

Intersection of Engineering, Construction and Logistics Post-Disaster

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Fluor

Today's highly engineered environment requires a new first responder team that includes engineers and constructors. The importance of these new first responders could be seen in efforts to remove bent steel beams in the search for survivors on 9/11; seal levee breaches after Katrina; restore power and water supply after the tsunami at Fukushima; and the massive infrastructure recovery efforts following Super Storm Sandy in New York and New Jersey. These new first responders are also essential for rebuilding after the immediate response phase.

Events of scale change the normal construction process. New logistical challenges emerge and evolve in the post-disaster phase. These challenges include destroyed logistical facilities; competition with other post-disaster aid flows; and disrupted supply chains.

This paper looks at these challenges and offers recommendations to better manage them.

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Events of scale change the normal construction process. **This is addressed in more detail in a companion paper at this conference.** New logistical challenges emerge and evolve in the post-disaster phase. These challenges include destroyed logistical facilities; competition with other post-disaster aid flows; and disrupted supply chains.



Figure 1

Today’s managers charged with designing, building and operating with resiliency in mind must be cognizant of the growing role these new first responders play after events of scale. Their effectiveness and the effectiveness of longer term aid and reconstruction flows are closely coupled by this weakened logistical chain.

LOGISTICS AFFECTING ACTIVITIES

Many of the work processes and engineering, procurement and construction activities traditionally associated with large scale construction programs must be modified to deal with the realities of post-disaster construction. Some of these changes are driven by logistical constraints of the post-disaster environment while other changes are driven by changed institutional processes. Each of these changes impact the normal logistical processes expected in large scale programs. This paper looks at changes based on prior experience. Recommendations are provided in the matrix incorporated in Table 5 at the end of this document.

Table 1. Logistics Affecting Activities

Client capabilities and resources	Global sourcing	Road and bridge transport	Vehicle safety
Client-contractor alignment and contract	Sourcing integrity	Oversized shipments	Human remains
Mobilization	Mission-critical, unique	Ocean freight	Communication

Table 1. Logistics Affecting Activities

	equipment sourcing		
Execution plans	Quality of locally procured material	Transportation insurance	In-country logistical institutional infrastructure
Project Management Manual	Expediting	Port capacity and operations	Site transport
Workshare	Traffic routing and logistics plan	Construction equipment	Staging areas
Design basis	Building permits and consents for temporary construction and logistical facilities	Construction fleet maintenance	Cash flow
Degree of design standardization	Warehousing	Non-process infrastructure (NPI)	Anti-corruption and transparency
Prefabrication	Material security	Craft training	Stakeholder engagement
Preassembly	Logistical contract forms	Small tools	Change management
Modularization	Construction waste		
Degree of client-furnished materials and equipment	Less-than-full truckload shipments		
Supplier relationship agreements (SRAs)			

Client Capabilities and Resources – Client organization may be lacking resources that understand engineering, procurement and construction processes and how they change in a post-disaster environment. Impacts and importance of logistics in post disaster situation may not be sufficiently understood or required resources not engaged. Lack of appreciation for nature or scale of logistical challenges adversely impacts overall construction effort

Client-Contractor Alignment and Contract – Private sector efforts are in support of clients with flexibility to quickly execute risk appropriate contracts. Public sector efforts are effective where prior contract vehicles exist and alignment activities have previously occurred. Lack of prior contract impacts efficiency of logistical commitments being made.

Mobilization – Certain government or aid agency contracts are task order based with no provision for mobilization costs. This delays activities to create efficient logistics operation.

Execution Plans – Funding driven baseline shaped by donor community

Project Management Manual (PMM) – PMM expanded to include procedures/ approvals linked to funding source. These procedures may vary by project delivery approach, contracting strategy and project phase. Added approvals and complexity impact logistics chain.



Figure 2

Workshare – Funding agencies may drive work to be performed locally.

Design Basis – Nature of funding sources constrains solutions reducing opportunities to modify supply chain.

