Communicating Constraints: Schedule Baseline and Recovery Measures on the Hong Kong Airport Projects

Jhan Schmitz, International Bechtel Incorporated

PMI *Proceedings*, 1995, pp. 121-28

Synopsis

This case describes the Hong Kong Airport core program, a $20.4 billion (United States' dollars) project. The author provides a report on the development of the project as of the second quarter of 1995 and discusses the scheduling, stakeholder, procurement, and political challenges which the project is facing. The case gives a background description of the project and analyzes ten of its subprojects. The author also describes the management methodology and conflict resolution techniques applied to meet the administrative challenges found in the project.

Learning Objectives

Through this case, the students will be able to explore the importance of using project management in mega-projects, the relations between different components of huge projects, dealing with complex governmental agencies, and the "top-down/bottom-up" management methodology. From the discussion of this case, the students should better understand:

- a project organization
- the impact of control/schedule management
- the importance of the scope definition
- the management of a very complex and international project.

Discussion Questions and Possible Answers

1. What are the main objectives of this project?
   a. To manage the overall project to include the ten subprojects with the 200 contractors sponsored by four different sources on time within budget, meeting technical objectives mindful of the political constraints.
2. The Hong Kong Airport core project (ACP) is one of the largest projects undertaken in the late Twentieth Century. It is made up of several segments, each of which could itself be considered a major project. What kind of organizational structure is used in this project? How does the job of project manager differ from that of the entire ACP project and one of the segments?

a. An example of this projectized organizational structure is depicted in Figure 2-8 in the PMBOK, section 2.3.3, Organizational Structure, where each project manager has his own organization and responds to a chief executive. In many ways there would be little difference in project manager jobs. The project manager for the ACP project must coordinate all of the segments and assure that their schedules coordinate just as a segment project manager must assure that the project adheres to the schedule for her project. The only significant difference is the level of complexity of tasks on which the project managers must focus, for example, handling the political aspects of the project and coordination of all of the subprojects.

3. Explain the "top down/bottom up" management methodology described in the case. Relate this to the scope management of the project.
   a. The methodology described can to be directly related to the scope definition of the *PMBOK Guide*, section 5, specifically, section 5.3, Scope Definition, defined as subdividing the major project deliverables into smaller manageable components, and 5.4, Scope Verification, which is defined as formalized acceptance of the scope. This is described in the case study as establishing program level objectives, getting these endorsed by the proper agencies, and setting these as targets for the project segments.
4. The method for physical progress measurement is detailed in the case. This method allows for all segments of the project to be aggregated for an overall project measurement of project completion. How does this method differ from the *PMBOK Guide*, Chapter 6, Project Time Management, methods, and why do these difference exist?
   a. The methods used by the ACP project managers allow for a gross level completion analysis by looking at individual project status and not task status. Because of the size of the ACP project, activities and tasks cannot be individually linked on the project level, except on a very detailed level. However, the methods described in the *PMBOK Guide* can be used for the subprojects and the general methods for schedule control described: updates, corrective actions, and lessons learned.
5. Why must this project be managed from a change control/schedule perspective?
   a. It is necessary to monitor the influential factors as described in *PMBOK Guide*, section 4.3, Overall Change Control. This is done in order to create the necessary changes in the project to guarantee the schedule, making sure that the deliverables are on time despite influencing factors. Specifically, if this is not done we will see increasing costs, delays in the interrelated projects, and political conflict and thus great difficulties throughout the ACP project. An example of this is the problem which was faced when the electrical power project was behind schedule and other projects requiring that power were affected.

›ITIONAL DISCUSSION POINTS:

This project has an important role in the Sino-British relationship regarding Hong Kong. The ACP requires resources from both parties and its impact will be carried out through the next century. The Chinese and British governments are two important stakeholders in this project. Students can research the literature and identify additional stakeholders.

Communicating Constraints: Schedule Baseline and Recovery Measures on the Hong Kong Airport Projects

Jhan Schmitz, International Bechtel Incorporated

PMI *Proceedings*, 1995, pp. 121–28

Introduction

This paper presents the background, overall parameters, and current status of the complex $20.4 billion Hong Kong Airport Core Program (ACP). It describes scheduling, interface management, and conflict resolution techniques applied to meet the significant challenges and constraints of the ACP.

