Seven Techniques for Project Control in a Functional (Matrix) Environment

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Most companies today are organized by functional department to optimize the efficiency of their primary business activities. A housewares distributor, for example, supplies products to retail outlets. Its many functional departments include order entry, purchasing, receiving, warehousing, inventory management, shipping, and billing. To maintain competitiveness, from time to time they review their procedures and improve them. This review and improvement effort is a project (defined as, "An effort that produces an end product or result at its conclusion") and it operates in a matrix management structure, that is, the project borrows individuals from the affected functional departments to perform the work. Figure 1 shows three projects borrowing workers from their functional departments.

Figure 2 illustrates the department/project matrix structure of the same projects.

Many people believe that the matrix structure is a major cause of project difficulty because functional department managers can interfere with the project schedule when pressing department business conflicts with the borrowed worker's project commitment. Some people believe that the solution is to reassign the project workers to a project organization, completely removing them from their functional departments. Creating a separate project structure for each project, however, particularly when there are many concurrent projects, is disruptive to functionally organized companies because it completely removes workers from the primary activity of the business and can impact productivity.

The matrix-management-is-the-problem argument fails, however, in light of the fact that most large engineering and construction companies are also organized by departmental function, yet have excellent project success records with the matrix structure as demonstrated by the fact that they are profitable and stay in business. In general, companies that do projects for outside clients (often referred to as contractors) appear not to be hampered by the matrix structure while companies that do inside client projects (mainly product and services companies) are. Is it possible to apply the project management processes and techniques employed by successful contractors to overcome the matrix management difficulties of inside client projects?

This paper will discuss the accelerating growth in the size and number of inside client projects in product and services companies leading to the intense interest today in project management. We then divide the world of projects into four categories because the lessons one can learn from contractors and where they can be applied in product and service organizations vary by project category. Finally we suggest seven techniques used by organizations performing projects in the successful categories that can be either adapted or simulated to bring about performance improvements in projects in other categories

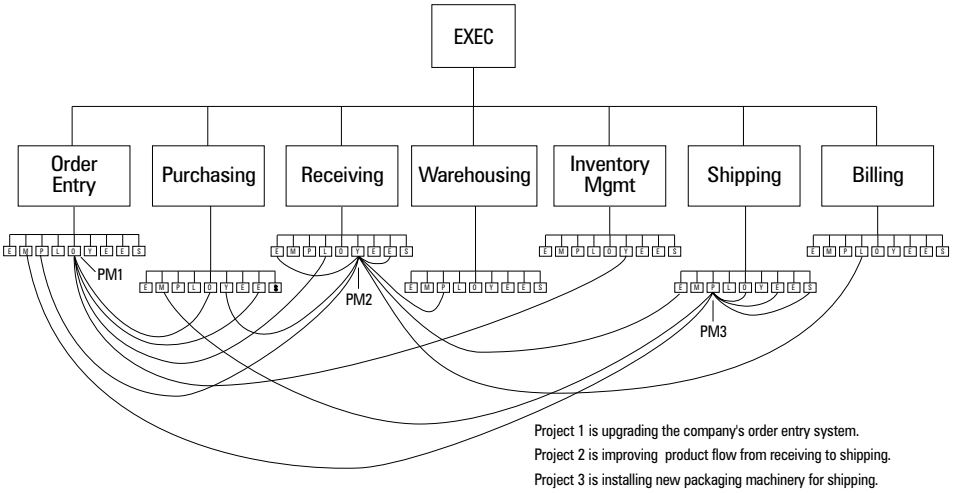
The Accelerating Growth of Interest in Project Management

Since the 1960's foreign companies have been flooding US markets with inexpensive products, putting tremendous competitive pressure on US producers. The 80's and 90's saw massive flows of capital out of the US and other first world countries into 3rd world countries to access the same cheap labor and natural resources in order to stay competitive. During the same period deregulation of airlines, banking, brokerage, insurance, communications, and utilities have brought tremendous competitive pressure to service industries.

Increasing competitive pressure on product and service industries over the last 35 years has forced these companies to take ever more drastic steps to cut costs and increase productivity to maintain market share, fueling the quest for improved quality, consolidation of operations, business and process re engineering, downsizing, and exporting of manufacturing operations along with jobs to lower overhead labor pools. All of these changes are projects, but not for outside clients. These are inside client projects.