Degree of Design Standardization – Required volumes limit standardization opportunities

Labor – OCONUS mobilization through Mobilization and Deployment Center (MDC). MDC in a Box for OCN mobilization (recruitment, training, and on-boarding process completed in 7 to 8 days)



Figure 3

Table 2. Typical Stabilization and Post-Disaster Labor Requirements

Contracts/Task Orders	Time Period	Fluor Personnel Mobilized	Subcontract Personnel Mobilized
BP MC 252 Incident Response	<70 days	8,447	0
LOGCAP IV, TO5–AOR	<120 days	1,480	1,924
LOGCAP IV, TO2	<90 days	64	376
LOGCAP IV, TO4	<60 days	72	248
FEMA Individual Assistance	<90 days	1,410	2,190

Table 2. Typical Stabilization and Post-Disaster Labor Requirements

Contracts/Task Orders	Time Period	Fluor Personnel Mobilized	Subcontract Personnel Mobilized
CETAC I	<45 days	50	2,950
CETAC II	<60 days	33	1,575
New Power Generation	<45 days	50	540
Public Works Water	<45 days	50	1,150

Prefabrication – Initially focused on response phase needs

Preassembly – Typically limited by funding coupled to job creation in affected area; access route constraints

Modularization – Use constrained by client awareness and procurement practices; site access may be limited to port areas and major routes

Degree of Client – Furnished Materials and Equipment - Adequate owner provided advance financing limits use; contracting practices by government limit PMC+ approaches; multiplicity of buyers (lack of sourcing hub) reduces supply chain efficiency

Table 3. Cost of Labor and Building Materials in Aceh

Late 2004 to Late 2006

Resource	Unit (RP)	End 2004	Mid-2005	Early 2006	Oct 2006	Change (%)
Labor	000/day	30	40	50	50	67

Table 3. Cost of Labor and Building Materials in Aceh
Late 2004 to Late 2006

Resource	Unit (RP)	End 2004	Mid-2005	Early 2006	Oct 2006	Change (%)
Wood	million/m3	1.0	1.5	1.9	2.2	120
Cement	000/50kg	20	26	34	37	85
Sand	000/3m3	150	300	300	300	100
Brick	each	250	580	700	700	180

Table 4. Cost of Labor and Building Materials in Sichuan
Mid 2008 to Mid 2009

Resource	Unit (RMB)	Mid 2008	End 2008	Early 2009	Mid 2009	Change (%)
Labor	Per day	30	60	100	80	167
Brick	Each	0.33	0.53	0.55	0.35	6
Cement	Per ton	390	460	550	480	23.1
Aggregate	Per m3	25	50	55	75	200
Steel	Per ton	5,400	3,800	3,600	4,200	22.2

Supplier Relationship Agreements (SRAs) – Effective use limited by competitive procurement and form of contract; high demand drives use of non traditional sourcing for which reduced supplier-buyer information exchange has occurred.

Global Sourcing – Expanded sourcing effort to meet times frames requires augmented vendor inspection, QA/QC and expediting. Supply identification of materials of construction should be undertaken for disaster types and locations in advance of disaster.

Sourcing Integrity – Supply origins for certain bulk materials (timber) and their preparation for use may be difficult and compliance with procurement norms harder at the subcontractor level.

Mission-Critical, Unique Equipment Sourcing – Supply chain compression activities may include new sources of supply, multi-vendor awards, use of CFM as feedstock to select vendors, phased procurement and pricing, expedited transport.

Locally Procured Material Quality – May take physical possession but not title at end of inspection line to prevent material substitution further straining logistical chain.

Expediting – Reflect evolving needs and on the ground conditions

Traffic Routing and Logistics Plan – Reflect evolving needs and on the ground conditions; consider evolving condition of transport routes and other logistics facilities; increased number of logistics choke points and greater competition for logistics capabilities



Figure 4

Building Permits and Consents for Temporary Construction and Logistical Facilities – Government capacity may be inadequate. Delay of facilities may result. Mechanisms for waivers may not exist.



Figure 5

Warehousing – Limited CFM and shortages make this a lower priority but inability to reliably implement a just in time supply chain can make this an even more significant activity. Warehousing may be needed to be located closer to site of reconstruction activities because of weakened local logistics networks.

Material Security – Augmented security; perimeter patrols; larger guard force

Trafficking – Trafficking is key link in supply chain management as logistical system reconfigures post-disaster

Logistical Contract Forms – Special requirements to address changed shipper risks

Construction Waste – Expanded volumes associated with site debris; high mixed waste; potential need to classify portions as hazardous waste

Less-Than-Full Truckload Shipments – Logistically expensive especially where shipments are rationed.

Staging Areas – Inefficient supply chains exacerbate staging needs. Out of zone staging process utilized to control flow into valuable routes

Road and Bridge Transport – Conditions and capacities unknown. Significant degradation may not be evident.

Oversized Shipments – Logistics constraints limit shipment sizes increasing volumes shipped.

Ocean Freight – Competition for vessels or harbor constraints drive undesirable load sizes and combinations.

Transportation Insurance – Unavailability affects logistics choices.

Port Capacity and Operations – Potentially impacted by damage at the port; cargo handling operations overwhelmed by lack of prioritization.

