

The Project Configuration Process  
In Mixed Delivery Settings  
Research Summary – Tren Urbano

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## **I. Outline of the Research Program**

The objective of this research is to identify essential project control issues in a mixed delivery setting. Tren Urbano poses a unique project control problem as it is divided geographically into seven alignment sections and contractually into a portfolio of contracts containing one design-build-operate contract and six design-build contracts. The hybrid design-build-operate/design build project acquisition strategy being implemented on Tren Urbano is unique. The project contract and organizational structure creates multiple challenges to obtaining the Puerto Rico Highway Transportation Authority's (HTA) project goals of obtaining a high quality transit system, completed on time and within budget.

The research outline as of March 30, 1998

- Research Focus: Controlling Design/Construction/Operations Issues in a DB/DBO setting
- The Philosophy of Design/Construction/Operations Control for TU in the Contract Documents
- Comparisons with Other DBO and Large Project Control Philosophies
- The TU Control Philosophy in Operation
  - 3 Case Studies on TU - System Elements
- Analyze/Compare Findings
- Recommendations

In the spring of 1998, I have focused on the first objective of the outline: Controlling Design/Construction/Operation Issues in a Mixed Delivery Setting. The work in sections II and III is the key to all my research. I have been working with Professor William Ibbs, and Professor John Miller, and have received comments from Henry Michel, Chairman Emeritus of Parson Brinkerhoff. In the Summer and Fall, I will apply the results of this background research to three sub-systems on Tren Urbano, the Central Artery, and to a third project.

## **II. Background Research on Project Control in a Mixed Delivery Setting**

### **1.0 Introduction**

The project delivery process is the means by which projects are consistently and efficiently planned, executed, and utilized. The objective of this research is to identify common strategic planning principles and activities in order to develop a project planning process that can be consistently applied by owners to deliver successful projects. To properly understand the intention behind developing such a process, it is useful to state the assumptions that were required to reach the results and conclusions. The initial assumptions that are fundamental to the development of the processes to follow are:

- The belief that a direct relationship exists between the level of project planning and the success of a project
- The belief that project delivery options for the public sector will eventually be expanded from exclusive use of segmented design-bid-build processes to create a collection of available delivery methods, which include segmented, combined, directly financed, and indirectly financed strategies.
- The understanding that the particular legal framework of an area in which the owner is operating will have an impact on the use of any project planning process.

Well-executed project planning, hereafter referred to as project configuration, by the owner, prior to a project's release into the private sector, can provide many benefits. An owner can consistently exploit these benefits through the development of a process that identifies common project configuration principles and activities. The goal or intention of the process is to provide an owner with strategic methods to obtain information, address risk, and commit resources to maximize the probability of a successful project. The focus of this research is on the premise that:

- The delivery of public infrastructure in America; with Federal, state, and local governments as the owner, can be greatly improved by the development of a project configuration process that can be consistently implemented, regardless of the project acquisition strategy that is selected.

In order for any new project configuration process to be fully accepted and implemented, attitudes and behaviors regarding project configuration need to be aligned with the new philosophy.

The development of a mission statement, an adaptation from the private sector, for public owners will help establish the overall goals that should be addressed. Collectively, the Federal, state, and local government's mission is to maximize the resources available to provide the greatest infrastructure value, in terms of cost and service quality, to the public. This mission lends support to the belief that public owners should be able to choose from multiple project acquisition strategies, not just design-bid-build.

The determination of the "success" of a project is inherently subjective and is strongly dependent on the point of view of the individual making the assessment.

Typical metrics for measuring project success often include total design and construction cost and schedule compared with estimates as well as performance of the facility compared with what was intended. Quality, for the most part, is considered an expectation and project success is reduced to favorable cost and schedule results. For the purpose of this research, project success is determined by:

- The level of satisfaction among the project participants toward the completion of a fully operational and functional facility, with the least number of changes, rework, cost overruns, delays, and disputes.

While traditional measures of project success focus on costs and schedules, this definition of project success places emphasis on relationships. Strong, team-oriented relationships lead to shared objectives, fewer conflicts, and faster dispute resolution. This change in focus is an important difference for these factors typically have a large influence on the final project cost and schedule.