Background

The existing Hong Kong airport at Kai Tak is a single-runway airport built on a finger of reclaimed land pointing into the sea, surrounded by hills and the dense urban development of Kowloon, and cannot be expanded. It is the third busiest international airport in the world, and Asia's busiest, with passenger volume growing at upwards of 10 percent per year. It will reach operational capacity as early as 1996. In addition to operational limitations, building height restrictions have been imposed along and adjacent to the urban-corridor flight path, and this has inhibited commercial and residential growth. Access between the western harbor container port area, prime commercial areas, and Kai Tak, which is also one of the world's busiest air cargo handling facilities, is constrained by a congested roadway system.

As part of an overall port and airport development strategy (PADS) to help assure Hong Kong's continued growth and position as the main commercial hub of Southeast Asia well into the Twenty-first Century, Hong Kong government approved development of a replacement airport in 1989. PADS also called for a five-fold expansion of Hong Kong's container port, already the world's busiest, with extensive transport links to connect the new port and airport with urban and industrial areas. The formal start of the new airport-related development of PADS occurred in September 1991, with signing of a memorandum of understanding (MOU) between Britain and the Peoples Republic of China. Under the MOU, it was agreed that the essential, or "core," scope of the new airport and transport links (airport core program—ACP) would be completed to the "maximum extent" possible by the midnight, June 30, 1997, transfer of sovereignty of Hong Kong to the Peoples Republic of China.

Notwithstanding the 1991 authorization to proceed with the ACP, major political issues related to debt financing of the new airport and its rail link;

creation of the airport authority as a statutory (public) corporation; and approval of contracts and franchises spanning the transfer of sovereignty were not substantially agreed between the British and Chinese sides until June 1995. Political delays had the effect of continually compressing the schedules for the airport and airport railway in regard to the June 30, 1997, target, until the point when this target was no longer physically realistic. This led to implementation of a multipath approach for the ACP, whereby sequential completion of the transport infrastructure projects remained targeted at not later than June 30, 1997, a target which ultimately became firm and fixed. However, the completion schedules for the airport and airport railway required reprogramming.

The first path included a control baseline of all project elements which were funded and in progress. Overall program objectives and key dates to meeting completion of these elements by June 1997 in accordance with the MOU were rigidly maintained. The second path included all unfunded project elements delayed due to external constraints. These elements were initially scheduled in terms of sequences and durations independent of the first path. As critical decisions were reached, the second path converged with the first path and was reintegrated with the overall ACP program plan and master schedule. The completion dates for such elements were then established using approved schedule sequences and durations from the points of political and funding approval, and contract award and commencement. This approach required a continuous cycle of baseline updating, including risk assessment and contingency planning; repackaging and resequencing of contract works and interfaces; and transfer of scope between projects. Communication of constraints, both internal and external; early identification of potential variances and conflicts; and proactive problem resolution have been essential to the success of the ACP.

Scope and Parameters of the ACP

The magnitude and complexity of the ACP are unprecedented in Hong Kong. Indeed, the ACP is one of the most extensive developments undertaken in the late Twentieth Century. The ACP comprises ten interrelated projects (over 200 contracts) being performed by four separate sponsors, each of which represents a large and complex development, which must be managed individually and in concert to meet the prime objective of completion within time, political, and budget constraints. The ACP projects include the first phase of the new airport and a new town adjacent to the airport; transport links extending between the airport and central Hong Kong; and extensive land reclamation to support these transportation facilities and to provide an attractive environment for commercial/residential development.

As of June 1995, progress on the ACP overall stood at approximately 35 percent complete. The seven government-sponsored transport infrastructure projects were at 62 percent complete, and the new harbor tunnel sponsored by a private franchisee, which connects the ACP expressway system to Hong Kong Island, also considered an essential part of the transport infrastructure, was approaching 50 percent complete. The transport infrastructure projects are on target for completion and commencement of operations before June 30, 1997. The operational targets for the airport and airport railway, being sponsored by government-owned public corporations, are now April 1998 and June 1998, respectively.

The site of the new international airport in Hong Kong is Chek Lap Kok, an island just off the village of Tung Chung on the northern coast of Lantau Island. Land for the airport was formed by leveling Chek Lap Kok and Lam Chau islands, and using the excavated materials along with marine-won sand to reclaim the additional land areas required.