Construction Equipment – Competition for equipment may drive ownership decisions; efficient equipment not available; shortages of operators.

Construction Fleet Maintenance – Maintenance requirements associated with difficult site conditions necessitate larger fleet sizes; fuel supply is critical resource.



Figure 6

Non-Process Infrastructure (NPI) – Constrained by site access (transport; site based debris) and community perceptions; competition for generators and water treatment limit construction activities.

Craft Training – Training expanded to include hazards of ongoing risk conditions; multiple client and contractor structures without strong program control undermines safety culture; local labor force may move between contractors more frequently diminishing training investment made by any one contractor.

Small Tools – Requirement to address shortages and expanded workforce.

Vehicle Safety – Difficulties encountered in driver certification and training

Human Remains – Protocols cause partial site shutdown and reconfigured logistics.

Communication – Regional communication networks degraded impacting efficiency.

In-Country Logistical Institutional Infrastructure – Institutional frameworks inappropriate for post disaster response and rebuilding.

Site Transport – Local transport dysfunctional.

Cash Flow – Need to bridge cash requirements of subcontractors makes payment terms an increasingly important selection factor in sourcing decisions.

Anticorruption and Transparency – Risks greatly increase and monitoring and surveillance become larger activities. Increased security in logistics chain.

Stakeholder Engagement – Changed stakeholder groups, priorities and communication difficulties impact effective communication.

Change Management – Impacts of change magnified in logistics chain post disaster

CONCLUSION AND RECOMMENDATIONS

Changes to some logistics affected and logistics affecting engineering and construction activities have been described. Table 5 that follows includes a comparison with non-disaster programs and suggests some areas for consideration by resiliency planners, implementers and post disaster managers. The considerations laid out will help prepare the managers to deal with a growing dimension of post-disaster activities.

Recommendations for individual considerations have been made based on experience.

These specific recommendations at the activity level are complemented by the following recommendations.

- 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

Table 5. Logistics Affecting Engineering and Construction Activities

Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
Client capabilities and resources	<ul style="list-style-type: none"> • Client organization is appropriately resourced or program manager engaged • Combined team brings necessary understanding of EPC activities and how they interact with necessary logistics considerations 	<ul style="list-style-type: none"> • Client organization may be lacking resources that understand EPC processes, and how they change in a post-disaster environment • Impacts and importance of logistics in a post-disaster situation may not be sufficiently understood in client organization, or required resources have not been engaged • Client lack of appreciation for nature or scale of logistical challenges may adversely impact overall engineering and construction effort 	<ul style="list-style-type: none"> • Client organizations must recognize that the linkage between end use and shipping and other logistical activities grows in importance in a post disaster situation • Pre-positioned contracts with experienced post-disaster construction contractors that have strong logistics capabilities provide owner organizations with the capability to efficiently respond and recover
Client-contractor alignment and contract	<ul style="list-style-type: none"> • Pre-established contractual basis reflective of overall procurement and construction strategy 	<ul style="list-style-type: none"> • Private sector efforts typically in support of major customers, with flexibility to quickly execute risk-appropriate contracts • Public sector efforts effective where prior 	<ul style="list-style-type: none"> • Pre-positioned contracts allow for pre-disaster alignment around basic work processes, allocation of responsibilities, and delegated and retained authorities and approvals • Supply chain and logistical

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	<ul style="list-style-type: none"> • Alignment with owner organization 	<p>contract vehicles exist and alignment activities have previously occurred (FEMA and LOGCAP IV)</p> <ul style="list-style-type: none"> • Lack of a prior contract impacts efficiency of logistical commitments being made • Lack of well-defined responsibilities and authorities in post-disaster organization may delay completion of required RACI charts, creating uncertainties in approval process for crucial logistics-affecting activities 	<p>strategies can be discussed and the new first responder in today's built environment can participate in select tabletop exercises</p>
Mobilization	<ul style="list-style-type: none"> • Typically recognized and funded activity 	<ul style="list-style-type: none"> • Certain government or aid agency contracts are task order-based with no provision for mobilization costs, delaying activities and commitments to create an efficient logistics operation 	<ul style="list-style-type: none"> • Create a limited mobilization task in pre-positioned contracts to accelerate response timeframes
Execution plans	<ul style="list-style-type: none"> • Scope-driven 	<ul style="list-style-type: none"> • Funding-driven baseline 	<ul style="list-style-type: none"> • Clearly identify any