Why develop the process from the owner's perspective? Project planning for public infrastructure is an owner-driven process that must be aligned with overall economic and social policies. It is essential to consider the future as well as the immediate implications of a project's financial obligation and social impact. Proper alignment requires consideration of design, construction, operation, financial support, and project management early in the project development process. This research focuses on the owner's planning activities, for it is a widely held, accepted belief that the early phases of a project's lifecycle will have a much greater influence on a project's outcome than the later phases.

It should be noted at the outset that this research does not represent either a complete project delivery system or a comprehensive guide for the development of a project. Rather the emphasis is on the identification of common principles that lead to project success and the development of a fundamental project configuration process that effectively addresses these principles. Many of the principles are not necessarily new and have been in use for some time. However, their critical importance to project success has not been properly established within a generic project planning process.

In order to facilitate a useful understanding of the material, a glossary of terms, used throughout this paper, is provided to establish a common language for discussion of the topic.

## Glossary of Terms:

- **Build-Operate-Transfer** – The combination of design, construction, and operations and maintenance within a contractual arrangement to obtain a single point of responsibility for these services; indirectly financed
- **Combined Strategy** – The combination of design, construction, and/or operations and maintenance within a contractual arrangement
- **Critical Project Success Factors** – Are elements that an owner has identified as critical to the success of the project and that can be influenced by the owner's response to configure the associated project variables.
- **Design-Bid-Build** – Segmented design, construction, and operations and maintenance with a single business entity acting as the contractor in complete and sole charge of construction
- **Design-Build** – The combination of design and construction within a contractual arrangement to obtain a single point of responsibility for these services; directly financed
- **Design-Build-Operate** – The combination of design, construction, and operations and maintenance within a contractual arrangement to obtain a single point of responsibility for these services; directly financed
- **Direct Financing** – Government financial support of a project
- **Indirect Financing** – Private sector financial support of a project
- **Parallel-Prime Contracting** – also multiple-prime contracting – The owner enters into multiple direct contractual arrangements with contractors, subcontractors, and a designer(s) to complete the project
- **Procurement** – Divided into two parts: 1. Contract procurement – contracts for labor and services; 2. Purchasing – purchasing of equipment, materials, supplies required for construction and operations
- **Project Acquisition** – The contractual and financial strategy used to deliver a project
- **Project Charter** – The definition of a project's objectives and scope as well as the definition and commitment to goals, roles, and relationships within the project team is the chartering process; the written documentation of these definitions and the commitment of project team members is the project charter.

- **Project Configuration** – The planning, defining, and organizing of project objectives, scope, functional design, financial analysis, and acquisition strategy
- **Project Configuration Activities** – Useful owner activities that lead to the development of project resources, referred to as the project configuration deliverables, that promote the delivery of a successful project.
- **Project Configuration Deliverables** – Resources that an owner can implement to promote the delivery of a successful project.
- **Project Configuration Principles** – Good project management principles or concepts that lead an owner to define project needs and that can be associated with CPSFs.
- **Project Delivery** – The means and methods of developing a project from concept to completion
- **Project Execution** – The realization of project planning and design through construction activities
- **Project Phases** – A typical method a describing the development of a project, project phases can be sequential or have significant overlap
- **Project Success** – The level of satisfaction among the project participants toward the completion of a fully operational and functional facility, with the least number of changes, rework, cost overruns, delays, and disputes
- **Portfolio** – The collection of infrastructure projects initiated or controlled by the government
- **Public Owner** – An agency, department, or body within the Federal, state, or local government that initiates a project
- **Pure O&M Contract** – A contractual arrangement for operations and maintenance services only
- **Segmented Strategy** – A distinct contractual separation of design, construction, and/or operations and maintenance

