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Sustainability on Large, Complex Engineering & Construction
Programs Utilizing a Program Management Approach
Second Edition paper[1]   Bob Prieto

Sustainability on Large, Complex Engineering & Construction Programs Utilizing a Program Management Approach[1]

By Bob Prieto

Large, complex engineering and construction programs may be found in all industry sectors ranging from extractive industries such as oil, gas and mining through infrastructure programs for transportation, water and power. Common to all of these programs is the potential they have to positively or negatively influence financial, social and environmental performance of the implementing organization as well as the communities and stakeholders they touch.

Together, financial, social and environmental outcomes define the three elements of sustainability or a program's "triple bottom line". The "triple bottom line" is a phrase coined by John Elkington and introduced in his 1998 book, *Cannibals with Forks*.

There are many reasons why an owner or program manager may select to practice sustainability including:

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[1] *Second Editions are previously published papers that have continued relevance in today's project management world, or which were originally published in conference proceedings or in a language other than English. This paper was originally published in the July 2011 edition of PM World Today; republished here with the author's permission.*

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- Reduced costs
- Reduced liability
- Efficient & effective management & disposal of materials
- Enhanced image in communities
- Corporate responsibility short-term & long-term

Large programs, comprised of multiple inter-related projects present new challenges and opportunities from a sustainability perspective driven by scale, complexity and the opportunity for leverage.

The life-cycle focus encouraged by good sustainability practice is reinforcing of the Strategic Program Management approach discussed below.

In this paper we will look at some of the challenges and opportunities programs present as well as a framework for application of sustainability principles in a program management approach.

Developing a Sustainability Framework

Management of sustainability from a program perspective must be built on:

- Recognition that the major elements of sustainability are increasingly a fundamental requirement to the successful undertaking of large capital construction programs.

  - Sustainability drivers may include not only the owner's and program manager's commitment to sustainability but also legal, regulatory or referenced standards requirements. In some industries these considerations in effect comprise the "social license to operate".

- Recognition that the owner's and program manager's focus must go well beyond a first cost or first delivery perspective, shifting to a more comprehensive life cycle perspective.

  - This broader life cycle framework increasingly lends itself to owner – program manager relationships more akin to alliancing or framework agreements. This broader life cycle approach is described as Strategic Program Management.

- Understanding that there is no single "solution to the equation" but rather that a set of balanced solutions exist.
  - This is the "sweet spot" seen in the figure above.

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- Changed management and execution approach which is reinforcing of many of the best practices found in well executed programs.

  o This changed approach rests squarely on the adoption of a systems perspective; more holistic program, project and issues definition; and increased stakeholder engagement.

- Application of this sustainability framework at all program and project phases.

  o Phases begin with the establishment of Strategic Business Objectives and extend through strategy development, project selection and definition, project delivery (study, pre-feasibility, design, procurement, construction and commissioning), operations & maintenance, and ultimate decommissioning.

Sustainability Framework for Large Engineering & Construction Programs
Major elements of sustainability are a fundamental requirement
Focus goes beyond first cost to a comprehensive life cycle perspective
Set of balanced solutions exist.
Management and execution approach based on systems approach
Sustainability framework at all program and project phases

Economic Bottom Line

The financial benefits that can accrue to the owner in a large program derive from the opportunities of leverage and include:

- Allocation of portions of project labor to lower cost areas
- Acceleration of engineering and other program activities through workshare approaches that act to expand the available labor pool
- Standardization to reduce overall supply chain size and spare part inventories
- Maximization of pre-assembly and modularization efforts by treating as client furnished materials (CFM) to multiple projects
- Craft pool wide safety training that elevates overall safety awareness across all project contractors
- Craft training of the shared labor pool, improving productivity for the program's benefit in ways that may not be justified on a project by project basis
- Design efforts better focused on project execution and life-cycle cost reduction

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- Capturing and sharing lessons learned and best practices on a programmatic basis for the benefit of all program contractors
- Risk consolidation opportunities including commodity hedges, exchange rate risk retention (and hedging), and contractor or owner provided insurance wrap-ups across the supply chain
- Smaller supply chain facilitates augmented supplier quality assurance
- Early O&M input on a programmatic basis
- Strategic suppliers involved early in overall design process allows better life-cycle optimization
- Comprehensive life cycle analysis design and construction facilitated

