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Case Study:
Implementation of Program Control Management On a Multibillion Dollar Project: SeaTac Airport upgrade

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A case study of the Seattle-Tacoma International Airport expansion program titled the SeaTac Airport Capital Improvement Program (CIP) is presented here to describe the successful implementation of Program Control on a multibillion dollar project.

Program Control Management that encompasses scope, plan, schedule, cost, budget and efficient use of resources is essential to any major engineering and construction project. Every aspect of the project should be reviewed at the outset, guidelines established, procedures developed, communication and interface must be enumerated with other groups in the organization including the client. A careful evaluation of major milestones, long lead equipment deliveries, vendor support, and construction contractor's knowledge on complex projects execution is essential on a Multibillion dollar project. The Engineering contractor's exposure to large projects will be a great asset. Schedule, Cost and Budget follow very closely as all costs associated with the project should be identified early and a cash flow prepared to show the out flow of funds from the client to contractors and equipment suppliers and inflow of funds to manage the project from the client. The Program Management team should consist of Program Managers, Project Managers, Project Control Managers, Procurement Manager, Project Engineers, Environmental Engineers and Construction Managers. They should also bring in experienced support personnel to the team that compliments their endeavor throughout the project. Monitoring of schedules, costs, resources, and timely recognition of risks is critical. Quick evaluation of the risk is vital to develop an action plan to formulate a solution and determine the impact on schedule and cost.

Introduction

Whether it is a mega or mini project, they all have to have a scope, a plan, a schedule, a cost estimate and ample resources to complete the planned project to the satisfaction and requisite of the Client. In a residential construction or in an infrastructure project, there has to be an established budget to spend certain amount of funds over a stated period of time to complete the project.

On the SeaTac Airport Expansion project with an estimated value of $2.6 billion necessitated meticulous planning from the very start. The author joined the project team as the Lead Program Scheduler (LPS) at the start of the program. Three engineering firms each one with reputable credentials to handle such a massive project which was expected to span over seven years (from

1 September 1999 to 31 August 2006) were selected as Joint Venture (JV) team to lead the Program Management Group (PMG) and Execution.

The Aviation Department appointed the Program Director (PD) and two Assistant Program Directors (APDs), while the third Assistant Program Director was from the JV team. Five Program Leaders (PLs) were from Aviation Department and two were from the JV team assigned to handle the proposed expansion of the airport. [(1)]

The detailed list of capital Improvement Projects and description is given in Appendix.

Alignment Meetings and Program Kick-off

Once the Program Leaders were nominated to execute the respective program, several alignment meetings were convened to make aware of project's scope, schedule, cost, major milestones on the project, and introduce team members assigned to work on that program. Internal communication within the project team was outlined by the PD. Aviation Director proscribed the PMG team members from communicating and discussing the project with Airlines Staff, Aviation Personnel, the FAA, Immigration and Customs officers, Tenants and other Security personnel at the airport. Aviation Department would send out bids, award contract and reconcile the invoices from contractors and suppliers. The procurement team, quality control team, expediters and inspectors resided at the Aviation Department. In the meetings it was stressed that the accuracy of the data, timeliness and completeness shall be maintained at all times on information sent to the PMG.

The PMG team was housed in a separate building from the Aviation Department. PMG had their own document control department to maintain list of drawings received from Architects, Engineers and equipment suppliers, copy of periodic reports, invoices to Client, computer software and hardware purchase, maintenance and upkeep. The PD and

APDs prepared the Program Control Procedure including schedule and cost, Trend procedure, Change Order Procedure, Engineering Quality Assurance (QA) procedure and field Quality Control (QC) procedure incorporating standards and specifications prepared by the Aviation Department.

Baseline Schedule and Cost

The Baseline schedule and cost, budget were prepared and approved by the Aviation Department, PD, PL and ADP on 31 May 1999. Each Program Leader presented the agreed upon baseline schedule, cost and budget for each CIP's milestones and other activities to their project team. The team members were asked to review and present a revised schedule, cost estimate and list of milestones for inclusion in the revised base line schedule. The Lead Program Cost Engineer (LPCE) gathered all costs from the PLs to produce a total budget for the baseline as $1.91 billion.

Program Schedule

The program Schedule was developed in Primavera P6 Project Management Software. LPS was responsible for integrating all Capital Improvement Projects (CIPs) with the planned start and finish dates, budget and coding system to sort and print various schedule reports.