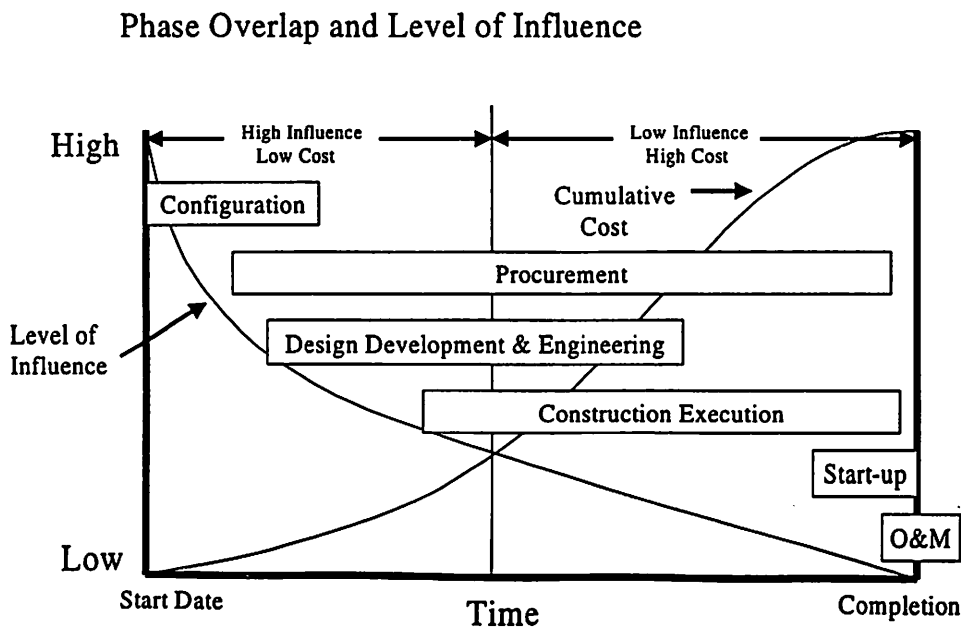
## 2.0 Problem Identification

### A Necessary Change:

There has been extensive debate, in recent years, concerning the justification for the government's exclusive reliance on the design-bid-build project acquisition strategy. As the demand for infrastructure has increased, the Federal, state, and local government funding available for these projects has decreased. The combination of the current and growing shortfall of public funds available for infrastructure and the requirement of direct public financing associated with the design-bid-build process will inevitably cause the government to fail in its mission. It has become clear that design-bid-build, and most likely no other singular project acquisition strategy, can be used exclusively to deliver the entire portfolio of infrastructure projects. The term portfolio is used here to describe the collection of infrastructure projects initiated or controlled by the government. (Miller, 1997, 13-2)

The state of infrastructure in America requires that the current method of public project delivery must change. Changes in current legislative statutes will be necessary to promote a long term, stable commitment to private sector participation in the development of infrastructure. Different combinations of project finance, design, construction, and operations and maintenance, involving both the public and private sectors, offer the greatest potential to adequately serve the growing infrastructure demand. If this change is believed to be inevitable, as I have assumed, the central issue then becomes how should the government react to this change. What does the government need to do in preparation to operate effectively in this open environment? The choice among various project acquisition strategies including; design-bid-build, design-build, design-build-operate, build-operate-transfer, and other variations will provide the best potential value in terms of infrastructure quality, level of service, and development of technology. The government can satisfy its mission to the greatest extent, if effort and resources are focused on planning activities, which includes project acquisition analysis, during the Project Configuration Phase.

Figure 2-2 Phase Overlap and Level of Influence



In support of this notion, Figure 2-2, first developed by Boyd Paulson, illustrates that it is easier to favorably influence a project's outcome during the Project Configuration Phase, when expenditures are minimal, than it is to affect the project's outcome during Construction Execution or Operations, when expenditures are more significant. (Paulson, 1976)

With the re-introduction of combined delivery strategies useful and successful project configuration will need to be redefined. Each project acquisition strategy will have a different distribution of responsibility between the owner, designer, contractor, and operator depending on the level of integration between the phases, owner involvement, and owner expertise. The owner, or government agency, needs to implement consistent project configuration methods to adequately prepare each project to progress through the remaining phases. It is important that project planning during the Project Configuration Phase accommodate the various options available for project delivery, which includes project acquisition, finance, organization, and management in order to successfully address lifecycle issues of cost and service quality.

