

Sustainable development of megaprojects in LDCs: An organizational framework for efficient project delivery – Mohammad Jahangir

FOREWORD

Contemporary East Asian growth experience exemplifies that a weak Less Developing Country (LDC) adapts developmentalism¹ to achieve economic advancement [Toshio Watanabe, 1995] [1]. There is a common understanding that megaprojects² are important drivers of societal changes and spur economic growth. Development of major infrastructure matters to growth and is now relatively well recognized and widely understood among practitioners and policymakers [Estache, A., and Garsous, G., 2012] [2]. Infrastructure megaprojects drive agricultural, industrial, and commercial development, influencing effective forward and backward linkages between and within the sectors of an economy. Strategic infrastructure projects foster productivity and competitiveness by lowering producer costs, promoting domestic and international trade, generating employment, enhancing sustainability and productivity. All these further growth in Gross Domestic Product (GDP) (UNCTAD, 2013) [3].

Successful implementation of megaprojects is a living query to LDC's sector managers, entrepreneurs, and corporate managers. Exact answers on how a mega-project can adhere to and embark on a set of defined process criteria leading to success are yet to be responded to. Looking at the uncertainties Flyvbjerg, B (Oxford, 2014) [4] possibly commented that mega-projects are systematically subject to "survival of the unfittest". Most mega-project experiences in LDCs reveal much distress to stakeholders. Various literature (Othman (2013), et. al [5], Brookes & Locatelli, 2015 [6] and others) reflect on the agonizing involvement and experiences of mega-project complexity and challenges. Data was collated from 44 mega-projects and quantitatively analyzed to pinpoint success factors. Several common idiosyncrasies were identified. However, the criteria analyzed covered various technical, logistics, competency and other concerns. Although researchers presented organizational issues in perspectives, they were found less absorbed in configuring a strategic project delivery organization for sustainable mega-project delivery.

Leading megaprojects to success relate not only to project objectives, benefits, and risk but is also convicted to competent project management (Misic & Radujkovic 2015) [7]. It was forwarded that key drivers of each project are people. It has been suggested that priority should be placed on future research to verify and validate whether project success is dependent on competency development and stakeholder management. Shenher and Holzmann (2017) [7], identified three (3) secrets of mega-project success (i) clear strategic vision, (ii) total alignment and, (iii) adapting to complexity. Contrary to analyzing reasons for success, Garemo, Matzinger & Palter; (2015) [8] investigated and identified three (3) specific idiosyncrasies for mega-project failures in the LDCs, viz (a) over-optimism and overcomplexity. (b) poor execution and (c) weakness in organizational design and capabilities. Choudhury, R. J., (2017)³ mentioned that Bangladesh is progressing in terms of infrastructure implementation. He was concerned on "people competency" and recommended, "establishing a special cadre on project management for mega-project endeavors" [9].

¹ *Developmentalism – the ideology that places the highest priority on economic development". Statement of Watanabe (1995) that "the economic success of East Asia is largely attributable to the adoption of developmentalism"*

² *A megaproject is a project (IPMA) (2011) designated a cost threshold of EUR 1 billion as the basis for defining megaprojects across all industries with at least a USD 1 billion budget. The project cost threshold of USD 1 billion is increasingly advocated worldwide as the key criterion for defining a megaproject.*

³ *Dr. Jamiliur Reza Choudhury, A National Professor of Bangladesh (2018), contributed enormously in major mega-infrastructure projects in the country. Currently is he the Vice Chancellor of the University of Asia and Pacific, Bangladesh.*

In fast developing LDCs, the hunt for an adaptable model for a project delivery organization with appropriate strategy and sustainable developmental focus is of immediate consideration. Unfortunately, the portrayal of a framework is still a partial retort. An LDC that is committed to World Commission on Environment and Development (WCED) propositions of SDG (1987) [10] should be proactive and add emphasise its context. Hagan, G., Baltov, M., and Brookes, N., (2012) [11] explored megaproject management, organizational dynamism and effectiveness. They augmented their view point from Socio-technical systems theory perspective. The Socio-technical systems theory proposes that the effectiveness of an organization is related to the joint maximization of its social and technical factors (Cherns, 1987) [12]. Based on this approach, “an organisation can be viewed as a system comprising various interrelated, co-dependent sub-systems in a state of dynamic interplay (Clegg and Shepherd, 2007) [13]. It becomes necessary therefore, to comprehend a megaproject as a single, interrelated system whose sub-systems must be considered jointly for maximum performance. This may prove a useful way forward in providing the kind of deep understanding required to reconcile the complex societal requirements of megaprojects and their extreme complexity of delivery”.

After a considerate review of available literature, this paper forwards an extended belief that ‘Without a group of competent people structured in a socio-technically configured Strategic Project Management Office (SPMO), adhering to appropriate methodology and governance, achieving sustainable development of a mega-project delivery endeavors would continue to be difficult and painful’.

This paper proposes a flexible mega-project SPMO model. Sector managers and entrepreneurs in LDCs shall select the SPMO structure in alignment with sustainable development and contractual obligation. This paper further emphasises working on an organic development⁴ and opines to not simply impose any wholesale style project management practices and processes (Rondinelli, D. A. 1976) [14].

⁴ By ‘Organic development’ - this author implies understanding and planning project delivery capabilities from the LDC’s organizations own perspectives. Considering all limitations, preparedness, capabilities, need analysis and, under-taking adequate steps forward.