The new airport, which is being developed and will be operated by a new statutory (public) corporation—the Airport Authority—owned by Hong Kong government, will initially have one runway in twenty-four-hour operation at opening, capable of handling a capacity of thirty-five million passengers and 1.5 million tons of cargo annually. The second runway, together with phased expansions of terminal and related facilities, will be operational according to air traffic demands. At ultimate capacity, planned for the year 2040, the airport will handle approximately eighty-seven million passengers and nine million tons of cargo annually.

Formation of the 1,248-hectare airport island and terminal foundation construction are now nearing final completion. The terminal construction contract and major systems contracts were awarded and commenced in 1994/1995. Overall, work on the airport was approximately 36 percent complete as of June 1995.

Physical construction of the airport is on track for completion in September 1997, to be followed by an extensive airport operational transition phase. The critical path to operations runs through privately financed franchise services such as air cargo, aircraft maintenance, and fuel supply. These services, which are essential for airport operations, have been significantly delayed in the political approval process.

The total budget for the airport is approximately $9.1 billion, including core airport facilities being constructed under sponsorship of the Airport Authority; government facilities such as the air traffic control center; and franchise services. Of this total, approximately $5.5 billion of funding has been approved, covering the government facilities and the maximum amount of equity that can be injected into the Airport Authority by Hong Kong government in accordance with prior political agreements. The remaining portion of the budget is to be financed by Airport Authority debt and pre-completion revenue, and private funding for franchises.

The political controversies to date have primarily centered on issues of funding and financing. These controversies have led to delays in the award of critical contracts and franchises, and have impacted the overall program. The revised opening date target, inclusive of minimum-capacity operating elements for franchise services, is now April 1, 1998, based on the results of re-programming and the recent agreement by the British and Chinese sides on airport financing and franchises.

Phase 1 Tung Chung New Town

The North Lantau development is a supporting community for the airport at Chek Lap Kok with a long-range target population of 260,000 by the year 2010. The Phase 1 Tung Chung New Town project is the initial part of this development and includes site formation and infrastructure for part of the new town. It will contain public and private high-density housing for approximately 20,000 residents by 1997 and local retail and commercial facilities.

Site development works have been completed, and housing and commercial construction commenced in 1994. The Phase 1 Tung Chung New Town project was 46 percent complete as of June 1995.

North Lantau Expressway

The North Lantau Expressway (NLE) is a dual three-lane expressway, approximately 12.5 kilometers in length on earthwork formation of reclamation and cutting. It provides a connection from the western end of the Lantau Fixed Crossing along the Lantau Island coastline to the airport and the new town at Tung Chung. The scope of work for the NLE project includes a utility reserve adjacent to the expressway alignment and site formation for the airport railway along the expressway. Construction started in May 1992 and is scheduled for completion in October 1996. The NLE project was 76 percent complete as of June 1995.

Lantau Fixed Crossing

The Lantau Fixed Crossing (LFC) project provides a fixed link accommodating an expressway and a high-speed railway between northwest Tsing Yi Island and the North Lantau Expressway at Tsing Chau Tsai on Lantau Island on the west. The LFC represents the most critical ACP transport link. The basic scheme includes a suspension bridge crossing the Ma Wan channel (the Tsing Ma bridge) with an overall length of 2,200 meters; viaduct structures to carry expressway traffic across Ma Wan Island; and a cable-stayed bridge over the Kap Shui Mun channel from Ma Wan to Lantau Island, linked by viaducts crossing Ma Wan Island. The Tsing Ma bridge will be the world's longest suspension bridge carrying both road and rail traffic on the same structure.

This project includes a toll plaza, maintenance depot, automated traffic control center, and administration buildings at the junction with the North Lantau Expressway on the west and a major interchange with Route 3 on the east. Although sponsored and funded by Hong Kong government, operation of the bridges may eventually be privatized. Construction started in May 1992, and LFC commissioning is scheduled for completion in May 1997. As of June 1995, the LFC project was 66 percent complete.