### **3.0 Process Development**

#### **New Strategy:**

Current industry practices, statutes and regulations, legal precedents, and industry structure support the use of the segmented design-bid-build project acquisition strategy. Requirements for the implementation of design-bid-build are standardized through the Model Procurement Code, which most states have adopted. Recent government "experiments" or "demonstrations" attempting to implement alternative project acquisition strategies have shown anything but standard requirements or procedures, executed by the government, prior to a project's release into the private sector. Therefore, the delivery of public infrastructure in America; with Federal, state, and local governments as the owner, can be greatly improved by the development of a project configuration process that can be consistently and efficiently implemented, regardless of the project acquisition strategy that is selected.

The intent of the new project configuration process is shown by the strategic goals in Figure 3-1.

Figure 3-1 Project Configuration Goals

## **Project Configuration Goals**

- Fulfill Government Mission
- Determine project drivers
- Check Financial Viability
- Enhance level of project quality
- Improve cost predictability
- Improve schedule predictability
- Improve definition and allocation of risk
- Align and prioritize objectives - Owner, Designer, Contractor, Operator
- Establish functional performance requirements
- Identify users
- Manage and reduce scope changes
- Maintain Team atmosphere and relationships - Partnering
- Provide adequate and appropriate staffing
- Provide adequate project control
- Identify socio-economic and environmental impacts

The general objective of any strategy is to meet the public infrastructure need in areas such as water and wastewater; air, land and water transportation; power generation; technology; and quality of the environment. The strategy must allow the government to adequately identify and define the public need, allow for options to meet these needs, clearly indicate government support of selected projects and delivery processes, allow for fair private sector involvement, and encourage the dedication of private sector resources to generate innovation in technology and design, as well as, construction and operation processes. The strategy must allow both the public and the private sectors to contribute in ways that are amenable to their inherent strengths. The public sector can best:

- Identify public need and viable projects
- Align economic and infrastructure strategies
- Establish government commitment to viable projects and delivery processes
- Provide a fair, competitive environment for private sector participation
- Establish reliable commitments for infrastructure financing

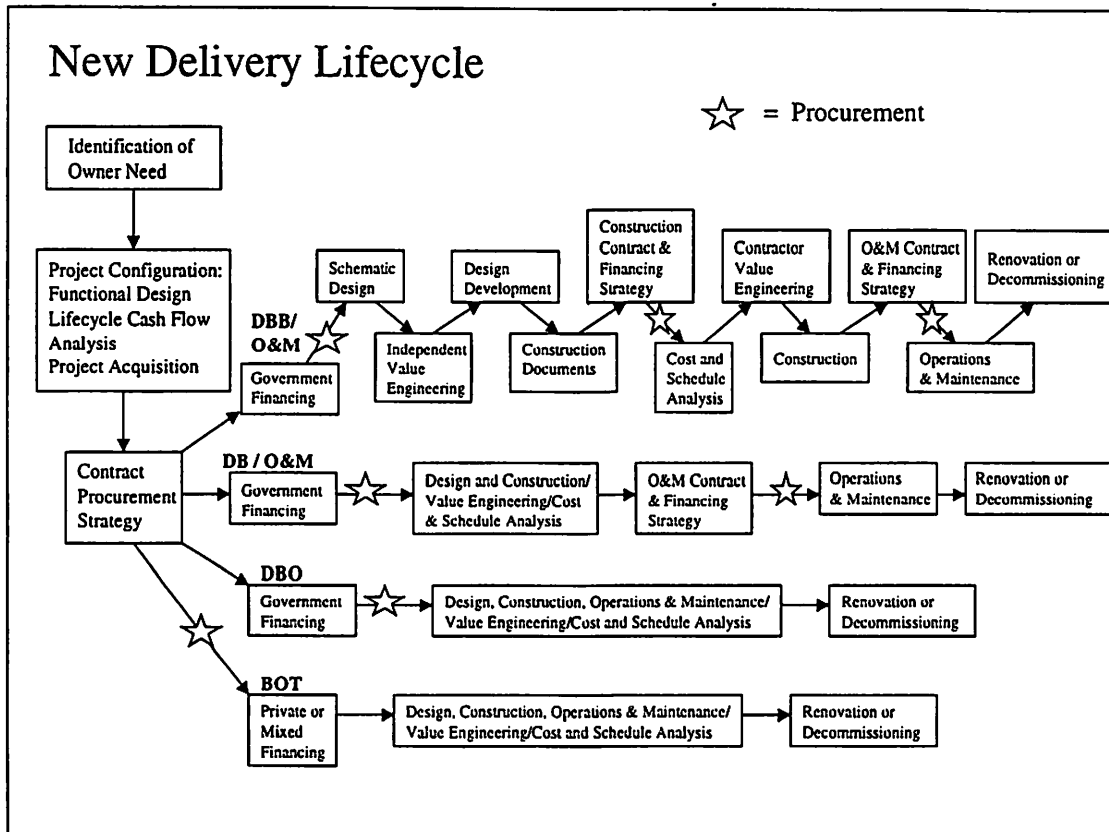
The private sector can best:

- Provide an independent competitive check on the technical and economic viability of projects
- Provide an alternative source of financing

- Develop and introduce innovations in technology, design, construction, and operation processes

These concepts lead to the creation of a new generic project lifecycle that depicts the multiple possibilities for a project's development. The new project delivery system, in Figure 3-2, attempts to establish consistent government planning prior to private sector

Figure 3-2 The New Delivery Lifecycle



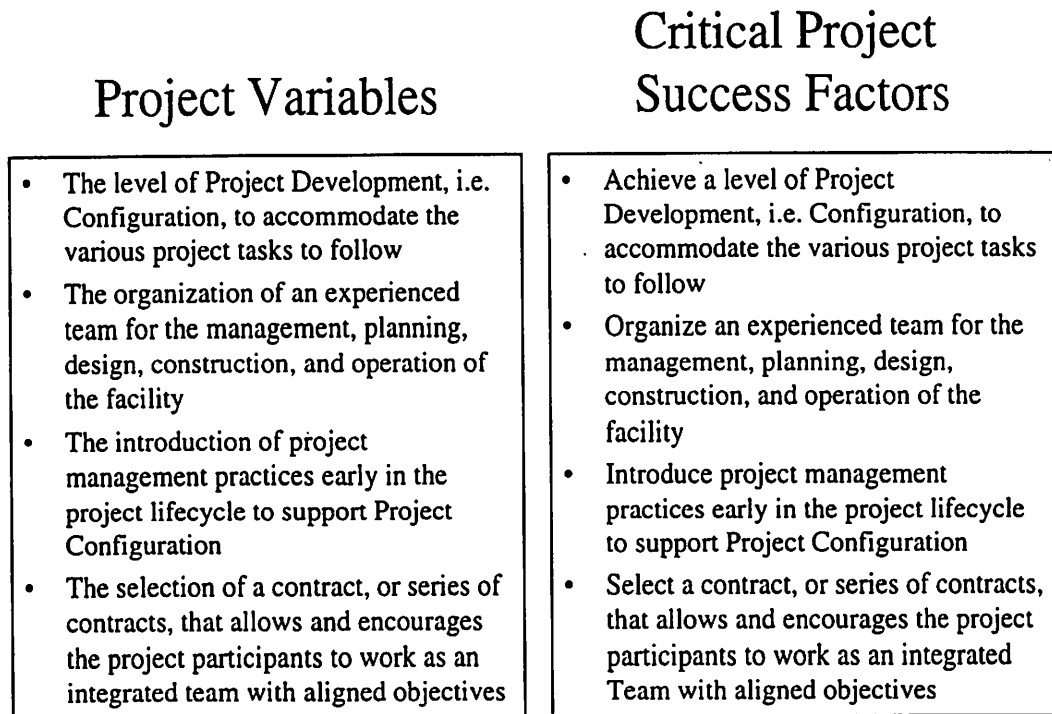
participation. After the government has sufficiently defined, organized, and analyzed the project the private sector becomes involved, and the direction of project development depends on the project acquisition strategy that is selected. The open system will create a new market that encourages private sector investment in infrastructure as it allows the private sector to innovate and implement the use of new technology and methods that would allow private firms to effectively compete in this market. Variations of integrated finance, design, construction, and operations will allow the private sector to achieve better service quality for lower costs by introducing competition across project lifecycle time periods.