Coincidentally The Project Management Institute (PMI) was founded during this period, 25 years ago. PMI is a world wide professional organization whose mission is to advance the practice of project management. Its

Figure 1. Housewares Distributor Functional/Matrix Project Organization



membership over its 25 years has been growing at an accelerating rate, quadrupling from 1984 through 1995 (Table A), and the number of its members certified as Project Management Professionals (PMP's) has grown by a factor of 100 over that same 10 year period (Table B).

Note that the percentage increase in membership increased each year with the last 11 months of 1995 increasing 38.1%. We suggest that the accelerating increase in interest in project management in the past 25 years is largely fueled by the increase in the number and scope of internal projects by the product and service industries, compounded by the tremendous cost overruns and poor outcomes they have experienced.

Table C summarizes PMI's current membership by industry dividing the figures into members from organizations that perform projects for outside clients such as engineering, construction, and defense contractors, and architects, with organizations that perform projects for themselves (inside clients) like manufacturers, distributors, financial services, communications, and natural resources companies. Over twice as many PMI members come from companies that perform projects for inside clients reflecting, in the authors' opinion, the increasing quest for help from those industries.

Who is Successful and How do They Run Projects?

Let's examine a typical medium size construction firm. Fort Myer Construction in Washington, DC builds roads, highways, streets, and airport runways in the DC area. They are site contractors doing excavation (the new terminal at Washington National Airport), conduit for electric lines, storm sewers, sanitary sewers and water lines. They do concrete work for bridges, roads, and monuments (the Vietnam War Memorial). Their projects are typically 6 months to 1-1/2 years, 30 to 40 people with a core group of 10 people, $100K to $15M. Fort Myer employs up to 600 people at any point in time.

Fort Myer's clients are external and their relationships are all arm's length through contracts in real dollars. They compete for each job in a bidding process. Their bids are prepared by professional estimators, some of the most experienced people in the organization. The client will not sign a contract without a detailed project plan showing the schedule of costs and completion dates, and insists on weekly or monthly status meetings with the project plan updated. In the company's early years they hired an outside firm to do their project administration. They would prepare the project plans, track progress, and provide reports for the status meetings. Today they employ a Project Administrator full time to prepare the plans with input from the project managers and their teams, track progress, and provide status reports.

Fort Meyer, like most other large firms that do projects for outside clients, is functionally organized. They contain departments that specialize in concrete work, asphalt, pipe work, brick, framing, excavation, etc. If they don't have the expertise required they subcontract it. The project manager doesn't have hire/fire authority over the workers on their projects. They oversee the job and make sure it is built in accordance with specifications, meets administrative requirements, schedule, and budget accord-

Figure 2. Housewares Distributor Functional/Matrix Organization

Functional Organizations

		Order Entry			Purchasing			Receiving				Warehouse		
		A	B	C	D	E	F	G	H	I	J	K	L	M
Projects	Project 1	x			x				x		x		x	
	Project 2			x			x			x		x		x
	Project 3		x			x		x					x	

Project 1 is upgrading the company's order entry system.
Project 2 is improving product flow from receiving to shipping.
Project 3 is installing new packaging machinery for shipping.

ing to the contract. Personnel performance issues are handled through the superintendent. The project manager raises personnel issues and gets them resolved in weekly meetings with the president of the company and the superintendent.

The mission of the Fort Myer organization is to perform projects on behalf of their clients at a profit, to win every job as lowest bidder with the best quality in the shortest time frame. Every project organization within Fort Myer has the same mission.

Many engineering and construction contractors are like Fort Myer. They perform projects for outside clients and have developed the internal disciplines needed to ensure project success and a profit. Product and service organizations, in most cases, have yet to adopt many of the disciplines that serve the engineering and construction firms so well. Why? In order to answer this question we need to understand how product and service organizations evolved.