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	baseline	shaped by donor community or “color of money”	funding-source-linked requirements at earliest possible stage • Select major donor organization requirements can be pre-identified in pre-positioned contracts (examples: FEMA Public Assistance, State Emergency Management, Red Cross)
Project Management Manual	<ul style="list-style-type: none"> • Standard go-by template with client-specific forms, procedures, and approvals 	<ul style="list-style-type: none"> • Expanded to include forms, procedures, and approvals linked to funding source • Procedures may vary by project delivery approach (direct execution or grant funded); contracting strategy (design-bid build, design build); and phase of project • Added approvals and complexity may impact logistics chain 	<ul style="list-style-type: none"> • Pre-positioned contracts allow for pre-disaster alignment around basic work processes and reports • Critical logistical hubs and choke points can be pre-identified
Workshare	<ul style="list-style-type: none"> • Global Engineering Centers (GECs) 	<ul style="list-style-type: none"> • Funding agencies may drive work to be performed locally 	<ul style="list-style-type: none"> • Local engineering and construction resource surveys may be periodically conducted as part of pre-

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	workshare limits need to move many resources to project location		positioned contract
Design basis	<ul style="list-style-type: none"> • Optimized against well-defined owner criteria through a formal tollgate process 	<ul style="list-style-type: none"> • Nature of funding sources may constrain solutions to replace in kind, reducing opportunities to modify supply chain 	<ul style="list-style-type: none"> • Existing planning documents should be inventoried and collected to accelerate reconstruction planning • Efforts focused on achieving plans versus creating entirely new ones where possible • Planning collection in advance of disaster also facilitates resiliency reviews by local disaster planning agencies
Degree of design standardization	<ul style="list-style-type: none"> • Maximized to reduce supply chain 	<ul style="list-style-type: none"> • Required volumes limit standardization opportunities 	<ul style="list-style-type: none"> • Incorporate resiliency features as part of new design basis
Labor	<ul style="list-style-type: none"> • Globally and locally sourced – standard HR systems and processes 	<ul style="list-style-type: none"> • OCONUS mobilization through Mobilization and Deployment Center (MDC) • MDC in a Box for other-country national (OCN) 	<ul style="list-style-type: none"> • Client organization must ensure response and reconstruction contractors have well developed mobilization plans and capabilities

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
		mobilization – From first speaking to a recruiter to a putting boots on the ground, the recruitment, training, and on-boarding process can be completed in 7 to 8 days	
Prefabrication	<ul style="list-style-type: none"> • Maximized to address labor availability and cost • Eliminates shipments of temporary equipment, materials, and construction consumables • Reduces construction waste streams 	<ul style="list-style-type: none"> • Initially focused on response-phase needs 	<ul style="list-style-type: none"> • Identify staging and prefabrication sites in proximity to critical infrastructure and population centers • Identify similar regional areas outside the evaluated zone
Pre-assembly	<ul style="list-style-type: none"> • Maximized to address labor availability and cost 	<ul style="list-style-type: none"> • Typically limited by funding linkages to job creation in affected area • May be constrained by 	<ul style="list-style-type: none"> • Identify staging and prefabrication sites in proximity to critical infrastructure and population

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	<ul style="list-style-type: none"> • Eliminates shipments of temporary equipment, materials, and construction consumables • Reduces construction waste streams 	access route constraints	centers <ul style="list-style-type: none"> • Identify similar regional areas outside the evaluated zone • Identify major access routes and weight and size constraints as part of disaster planning efforts
Modularization	<ul style="list-style-type: none"> • Maximizes benefits associated with manufacturing efforts, such as those realized on a smaller scale with prefabrication and pre-assembly • Allows parallel construction to shorten schedules • Facilitates pre-commissioning 	<ul style="list-style-type: none"> • Uses constrained by client awareness and constraining procurement practices • Site access may be constrained to port areas and, at later stages, major overland logistical routes 	<ul style="list-style-type: none"> • Identify staging and prefabrication sites in proximity to critical infrastructure and population centers • Identify similar regional areas outside the evaluated zone • Identify major access routes and weight and size constraints as part of disaster planning efforts.
Degree of	• Best practice	• Use adequate	• Prepositioned response and

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
client-furnished materials and equipment	moving beyond major equipment to include select construction bulks, piping, cabling, pumps, motors, and MCC <ul style="list-style-type: none"> • Targeted levels nominally 30 percent • Necessitates strong materials management organization as part of expanded program management contractor (PMC) role (PMC+) 	owner-provided advance financing limits <ul style="list-style-type: none"> • Contracting practices by government limit PMC+ contracting approaches • Multiplicity of buyers (lack of sourcing hub) reduces supply chain efficiency 	reconstruction contracts should provide for use of commercial practices to the maximum extent possible <ul style="list-style-type: none"> • Contractors with well-developed supply chains are essential in post-disaster settings