#### 4.0 Process Development

As stated earlier, the objective of this research is to identify common strategic planning principles and activities to develop a project configuration process that can be

consistently applied by owners. The goal or intention of the process is to provide an owner with strategic methods to obtain information, address risk, and commit resources to maximize the probability of a successful project. Therefore, it is critical that an owner personally define what is meant to complete a successful project and then identify project variables that affect the outcome of the project. A few typical project variables are shown in Figure 4-1.

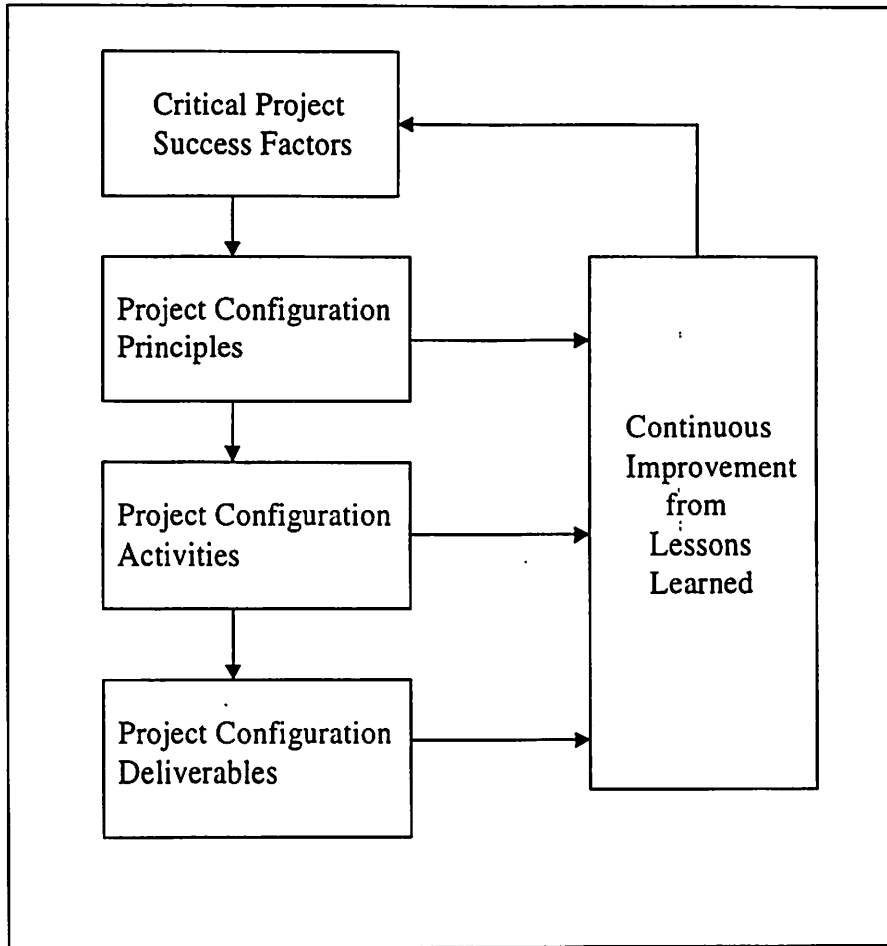
Figure 4-1 Project Variables and CPSFs



These variables are directly associated with Critical Project Success Factors (CPSF) which are considered the starting point for the development of the project configuration process. Project planning is an owner driven process therefore owners must configure each variable to the necessary level of project planning development, organize a project team, initiate a project management workplan, and select a project acquisition strategy. The direct translation of project variables into CPSFs demonstrates their importance to all projects, but they are still variables because each project is unique and therefore an owner must configure each variable to maximize the probability of a successful project.

The main purpose of process development is to identify and define good project planning and management principles and activities. The development of planning and management resources begins with the CPSFs and ends with project configuration deliverables that can be used by an owner to guide the initial development of the project. The development of project configuration deliverables follows the process shown in Figure 4-2.