Route 3 (Tsing Yi and Kwai Chung Sections)

Route 3 will ultimately provide a direct north to south link within the territory, serving cross-border traffic with China. Development areas in the North West New Territories, the expanding container port at Kwai Chung, as well as growing traffic in West Kowloon and Hong Kong Island will also be served. The Tsing Yi and Kwai Chung sections of Route 3, which link the Lantau Fixed Crossing to the West Kowloon Expressway, form an important section of the road access to the airport. ACP-related Route 3 construction started in February 1993, with completion targeted for December 1996. The expansion of Route 3 from the LFC interchange to the Chinese border will be undertaken as a privately funded venture, starting in 1995. The ACP-related Route 3 works were 53 percent complete as of June 1995.

West Kowloon Reclamation

The West Kowloon Reclamation (WKR) project reclaims approximately 330 hectares of land along the West Kowloon waterfront from Yau Ma Tei to Lai Chi Kok to provide land for planned major transportation infrastructure

works and other developments. The reclamation includes formation of new breakwaters and seawalls, and reprovisioning of all affected waterfront uses. The WKR project provides reclaimed land for transport links to the airport according to target dates required by various transport infrastructure projects. These links include the West Kowloon Expressway, the Route 3 highway facilities, the Western Harbor Crossing, and the airport railway and its associated Kowloon station. In addition, the WKR project seeks to form commercially attractive packages of land that will support early generation of development revenue. Reclamation works commenced in 1991, and land formation is being phased, with final completion by 1996. West Kowloon Reclamation works were 83 percent complete as of June 1995.

West Kowloon Expressway

The West Kowloon Expressway (WKE) project is a portion of Route 3 to be constructed on the West Kowloon Reclamation platform. It runs from the northern limit of the Western Harbor Crossing toll plaza to the southern limit of the Kwai Chung viaduct (Route 3 project) as a dual three-lane expressway. It is linked to the airport via the Lantau Fixed Crossing, the North Lantau Expressway, and Route 3 (Tsing Yi and Kwai Chung sections). Construction commenced in July 1993, with completion by October 1996. Progress as of June 1995 was 47 percent complete.

Western Harbor Crossing

The Western Harbor Crossing (WHC) project will provide a 2-kilometer-long (portal to portal), dual three-lane-immersed tube crossing of the western harbor, from the West Kowloon Expressway to the local road network on Hong Kong Island, and will allow direct expressway access between the airport and Hong Kong Island. This design/build project includes ventilation buildings at each end of the crossing, as well as a toll plaza, automated traffic control center, and administration buildings. The project is being implemented by a private franchisee who is financing, designing, constructing, operating, and eventually transfering the facility to Hong Kong government. The WHC franchise was approved by the Chinese side and construction started in mid-1993. Commissioning is scheduled for June 1997. As at June 1995, the Western Harbor Crossing was 48 percent complete.

Phase 1 Central Reclamation

A 20-hectare area on the harborside of the Central district of Hong Kong Island is to be reclaimed to provide a platform for construction of the Hong Kong terminus of the airport railway. This project also includes approach and overrun tunnels, together with efficient vehicle and pedestrian access routes to connect the terminus with existing transport infrastructure and other commercial developments. Central Reclamation works commenced in mid-1993, approximately one year later than planned due to delayed agreement by the Chinese side. The delay directly impacted the program for the airport railway.

Airport Railway

The airport railway is being sponsored by the Mass Transit Railway Corporation (MTRC), a statutory (public) corporation owned by Hong Kong government which operates the current subway system in Hong Kong. Two services will be operated. The airport express line is a dedicated airport service which

will extend 34 kilometers in length from the airport at Chek Lap Kok via Tsing Yi and West Kowloon to the Central district of Hong Kong island. The airport express line, with a planned transit time of twenty-three minutes, is specifically designed to attract a high proportion of airport passengers. Four stations are planned at Central (with future provision for in-town airport check-in facilities), West Kowloon, Tsing Yi, and the airport where the station will be located in a separate ground transportation center complex adjacent to the terminal building. The Lantau line will provide a domestic service on the same route to the new airport support community at Tung Chung. This line will initially serve six stations, and will help relieve congestion from the existing system between Central and Kowloon, which is one of the world's heaviest-traveled subway sectors.

Along its route, the airport railway is dependent on all other ACP projects, with the exception of the Western Harbor Crossing, to provide essential infrastructure works which are necessary for the construction and operation of the railway, such as the lower rail deck and track form across the Tsing Ma bridge. In order to preserve the physical alignment of the airport railway and mitigate the impacts of schedule delay, a significant number of works items originally to have been undertaken by the Mass Transit Railway Corporation (MTRC) were transferred to government-sponsored transport infrastructure projects as "advance works."