Table 5. Logistics Affecting Engineering and Construction Activities

Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
Supplier relationship agreements (SRAs)	<ul style="list-style-type: none"> • Maximize use of PMC's SRAs to simplify supply chain, gain greater assurance on delivery timeframes, and consolidate shipments • High level of pre-transaction information transferred between buyer and supplier 	<ul style="list-style-type: none"> • Effective use limited to private sector facilities and clients due to traditional limitations on competitive procurement and form of contract for non-private buyers • High demand drives use of non-traditional sourcing for which reduced supplier-buyer information exchange has previously occurred 	<ul style="list-style-type: none"> • Prepositioned response and reconstruction contracts should provide for use of commercial practices to the maximum extent possible • Contractors with well-developed supply chains are essential in post-disaster settings
Global sourcing	<ul style="list-style-type: none"> • Leverage of ongoing supplier analysis and assessment activities consistent with anticipated business volumes by supply category and regions 	<ul style="list-style-type: none"> • Expanded sourcing effort to meet required timeframes and budgets requires augmented vendor inspection, QA/QC, and expediting efforts • Identification of supplies of materials for construction and required non-process infrastructure undertaken for limited number of disaster types 	<ul style="list-style-type: none"> • Periodic assessments should be made of basic construction material availability for a range of disasters (local, regional, multi-regional)

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	<ul style="list-style-type: none"> • Appropriate supply sources pre-identified prior to major program activities 	and locations in advance of disaster-limiting logistics system planning activities	
Sourcing integrity	<ul style="list-style-type: none"> • Pre-acquisition surveys confirm environmental, labor, and legal compliance by supply base • Local supply capabilities well defined and capacity building undertaken off a known base 	<ul style="list-style-type: none"> • Supply origins for certain bulk materials (timber) and their preparation or treatment for use may be difficult to ascertain • Compliance with global procurement norms harder to police at the subcontractor level 	<ul style="list-style-type: none"> • Best-value procurement, with strong quality and inspection efforts, produces more consistent and timely outcomes and, at the end of the day, the most cost-effective outcome, all costs considered
Mission-critical, unique equipment sourcing	<ul style="list-style-type: none"> • Traditional long-lead items procured through early funding commitments 	<ul style="list-style-type: none"> • Supply chain compression activities may include: <ul style="list-style-type: none"> – New sources of supply – Multi-vendor awards – Use of CFM as feedstock to selected vendors 	<ul style="list-style-type: none"> • Prepositioned response and reconstruction contracts should provide for use of commercial practices to the maximum extent possible • Contractors with well-developed supply chains are essential in post-disaster

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
		<ul style="list-style-type: none"> – Phased procurement and pricing – Expedited transport (Aeroflot) 	settings
Locally procured material quality	<ul style="list-style-type: none"> • Standard vendor qualification and inspection programs • Material (batch) inspections 	<ul style="list-style-type: none"> • May take physical possession, but not title, at end of inspection line to prevent material substitution further straining overall logistical chain 	<ul style="list-style-type: none"> • Strained logistical chains require the right shipments, at the right time, to the right place • Poor quality and associated back-shipment and rework or workarounds strain an already over-taxed supply chain
Expediting	<ul style="list-style-type: none"> • Focused on baseline schedule execution 	<ul style="list-style-type: none"> • Reflect evolving needs and on-the-ground conditions 	<ul style="list-style-type: none"> • Trafficking into disaster area should not be left to inexperienced suppliers buying shipment services on a low-cost and uncoordinated basis
Traffic routing and logistics plan	<ul style="list-style-type: none"> • Focused on baseline schedule execution 	<ul style="list-style-type: none"> • Reflect evolving needs and on-the-ground conditions • Consider evolving condition of transport routes and other logistics facilities 	<ul style="list-style-type: none"> • Trafficking into the disaster area should not be left to inexperienced suppliers buying shipment services on a low-cost and uncoordinated basis