Figure 4-2 Configuration Development Process



The process is used to clearly indicate the connection between the implementation of project configuration deliverables and project success through the critical project success factors. The direct connection between CPSFs and project variables demonstrates how an owner can set the tone for a successful project during the project configuration phase. Although typical project success factors and project configuration principles are identified in this paper, it is important that an owner understand the configuration development process in order to improve on the process developed here and to properly configure the planning effort for individual projects. An owner, therefore, must understand the intention of each step.

**Critical Project Success Factors** – Are elements that an owner has identified as critical to the success of the project and that can be influenced by the owner's response to configure the associated project variables.

**Project Configuration Principles** – Good project management principles or concepts that lead an owner to define project needs and that can be associated with CPSFs.

**Project Configuration Activities** – Useful owner activities that lead to the development of project resources, referred to as the project configuration deliverables, that promote the delivery of a successful project.

**Project Configuration Deliverables** – Resources that an owner can implement to promote the delivery of a successful project.

**Continuous Improvement from Lessons Learned** – Continuous improvement and refinement of each stage allows the project configuration process to evolve with the changing needs of the owner.

The last stage is essential to the development of a project configuration process that is useful to an owner. It is very important that owners evaluate the effectiveness of project configuration activities and the use of project configuration deliverables to incorporate the lessons learned into the planning efforts of future projects. Only through continuous refinement and improvement can an owner obtain the greatest benefit from the project configuration process and consistently produce successful projects.

## **5.0 Process Application**

The project configuration process developed here is intended to provide owners with consistent project planning objectives that will serve any of the available project acquisition strategies. The consistent application of the configuration development process by an owner will help identify useful project configuration methods and activities that address problems identified through the owner's experience and the continuous improvement process element.

## **6.0 Evaluation**

The evaluation of the project configuration process, once a project is complete, is an essential element behind the intention to obtain the greatest benefit from an owner's project planning activities. The evaluation must address both the ideology behind project planning expectations and the owner's implementation of project configuration deliverables. The ideology behind project planning refers to the determination of project configuration activities that can be best fulfilled through an owner's efforts. The evaluation of the appropriateness of an owner's project configuration scope is restricted to qualitative criteria. The main criteria are whether the project configuration efforts can be associated with the successful outcome of the project and whether the efforts are appropriately allocated within the owner's scope. The research presented in this paper provides a description of multiple project configuration deliverables and suggests how these deliverables can be useful to an owner. An owner's implementation of project configuration deliverables can be evaluated by their contribution to developing positive relationships between project team members and/or to the completion of a successful project.

## **7.0 Process Improvement**

It is very important that owners evaluate the effectiveness of project configuration activities and incorporate the lessons learned into the planning efforts of future projects. Time, financial, and personnel resources are always limited, therefore, it is essential that an owner determine how planning efforts relate to the outcome of the project. Project configuration methods and principles that prove to enhance the outcome of the project must be incorporated into a long-term strategic project configuration process. Only through continuous refinement and improvement can an owner obtain the greatest benefit from the project configuration process.

## **8.0 Research Application**

Once the Project Configuration Process presented here is solidified and refined, comparisons between the Project Configuration Process with those used for large infrastructure projects will test its general applicability and usefulness. The Central Artery and Tren Urbano will be used for this purpose. The Central Artery is currently a \$10.4 billion design-bid-build highway renovation/expansion in Boston, MA. Tren Urbano is complex hybrid design-build-operate/design-build mass transit project in San Juan, Puerto Rico. Essentially the procurement strategy for Tren Urbano resembles a geographical and discipline specific, multiple prime design-build strategy. This procurement strategy is unique and requires special attention to coordination of multiple designers and contractors as well as integration of designs and construction activities. Construction documents, in particular the Request for Proposals, will serve as a good source of information to evaluate the project configuration efforts of each owner.

The evaluation of these two projects will highlight the project configuration and management principles and methods used throughout each project's development as well as the problems that have been identified. Analysis will determine whether the Project Configuration Process that was developed in this paper effectively addresses these concerns and as a result may lead to recommendations for future projects.