Why Product and Service Organizations Have Difficulty With Projects

At the turn of the century Henry Ford figured out that it would be faster and more economical to have his cars produced by assembly lines rather than craftsmen. The highly paid skilled craftsmen were phased out and their jobs divided into steps, each of which could be performed by a less skilled worker. The craftsmen's skills and intelligence were, in effect, built in to the process. Today's product and service companies all practice functional specialization for continuous process production of the same product because once the process to produce a product or service is defined and optimized, there is no more efficient way to deliver it, providing nothing changes.

But the very structure and culture that makes these companies so efficient at delivering the same product or service over and over is poorly equipped to deal with change or projects. Projects in these companies divert people from their familiar routine. Instead of working by the hour or day, people on projects must complete tasks. Projects demand problem solving skills and flexibility of the long departed craftsman, not required in the routine continuous process environment.

Until the recent acceleration in competition the highly profitable product and service companies performed fewer smaller projects and inefficiencies in their project management were not as noticeable on the bottom line. It is suggested that PMI's membership growth figures correlate with the increase in project related overruns and losses experienced by these companies over the same time period.

The Four Project Categories

Before we apply the techniques of engineering and construction contractors to the projects of product and service companies we need to further distinguish the kinds of projects they each do. Their projects may be divided into four categories, Table D.

The four categories are combinations of the following characteristics:

Recurring Projects involve activities that have been done before. Construction and engineering contractors build roads and buildings. Product and service organizations move people and/or equipment from one site to another, upgrade an assembly line, or install a new phone system. Recurring projects can always find people who are experienced doing the components (i.e. concrete and steel work, planning office space, installing machinery, wiring, plumbing, moving furniture and fixtures) who can provide accurate estimates and perform the work.

Table A. PMI 10 Year Membership Growth

Year	Year End Membership	% Growth
1984	4905	
1985	5272	7.5%
1986	5699	8.1%
1987	5882	3.2%
1988	6570	11.7%
1989	7356	12.0%
1990	7744	5.3%
1991	8413	8.6%
1992	8817	4.8%
1993	9804	11.2%
1994	12067	23.1%
11/30/95	16669	38.1%*

*'11/30/95 growth based on 11 months of 1995 only!

Table B. PMI 10 Year PMP Growth

Year	Accumulated PMP's
1984	41
1985	89
1986	104
1987	155
1988	264
1989	355
1990	483
1991	745
1992	1252
1993	2117
1994	3329
11/30/95	4164*

*'11/30/95 growth based on 11 months of 1995 only!

Unique Projects are usually product development or computer software development. In contrast to recurring projects a unique project involves one or more components that no one can estimate accurately from personal experience or historical data. Construction and engineering contractors , for example, build new weapons systems, product and service organizations develop new products or computer software. Unique projects require creativity and the more unique or complex the product the more difficult it will be to accurately estimate and control time, cost and quality.

Outside Client Projects are performed for another company or organization. The relationship of the performing organization to the client is arm's length through a contract in real dollars. The project organization usually competes for each job in a bidding process. Their bids are prepared by professional estimators, the most experienced people in the organization. If the project is successful the performing organization receives remuneration for its effort, if not they may lose money and the project participants may lose their jobs. Outside projects are usually performed by construction and engineering companies or contractors.

Inside Client Projects are performed for a client within the same company or organization. The relationship of the performing organization to the client is political. Documents of understanding or verbal agreements are used rather than financial contracts. The project organization is usually selected by management rather than through a bidding process and may receive recognition, bonuses, raises, and/or promotions if successful. If the project fails project participants do not lose money or their jobs. These projects are usually performed by product and service organizations to service the needs of the business.

The four project categories are combinations of the above four characteristics. In order of increasing difficulty they are:

1. Outside Recurring Projects

Usually performed by construction or engineering contractors for outside clients, every component of their projects has been done before and there are professional estimators on staff to help bid the job and assemble detailed project plans. The project management tool work associated with planning, tracking, and reporting status is performed by a Project Administrator, not the project manager. These projects have the highest probability of success.

2. Outside Unique Projects

Usually performed by a defense contractor developing a weapons system, a computer software contractor developing a system for a client, an architect, or a consulting firm helping a client. Companies that do these projects well have developed sophisticated techniques to protect themselves from loss due to unreliable estimates. These projects are somewhat more problematical than Outside Recurring projects but practitioners have developed techniques for ameliorating their risks.