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
		<ul style="list-style-type: none"> • Increased number of logistics choke points and greater competition for logistics capabilities 	
Building permits and consents for temporary construction and logistical facilities	<ul style="list-style-type: none"> • Routine activity 	<ul style="list-style-type: none"> • Government capacity may be inadequate given widespread damage and competing demands for permits • Delay of logistical and temporary construction facilities may result • Mechanisms for waivers may not exist 	<ul style="list-style-type: none"> • Identify and put in place an expedited process for temporary or transitional facilities after a declared disaster
Warehousing	<ul style="list-style-type: none"> • Consistent with higher CFM 	<ul style="list-style-type: none"> • More limited CFM and shortages of labor and materials may make warehousing a lower priority facility • Inability to reliably implement a just-in-time supply chain can make warehousing an even more significant activity • Warehousing may need to be located closer to site of reconstruction activities 	<ul style="list-style-type: none"> • Mechanisms to identify vacant, large-scale commercial facilities equipped to receive and warehouse equipment and materials should be pre-established (Examples: vacant "big box" stores, warehouses, and supermarkets)

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
		because of weakened local logistics networks	
Material security	<ul style="list-style-type: none"> • Warehouse and lay-down areas typically have controlled access and routine security 	<ul style="list-style-type: none"> • Augmented security • Perimeter patrols • Larger guard force 	<ul style="list-style-type: none"> • Pre-establish badging requirements and requirements for security or auxiliary police
Trafficking	<ul style="list-style-type: none"> • Most contractors rely on supplier to ship goods • Supplier not expert <ul style="list-style-type: none"> – Materials arrive late, or worse, damaged because the supplier went with the low-cost shipper, without checking quality and safety records 	<ul style="list-style-type: none"> • Key link in supply chain management as logistical system responds to stress and reconfigures post-disaster 	<ul style="list-style-type: none"> • Trafficking into the disaster area should not be left to inexperienced suppliers buying shipment services on a low-cost and uncoordinated basis

Table 5. Logistics Affecting Engineering and Construction Activities

Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	<ul style="list-style-type: none"> • Fluor controls delivery <ul style="list-style-type: none"> – Use companies that have good tracking (GPS) and dispatching capabilities – Can change routes or even delivery locations as the situation dictates 		
Logistical contract forms	<ul style="list-style-type: none"> • Generally industry standard 	<ul style="list-style-type: none"> • Special requirements to address changed shipper risks: <ul style="list-style-type: none"> – Demurrage – Labor strife – Excess wear and tear – Lost productivity – Availability of fuel – Security 	<ul style="list-style-type: none"> • Strategies for changed logistical risk management should be pre-assessed and decisions made on types of risk best retained

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
Construction waste	<ul style="list-style-type: none"> • Seek to minimize volumes generated (25 percent of construction materials are waste) • Minimize mixed waste • Recycle 	<ul style="list-style-type: none"> • Expanded volumes associated with site debris • High mixed waste • Potential need to classify portions as hazardous waste 	<ul style="list-style-type: none"> • Pre-identification of temporary and permanent debris storage locations and preferred logistical movements associated with debris handling for a range of total impacts
Less-than-full truckload shipments	<ul style="list-style-type: none"> • Limited attention beyond CFM volumes 	<ul style="list-style-type: none"> • Logistically expensive, especially where possession times or number of shipments are effectively rationed 	<ul style="list-style-type: none"> • Trafficking into the disaster area should not be left to inexperienced suppliers buying shipment services on a low-cost and uncoordinated basis
Staging areas	<ul style="list-style-type: none"> • Staging area at port or key local hub • Staging and warehouse area at or near site 	<ul style="list-style-type: none"> • Inefficient supply chains may exacerbate staging area needs • Out-of-zone staging process utilized to control flow into valuable shipping space and routes 	<ul style="list-style-type: none"> • Identify staging and prefabrication sites in proximity to critical infrastructure and population centers • Identify similar regional areas outside the evaluated zone • Identify major access routes and weight and size constraints as part of disaster

Table 5. Logistics Affecting Engineering and Construction Activities

Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
			planning efforts
Road and bridge transport	<ul style="list-style-type: none"> • Conditions and capacities generally well understood 	<ul style="list-style-type: none"> • Conditions and capacities unknown • Significant degradation may not be evident 	<ul style="list-style-type: none"> • Preposition a structural assessment contract for critical logistical infrastructure to provide early information of logistical degradation of any form
Oversized shipments	<ul style="list-style-type: none"> • Limited to high-value equipment and modules • Platooned where possible 	<ul style="list-style-type: none"> • Logistics constraints may cause shipment sizes to be constrained, increasing volumes shipped and associated labor requirements 	<ul style="list-style-type: none"> • Client organizations must recognize that the linkage between end use and shipping and other logistical activities grows in importance in a post-disaster situation • Prepositioned contracts, with experienced post-disaster construction contractors who have strong logistics capabilities, provide owner organizations with the capability to efficiently respond and recover
Ocean freight	<ul style="list-style-type: none"> • Heavy lift needs identified in conjunction with long-lead and modularization 	<ul style="list-style-type: none"> • Competition for vessels or harbor constraints may drive undesirable load sizes and combinations 	<ul style="list-style-type: none"> • Client organizations must recognize that the linkage between end use and shipping and other logistical activities grows in importance in a post-disaster situation