INTRODUCTION

[Keywords: Developmentalism, Sustainable Development Goal – SDG, Mega-project, Socio-technical systems, Business Development, LDC-Less Developing Country, Competency, organic development, SPM–Strategic project management, SPMO - Strategic Project Management Office, Organizational frameworks, Sector leaders, Innovation, Integration, Interface, Scope, Quality, Schedule slippage, Risk, Cost Growth]

Megaprojects are temporary endeavors characterized by large investments, vast complexities, and long-lasting impacts on the economy, the environment, and society (Brookes & Locatelli, 2015).

“Megaprojects include the creation of power plants (including nuclear plants), oil, and gas extraction plants, airports and processing projects, railways, motorways, dams, and even cultural events such as the Olympic games or universal expositions” (Van Wee, 2007) [15]. The UNCTAD background study noted (Hirschman 1967, Khan, M., H. 2008) [16], and also Watanabe (1995) observed that “programs and projects are increasingly used in developing countries to add to their process of economic and social development”.

Due to prolonged colonial subjugation and supplementary blockages in development works, LDCs inherit deficits in technological acquaintance and project management experience⁵. This is marked by a dearth of diligence in project choice, methodology support, lessons learned documentation (LLD), R&D (Research & Development), back up system logistics, and reference OPAs (Organizational Process Assets)⁶. Similar views have been resonated by (Mistic & Radujkovic 2015) [17] and point out that mega-projects are characterised with the need for high design knowledge and technical skills, competent human resources, managerial capabilities as well as excessive cost of investments. Conversely, developing countries experience a shortage of many of these requirements that obstruct the development of mega-projects. Without a doubt, preferential but hired knowledge, reliance on external project resourcing, and misinterpreted contracting strategies present cautious concerns.

As identified by Garemo, Matzinger & Palter (2017), out of the three (3) main reasons of mega-project failures (a) over-optimism which settles down with time and forbearance. Poor execution (b), is a subject of an acquaintance of adequate project management knowledge, resolute experience, advance enterprise resource system support, and people competency. The last of the three odds i.e., (c) weakness in organizational design and capabilities, poses most perilously. Research states that as more organisations adopt project management strategies and as the demand for project managers grow, there is increasing interest in the competence of project managers and standards for development and assessment of project management competence (Crawford, 2005) [18]. Identical conclusion was drawn by, Mistic & Radujkovic (2017).

⁵ Bhalla, G. S. explains the issue in “Political economy of Indian development in the 20th century- India’s road to freedom and growth, *Indian Economic Journal*; Bombay Vol. 48, Iss. 3, 2001: 1

⁶ PMBOK® 6th Edition, 2017 - Project Management Body of knowledge denotes “OPA” are as the “plans, process, policies, procedures, and knowledge bases specific to and used by the performing organization” - see pp.-39

This author conducted a through review of associated literatures and echoed the issue of people competency with sheer importance. It is a project management risk. However, the critical factor is the “strategic project management focus and an organization”. Project management organization is the prime mover that, covers all perspectives.

STRATEGIC PROJECT MANAGEMENT (SPM) PERSPECTIVES

Shenar, A & Holzemann, V., JPMI, (2017) forwarded that relatively successful megaprojects are distinguished by three major elements: (i) Clear strategic vision (ii) total alignment and (iii) adapting to complexity. Authors observed that an organization’s weaknesses and strengths are consequences of strategic design, lack of system orientation, insufficient organic growth and a lacking people’s competency and knowledge levels. Authors including Hagan, G., et. el (2012) opined that mega-projects require value support from a single source that is strategically structured with socio-technical orientation.

In LDCs, be it national sector project management organ or large private project corporations, the existence of the comprehensive SPMOs with socio-technical focus is occasionally observed. Even if they exist, they are found to be a separated one. The separation from a ‘permanent’ organization and their ‘uniqueness’ yields the obstacles (Chang, Hatcher, & Kim, 2013 [19]; Chapman, (2016); and Van Marrewijk et al., 2008 [20]). Observers noted that the size and complexity of megaprojects can make it very difficult to discern which actors and elements of the myriad of configurations truly influence the success and delivery. The scale and complexity of mega-project undertakings can overwhelm the typical enterprise. To successfully execute mega-projects, enterprises should adjust and adapt their existing ‘regular’ approach to project management. Zucker, A., (2015) [21] recommended that for an enterprise to kick start the SPM processes, it should consider implementing five specific steps. (i) Establishing the Project Management Organization (ii) Executive Stakeholder Management (iii) Communication Management (iv) Project Management Processes (v) Project systems and tools.

In hindsight, questions were asked such as, what is the real value that this PMO has to offer? Zwainy et. el (2016) [22] researched and verified that creating a PMO value framework had been contributory to the improvement in mega-project delivery. Clifton, D., (2015) [23] of Faithful and Gould, a world-leading integrated project and programme management consultancy corporation, defined the PMO (Project Management Office) as, "a group or department within an organization responsible for defining and maintaining the organization's project management standards". Clifton endorses Zwainy et. el’s findings. Stated, that “The Project Management Office has become the mainstream organisational structure for standardising the practices of companies delivering large capital projects and programmes in the Middle East”. Government entities in the Middle East increasingly want to embed these global best practices into their delivery”.

Isolation or limited practice to the expressed understanding and preparation in strategic project management put project offices in LDCs in a defensive stance. Slower progress in the adjustment with innovations in global standards in project management knowledge, skills, and strategies, creates stranded perspectives.