Project Control Managers, Schedulers from each program jointly developed the coding system to be used in P6. The reports were converted to web pages and posted on the Aviation Department Intranet for Senior Managers review and comment. The baseline schedule had 18,000 activities including logical restraints for the seven programs. There were 109 Capital Improvement Projects (CIP) in the Baseline Schedule. Hammock activities added to obtain summary activities for Engineering, Procurement and Construction. The Program schedule, Cost and Budget were updated once every two weeks to facilitate discussion in the biweekly Monday morning meetings hosted by the Aviation Department. PD and APDs jointly wrote the coordination procedure between the Aviation Department and the Project personnel.

Manpower planning was done on an Excel spreadsheet identifying more than 1,100 personnel to work on the project over the seven-year duration. It was loaded on to the Project baseline schedule with hourly wages to produce the manpower histogram and cash flow 'S' curve.

Several CIPs in which work had commenced were added to the Phase 1 program, for ease of control and possible impact on new contracts. By October 15, information on all CIPs was available and the final budget was set at $2.6 billion to be spent over a seven-year period ending on 31 August 2006. The revised baseline schedule had nearly 35,000 activities covering all CIPs in the Phase 1 program. There were 45 major milestones identified and coded as such in the schedule. LPCE captured all payroll costs for the PMG personnel, including travel and other expenses and added to the final baseline budget.

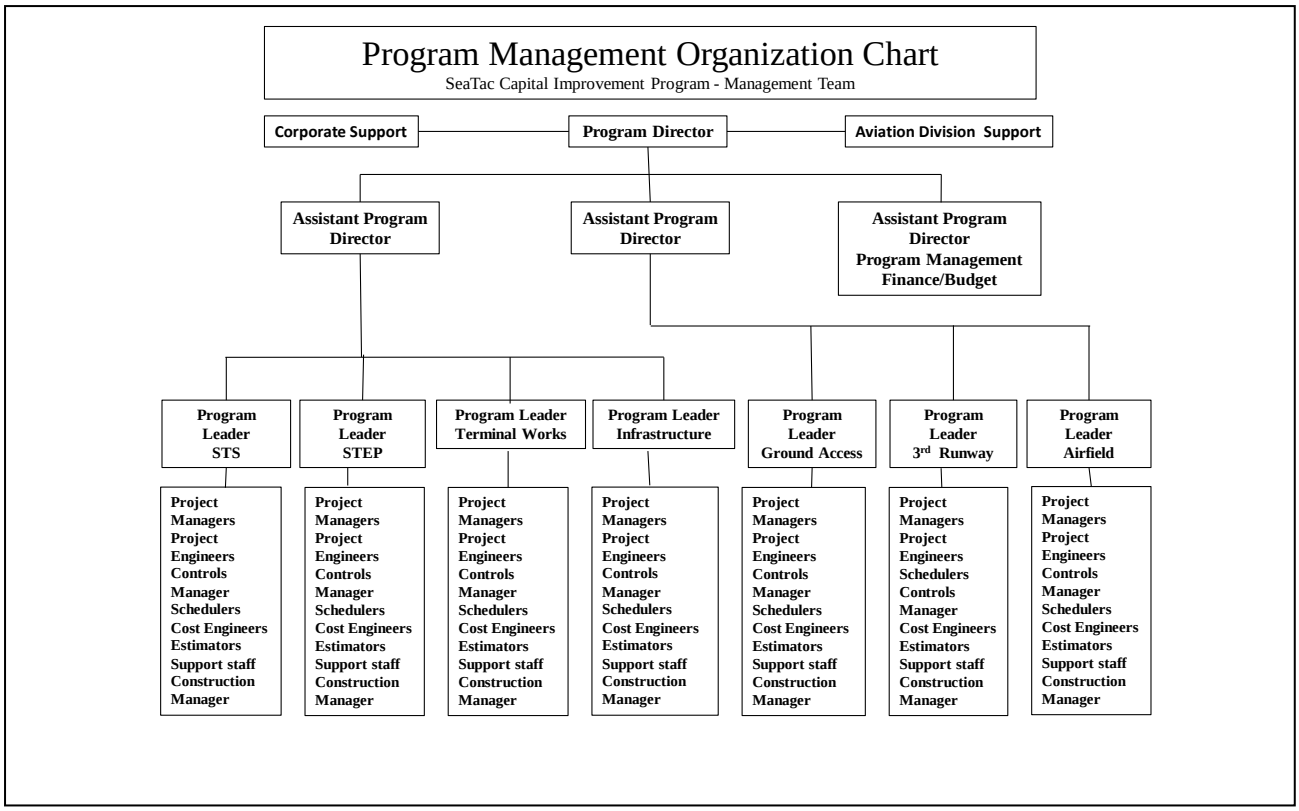
Incorporating Geographic Information System (GIS)

The drawings developed by Architects and Engineers needed to show the location of the building at the airport property. Drawings produced during various stages of expansion of the airport in previous years were not tied to airport buildings. Therefore, it was decided to engage a Professional Engineering Surveyor to survey all buildings, runway, taxiway, and proposed third runway, taxiway, into one plan drawing with GIS Coordinates. A Project Manager was specifically assigned to monitor the work of Surveyor and coordinate with the Aviation Department to incorporate GIS coordinates in all old drawings.