Table 5. Logistics Affecting Engineering and Construction Activities

Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	planning		<ul style="list-style-type: none"> • Prepositioned contracts, with experienced post-disaster construction contractors who have strong logistics capabilities, provide owner organizations with the capability to efficiently respond and recover
Transportation insurance	<ul style="list-style-type: none"> • Generally industry standard 	<ul style="list-style-type: none"> • Unavailability and cost or coverage limitations may affect logistics choices 	<ul style="list-style-type: none"> • Strategies for changed logistical risk management should be pre-assessed and decisions made on types of risk best retained
Port capacity and operations	<ul style="list-style-type: none"> • Often saturated by global-scale programs • May necessitate separate material handling wharfs 	<ul style="list-style-type: none"> • Traditional challenges scaled up and potentially impacted by damage at the port • Cargo handling operations may be overwhelmed by lack of coordinated prioritization of needs 	<ul style="list-style-type: none"> • Preposition a structural assessment contract for critical logistical infrastructure to provide early information of logistical degradation of any form • Trafficking into the disaster area should not be left to inexperienced suppliers operating on an uncoordinated basis
Construction equipment	<ul style="list-style-type: none"> • Lease-versus-buy decisions intermittently constrained by 	<ul style="list-style-type: none"> • Competition for equipment may drive less than desirable ownership 	<ul style="list-style-type: none"> • Local construction equipment resource surveys may be periodically conducted as part

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	availability <ul style="list-style-type: none"> • Specialized equipment identified at early stage 	decisions <ul style="list-style-type: none"> • Most efficient equipment may not be available • Shortages of major equipment operators 	of pre-positioned contract
Construction fleet maintenance	<ul style="list-style-type: none"> • May be delivered as part of PMC+ services • Fueling operations may best be done as a client-furnished service • Fuel logistics may be critical challenge 	<ul style="list-style-type: none"> • Increased maintenance requirements associated with difficult site conditions may necessitate larger fleet sizes • Fuel supply is critical resource during early phases 	<ul style="list-style-type: none"> • Local construction equipment resource surveys may be periodically conducted as part of pre-positioned contract
Non-process infrastructure (NPI)	<ul style="list-style-type: none"> • Growing challenge • Increased use of modular camp and ancillary facilities • Requires early 	<ul style="list-style-type: none"> • Meeting the NPI challenge may be constrained by site access (transport or site-based debris) and community perceptions • Competition for generators and water treatment may limit rates 	<ul style="list-style-type: none"> • Identify NPI requirements for a range of disasters (scale and type) as part of prepositioned contract activities • Identify gaps in existing capacity

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	site access <ul style="list-style-type: none"> • Site power and water may be met from nearby networks in many instances or temporary generators or treatment plants elsewhere 	of certain construction activities	
Craft training	<ul style="list-style-type: none"> • Skills, construction safety, and process safety training focused on labor force are intended to serve program's needs • Consistent safety culture across program reinforces safety 	<ul style="list-style-type: none"> • Training expanded to include increased awareness of hazards associated with prior destruction and any ongoing risk conditions • Multiple client and contractor structures without strong program control undermine efforts to build safety culture • Local labor force may move between contractors more frequently, diminishing the training investment made by any one contractor (no overall 	<ul style="list-style-type: none"> • Develop post-disaster craft training program template for likely post-disaster conditions to be encountered • Emergency authorities to include a mandate for safety

Table 5. Logistics Affecting Engineering and Construction Activities

Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
		program focus)	
Small tools	<ul style="list-style-type: none"> • Implement program-wide small tools program to control cost, reduce theft, and improve safety 	<ul style="list-style-type: none"> • Small tools program a requirement to address shortages and expanded workforce 	<ul style="list-style-type: none"> • Prepositioned contractor should have an in-place, small tools capability to foster response and reconstruction activities
Vehicle safety	<ul style="list-style-type: none"> • Driver certification and safe driving program • Reduced accidents support increased logistics availability 	<ul style="list-style-type: none"> • Difficulties may be encountered in driver certification and training, given competition for limited supply 	<ul style="list-style-type: none"> • Strengthened driver inspection program as part of materials receipt process
Human remains	<ul style="list-style-type: none"> • Not typically encountered 	<ul style="list-style-type: none"> • Protocols put in place and may cause partial site shutdown and reconfigured site or supply chain logistics 	<ul style="list-style-type: none"> • Defined program for human remain recovery, with clearly assigned responsibilities and augmentation plan for large-scale events
Communication	<ul style="list-style-type: none"> • Utilize regional communication 	<ul style="list-style-type: none"> • Regional communication networks may be 	<ul style="list-style-type: none"> • Project Management Plan should identify planned