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Thinking with Sustainability in Mind

A manufacturer's plant utilized a liquid circulated through a standard pumping loop. A top company designed this standard pumping loop with pumps requiring 95 horsepower. A life-cycle, systems based approach was able to reduce power requirements to 7 horsepower!
- larger pipes reduced friction and pumping energy
  - larger pipes cost more (traditional tradeoff)
  - smaller pumps cost less (total system perspective)
  - first cost was less and life cycle cost was also reduced
- make pipes short and straight by laying out first
  - then position equipment
    - less piping
    - less fittings
    - less friction, smaller pumps
    - easier to insulate

A life-cycle based systems approach reduced first cost and life-cycle power costs by 92%

From an economic perspective, the program can bring direct benefits to affected communities through:

☐ Procurement of local goods
  – Local construction materials & tools adds income in immediate area & contributes to local tax base through sales tax
☐ Creation of a local service base to support the facility during operations and maintenance phases.
☐ Anti-corruption measures
☐ Tied closely with social opportunities and benefits

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Social Bottom Line

Standards exist that identify indicators of social performance as well as methodologies for measuring and auditing performance along these indicators. These include:

- Global Reporting Initiative (GRI)
- SA 8000 from Social Accountability International
- AA 1000 from Accountability
- Parts of various ISO standards.

What is lacking is an obvious and measurable, common "currency" (monetary or non-monetary) for expressing the magnitude of all good and bad produced by the firm's operations and affecting individuals in different stakeholder groups. This lack of a singular metric makes it harder for a program manager to "sum" the social impacts and benefits across a program and drives the tracking and monitoring of a multiplicity of metrics indicative of broader program performance in the social dimension. Social metrics are reflected in the following table.

Social Metrics	
Diversity	• Existence of equal opportunity policies or programs
	• Percentage of senior executives who are women
	• Percentage of staff who are members of visible minorities
	• Percentage of staff with disabilities
Industrial Relations	• Percentage of employees represented by independent trade union organizations or other bona fide employee representatives
	• Percentage of employees covered by collective bargaining agreements
	• Number of grievances from employees.
Child Labor	• Whether contractors are screened (or percentage screened) for use of child labor.
Community	• Earnings donated to the community;
	• Use of local contractors and suppliers.
	• Involvement in projects with value to the greater community

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The program manager's social responsibility program must be guided by an over arching set of principles based on accountability, transparency, ethics, respect for stakeholders, the rule of law, and respect for the norms of behavior and human rights.

While many of these will be the subject of local, national and international law, the program manager together with the owner must establish a practice above reproach and ensure its adoption and implementation by all contractors involved in the program. Aberrant behavior by one contractor can undermine all of the good work undertaken to demonstrate social responsibility of the program.

Increasingly and in many industries securing this "social license to operate" is key to a program's success.

Social Responsibility Principles
Accountability
Transparency
Ethics
Respect for Stakeholders
Rule of Law
Norms of Behavior
Human Rights

> *'You don't get your social license by going to a government ministry and making an application or simply paying a fee… It requires far more than money to truly become part of the communities in which you operate.'*
>
> **- Pierre Lassonde, President of Newmont Mining Corporation**

This social license to operate does not come about by paying a fee but by truly becoming a part of the community in which the program will be undertaken. It comes about by building legitimacy, credibility and finally trust.

ISO26000 – Social Responsibility, lays out a number of areas requiring the program manager's attention. Among these is involvement in and development of the communities affected by the program. It is important for the program manager to recognize that these may all not be at the final project locations but could also include major manufacturing, logistics or module assembly sites far away from the final project

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location. Much like risks and opportunities, social sustainability issues are program wide and not geographically bounded.

The program may become involved in community engagement and development in a number of different ways including through social, health and education programs; job creation, enhancement of community based skills and organization building including technology transfer to local enterprises.