SPM- Strategic Project Management –The SPMO Spectrum

Strategic project management involves selecting, managing and continuously measuring project outcomes to ensure optimal values for an undertaking by an organization. (Wessels, D. J., 2007) [24]. The SPMO⁷ links the organization's projects and maintains alignment with its strategic business values and plans. This paper identifies 10 (Ten) organizational components to position the SPMO as an enabler of sustainable mega-project development, execution, delivery.

Listed below is a representation of a responsible Socio-technical SPMO configuration. The list is not an exhaustive one. Contents of each structure of the SPMO are adjustable according to project size, complexity, and mandate.

1. SPMO the Manager of Sustainable Development and Corporate Social Responsibility (CSR)
2. SPMO the Mega-project HSEQ manager
3. SPMO the Business Developer and Objective Project Selector
4. SPMO The Manager of Integrated Project Delivery Model (PLCs -Project Life Cycle, and PMLCs -Project Management Life Cycle)
5. SPMO The Scope, Risk, Schedule Cost, Quality and Procurement Manager
6. SPMO Integration, Interface, Value management, and Integrated change manager
7. SPMO the mega-project set up planner, controller, governor and quality reporter
8. SPMO, the innovation, R&D, Systems and agile project manager
9. SPMO the Synthesizer of knowledge and skills, competency, and professional ethics
10. SPMO the Operations readiness manager in alignment with SDG

Following sections briefly provide a summary of procedural roles and responsibilities of an SPMO and its component offices. Technical issues will be limited and described in very short scopes.

SPMO: The Manager of Sustainable Development

Gro Harlem Brundtland⁸, chairman of the WCED and the team laid out the SDGs for all nations. It was envisioned, "that a country must be committed to the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 46) [25]. The SDGs have been considered with utmost sincerity at the highest level of macro-governance⁹ in fast developing LDCs such as Bangladesh.

Risk, scope, schedule, and budgets are to be the responsibly managed in order to reduce waste. Innovational changes and R&D challenges are fittingly dealt with and, are to be documented. Knowledge and competencies are to be enhanced, synthesized and communicated. Professional ethics and values should be maintained across sub-projects, programs and the mega-project itself under judicious contractual stipulations and guidance. Mega-projects are responsible for missions and characterized as transformational projects.¹⁰ In complex project endeavors, the HSEQ (Health, Safety, Environment and

⁷ This paper would designate The Project Management Offices as "SPMO" - Strategic Project Management Office

⁸ Gro Harlem Brundtland, was appointed by United Nations Secretary-General Javier Pérez de Cuéllar as the Chairperson of the World Commission on Environment and Development in December 1983. The SDGs were articulated by the WCED team under her supervision

⁹ As a valid example, Bangladesh, as part of her commitment to implement the SDGs, decided to take part in the Voluntary National Review at the UN High-Level Political Forum. The Government of Prime Minister Sheikh Hasina envisioned transforming Bangladesh into a middle-income country by 2021 from LDC status and a developed country by 2041.

¹⁰ Azad., A.K.M., an statement on a Presentation on Eradicating poverty and promoting prosperity in a changing world, July 2017. (PCO, SDG, Prime Minister's Office, Gov. of Bangladesh).

Quality) objectives are to be strategically planned to meet regulatory and methodological compliances and shall support upholding sustainable development perspectives¹¹. Listed below are allied SPMO responsibilities.

- CSR
- HSEQ
- Business Development and Objective project selection
- Integration, Interface, Value management, and Integrated change management
- Innovation, R&D, Agile and specials projects development (ICT, Nuclear programs and R&D)
- Synthesizing knowledge, competency, professional ethics. LLD and skills enchantment
- Operations readiness in conformity with sustainability plan

The head of SPMO would be the champion of all inter-related functions. The overall SPMO manager shall have the mandate to oversee, integrate, respond and resolve issues that may arise.

SPMO the Business Developer and Objective Project Selector

Project selection is a delicate subject that holds definite strategic significance. Project selection techniques available at PMI® PMBOK®, AACEI (Association for The Advancement in Cost Engineering, International)¹² and other professional bodies to provide subject matter guidance¹³ [26]. Special Purpose Simulation (SPS) tool are used¹⁴ in critical project selection contexts.

A business case is a fundamental component of the mega-project charter¹⁵. Versatile indicators such as net present value (NPV) or internal rate of return (IRR) or a combination of the two, and are pertinent in selecting a commercial or manufacturing sector project [27]. For a complex infrastructure project undertaking, an LDC's sector or project corporation needs to validate many other indices as suggested by development, welfare and ecological economics¹⁶. Holistic parameters at the macro-level such as impacts on the growth in GNI (Gross National Income) or NNI (Net National Income)¹⁷ are leading ones.

¹¹ Sustainable development (SD) has been defined in many ways, but the most frequently quoted definition is from "Our Common Future", also known as the Brundtland Report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The SD has 3- principle pillars: (A) Environmental sustainability (B) Societal sustainability and (C) Economic sustainability.

¹² AACEI, a notable professional organization dedicated to promoting skills and knowledge for Cost Engineering. www.AACEI.org

¹³ Project Economics, Advanced Engineering Economics are subject matters in developing technical and economic feasibilities, cost-benefit analysis and societal value realizations on a certain category of a project are discussed in Skills and Knowledge Book of AACEI, USA; www.aacei.org.