Project Milestones

Operating airlines were asked to provide operating dates from the new terminal gates. They had to plan their fleet, prepare flight schedules, and train the operating personnel in the use of new gates, computerized boards and public announcement system. Retail outlets, restaurants and passenger assistance depend on the operating dates. These dates were incorporated in the schedule to show when each CIP should be completed in time to support the airline operation. Operating dates for Baggage Handling systems, the Satellite Transit System (STS), new escalators, elevators, display boards were tied to the schedule. Access roads, structural steel seismic supports in the arrival area need to be completed in time for the opening of new terminal (STEP). Many of the proposed new CIPs did not have a completion date. The Program Leaders were asked to forecast a completion date and incorporate the dates in the schedule.

All communication with Airlines, Tenants and the FAA was conducted by the Aviation Department.



Any request for information from the Terminal was sent to the Program Director.

A very systematic approach was used in all aspects during the execution phase of the project.

Each PL/PM was responsible to review each CIP and provide cost and schedule information to the LPS and LPCE.

The Program Management Group (PMG) Organization Chart shows the hierarchy and Projects responsible for each individual assigned to the team.

Revised Baseline Schedule and Cost

Revised baseline schedule put the completion date as 31 August 2006, at an estimated budget of $2.6 billion. Several hundred activities were added to the schedule for additional CIPs that were moved to Phase 1 program from Phase 2 program, as many of the CIPs had overlap during construction. The Aviation Department was using Peoplesoft Software program for procurement, contracts and supplies order and delivery. PMG had to write an interface program to transfer data to P6 and Cost engineering programs.

Disruption to Program

The terrorist attack on September 11, 2001 in New York and Washington D.C. had profound impact on the Capital Investment Program at SeaTac. The increased security at the airport, airfield and passenger waiting areas caused certain amount of delay to ongoing projects. Many CIPs were moved to new start date to accommodate the new security systems at the airport.

STEP Project Execution (2) (7)

(Example #1)

Aviation department had assigned an Engineer to exclusively coordinate the work between the contactor, Airlines, Tenants, Architects and Engineer. The PL was an experienced Engineer who came from a major airport expansion project. He was supported by two PMs and three PEs on the STEP project.

The new STEP Concourse was constructed adjacent to the existing terminal. Throughout demolition and the construction of the nearly one-half-mile-long concourse, the contractor ensured that the airport could continue their daily operations with minimal interruptions.

Completed in May 2004, the South Terminal Concourse featured 14 new gates, four retail stores, nine food concessions, moving walkways, inbound and outbound baggage handling systems, loading docks, auditorium spaces, and airline offices. The

contractor also completed infrastructure work, installing new electrical feeders, reconfiguring the adjacent Air Cargo Road, and relocating airfield security gates and utilities. Throughout the project, the contractor incorporated airline programming revisions and design changes as the aviation industry increased security subsequent to terrorist attacks. In addition, the project team oversaw ground improvements, including regrading and expanding parking facilities and, landscaping a new pedestrian bridge.

The PMG team's attention to phasing and coordination minimized the impacts of construction on travelers, airport patrons, airport security, and general airport operations. The contractor communicated effectively with airport personnel to advise them of the upcoming and pending work. In addition, they worked with the Aviation Department to allow all of the airport's follow-on tenant work to proceed on schedule. Several innovative measures incorporated into this project resulted in schedule time savings, cost savings, and increased quality. These included a composite coordinated shop drawing process, which created a smoother field installation process, and the use of shotcrete for the below-ground utilidor. STEP's completion cost was $587 million including all ancillary works for information technology upgrades.

Central Terminal Project Execution (Example #2) [5]

The Central Terminal at SeaTac Airport was completely expanded, seismically upgraded and remodeled over a two-year period commencing shortly after the events of September 11, 2001. The Central Terminal was the anchor for two major air carriers' baggage operations and was the crossroad and hub for most pedestrian air travelers. Passengers departing, arriving or connecting walked through the construction area.