Community Involvement Focus Areas
Social development
Education
Job creation
Capacity development
Community engagement
Health
Technology transfer and organization building

The program's social responsibility efforts can include:
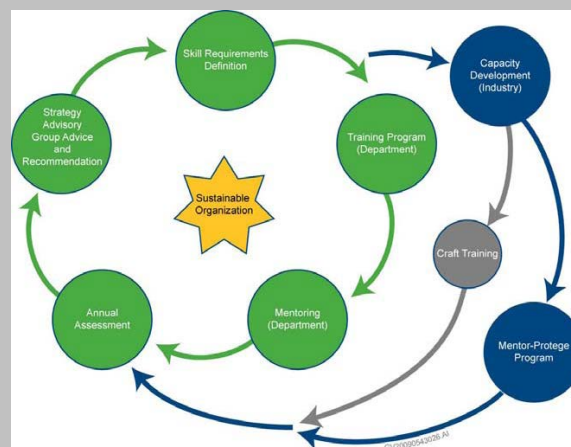
- Procuring local services

    o Employment of local specialty contractors such as steel fabricator or HVAC contractor
    o Provides environmental benefit of reduced travel time resulting in reduced energy consumption
    o Incorporating mentor-protégé programs

- Performing supplier pre-qualification surveys

    o Query whether procedures exist to prevent discrimination & harassment
    o Query existence of certifications such as ISO 14001

- Precluding child or compulsory labor

- Reducing work-related injuries

- Reducing construction waste sent to landfill can result in reduction in truck noise in communities

- Conducting craft worker training programs

    o Training centers for craft personnel

o   Training at projects in remote locations

- Developing owner's local staff capabilities

Capacity Building Through
Craft Training & Mentor Protégé Programs

Training, technology transfer, and organizational development would not be confined to Owner staff. Recognize the broader societal objectives as well as the opportunities created through the program.

- **Craft training** – The implementation and longer term maintenance of the program's facilities will often require the local construction industry to expand their skills base to include specialized skills associated with the program. In addition, increased attention to safety is paramount in a program of scale since construction-related accidents can be a primary cause of project disruption. Craft certification programs can be used to create a permanent local craft pool to meet operating phase requirements.
- **Mentor-protégé program** – This program will identify targeted areas (those with a long-term requirement) for subcontracting to local contractors. These subcontract requirements, to be incorporated into the various design and construction procurement packages, would require a best efforts approach by prime contractors and participation in a formal mentor-protégé program. Key elements in the implementation of the program would be:

  – Breaking out contract work items into economically feasible units
  – Conducting capacity surveys and targeting local business participation in pre-bid and informational meetings; also soliciting local business concerns as early in the acquisition process as practical
  – Providing interested small businesses with adequate and timely information about the plans, specifications, and requirements for performance of the prime contract to assist them in submitting a timely offer for the subcontract
  – Assisting interested local businesses in obtaining bonding, lines of credit, required insurance, necessary equipment, supplies, materials, or services
  – Requiring prime contractors in targeted areas to participate in a formal mentor-protégé program with one or more local-business protégés that results in developmental assistance to the protégés

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Environmental, Health and Safety Bottom Line

Large projects require cognizance of the requirements and guidance contained in the ISO 14000 family of standards. Increasingly these standards may be directly included in project contracts. The following table identifies the standards that comprise the ISO 14000 family of standards.

ISO 14000 Family of Standards	
ISO 14001 Environmental management systems	Requirements with guidance for use
ISO 14004 Environmental management systems	General guidelines on principles, systems and support techniques
ISO 14015 Environmental assessment of sites and organizations	
ISO 14020 series (14020 to 14025)	Environmental labels and declarations
ISO 14031 Environmental performance evaluation	Guidelines
ISO 14040 series (14040 to 14049), Life Cycle Assessment, LCA	Discusses pre-production planning and environment goal setting.
ISO 14050	Terms and definitions.
ISO 14062	Discusses making improvements to environmental impact goals.
ISO 14063 Environmental communication	Guidelines and examples
ISO 14064 Measuring, quantifying, and reducing Greenhouse Gas emissions.	
ISO 19011	Specifies one audit protocol for both 14000 and 9000 series standards together

On programs utilizing a program management approach, the importance of attention to environmental sustainability is heightened. Multiple projects, managed in an uncoordinated way, may cause total environmental impacts from the program to exceed threshold limits. Additionally, various emissions and discharges, while on average within acceptable levels, may reach unacceptable levels if discharges by multiple projects coincide or overlap in unanticipated or unacceptable ways.