The completion of the airport railway was originally targeted at June 30, 1997, per the MOU. However, award of critical contracts was delayed until late 1994 following initial approval of project financing by the Chinese side; final approval was not forthcoming until June 1995. While a significant amount of schedule delay had been absorbed through re-programming efforts and transfer of scope, the ultimate effect of delay was a formal shift in the completion target for the airport railway by one year, to June 30, 1998.

All major contracts have now been awarded for the airport railway. A separate immersed tube tunnel is under construction for the airport express line from West Kowloon to the Hong Kong Central terminus, and construction of airport railway stations has commenced. Overall progress on the airport railway was 13 percent complete including "advance works" as of June 1995.

ACP Program Management Organization

Hong Kong government has established the New Airport Projects Coordination Office (NAPCO) to undertake overall program management and coordination of the multiproject ACP on its behalf. NAPCO is comprised of an integrated team of Hong Kong government personnel and International Bechtel Incorporated consultant staff. NAPCO reports directly to the Airport Development Steering Committee (ADSCOM), which is the executive decision-making body ultimately responsible for the ACP, and for coordinating policy issues with regard to the ACP projects.

ADSCOM is chaired by the chief secretary, whose executive authority is secondary only to the governor in Hong Kong, and membership includes government secretaries, such as the Secretary for Works and Financial Secretary, who are responsible for ACP matters in their respective policy areas.

The individual ACP projects are assigned to "works agents" for project-level planning, execution, control, and management. Works agents are Hong

Hong Kong government works departments and non-government ACP participants, such as the Airport Authority and MTRC, with direct responsibility for completing ACP projects within the framework of the baseline scope, master schedule, and budget developed and implemented by NAPCO, as approved by ADSCOM.

NAPCO's responsibilities are to ensure adherence by the works agents to the terms, conditions, and constraints dictated by the requirements of the approved baseline implementation plan for the ACP, and to act as a focal point for the management of project interdependencies and interfaces, and resolution of conflicts, changes, and claims which have a potential program-level impact.

ACP Program Management Methodology

A comprehensive integrated program/project control approach and system have been devised and implemented by NAPCO for the ACP. Details of the approach and system, including controls, administrative, and reporting requirements, are contained in a set of procedures and standards which all works agents must implement and adhere to under NAPCO guidance. Additionally, Hong Kong consultant agreement provisions and general conditions of contract for construction works have been revised to increase the level of schedule visibility and control, to ensure contractor participation, and to streamline decision-making processes in regard to dispute resolution, changes, and claims.

The overall management methodology is "top-down/ bottom-up," where ACP program-level objectives are established by NAPCO, endorsed by ADSCOM, and adopted as baseline targets at the project and contract levels through the works agents. Progress and status details are analyzed against the targets and progressively summarized upward through the works agent project offices to NAPCO.

Baseline Planning and Implementation

The basic control tool at the program level is the formal ACP baseline implementation plan approved by ADSCOM, which sets out a clear definition of the scope and budget of each ACP project as well as master milestone and interface schedules to execute them; project and contract scope, packaging, schedules, and budgets are developed by the works agents within the framework of the overall ACP baseline implementation plan, subject to NAPCO approval.

The ACP baseline implementation plan provides a comprehensive road map at the overall program level to point the projects toward their interim milestones, interface handover dates, and completion targets. It is the basic "original control" frame of reference by which NAPCO monitors the projects, detects and resolves problems, and is the prerequisite for program-level change control. The ACP baseline implementation plan is updated periodically to incorporate formally the effect of commitments and changes approved since the previous plan update, and to provide an opportunity for formal risk and contingency assessment, and reprogramming as necessary to meet ACP objectives.

A "current control" baseline is also maintained on a more contemporaneous basis by NAPCO, to reflect day-to-day contract variations and works schedule revisions as they are approved by the works agent project offices in accordance with ACP procedures. Where such revisions potentially impact program-level interfaces and milestones, prior review and concurrence by NAPCO is required. The "current control" baseline is then resolved into the overall ACP baseline implementation plan during the next following plan update cycle.