¹⁴ Ruwanpura, J., Simulation based project selection decision analysis tool, University of Calgary, Conference Paper, January 2003

¹⁵ Project charter is a critical document developed early at project initiations stage and is the mandate of mega-project business. It includes the project finance model, cost-benefit analysis, high-level risks, high-level schedule, high-level budget, and a mandate to the mega-project assignment to the project director (PMI®, PMBOK® 6th Ed.).

¹⁶ Key Differences Between Economic Growth and Economic Development. Economic growth enables an increase in indicators like GDP, per capita income, etc. On the other hand, economic development enables improvement in the life expectancy rate, infant mortality rate, literacy rate, and poverty rates etc. A composite sustainable development Index – CSDI, or Composite Environmental performance index- CEPI, or Genuine progress indicators -GPI, HDI (Human Development Index) etc.

¹⁷ GDP, GNP, GNI, or NNI are parameters used to denote economic growth rates of an economy. A country's GDP -Gross Domestic Product growth rate is the most common parameter to state that particular country's economic growth trends. There

Contribution in GDP (Gross Domestic Product) growth is also a familiar one. Currently world organizations focus on Human Development Index (HDI), Multiple Poverty Index (MPI) and others, which relates to more social-technical perspectives. However, there are differences of parameters that denote economic development and economic growth¹⁸. Infrastructure Mega-projects contribute to enhancing various sets of indicators through their versatile influence in all the sectors of an economy. Country risk analysis, inflation, political stability and the regime (Kuznets 1966)¹⁹ in power are considered by JVs partners, financial consortiums, and international investors. The SPMO maintains an office and expertise links in order to support stake-holders in providing assessments and decisions in related quests and works as the key functional instrument.

SPMO -The manager of the HSEQ

Building an HSEQ plan into project execution plans (PEP) is related to the size and category of the project. A nuclear sector project should be built-in with higher levels of HSEQ perspectives, capacity, and constraints. Conventional waterfall type (PMBOK®2017b) [28] mega-project SPMO teams would be more inclined towards an integrated health, safety, environment, and quality management approach. However, the question can be asked, will it be different in the case of an IT or agile project undertaking? The answer is “NO”! HSEQ are clear priorities in any project endeavor.

The execution plan book will include project Health, Safety, Environment, and Quality management plans. The occupational health and safety agencies (OSHAs) shall red-line necessary project and sector obligations. ISO 9000 – 2015 [29] standards, shall guide the QMSP (Quality Management System and Plan), the ISO 14000 –2015 QMS [30] shall guide the environmental quality and performance management standard and plan procedures.

Generally, an infrastructure mega-project falls into a waterfall category²⁰. SPMO libraries shall maintain necessary boilerplate plan documents for waterfall project types. The Agile project team would brainstorm and identify a fitting HSEQ model for its PEP development.

A small project or subcontracting organization should align the owner's or prime contractor's HSEQ plans as stipulated in the contract and risk management procedures.

SPMO - The Manager of integrated project delivery, PLCs, and PMLCs:

The PLC separates a large project into various phases. The series of phases a project passes through from initiation to its completion is referred to as the PLC. Various professional institutions recommend Integrated Project Delivery (IPD) and sequential PLC phases.

are debates among economist on which parameters to use. Some economists prefer GNP (Gross National Products) rates and some prefer NNI (Net National Income) growth rates. Tobin, J., & Nordhus, W., Measure of Economic Welfare, 1972.

19 "Modern economic growth" depends not only on the meeting of certain economic requirements, but also on the prior or concomitant development of certain social and political frameworks and ways of thinking that are compatible with the economy's evolution a strong and stable government, an honest, efficient, and technically trained bureaucracy, imaginative entrepreneurial talent with freedom to operate, an educated and disciplined labor force, a cohesive social community, and a social ethic placing a high priority on growth". Simon Kuznets, Modern Economic Growth: Findings and Reflection, Lecture to the memory of Alfred Nobel, December 11, 1971

20 Waterfall project management is a sequential, linear process of project management. It consists of several discrete phases. No phase begins until the prior phase is complete, and each phase's completion is terminal—waterfall management does not allow you to return to a previous phase. The PMBOK® Guide states that the transition from one phase to another usually involves some type of technical transfer or hand-off (PMI, PMBOK, 2004, p. 20). This is the type of phrasing that might lead readers to believe that only a waterfall methodology is appropriate when following PMBOK® Guide practices

American Institutes of Architects (AIA) recommended the IPD model with eight (8) sequential phases. IPD incorporates collaborative alliance of people, systems, business structures and practices into a process that harnesses the talents and insights of all participants to optimize project results. This helps increasing value to the owner, contractors and service providers to reduce waste and maximize efficiency through all phases of development, design, fabrication, and construction [31]. The AIA recommended 8 phased IPD model appears as follows:

- Conceptualization phase [expanded programming]
- Criteria design phase [expanded schematic design]
- Detailed design phase [expanded design development]
- Implementation documents phase [construction documents]
- Agency review phase
- Buyout phase
- Construction phase
- Closeout phase
- Facilities management

Major **construction** projects [32] may have a model with phases named differently, however, PMLC (Project management Life Cycles) procedures in phases are not different. The Construction project delivery model will generally include the following phases:

- Construction planning and feasibility studies
- Design and Engineering (Sub-phase: Pre-design -> Schematic Design ->Design Development-> Construction documentation)
- Procurement (Construction contact documentation->Bidders selection->Sub-Contract selection-> Construction budget)
- Construction
- Commissioning, and Startup

The PMI® has standardized a 5-phased project development and implementation life cycle (PLC) [PMBOK®, 2017]. A complex mega-project can follow a 5-phased Project Life Cycle (PLC) and apply all generic project management life cycles elements.

