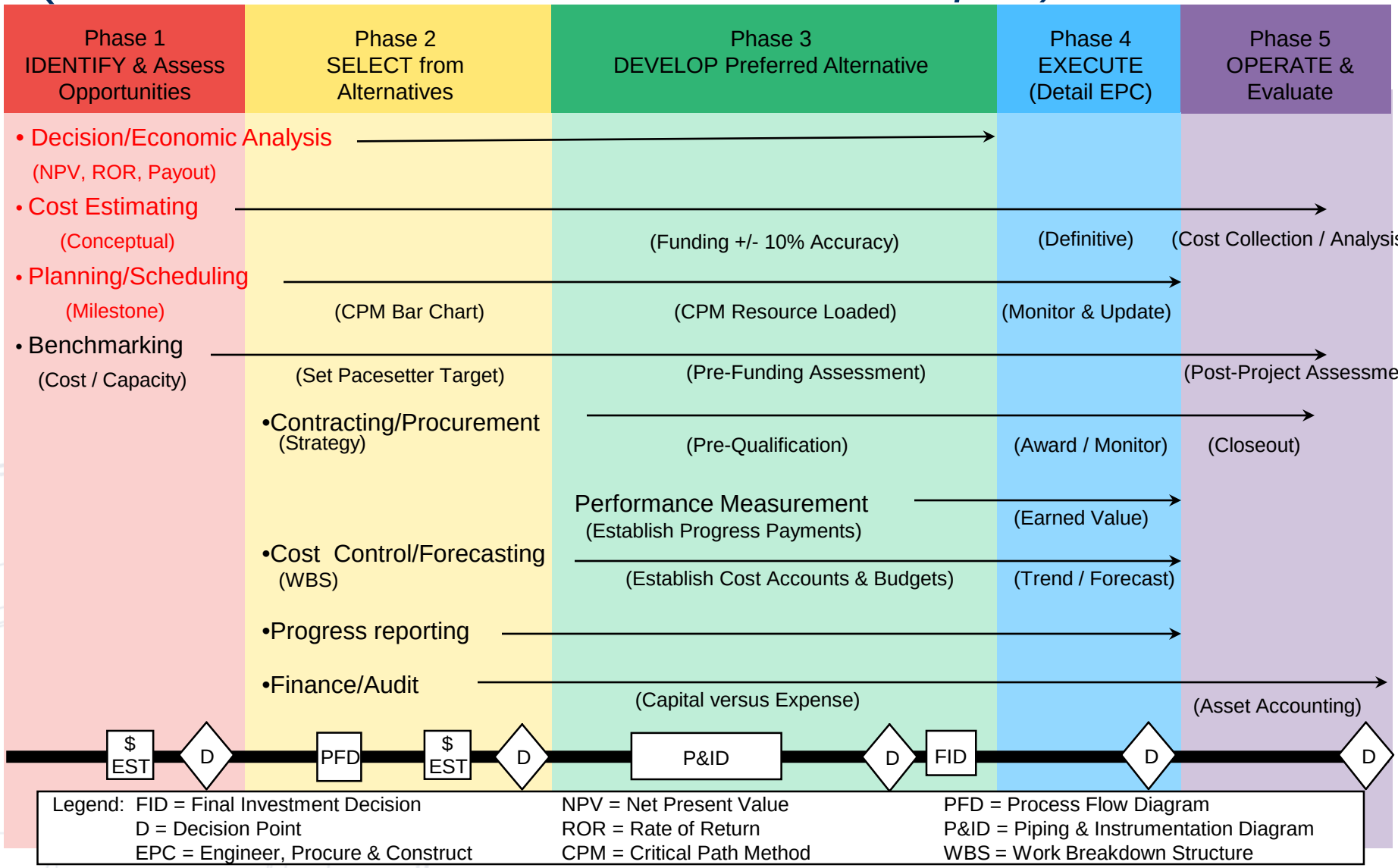
(Source: CII 2004)