3. Inside Recurring Projects

These projects primarily service the internal business needs of product and service organizations, and to some degree also appear in contracting firms. They may be moving people and/or equipment from one site to anoth-

Table C. PMI Members by Project Category

PMI 4/30/96 Membership Survey by Industry	Total Responses	Outside Client Projects	Inside Client Projects
Total Members	18534		
No. of Responses *	19107	5990	13117
Percent of Members	100 %	31%	69%

*3355 members affiliated with more than 1 Industry

er, upgrading an assembly line, or installing a new phone system. Inside Recurring Projects are staffed by workers borrowed from the primary business environment. These projects generally have poor track records because of their project management practices.

4. Inside Unique Projects

These projects service the internal business needs of product and service organizations. They are responding to the need to develop a new product or service, or to develop new computer software to support a process change. They are usually performed within an organization of dedicated project teams separate from the primary business activities of the company, in contrast to Inside Recurring Projects that are staffed by workers borrowed from the primary business environment. Outside Client companies that do these projects well share the risk of cost and schedule overrun with the client. Inside client projects, conversely, have no outside client to share the risks. Inside Unique projects suffer from both undisciplined project management practices and high risk. They are the most likely to generate the greatest cost overruns.

Inside Client products and services projects can benefit great;y from the project management practices of Outside Client contractors. In the following discussion we suggest ways to adapt or simulate some of the techniques that serve contractors so well.

Seven Techniques for Improving Project Control in a Functional (Matrix) Environment

1. Establish the Project Administrator Role

Outside Client organizations use Project Administrators to perform the project management tool work associated with planning, tracking, and status reporting. They recognize that the skills required to use a project management tool compliment the skills required to manage a project. Project managers, for example, are experts dealing with people and politics, and generally not proficient at tools. Project Administrators are experts with tools.

Table D. Project Categories

Type of Project	Outside Client	Inside Client
Recurring	1	3
Unique	2	4

Many Inside Client Project organizations, however, consider the project management tool skill part of the project manager's job and believe that their project managers cannot manage a project without using the tool themselves. They believe that if the project manager doesn't enter and maintain the plan with the project management tool then they don't own the plan. Outside Client project managers, on the other hand, don't have any problem owning a plan produced by their Project Administrator, they don't possess the skills to operate the tool, and they don't want to operate the tool.

Outside Client project managers have their Project Administrators build comprehensive detailed plans which enable them to identify every resource required and every expense to be incurred, dates when the resources will be needed and the expenses disbursed, and expected completion dates of all deliverables. They cannot properly bid the job without the plan and their clients will not sign a contract without it. Once under way the Project Administrator monitors progress and produces status reports which are used in weekly or monthly status meetings with the client.

Inside Client Project organizations need to establish the Project Administrator position to support the same planning, reporting, and accounting disciplines. A Project Administrator can support up to 30 projects concurrently. This eliminates the need for the project managers to learn a tool, ensures professional plans, controls the planning schedule, ensures that the plans conform to the organization's standards (format, terminology, common tools, templates), reconciles cross plan interdependencies and resource conflicts, reconciles the project team's bottoms up detailed plan with management's top down plan objectives, provides a focal point for project information for all levels of the organization, provides on time tracking and reporting, and mentors inexperienced project managers and project executives.

Savings are realized in project management tool training, tool licensing costs, and efficiencies derived from ad-

ministrative specialization and centralization. A Project Administrator can off load 10-20 percent of the work of up to 30 project managers, doing the tool work more efficiently, thus adding the equivalent of at least 3 project managers' productivity (10 percent of 30) to the organization.

2. Establish or Simulate Career Project Managers

Outside Client project managers spend 10 to 25 years on projects to become professional project managers. Inside Client Project companies are moving in that direction but their seasoned professionals are few and far between. Many companies still don't recognize the need for career professionals and believe that once a person has had some project management education, and/or been certified by a professional organization, they will be a satisfactory project manager.

Too often an Inside Client project manager, after successfully completing a project, is drawn back into the company's primary business activities, their project management experience never to be used again. Companies need to identify those who have been successful project managers, keep track of them, and reuse them. It takes time and experience to build professional project managers comparable to those found in Outside Client organizations.