PMLC and PLC:

Each individual project phase is like a mini-project that goes from the first process group (Initiating Processes) to the last process group (Closing Processes). The phases are completed in sequence. The connection between the individual phases in the project life cycle is called a phase gate [PMBOK, 6th Editions, 2017, pp 20] [33].

CII-Construction industry Institute offered PDRI (Project Development Rating Index) guides to gate scores²¹. SPMO leads the process, and mega-projects will get decisions for a “go” or “kill” decision on that phase gates.

²¹ PDRI- Project definition rating index, a set of scaling orders or values that can be assigned to project development parameters by experts in specific fields. CII- Construction industry institute provides complete guidance of PDRI rating and assignment. Construction Industry Institute (CII), is based at The University of Texas at Austin, USA. www.construction-institute.org

The PMI® PMBOK® guided PMLC phases are:

- Project Initiation
- Project Planning
- Project Execution
- Project Monitoring and Control
- Project Closure

There are Forty-nine (49) project management processes included in PMBOK ® 6th Edition (2017). They are grouped logically into five process groups. The initiating (2 processes), planning (24 processes), executing (10 processes), monitoring and controlling (12 processes), and closing (1 process). PMI® PMBOK® has structured project management knowledge into 10 (Ten) areas. Which are:

- | | |
|-------------------------------------|----------------------------------|
| • Project Integration Management | Project Scope Management |
| • Project Schedule Management | Project Risk Management |
| • Project Quality Management | Project Resources Management |
| • Project Communications Management | Project Communication Management |
| • Project Stakeholders Management | Project Cost Management |

Each of the 49 project management processes has been categorised in Five (5) process groups and capture 10 knowledge areas consisting of the following components:

- Inputs–items which can be outputs from other processes
- Tools and techniques–tools are items that are used with techniques to take inputs and process them into outputs
- Outputs–deliverables to the project or items which can be inputs to subsequent processes

This paper *intentionally* limits technical discussions on project management processes, associated procedures, and work instructions. However, it emphasises that this would be a comprehensive task for an SPMO to embark on building an appropriate model library of all the project management standards, including engineering and construction management standards, procedures and work instructions.

Following **Figure (1)** depicts the relationship between PLC, Ten (10) Knowledge Areas, and Process groups [PMBOK®, 6th Edition (2017) [34].

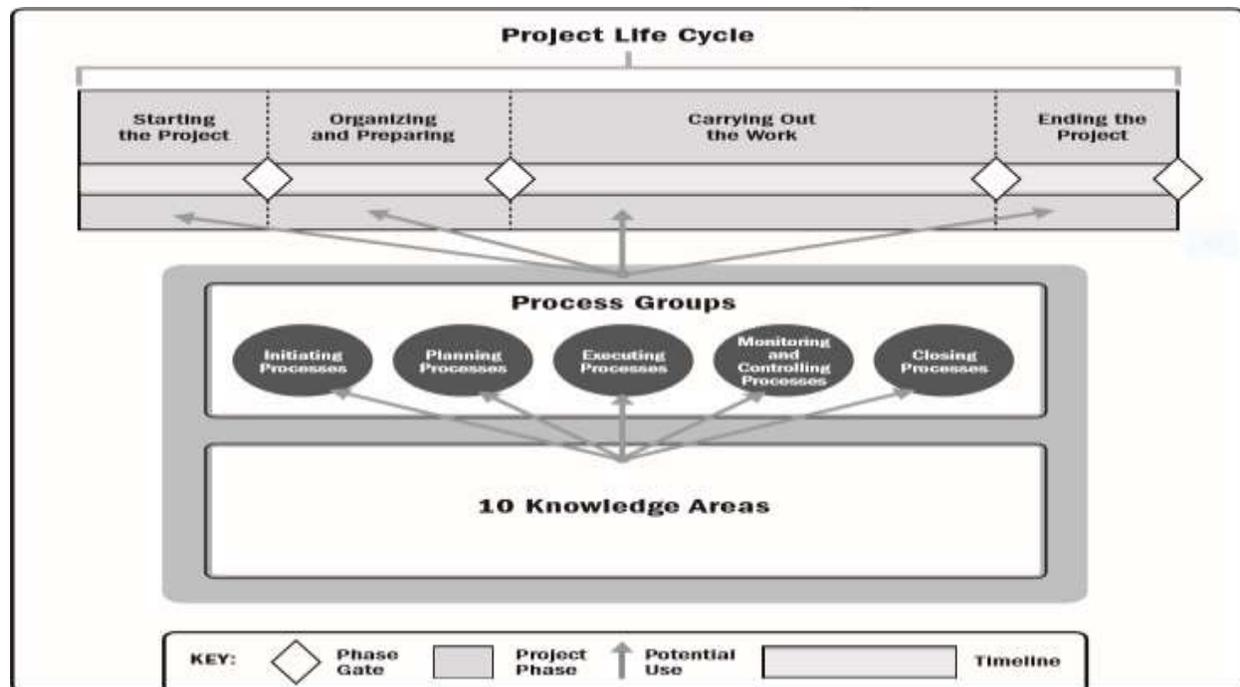


Figure 1-5. Interrelationship of PMBOK® Guide Key Components in Projects

Figure- 1: Adapted from PMI® PMBOK®, 6th Edition pp. 19

SPMO Scope, Schedule, Cost, Risk, Procurement and stakeholder manager

The project business case will have a high-level project scope delivered by the Project Sponsor²² in their concept paper. It will also include a high-level schedule, high-level risk register, and project stakeholders register. The scope, schedule, and budget get better defined as the project design matures and estimates of materials, resources, and time progress toward definitive status. The SPMO team shall present alternative contracting strategies to the sector leaders or board of managers for specific decisions at early planning stages. This will result in developing the project delivery model and methods. A DB or EPC²³ project