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
	networks and supplement with site-based communications as needed	unavailable or degraded, impacting efficiency of supply chain operations	communication strategy and contractor provided-capabilities (Example: Sat-Phone)
In-country logistical institutional infrastructure	<ul style="list-style-type: none"> • Policies defined: <ul style="list-style-type: none"> – Imports and duties – Weight limits – Packaging requirements – Rules of origin – Required documentation – Typical approval timeframes • Agency roles understood (even if inefficient) 	<ul style="list-style-type: none"> • Institutional frameworks may be inappropriate for post-disaster response and rebuilding • Institutional frameworks for modification may be absent, contributing to logistical chain ineffectiveness or uncertainty 	<ul style="list-style-type: none"> • Establish institutional frameworks for engineering, construction, and logistical response activities and the specialized issues associated with reconstruction • Clearly identify variance from normal processes and authorities

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
Site transport	<ul style="list-style-type: none"> • Typically bus transport from site gate or construction camp • Local transport, if available 	<ul style="list-style-type: none"> • Local transport may be dysfunctional • Travel times for critical specialty labor may necessitate increased helicopter operations 	<ul style="list-style-type: none"> • Logistical plan should identify extraordinary transportation capabilities: <ul style="list-style-type: none"> – Heavy lift – River access – Heliport or potential landing sites in vicinity of staging areas – Warehouse – Command centers
Cash flow	<ul style="list-style-type: none"> • Positive cash flow or minimum working capital needs do not influence logistical decision making 	<ul style="list-style-type: none"> • The need to bridge cash requirements of subcontractors makes payment terms an increasingly important selection factor in sourcing decisions 	<ul style="list-style-type: none"> • Prepositioned contracts should have necessary payment mechanisms, invoicing requirements, and approval mechanics thoroughly addressed
Anticorruption and transparency	<ul style="list-style-type: none"> • Required business process 	<ul style="list-style-type: none"> • Risks greatly increase, and monitoring and surveillance become larger activities • May impact sources of supply, logistic routes, 	<ul style="list-style-type: none"> • Strong transparency and anticorruption requirements in place and incorporated into all contracts

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Logistics-Affecting Activities	Global Scale CAPEX Program - Leveraged Execution and Procurement	Post-Disaster Reconstruction	Recommendations for Post-Disaster Management
		and ports of entry <ul style="list-style-type: none"> • May necessitate increased security in logistics chain 	
Stakeholder engagement	<ul style="list-style-type: none"> • Keep stakeholders informed in advance of logistics activities impacting local or regional transportation networks 	<ul style="list-style-type: none"> • Changed stakeholder groups, priorities, and communication difficulties impact the effective communication of planned logistic activities that affect local and regional networks • Stakeholder impacts may be exacerbated by difficulties in stakeholder engagement 	<ul style="list-style-type: none"> • Communication plans, focused on both response and reconstruction activities, developed in advance
Change management	<ul style="list-style-type: none"> • Critical activity for efficient supply chain operations 	<ul style="list-style-type: none"> • Impacts of change magnified in logistics chain post disaster 	<ul style="list-style-type: none"> • Responsibility and timely decision processes incorporated into Project Management Plan and institutional frameworks for post-disaster operations

About the Author



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Bob Prieto is a senior vice president of Fluor, one of the largest, publicly traded engineering and construction companies in the world. He is responsible for strategy for the firm's Industrial & Infrastructure group which focuses on the development and delivery of large, complex projects worldwide. The group encompasses three major business lines including Infrastructure, with an emphasis on Public Private Partnerships; Mining; and Industrial Services. Bob consults with owners of large engineering & construction capital construction programs across all market sectors in the development of programmatic delivery strategies encompassing planning, engineering, procurement, construction and financing. He is author of "Strategic Program Management", "The Giga Factor: Program Management in the Engineering and Construction Industry" and "Application of Life Cycle Analysis in the Capital Assets Industry" published by the Construction Management Association of America (CMAA) and "Topics in Strategic Program Management" as well as over 450 other papers and presentations.

Bob is a member of the ASCE Industry Leaders Council, National Academy of Construction and a Fellow of the Construction Management Association of America. Bob served until 2006 as one of three U.S. presidential appointees 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 and 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.

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