Post Disaster Engineering & Construction Program and Project Management[1, 2]

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The post-disaster environment changes both engineering and construction requirements as well as the framework within which it is undertaken. These changes drive post-disaster program and project managers to address different considerations than those encountered on a more traditional global scale program while simultaneously dealing with the added constraints imposed by an evolving logistical situation.

Previously in, "Personal Perspective: Program Management and Events of Scale" (*PM World Today*; July, 2008) the focus was on programmatic features common in the preparation and planning to resist, respond and recover from so-called events of scale. This paper looks more deeply at how the engineering and construction model changes post disaster and how various logistics affecting activities are modified from those employed on global scale programs undertaken in a non-disaster environment.

Types of Disasters

Before jumping directly into the post disaster environment it is worth spending a minute to understand the range of disasters that engineering and construction program and project managers are likely to be called to engage in. We have tried to characterize these simply as those with a broader scale (both natural and human caused) and those that are more discrete in nature. The later however may have consequences as severe as the broader scale disasters depending on the facility involved. We have specifically included so called "Natech" disasters or naturally induced technological failures. The most recent example of such a Natech disaster is at Fukashima.

- Broader Scale Disasters
  - Human
    - War, civil strife, terrorism

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- Natural
  - Regional – wind, water, earthquake, geological

- Discrete Disasters (Specific facility)
  - Human – terrorism, explosion, fire
  - Natural – tornado, fire
  - Natech - naturally induced, technological failure

Each of these disasters moves through three phases but in this paper we will focus only on the later two.

- Resist (pre-disaster)
- Response
- Recover and reconstruct
  - Enhance resiliency for each phase

Simplified Engineering & Construction Project Model

In order to understand how the engineering and construction project model changes post-disaster, it is first necessary to construct a simplified model for the non-disaster scenario. Such a simplified model is reflected in the following figure and includes a set of project inputs which are transformed at a project site, within a well-defined framework, to deliver the desired project outputs. Framework elements include:

- Business framework
- Project environment and setting
- Social and stakeholder framework
- Economic and political frameworks

In the non-disaster scenario project inputs simplistically include:

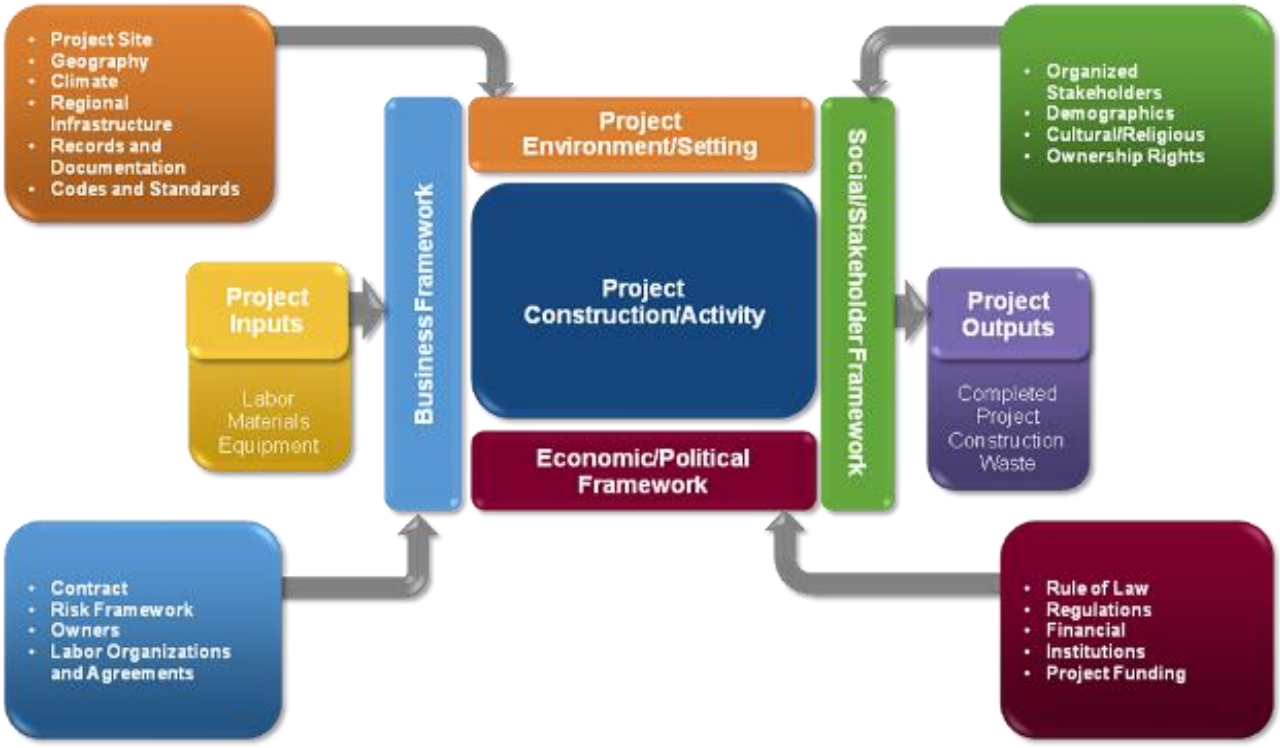
- Labor
- Materials
- Equipment

Outputs from the engineering and construction process include not only the completed project but also a significant amount of construction waste (25% of construction inputs).

Turning now to each of the framework elements in which construction typically occurs, we can define the prime components comprising each element in a "simplified" non-disaster construction setting. These will include business framework components such as the contract, risk factors, the facility owner, and various labor organizations and associated labor agreements that may exist.

Project environment and setting components of this framework element will include project site factors, geography, climate, existing regional infrastructure, available records and documentation and applicable codes and standards. The social and stakeholder framework element will include components such as existing organized stakeholders, local and regional demographics, a range of cultural or religious factors to be considered and hopefully well-established ownership rights.

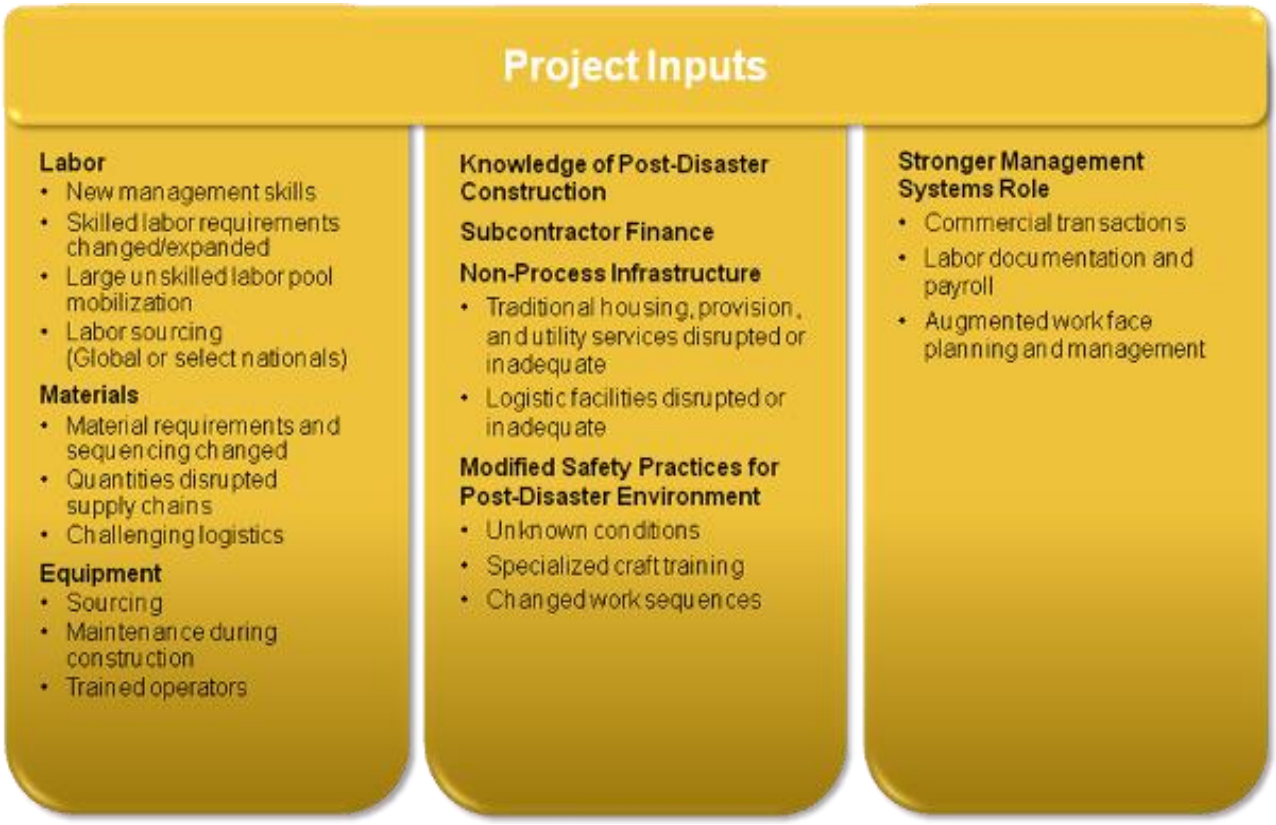
Finally the economic and political framework element will include components related to a well-established rule of law, clear regulations, the required well-defined financial institutions as well as other institutions taken for granted in everyday commercial activities and a well-defined and efficiently structured approach to project funding.