Project documents contained basic phasing plans, but these designs were created and issued prior to the events of 9/11 and the inception of the Transportation Security Administration (TSA). The contractor developed expanded phasing plans to accommodate major structural demolition and construction of the new terminal shell, interior build-out and finishes.

Coupled with the new rules imposed by the TSA, the operations logistic plans had to serve many stakeholders (TSA, FAA, Airside Operations, Landside Operations, Terminal Operations, Airlines, etc.). Temporary pedestrian tunnels were constructed to route passengers and airport guests through the project. The tunnels were built of fireproof lumber, were handicap accessible and portable. They were well-lit, contained non-slip flooring, temporary fire protection and were safe for the public to use while carrying luggage. In addition, the tunnels were secure enough to prevent intrusion from the terminal side to the air operations side. The security aspect was achieved using wire security mesh in areas where plywood or solid surface was not possible. The tunnels interfaced with fire rated zones in the existing adjacent terminals and passageways. The tunnels were equipped with highly visible signage for passengers and other users of the airport.

Since the airport was a 24-hour facility, changing phases was always a major challenge. Pre-planning, communication and coordination with all of the airport, PMG, and construction entities was very important for each transition to happen smoothly. There were multiple moves required throughout the project and several moves required near the end due to the extensive use of terrazzo and stone tile flooring.

Below the terminal, the two airline tenants conducted uninterrupted baggage handling operations during construction. Contractor's task was to seismically upgrade this part of the structure. But, after 9/11, new baggage screening equipment was required to be installed concurrently with the structural modifications. This was coordination and scheduling challenge which was very successful due to the contractor's staff willingness to plan, schedule and communicate with every stake holder involved.

Access to the terminal structure was from the airside. Movement of major material and equipment required construction traffic to share common terminal aprons and roadways with airplanes and swiftly moving luggage cart tugs. The contractor created detailed logistic plans showing routes of travel. Shift times were adjusted and major material movements coincided with lull periods in airline schedules. Again, a high level of communication and coordination was required to make for a safe and smooth operation. The 263,000 sf project was completed in May 2005 at a cost of $126 million.

3rd Runway Project Execution (Example #3) (6) (3) (8)

The third runway finally opened to traffic on November 20, 2008, as an Airline flight took off from the new runway following a dedication ceremony. The completed runway is 8,500 ft long, 150 ft wide and 17 inches deep. To make it level with the existing two runways, it sits on a raised ground built up with 16 million cubic yards of fill dirt held in place by a 1,430 ft long, 130 ft high, recessed retaining wall. When completed the 3rd runway and the parallel taxi way cost came to $1.2 billion, in addition to restoring several wet lands, including the Miller Creek watershed, on the southwest side of the airport. Nearly 400 private homes were bought to make room for the safety areas and other facilities near the runway.

Conclusion

Many of the Capital Improvement Projects at SeaTac airport were completed by summer of 2007. Several CIPs from Phase 2 were added to Phase 1 program, thus the final cost came to $3 billion after all CIPs were closed and final payments made to contractors. Major expansion work and renovation of North and South Satellite Terminals, International Arrival hall is scheduled to take place near future. Estimated price for these projects is $4 billion. As SeaTac Airport keeps adding flights and breaking passenger records, the Aviation Department is making plans to build a new terminal. The Sustainable Airport Master Plan includes 30 projects, roughly estimated to cost $4 billion, to add capacity to the airport by 2027. A second phase, which doesn't have a cost estimate, would add facilities to meet the airport's projected needs in 2035.

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About the author

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Appendix: List of Capital Improvement Projects (CIPs) [4]

1. Satellite Transit System (STS) Program ($157.6 million)

The Project is divided into 2 main elements.

a) Facilities Construction, renovation of North and South Main Terminal Stations, renovation to North and South Satellite Terminal Stations, renovation to Concourse B and C stations, extending the STS shuttle tunnel into the North Ground Transportation Lot, tunnel ventilation upgrades to meet NFPA130 and code required upgrades to the STS maintenance shop.

b) Refurbishment and replacement of the STS including vehicles and train control, communications system, and repairs of the tunnel guideway structure.