22. Generally, the Project Sponsor is the individual (often a manager or executive, sometimes a political authority) with overall accountability for the project. The Project Sponsor is primarily concerned with ensuring that the project delivers the agreed business benefits. The Project Sponsor acts as the representative of the organisation and plays a vital leadership role (http://philrichardson.co.uk/pa450/teamwork/sp_role.htm)

23 The Engineer Procure and Construct (EPC- close to DB – Design Build contract) form of contract is popular with smaller mining companies, particularly those seeking to finance on a limited recourse basis. The principal advantages of this form of a contract are that the contractor will take the major risks relating to the cost of construction, the time for completion and the quality of the finished product (including, in certain circumstances, in relation to commissioning and ramp up). [Douglas R., EPC or EPCM Contracts, Minerals and Metals; Oil and Gas; Industrial, 2016]

23 EPCM: The Owner selects an EPCM Contractor to manage the whole Project on its behalf. Generally, the EPCM Contractor performs Engineering, Procurement and construction management services i.e. the EPCM completes the design / Procurement phase and manages the construction phase of the Project. The actual construction work is performed by one or more "Works Contractors" under the direction of the EPCM Contractor. DBB (Design Bid Build contract strategy is similar to an EPCM contract, *ibid.* Douglas R., EPC or EPCM Contracts.

model is chosen, it is critical that the owner/sponsors know the scope of the mega-project well. In DBB or EPCM²⁴ strategy are similar, but it's a different ball game. Owner involves EPCM company to finalize a scope. The budget or cost risks go to the owner. SPMO refines the scope, budget (inclusive of OPEX – Operating cost estimates and CAPEX- Capital Cost Estimates), schedule and the risk register as it succeeds phase gates. At each phase gate, the project will be re-estimated, and schedules will be re-visited.

The SPMO shall consider the risk management plan of the project as the project concept is conceived. PMI® emphasises that a project manager should know his project risks and manage his project accordingly, otherwise the project would manage the project! [PMBOK® 6th Edition, Project Risk Management 2017] [35].

The PEP game book shall incorporate four management plans (i) Project Scope Management Plan (ii) Project Risk management Plan (iii) Project Scope Management plan and (iv) project Stake-holders management plan along with others.

Cost and Schedule are two arms of the project quality triangle (PMI®, PMBOK® 6th Edition, (2017) pp179, and pp 131) [36]. Both are critical to project quality objectives. The scope of the mega-project should be delivered as an integrated one. A neat project schedule management plan and cost management plan are created as the project succeeds in reaching its implementation/execution phase, and a frozen scope.

Project Stakeholders management stands as one of the most critical knowledge areas, accountable for mega-project success. With the business case taking shape, SPMO prepares a preliminary stake holder's list. The list continues to expand as the project scope matures. The PMI® reinforces stakeholders' education and communication as an important piece of the PEP, help developing relationship and impacts project success. PMBOK® 6th Edition (2017) [37]

SPMO the mega-project set up planner, controller, communication manager, and quality reporter

The SPMO shall provide governance and project controls services. The office shall create the project set up plan in support of the execution of appropriate project controls. A project set up plan and control system mapping is necessary before engaging the project controls plan. Integration and change management plans will ensure scope integrity. The SPMO will deliver an integrated scope to sponsors, customers or owners.

Quality reporting is critical to major stakeholders, society, JV partners, political authorities and press. These must follow a well-orchestrated communication management plan. 90% of a project managers job on a project is communications [Project Communication Management Plan, PMBOK® 2017] [39] The society and people have the right to know the progress or performance, productivity or efficiency of mega-projects that are being commissioned at the expense of tax payer's money. SPMO must conduct quality assurance, and analytical reviews on the performance and efficiency reports prior to communications to respective stakeholders. Innovations as Earned Value Management Systems (EVMS) and techniques could be introduced [PMBOK® - Project Cost Management Plan, pp.264] [38] for better cost and schedule reporting. However, it is important to have these as the project construction or phase kicks off.

PMI® has recorded many interesting innovations in project management methodology, beyond F.W. Taylor's contributions in Modern scientific Management Principles²⁵. Three (3) major innovations contributed as credible agents in today's project management standards and governance. (A) The WBS – Work breakdown structure, (B) The Critical path Analysis and (C) The EVMS – Earn Value Management Systems. Detail discussions of all these elements are beyond the objectives of this paper and have been discussed elsewhere [PMBOK® 6th Edition, ACEI Skills and Knowledge Book etc.]. An SPMO shall effectively use these innovations to implement governance, quality project controls and report to major stakeholders.