Site based factors further constrain how project inputs are transformed into the desired project outputs within this constraining and defining framework. The transformation process is also enabled through a set of required site services, the esprit de corps built among the project team and the know how the contractor and his management and technical experts bring to bear.

How the Engineering and Construction Project Model Changes Post-Disaster

Disasters change each element of this model and as we will see later on activities normally undertaken are modified by post-disaster logistics constraints as well as modify post-disaster logistics themselves. Let's look now at each element of the simplified model described above and how it is modified post disaster starting with project inputs themselves.



Each of the basic inputs from our simplified model (labor, materials, equipment) is modified post-disaster and several new input considerations become significant. These modified and new input factors include:

Labor
- New management skills
- Skilled labor requirements changed/expanded
- Large unskilled labor pool mobilization
- Labor sourcing (Global or select nationals)

Materials
- Material requirements and sequencing changed
- Quantities disrupted supply chains
- Challenging logistics

Equipment
- Sourcing
- Maintenance during construction
- Trained operators

Knowledge of Post-Disaster Construction

Subcontractor Finance

Non-Process Infrastructure
- Traditional housing, provision, and utility services disrupted or inadequate
- Logistic facilities disrupted or inadequate

Modified Safety Practices for Post-Disaster Environment
- Unknown conditions
- Specialized craft training
- Changed work sequences

Stronger Management Systems Role
- Commercial transactions
- Labor documentation and payroll
- Augmented work face planning and management

Similarly, the various framework elements are subject to modified or added components which act to shape post disaster project management in ways not encountered in non-disaster scenarios. Let's look at each of the framework elements in turn and how the various components are modified post-disaster.

Disaster Changes Business Framework

Disaster changes the business framework, introducing new factors into basic construction contract considerations, significantly altering risk frameworks that the program or project team may experience, creating new de facto owner groups different than those the engineering and construction team and broader community may be used to engaging with, and creating new challenges with various labor organizations.

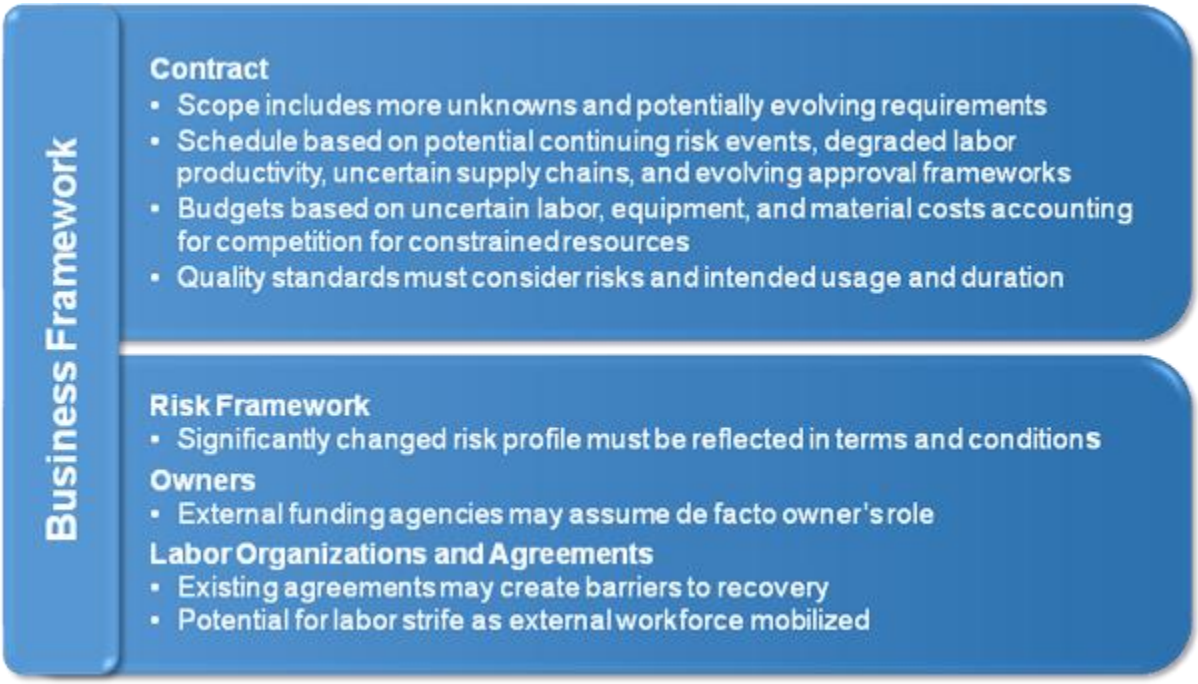
Specific modifications to the "simplified" model may include:

Contract
- Scope includes more unknowns and potentially evolving requirements
- Schedule based on potential continuing risk events, degraded labor productivity, uncertain supply chains, and evolving approval frameworks
- Budgets based on uncertain labor, equipment, and material costs accounting for competition for constrained resources
- Quality standards must consider risks and intended usage and duration

Risk Framework
- Significantly changed risk profile must be reflected in terms and conditions

Owners
- External funding agencies may assume de facto owner's role

Labor Organizations and Agreements
- Existing agreements may create barriers to recovery
- Potential for labor strife as external workforce mobilized



Disaster Changes Project and Environmental Setting Framework

Disasters, in particular broader scale disasters, fundamentally alter the project and environmental setting. Site access will be constrained in new and potentially evolving ways, basic site and regional geography may be fundamentally modified and the regional infrastructure, at whatever level, that projects rely on to meet many of their basic needs may now be non-existent. Basic assumptions under the "simplified" pre-disaster model are no longer valid.

Changes to the various components of this framework element include:

Project Site
- Constrained access
- Denied access
- Uncertain ownership or other property rights

Geography
- Modified topography (floods, landslides, or mudslides; earthquake displacement; lava fields; aftermath of military action)
- Terrain limits rate of response or reconstruction
- Accessibility constrains available options

Climate

- Adverse climactic conditions impact response activities (continuing hurricane season, seasonal extremes of temperature or precipitation)
- Event of scale necessitates construction in non-traditional time periods (monsoon, depth of winter, peak of summer)

Regional Infrastructure

- Widespread destruction of regional infrastructures important to response and reconstruction (roads and rails washed away, bridges severely damaged or destroyed, airports rendered unusable, destroyed power generation and transmission capability, destroyed or degraded potable water treatment and distribution capability, degraded wastewater capability, constrained telecom services from facility damage)
- Regional infrastructure inadequate for level and nature of response and rebuilding activities

Social Infrastructures Disrupted or Destroyed

- Housing, medical, police, fire, sanitation
- Banking and other financial institutions

Records and Documentation

- Lost records
- As-builts no longer meaningful
- Property rights not well documented or inconsistent with social realities (squatter populations)

Codes and Standards

- Evolving as a result of event of scale
- Variable – affected by donor/funder requirements

Disaster Changes Social and Stakeholder Framework

Social and stakeholder frameworks undergo some of the most significant changes post-disaster, often in ways that are not readily visible. These changes impact each of the components that comprise this framework element. Traditional problem resolution mechanisms may breakdown and new sources of concern or conflict emerge. Displaced populations, transient relief and reconstruction populations and a re-emergence or strengthening of cultural or tribal issues compound the difficulty in undertaking the engineering and construction activities needed to respond and reconstruct post-disaster. Often the debilitating and corrosive impacts of corruption are more sharply felt.
Changes to specific framework components include:

Organized Stakeholders

- Traditional stakeholder groups dysfunctional
- Stakeholder objectives evolving
- New stakeholder groups emerging
- National or international stakeholders gain roles to enable or Intervene

Demographics

- Loss and displacement of populations

- Impact of relief, response, and reconstruction populations
- Constraints on construction labor

Cultural/Religious

- Transitional roles often played by cultural or religious groups
- Cultural and religious sensitivities often elevated
- Tribal issues and prerogatives may resurface

Ownership Rights

- Lack of documentation and records
- Conflicting claims
- Formal versus informal rights
- Confiscation in the absence of the rule of law
- Corruption