Inside Client Project organizations can simulate the effect of many experienced project managers by leveraging the skills of their most experienced project managers. By making them Senior Project Administrators they provide planning, tracking, and reporting project management tool services for multiple project managers, but instead of the project manager directing the Project Administrator's activities, the Project Administrator mentors the less experienced project managers, ensuring that they build complete plans, track them properly, and provide effective reporting that helps to control the projects and keep everyone informed of status.

3. Unify the Project Mission and the Primary Business Mission in the Matrix Environment

Matrix management is successful for Outside Client contractors because the mission of their project is the same as the mission of the company. The worker may be hired and paid by a functional manager and directed by a project manager but their missions are consistent and there is no danger of the functional department manager borrowing the worker for another business purpose.

Inside Client Project organizations performing projects in a matrix environment create conflicting missions. People are borrowed from functional departments for the project while their departments continue to perform the primary business activities that generate revenue for the company. Projects suffer when both the department and the project need the same worker at the same time. Even when the functional department manager has signed an agreement specifying when the worker will be available, project managers still have difficulty holding them to their commitments.

The Senior Project Administrator described above can simulate the consistent mission environment in Inside Client Project organizations by elevating the reporting of information about the project's activities to the level of management to which both the functional and project manager report. That executive (who we will call the Project Executive) will have the perspective needed to balance the project mission with the primary business mission because they are responsible for the success of both. Figures 3 and 4 are examples of reports the Project Administrator can provide that enables the Project Executive to see any interference of functional department activity on the project without drawing the executive too deeply into the details. The Status by Project report summarizes late status of each of the projects. The Status by Organization report tabulates how much of the project lateness is owned by the resources reporting to each manager at every level of the organization. This report in effect maps the project organization onto the functional organization so that the project executive can address each functional manager's role in project status.

4. Ensure Worker Skills

Outside Client Project organizations are extremely sensitive to worker performance. They select people known to possess the needed skills and know what to expect for each job. Worker performance directly affects the profitability of the project and they have mechanisms to remedy performance issues.

Inside Client Project participants are frequently assigned to a project either because they are not busy or because their contribution to the primary business activity of their department is such that they can be spared. A program that incents managers to put the mission of their department above the interest of the project or above the whole organization will prevent the use of the most qualified candidates, or the reuse of individuals who have proven themselves on past projects and can make the greatest contribution. Upper management needs to structure its incentive programs to ensure that department managers act in the interest of the company, not just their department.

Outside client organizations keep track of people's skills so they can reuse those that have proven their abilities in subsequent projects. Inside client organizations of-

Figure 3. Status by Plan, Week Ending April 2

PLAN NAME	Pers-Days Behind (PDB)	Days Late (DL)	Percent Of PDB	Percent Of DL
HOMETERM	0.25	5.0	1.3%	1.5%
MSGCTR	0.00	0.0	0.0%	0.0%
OPERATNS	2.00	84.0	10.8%	24.4%
VOICE	0.10	5.0	0.5%	1.5%
OB3ML	1.70	7.1	9.1%	2.1%
IC1CS	0.00	0.0	0.0%	0.0%
IC1IRES	0.00	0.0	0.0%	0.0%
IC1NSW	0.00	0.0	0.0%	0.0%
IC1OST	0.00	0.0	0.0%	0.0%
IC1PECO	0.00	0.0	0.0%	0.0%
IC1ROP	0.00	0.0	0.0%	0.0%
IC1RTI	0.00	0.0	0.0%	0.0%
IC1VM	0.00	0.0	0.0%	0.0%
DP3CS	3.00	15.0	16.1%	4.4%
DP3NPL	0.50	25.0	2.7%	7.3%
DP3NSW	1.00	5.0	5.4%	1.5%
DP3OST	4.25	16.0	22.8%	4.6%
DP3PECO	1.00	5.0	5.4%	1.5%
DP3RTI	0.00	0.0	0.0%	0.0%
DP3VM	1.00	5.0	5.4%	1.5%
CHQHWP	3.30	162.7	17.7%	47.2%
CHQNPL	0.50	10.0	2.7%	2.9%
Total Lateness	**18.60**	**344.8**	**100.0%**	**100.0%**
Plans Reporting	**14.25**	**323.8**	**76.6%**	**93.9%**
Not Reporting	**4.35**	**21.0**	**23.4%**	**6.1%**