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Comprehensive attention to environmental, health and safety bottom line will not only help eliminate these unintended consequences but can identify opportunities to performance enhancement in each of these areas on a programmatic basis.

Let's start by looking at some of the environmental bottom line facts associated with large engineering and construction programs:

- Estimated that 25% of construction materials is waste
- Estimated that 20% of landfill volume is due to construction waste
- Construction consumes estimated 40% of extracted resources in developing countries
- Construction consumes estimated 30-40% of generated energy in world

Large programs utilizing a program management approach have an opportunity to change this paradigm by undertaking program wide efforts that may be financially prohibitive on a project by project basis. Examples of some of these environmental opportunities that a program management approach may facilitate include:

- Return of unused materials to suppliers
- Return of equipment packaging to suppliers
- Use of fly ash in concrete
- Conservation of water
- Conservation of energy
- Use of recycled materials
- Recycling of waste
- Remediation projects
- Use of environmentally preferred products (eco-labels or green certifications)
- Engineer projects with sustainability in mind (e.g., lower emissions, recirculation of water in process unit)

Programmatic consideration of health and safety is equally important in large programs.

Discussion with project manager after project manager in organizations with strong safety cultures provides a steady stream of anecdotal evidence that delivery of a safe project goes hand-in-hand with lower disruptions to project work, higher worker morale, and more efficient execution practices. Documented financial improvements from reduced worker compensation claims also exist. Similarly, improvements in analogous industries are viewed as having positively contributed to improved productivity.

Common drivers of safety and productivity include better planning, increased focus on identifying and managing risks of all types (safety and non-safety), control of the disruption effects of unwanted changes and events, and improvements in project execution practices.

On large programs, the effects of disruption behaves in non linear ways. Deterioration of a common safety culture, unacceptable safety practices or poor safety performance can spill over into the other projects comprising the program. It is essential for the owner

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and program manager to work together to create an environment of safety awareness by getting everyone involved, generating safety talk, and maintaining a safety incentive and reward system. The safety program must have a solid foundation starting with the top program executives from all contractors, consultants, and owner's team.

This last point cannot be overstated. Owner commitment to safety is essential to the Program Manager successfully implementing a program wide safety program. Not just lip service.

The program manager must ensure that any system, structure or component that could jeopardize the health and safety of the work force or general public must be able to comprehensively demonstrate that all management, quality and safety processes have been rigorously applied. These efforts must include not just permanent works but temporary ones as well.

The program manager must ensure that design responsibility for any temporary works, in particular for any temporary works benefiting multiple projects in the program, is clarified. Safety staff should be engaged early in program development and safety reviews of preliminary designs conducted in parallel with constructability reviews.

Programmatic consideration of safety should include the interaction at a human and physical level between all projects not just within the battery limits of a given project. Safety and associated environmental and health standards must be consistently applied across all projects.

Programs with phased operation of facilities must consider operational risks to the surrounding construction workforce. Safety processes must recognize that the external factors influencing the safety of a given project will evolve over time and may not be intuitive to project related safety operations. The owner and program manager should Institute a comprehensive safety program for both facility operators and constructors during the construction phase.

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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 Manufacturing and Life Sciences. Bob consults with owner's 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" and "The Giga Factor: Program Management in the Engineering and Construction Industry" published by the Construction Management Association of America (CMAA) and "Topics in Strategic Program Management" as well as over 400 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.

Previously, he established a 20-year record of building and sustaining global revenue and earnings growth as Chairman at Parsons Brinckerhoff (PB), one of the world's leading engineering companies. Bob Prieto can be contacted at Bob.Prieto@fluor.com.