ACP Schedule Controls

Given the constraints, complexities, and interdependencies of the ACP, as well as the fact that interim delays will often have a cost implication, schedule control is the centerpiece of ACP program and project control. An integrated hierarchy of schedules has been developed by NAPCO for the ACP, in line with the "top-down/bottom-up" management methodology. This hierarchy, which has been implemented at all levels using a computerized critical path method (CPM) scheduling system, extends from detailed contract works schedules to project, interface, master program, and executive summary schedules. The ACP schedule hierarchy at the lowest level of detail will encompass upwards of 225 construction contracts and 350,000 activities at peak. Approximately 25,000 activities and 1,100 major interfaces will be maintained in the master program at peak.

Each schedule is statused monthly or more frequently as may be required by NAPCO against both the "original control" and "current control" baselines to indicate progress to date; report earned value, resource utilization and quantity completion; and forecast the work remaining in relation to milestones, targets, and key dates. Potential interface conflicts and program problem areas are flagged and addressed in critical item action reports for resolution via NAPCO.

Physical Progress Measurement

While concentration on monitoring of exceptions at control points such as interfaces is a primary program management technique, overall progress measurement has also been important for establishing acceptable parameters of progress and for schedule trending. However, an acceptable method is sometimes difficult to achieve consistently on an undertaking such as the ACP, given program complexities and multiple sponsors.

The physical progress measurement approach implemented by NAPCO at the integrated program level is somewhat unique. Each works element (or milestone with its attendant path of predecessor activities) within a construction contract schedule is summarized from its constituent detailed activities and weighted by its agreed dollar value (engineer estimate or original contract value for the "original control" baseline, and current contract value inclusive of executed changes for the "current control" baseline comparison). Actual physical progress for each works element is then determined monthly based on the duration from actual start through time-now, versus the total duration from actual start through the forecast finish date calculated from remaining duration, as reported in the latest status update of the contract schedule. The resulting duration-based percentage is then applied to the weighting for the given works element and divided by the total weighting for the element. Works element progress is aggregated to the contract level,

contract progress to the project level, and project progress to the overall program level. Progress measurement results using this approach have a range of accuracy consistent with more conventional contract-level methods based on quantities or manhours.

Schedule-Based Risk Assessment

Within the "top-down" framework of fixed program completion objectives and constraints, schedule development has been iterative, and a significant amount of reprogramming has been necessary via NAPCO coordination, given political, administrative and technical delays, to keep the ACP on track.

Schedule-based risk assessment has been used to advantage by NAPCO and works agents in necessary reprogramming efforts. For example, a series of comprehensive risk assessments jointly conducted by NAPCO and the Airport Authority on the airport schedule, with a constrained June 30, 1997, opening date target, identified significant risks on paths through terminal building construction, testing, and commissioning. Based on the results of these assessments, risk mitigation plans were developed and implemented. Mitigation measures included repackaging of contracts for more effective sequencing; a further study of modular prefabrication and construction of terminal structural elements; development of a separate systems integration contract package for terminal specialist systems and equipment; and plans for authority-supplied construction support facilities and services to reduce mobilization periods and enhance construction efficiency by ensuring the supply and availability of construction commodities such as concrete.

TERFACE MANAGEMENT AND CONFLICT RESOLUTION

NAPCO has the authority to direct program-level changes such as ordering acceleration for construction schedules to meet overall program objectives. The final decision in regard to acceleration and other program-related measures lies with NAPCO.

As a matter of policy, early notification of all matters likely to cause delay to the works is required so as to maximize the opportunity for early corrective action, given the degree of importance attached to the overall objective of timely completion of the ACP.

The obligation to notify includes all program, project, and contract participants, and is triggered by the event being foreseen or occurring rather than by delay actually being caused.

Acceleration measures are those actions to achieve completion of the works or a section of the works earlier than a key date or milestone stated in the contract, or to reduce an extension of time to which the contractor may be entitled. Typical reasons for acceleration include situations where an extension of time significantly increases the schedule risk on overall ACP completion objectives; the prolongation costs associated with an extension of time are greater than anticipated acceleration costs; an interfacing contract requires an earlier handover from the preceding contractor; and/or the end-user requires earlier access.