Husky Energy Inc. PROJECT DEVELOPMENT AND EXECUTION PROCESS

PHASE 1: IDENTIFY	PHASE 2: SELECT	PHASE 3: DEFINE	PHASE 4: EXECUTE	PHASE 5: COMMISSION
Identify and Assess Business Opportunity	Evaluate Alternatives and Select Best Development Plan	Further Define Best Development Plan for Successful Delivery	Implement Execution Plan and Control to Plan	Commission, Start-Up and Close-Out
KEY OBJECTIVES:				
Frame Business Opportunity	**Maximize Expected Value**	**Obtain Project Sanction**	**Functional Completion**	**Operate and Evaluate**
FOCUS ITEMS:				
- Test for Strategic Fit - Preliminary Plan & Economic Assessment - Strategic Risk Assessment - Preliminary List of Alternatives - Preliminary List of Technologies - Preliminary Regulatory Plan - Generate Plan for Phase 2	- Generate Alternative Development Plans - Screen Alternatives - Identify Preferred Alternative - Develop Conceptual Design and Expected Values of Alternatives - Determine Best Alternative - Refine and Evaluate Scope, Cost and Schedule for Best Alternative - Develop Design Basis Memorandum (DBM) - Identify Value Improvement Practices (VIPs) - Produce Quality Assessments - Prepare Risk Assessment and Regulatory Plan - Formulate Expected Value Analysis - Generate Plan for Phase 3	- Full definition of development project scope (BDS) - Front End Engineering Design (FEED) - Regulatory Plan Execution (applications and approvals) - Detailed Execution Plans - Procure Long Lead Equipment - Preliminary Operating Plan & Costs - Refine Estimate & Schedule - Identify Value Improvement Practices 2 - Value/Quality Assessments - Final Project Risk Assessments - Final Expected Value - Develop HSE Plan - Generate Plan for Phase 4	- Execution Plan Implementation - Detailed Engineering Design - Procurement - Contracting - Construction - Drilling and Completions - Turnover to Operations - Value/Quality Assessments - Final Operating Plans - Commissioning Plan - Operations Readiness - Generate Plan for Phase 5	- Operating Plans Implementation - Execute Commissioning Plan - Start-up Systems/Facilities - Project Review and Close out - Post-Project Business Evaluation
KEY DELIVERABLES:				
- Phase 1 Decision Support Package (DSP) - Request to Proceed to Phase 2 - AFE for Phase 2 Funds	- Phase 2 DSP - Phase 2 PDE Assessment - Request to Proceed to Phase 3 - AFE for Phase 3 Funds	- Phase 3 DSP - Phase 3 PDE Assessment - Request to Proceed to Phase 4 - AFE for Phase 4 Funds	- Phase 4 Operational Readiness Audit	- Phase 5 Project Close-Out Report

Total Cost Management

(*Plan, Schedule, Estimate, Monitor and Report*)



SUV Analogy

Phase 1: Project Audit and Site Assessment

- Interview different levels of site professionals to audit construction management practices
  - Evaluate the projects performance on 14 key components
  - Determine where improvements can be made
  - Determine areas of the project that are most at risk of extending projects cost and schedule
  - Determine the ground work for a work sampling process and cycle

Phase 2: Work Sampling

1. Time & Labour Analysis

- Field time & labour data collection.
- Root cause analysis & recommended remediation.
- Assistance in aligning all tools, equipment, material and information required for successful completion of the Installation Work Packages in the field.

Phase 2: Work Sampling

2. Quantity & Labour Survey

- Shadow work crews to obtain real-time information pertaining to the completed work scope.
- Participate in weekly construction management team progress meetings.
- Discuss opportunities to improve productivity and removal of barriers for the field crews.

3. *Root Cause Labour Analyses*

- Analysis of “time analysis” data and site interviews.
- Complete root cause analysis outlining opportunities to increase site productivity and remove risks.
- Report the findings from analysis.