SPMO Integration, interface, integrated change and value manager

Complex projects constantly embrace odd scope creeps, schedule slippages, and cost growths. These present excruciating frustrations and shrinkages in the time value of money. Mega-projects own various sub-projects and parallel projects. SPMO's responsibility is to manage the interfaces of all the projects and sub-projects involved. A sector may entertain multiple projects and programs. Integration management is a serious concern. SPMO must appoint an experienced PM to lead the wing of the SPMO. This PM must have profound schedule management, conflict management, financial analysis, value engineering, ERP systems knowledge along with risk and contract management expertise. The same wing can be mandated with the integrated change controls, value management exercise for cost and waste reduction.

SPMO, Innovation, R&D and Agile project manager

Innovation, Information technology (Agile projects) and R&D are intertwined. PMI® is constantly involved in capturing the latest innovations in the science of project management covering both the Predictive/Waterfall type projects and Iterative/Agile project management. The reflections are readily available in PMBOK® 6th Edition (2017) [38]. PMBOK® has incorporated the latest innovations in agile project management methodologies and strategies, that are developing at a faster pace.

The ERP systems are critical in facilitating integrated project delivery. Various mega-project corporations are investing enormously across the globe to implement world-class ERP platforms, integrating state-of-the-art project management system for better governance, controls, and ROI.

SPMO the Synthesizer of knowledge, competency, professional ethics, LLD, and Skills enhancer

Mega-projects are challenging endeavors. Every day these projects encounter complexities and conflicts. Every day changes are one constant truth in a project manager's life. Management of change is a source of project knowledge. Changes are integrated as they arise and are managed. The project team shall verify whether a true change has occurred and, is the change necessary, and the change is clearly understood by all, especially the principle actors [Morris, P. W. G. & DeLapp, S. E. (1983)] [39]. Change induces risks. A positive change extends positive developments and therefore induces opportunities²⁶. The experiences shall be deposited into the LLD. This becomes the synthesizing instrument of project knowledge on issues, change management strategies, project scope creeps, schedule growth, and cost slippages. These experiences also deliver the knowledge pertinent to the problem resolved, deeper insight into mitigated risks, prospects, and innovations. These exercises harvest wonderful opportunities for learning and shall go in favour of future mega-projects.

²⁵ See, Taylor, F.W.; *Father of Modern Scientific Management, Time and Motion Study*, Routledge, London 2003.

²⁶ Pls. see *project integration management and project risk management, PMBOK® 6th Edition*

SPMO the Operations Readiness manager, and the corporate social responsibility (CSR) manager

The Operations Readiness (OR) is an area to be considered seriously for sustainable development. It is generally understood that the EPC/EPCM/Equipment suppliers and project consultants will provide the as-built designs and SOPs (Standard Operating Procedure) library, and it's all 'hunky-dory'. A detailed Operation Readiness Management Plan (ORMP) is critical in post handover operations, processes and suitability.

As the project concludes the CSR documents, HSEQ plans, close out schedule reports, cost reports, performance reports, Issue logs, change logs, risk registrars, finalized LLDs and ORMPs are to be audited and deposited into to SPMO library. It was advocated EPC/EPCM/Prime consultants/Prime contractor would not be signed off till the entire mega-project team completes an LLD by all parties involved and is endorsed.

The major contractors' project offices and small projects corporations will have flexibility in selecting their SPMO components. The special project offices relating to security and intelligence, space and aviation, defense and R&D etc. are to be dealt and structured with due confidentiality.