Disaster Changes Economic and Political Framework

The destructive impact of a disaster on economic activity that existed pre-disaster is easy to understand. Harder to come to grips with is the trajectory of economic activity post-disaster. This trajectory is often shaped by political functionality and the extension of politics into every aspect of life and every decision essential to post-disaster relief and recovery. Examples of changes in the various components of this final framework element include:

Rule of Law
- Confiscation and security risks elevated due to lack of rule of law
- Emergency decrees inconsistently interpreted and applied
- Local laws of convenience
- Corruption

Regulations
- Regulations not relevant to situation on ground or act to impede progress
- Traditional regulations extended to situation for which they were not designed

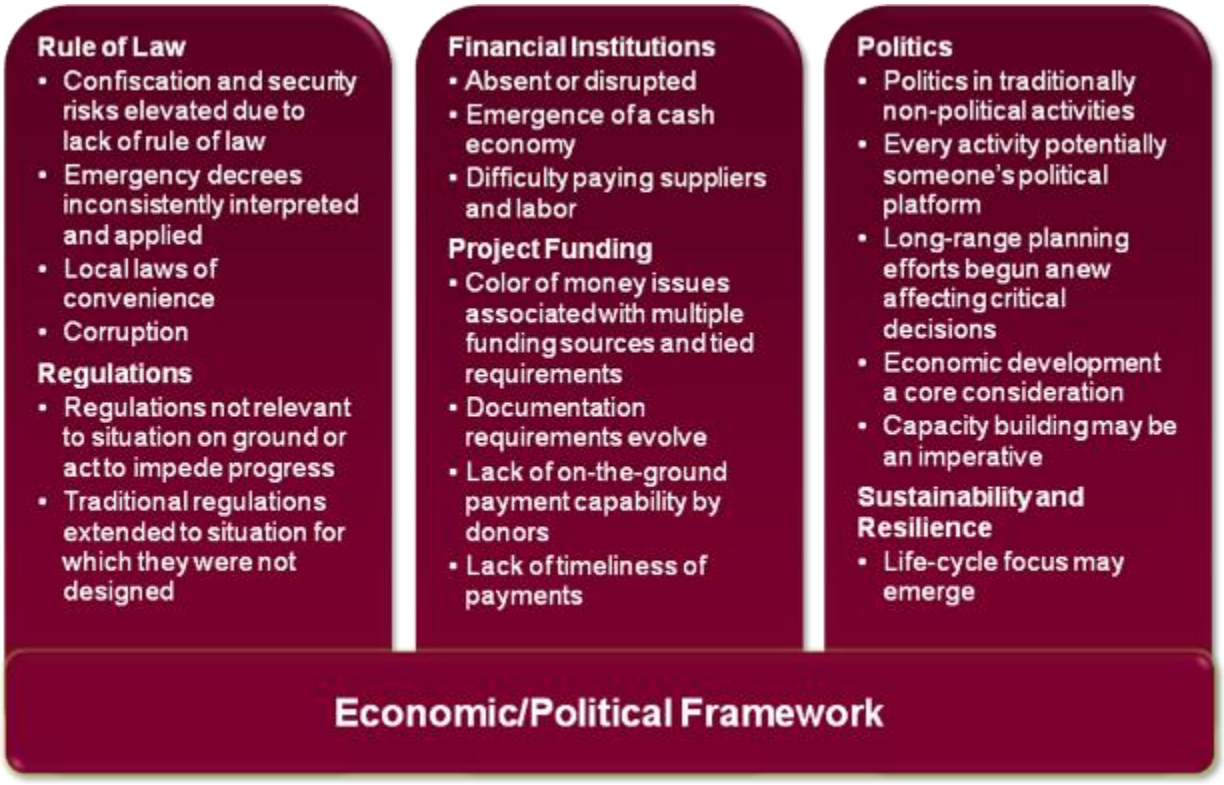
Financial Institutions
- Absent or disrupted
- Emergence of a cash economy
- Difficulty paying suppliers and labor

Project Funding
- Color of money issues associated with multiple funding sources and tied requirements
- Documentation requirements evolve
- Lack of on-the-ground payment capability by donors
- Lack of timeliness of payments

Politics
- Politics in traditionally non-political activities
- Every activity potentially someone's political platform
- Long-range planning efforts begun anew affecting critical decisions
- Economic development a core consideration

- Capacity building may be an imperative

Sustainability and Resilience
- Life-cycle focus may emerge



Post-Disaster Project and Construction Activity

Post-disaster project and construction activity must now occur at a site where traditional inputs and project frameworks have been modified and special challenges are present. These special challenges include debris removal and potential reuse to mitigate ever present logistical challenges; changed psychology both with respect to decision making and risk taking but also with respect to a labor force that itself may be displaced or suffering the loss of close relatives; and changed liability concerns as one of the first things to grow post-disaster is uncertainty which is a root cause of much liability.