In cases when the contractor is in delay and not entitled to an extension of time, and the progress of the works appears insufficient to ensure timely completion of contractual key dates and milestones, the works agent is required to

instruct the contractor to expedite progress and provide recovery schedules. The contractor is not entitled to additional payment under such an instruction, and indeed is subject to the disincentive of liquidated damages if contractual key dates are missed. If the contractor fails to properly implement the instruction to recover schedule, and the rate of progress remains insufficient, the works agent may suspend those works in delay and replace the contractor with another, to the account of the original contractor.

Except for relatively minor works, ordering of acceleration has not yet been required for the ACP. NAPCO has successfully worked with the works agents and contractors to recover from potential delay impacts, as exemplified by the following case.

The North Lantau Expressway (NLE) Tung Chung section contract includes 2.5 kilometers of dual three-lane expressway and 1.7 kilometers of two-lane utility service roadway. This section of the NLE project is constructed substantially upon reclamation formed under the Phase 1 Tung Chung New Town site formation contract. In addition, contract works include two major pre-stressed concrete bridges approximately 320 meters in length across the sea channel connecting Tung Chung and the new airport at Chek Lap Kok. The contract also incorporates works related to the airport railway, including the substructure of the airport railway's Tung Chung station.

NLE Tung Chung section contract works commenced on September 27, 1993. Completion of the works was contractually set at September 15, 1996, and subsequently revised to September 28, 1996, based on an extension of time claim granted by the works agent with NAPCO's concurrence. Although delays have been experienced for a number of works items, the contractor was instructed to recover such delays, and the contract is now forecast to complete per its revised schedule. From the perspective of the works agent sponsoring the NLE project, this is an apparently acceptable situation.

However, the commencement of construction of the airport railway Tung Chung station substructure, incorporated in the NLE Tung Chung section contract, was delayed. Although this delay did not have an adverse impact on the completion target for the NLE Tung Chung Section contract, there was a potential delay impact on the interface for installation of 132-kilovolt cables by a private utility provider, routed over the station box on the permanent power system alignment along North Lantau and across the sea channel bridges to the airport. From the NAPCO program management perspective, this is not acceptable.

Technical problems arising from the Phase 1 Tung Chung New Town site formation contract led to the late handover of site areas to the NLE Tung Chung section contractor, resulting in the contractor's successful extension of time claim. These technical problems, related to reclamation settlement and structural bearing capacity, forced the redesign of the station substructure by the Mass Transit Rail Corporation, in turn delaying construction commencement for the substructure. Additionally, the NLE Tung Chung section contractor's works progress fell significantly behind baseline schedule targets. Analysis of the contract and project schedules by NAPCO and the works agent, combined with joint planning reviews involving the utility provider, indicated a potentially critical schedule impact.

NAPCO developed a number of options to mitigate the effects of potential delay, so as to ensure that permanent power would be available to the airport in time for testing and commissioning to proceed. It was finally determined that

structure area offered the best option to recover from delays and mitigate risk.

NAPCO took a proactive approach with the project participants toward resolving a potential schedule variance problem before it became critical and impacted the overall program, providing an alternative solution which minimized cost and schedule impacts. If this action had not been taken, there could have been serious consequences to supplying permanent power to the airport.

Conclusion

The ACP is a complex undertaking requiring the application of enhanced program and project management. The methodologies and basic set of controls, including the schedule baseline and recovery measures described in this paper, have been implemented successfully, and are providing the tools to achieve the prime objective of ACP completion within time, political, and budget constraints.

Study Questions

Communicating Constraints: Schedule Baseline and Recovery Measures on the Hong Kong Airport Projects

1. What are the main objectives of this project?
2. The Hong Kong Airport Core Project (ACP) is one of the largest projects undertaken in the late Twentieth Century. It is made up of several segments, each of which could itself be considered a major project. What kind of organizational structure is used in this project? How does the job of project manager differ from that of the entire ACP project and one of the segments?
3. Explain the "top down/bottom up" management methodology described in the case. Relate this to the scope management of the project.
4. The method for physical progress measurement is detailed in the case. This method allows for all segments of the project to be aggregated for an overall project measurement of project completion. How does this method differ from the *PMBOK Guide* Chapter 6, Project Time Management, methods, and why do these differences exist?
5. Why must this project be managed from a change control/schedule perspective?