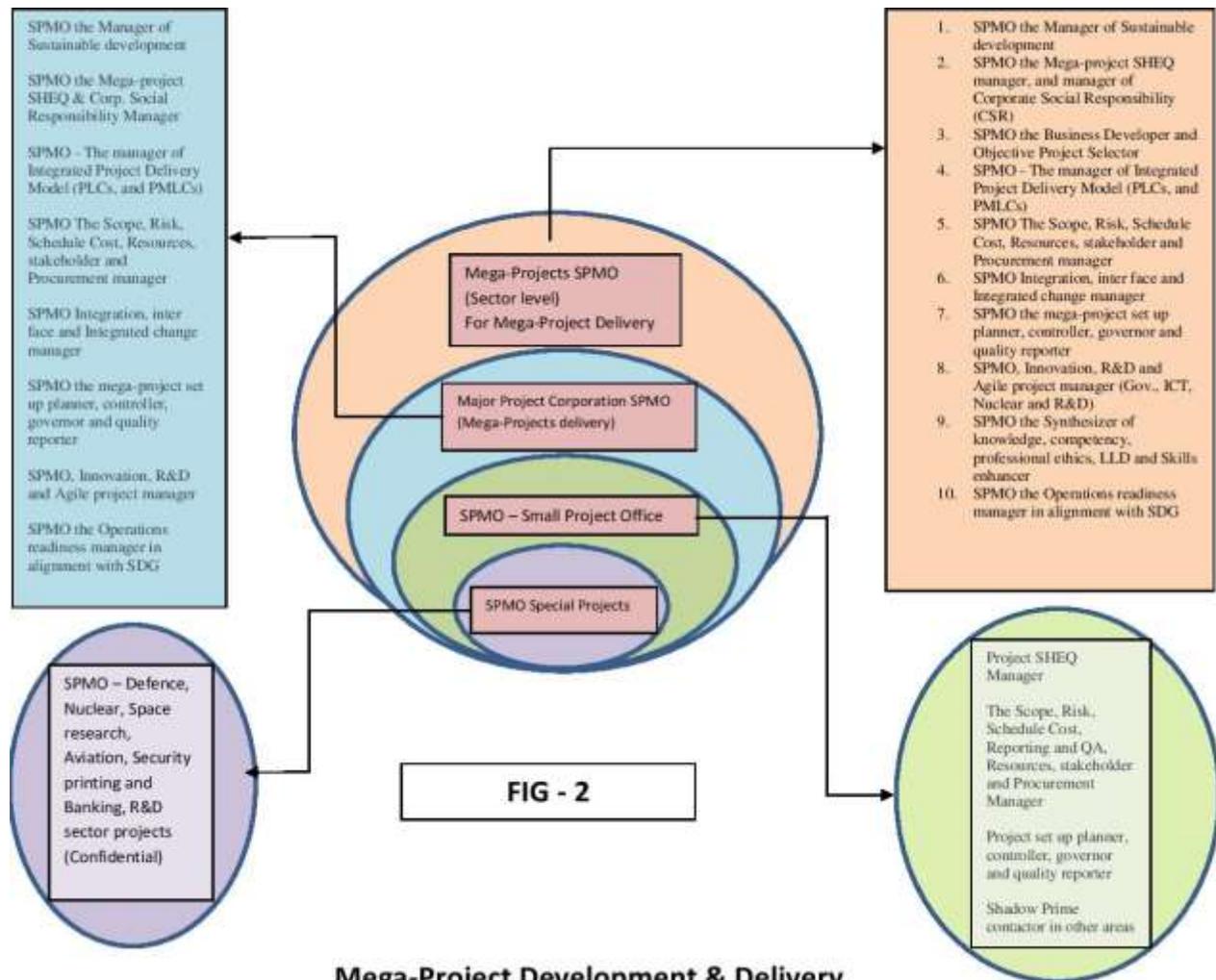
The Prime SPMO must develop working alliance procedure manuals, management plans and work instructions to oversee the integration of all parties involved. Parties may include the JVs (joint ventures), partners, EPCM alliance, EPCs, design and development consultants, construction sub-contractors, special project offices etc.

These discussions take a long course. Some essential briefs on SPMO components appeared necessary and have been provided to connect the organization and mega-project's socio-technical integration.

However, a delineation mark should be drawn here. This paper focuses on a central aspect as noted on the subject line.

SPMO FRAMEWORK FOR SUSTAINABLE MEGA PROJECT DELIVERY

Figure – 2, chalks out a framework of SPMO. The SPMOs may assume a flexible configuration. To be noted that the compositions and structure of the organization are not exhaustive.



**Mega-Project Development & Delivery
Organizational Framework/Model
in
an LDC – Less Developing Country Environment**

Mega-Project Development and Delivery Challenge- A Sustainable and Flexible Organizational Framework – Mohammad Jahangir, Dhaka, CDNE Conference - Feb 26-27, 2019

Conclusion

Dazzling infrastructure projects commissioned over and across the Hudson River in the vicinity of the Manhattan neighbourhood of New York (NY) certain to astound any LDC onlooker with immense exhilarations. About 793 bridges and tunnels, including 5 large crossings²⁷ and some of the world's tallest tubular skyscrapers stand erect in NY State. Witnessing with awe, the onlooker could strive to realize the worth and implications of these mega-projects in NY's economy. NY alone contributes \$1.675 Trillion to the massive \$20.18 Trillion US GDP [40].

An LDC GDP figure may appear too shy against NY's robust profile. *However, NY's growth stance does not deny the very fact that it did not by-pass the status of LDC at the advent of the last century!*

Undeniably the democratic developmentalism and massive undertakings of rationally chosen mega-projects spurred NY's backward and forward linkage to the great US economy and the world economy thus enhancing competitiveness, productivity, knowledge, innovation and thereby contributing to the spectacular economic growth and economic development.

Regrettably, today's LDCs hold odd economic demeanours and have specific and general challenges. Terms and conditions of international financial organizations and consortiums may appear humiliating [41]. Three specific eruditions may appear thoughtful to the readers on Mega-project development challenges prior to reaching an open conclusion.

They are:

1. Borrowed resources and hired knowledge induce harsh risks as mega-assets get trapped into an apparent vacuum. Innovation, fast learning, gaining competence and synthesizing are feasible process forward
2. Collecting experience from lessons learned from existing mega-projects help mitigating risks on future mega-project endeavours and promote success
3. Inclusion of Socio-technical considerations are inklings to resolve complex societal requirements of megaprojects environment, extreme intricacy of delivery and attain sustainability. There is no alternative to adapt to and embark on developing structured organizational capacity and knowledge building in successful complex-project delivery.

This paper concludes here-with an unwavering understanding:

“Sustainable delivery of complex mega - projects should be led strategically with judicious socio-technical inputs, whilst adhering to knowledge and quality project management standards are preconditions for success. These should be dispensed by competent people, processes, systems and logistics, orchestrated through an efficient office of strategic project management”.

²⁷ The top 5 include Brooklyn Bridge, Manhattan Bridge, Verronzo-Narrow Bridge, George Washington Bridge, and Queensboro Bridge. The Brooklyn Bridge was built in 1883, and it was an engineering innovation of its time and it provided lessons learned documents that transferred necessary skills and troubleshooting support to future mega-project in the US. Tappan Zee Bridge is the largest bridge on the Hudson River with 8 lanes and 5 kilometers in length.

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