We have already touched upon the corrosive effects of corruption which may be controlled or compounded by governmental leadership and enablement. These are real issues as are those related to human and construction safety. The construction environment is inherently dangerous and post-disaster uncertainties only exacerbate these concerns.

Finally, post-disaster construction activities face modified output requirements from more traditional non-disaster construction.

Post-Disaster Construction Outputs

Traditional construction activities are traditionally focused on creating new facilities, usually "permanent" in nature. Post-disaster, constructed projects may take on a wider range of time frames including temporary, transitional and permanent dimensions.

Pressures to use disaster debris in construction may modify certain design and construction choices and considerations related to not adding to this material problem are only heightened post-disaster. Social dimensions of the "triple bottom line" of sustainability take on increased importance as part of the overall disaster recovery process.

Specific changes to post-disaster outputs include:

Completed Project
- Temporary
- Transitional
- Permanent

Construction Waste

- Linkage to debris considerations (disposal and reuse in construction)
- Recycling drivers

Sustainability

- Capacity building
- Economic development
- New industry creation
- Enhanced resiliency
- Lessons learned and best practices

Conclusion

Post-disaster engineering and construction program and project management activities are significantly modified from non-disaster activities. Changes to the fundamental project model employed in the management of these types of programs and projects requires a fundamental re-think of skill sets, management processes, risks and constraints. In addition, these changes collectively significantly change the logistical characteristics of such programs while simultaneously significantly modifying the broader logistical space within which the disaster has occurred. Even the most basic project activities have the potential to significantly affect project and regional logistics and even the best intentioned relief and recovery activities have the ability to impact response and recovery in today's highly engineered, built environment.

The challenges of this changed environment can be met through concerted action by the engineering, construction, government and NGO sectors. Specific recommendations include:

- Government and NGO community must plan for assisting in post-disaster recovery
  - Provide accessibility to the sites of critical infrastructure
  - Maintain awareness of global logistics chain
  - Ensure availability of specialized construction equipment, contracts, and materials
  - Develop well-documented system with clear interface points
  - Preplan and rehearse response and recovery scenarios for high-probability events
    - Earthquake
    - Hurricane
    - Flood
- Engagement with engineering and construction community must begin pre-disaster
  - Pre-placed contracts
    - Program management
    - EPC
    - Supply chain
  - Earliest mobilization to disaster zone

- Early activation of logistics chains

- Post-disaster period requires streamlined decision frameworks
  - Decision authorities at project and disaster site
  - Logistical-affecting processes may act as barrier in post-disaster scenario
    - Examples are customs, building permits, and liability legislation
    - Consider a standard “modified” logistical template for local government consideration
      - “Go-bys”
      - Best practices

About the Authors

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Bob Prieto is a senior executive effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering and construction industries. Currently Bob heads his own management consulting practice, Strategic Program Management LLC. He previously served as a senior vice president of Fluor, one of the largest engineering and construction companies in the world. He focuses on the development and delivery of large, complex projects worldwide and consults with owners across all market sectors in the development of programmatic delivery strategies. He is author of nine books including "Strategic Program Management", "The Giga Factor: Program Management in the Engineering and Construction Industry", "Application of Life Cycle Analysis in the Capital Assets Industry", "Capital Efficiency: Pull All the Levers" and, most recently, "Theory of Management of Large Complex Projects" published by the Construction Management Association of America (CMAA) as well as over 700 other papers and presentations.

Bob is an Independent Member of the Shareholder Committee of Mott MacDonald. He is a member of the ASCE Industry Leaders Council, National Academy of Construction, a Fellow of the Construction Management Association of America and member of several university departmental and campus advisory boards. Bob served until 2006 as a U.S. presidential appointee to the Asia Pacific Economic Cooperation (APEC) Business Advisory Council (ABAC), working with U.S. and Asia-Pacific business leaders to shape the framework for trade and economic growth. He had previously served as both as Chairman of the Engineering and Construction Governors of the World Economic Forum and co-chair of the infrastructure task force formed after September 11th by the New York City Chamber of Commerce. Previously, he served as Chairman at Parsons Brinckerhoff (PB) and a non-executive director of Cardno (ASX)

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