2. South Terminal Expansion Project (STEP) Program ($362.1 million)

This project will be the last major capacity expansion to the existing passenger terminal buildings. In general terms, the scope includes the rebuilding and expansion of Concourse A, a new south arrivals hall, expansion of the main terminal, a five story office structure, site and infrastructure work, baggage systems (BHS), and a concession distribution center. The South Terminal Expansion Project is one element of a STEP was major components include the demolition of the existing Airlines hangar, flight kitchen, and air cargo facility; relocation of Air Cargo Road; expanded cruise ship facility; substantial infrastructure upgrades; relocation of another Airlines hangar operations; construction of a new Airline hangar; construction of overnight aircraft parking; combined communication center; and, development of an airport-wide fuel hydrant system. When completed, Concourse A capacity will increase from 7 to 14 gates, all of which will accommodate variety of Boeing aircraft. On completion, the 2,100 foot long Concourse A will enhance and facilitate passenger convenience through the use of power walks, consolidated security checkpoints, and enhanced concessions. The common use facility will also improve the efficiency and capacity of the new ticket counters, gates, and baggage systems. The STEP also includes both the interim and permanent relocation of existing tenants located within Concourse A, the PanAm hangar, and portions of Concourse B. The project also includes the required relocation of boarding bridges, the existing aircraft lavatory dump station, and the Olympic fuel farm booster pump.

3. Terminal/Tenants Work Program ($154.5 million)

Scope includes redesign and construction of architectural, mechanical (HVAC, plumbing, fire protection) and the electrical (electrical systems, lighting, telephone, fire alarm) infrastructure required for the renovations of tenant-provided spaces. Costing also includes planning, administration (POS), legal, design, and construction management. Due to the dynamics of retail space improvements, scope also includes an allocation of funds into reserves for effort yet to be defined as well as funds allocated to other CIP's. For purposes of this analysis, there are 4 major funding segments defined as follows:

Segment 1, was under construction (as of March '99) and consists of upgrades to the central core retail space in both the North and South Satellites. Work includes infrastructure support for retail spaces plus POS improvements to the core area of the central retail space.

Segment 2, consists of infrastructure upgrades for retail spaces located in the North and South Esplanades and is allocated to the Central Terminal project.

Segment 3, is referred to as a reserve for future work. Included within this reserve is a portion of work that is currently defined for specific areas in the North and South Esplanades, Concourses B and D, and the South Baggage Claim area within this segment. This work is anticipated to be done in the 2001 and 2002 time frame.

Segment 4, represents a budget allotment for the Central Terminal Construction related to retail spaces.

4. Infrastructure Program ($294.5 million)

Emergency generators upgrade, Electrical System upgrade. HVAC renovations -1, Retrofit tanks 2, Direct Digital Control 2, Security Master Plan, Special Systems Implementation, Electrical System Infrastructure Projects, Mechanical Systems Infrastructure Projects, Water Infrastructure Projects, Sewer System Infrastructure Projects, Special System Master Plan.

5. Ground Access Program ($106.3 million)

North Employee Parking Lot - Phase I, Miscellaneous Access Improvements, Parking Revenue Control System, Public Parking Terminal Design & Construction Parking Terminal Major Maintenance , GA Parking Revenue Control System, Road Upgrades, Courtesy Van Plaza, ILA Landscaping (3 projects), Roadway Signage, Helix Beam/Core Water Proofing, 3rd Floor Van Structure Improvement.

6. Third Runway Program ($433.2 million)

New Runway Project Management, New Runway Preliminary Planning/Design, Safety Areas 16R/16L, Safety Area Land Acquisition, New Runway Land Acquisition, Taxiway Connections for 3rd Runway, 3rd Runway Embankment, FAA & Navigation Aids.

7. Airfield Program ($184.8 million)

Apron Pavement Rehabilitation-l, Pavement Improvement Runway 16R, ARFF Training Facility, IWS Improvement/Construction-l, Hydrant Fueling Study, Apron Pavement Rehabilitation -2, Taxiway Pavement Replacement, Hydrant Fueling Preliminary Planning,

IWS Lagoon #3, Joints Resealing-2, Airfield Lighting Reconstruction, FAA ATC Tower Interface, Transitional Navaids, Hydrant Fuel Construction, Cargo Hardstands, Phase-1 Maintenance Building, Lake Reba Outfall.

8. Program Management/Finance/Budget ($211.1 million)

Small Projects, PMG Offices, Management Reserve ($100 million), un-programmed projects ($100 million)

9. Other: FAA Control Tower

The FAA designed and built a new Control Tower on the north side of the airport at a cost of $19.6 million to handle the ever increasing air traffic at SeaTac airport. The new Air Traffic Control Tower and Support Services Building accommodates air traffic controllers, supervisors and support personnel for the increased activity. Maximum visibility and radar effectiveness were provided in the 285-foot tower. Airfield work tied all cables, drains, water and sewer at the interface point in the field.