Figure 4. Status by Organization, Week Ending April 2

Department Managers & Team Leads	Number of Plans	Pers-Days Behind (PDB)	Days Late (DL)	Percent Of PDB	Percent Of DL
Daddona (Proj Exec)	22	18.60	344.8	100.0%	100.0%
Green13	4.25	65.3	45.2%	40.4%	
Dath	5	2.25	60.3	23.9%	37.3%
Curran	2	2.25	60.3	23.9%	37.3%
Cavalluzzo	0	0.00	0.0	0.0%	0.0%
Garcia	1	2.25	60.3	23.9%	37.3%
Pigat	1	0.00	0.0	0.0%	0.0%
Driscoll	0	0.00	0.0	0.0%	0.0%
Nichols	0	0.00	0.0	0.0%	0.0%
Phung	2	0.00	0.0	0.0%	0.0%
Swetz, Stueck	2	0.00	0.0	0.0%	0.0%
Kersten, Rose	1	0.00	0.0	0.0%	0.0%
Southworth	4	2.00	5.0	21.3%	3.1%
Jahn	2	2.00	5.0	21.3%	3.1%
Carden	1	2.00	5.0	21.3%	3.1%
Miller	1	0.00	0.0	0.0%	0.0%
Nutini	0	0.00	0.0	0.0%	0.0%
Watson	2	0.00	0.0	0.0%	0.0%
Eaton	2	0.00	0.0	0.0%	0.0%
Tartaglia	4	0.00	0.0	0.0%	0.0%
Predmore	0	0.00	0.0	0.0%	0.0%
Koncewicz	0	0.00	0.0	0.0%	0.0%
Cipriano, Greenbaum	0	0.00	0.0	0.0%	0.0%
Greenbaum	0	0.00	0.0	0.0%	0.0%
Kelly	0	0.00	0.0	0.0%	0.0%
Tartaglia(Acting)	4	0.00	0.0	0.0%	0.0%
Amoroso	3	0.00	0.0	0.0%	0.0%
Sweeny	1	0.00	0.0	0.0%	0.0%
Mitchell	0	0.00	0.0	0.0%	0.0%
Kublanow	0	0.00	0.0	0.0%	0.0%
Morgen	0	0.00	0.0	0.0%	0.0%
Griffin	0	0.00	0.0	0.0%	0.0%
Yagoda	3	5.05	91.5	53.7%	56.6%
Lehr	1	0.00	0.0	0.0%	0.0%
Epp	0	0.00	0.0	0.0%	0.0%
Jones	0	0.00	0.0	0.0%	0.0%
Owens	1	0.00	0.0	0.0%	0.0%
Benson	1	0.00	0.0	0.0%	0.0%

ten lose the knowledge of who has made significant contributions in the past. This is equivalent to the loss of an asset whose value is the investment in time and dollars to develop that individual.

Outside Client Project organizations are extremely sensitive to worker performance and have a process to replace workers that do not meet performance expectations. Inside client organizations need to establish a similar performance management system.

5. Use or Simulate the Motivation of the Arms Length Real $ Contract Environment

The Outside Client Project organization's relationship with their client is an arm's length contract in real dollars. If the project is successful the performing organization receives remuneration for its effort, if not they may lose money and the project participants may lose their jobs. This risk/reward environment is a primary motivation leading to the high project success rates of Outside Client Project organizations.

A similar risk/reward environment needs to be created for Inside Client Project organizations where meeting or exceeding time, cost, and deliverable specifications is rewarded by bonuses, raises, and/or promotions. Failure

should conversely result in delayed raises and promotions, demotions, never working on another project, or even loss of employment. Personal success needs to be tied to company success.

6. Focus on the Project, not the Process

Outside Project contractors expect their project teams to be experienced professionals able to adapt to each project's needs. They provide no predefined processes, procedures, or guidelines other than to operate within legal and code restrictions. Instead of auditing the process they monitor project status. Project failure is associated with people, not process.

Many inside project companies have defined processes for everything they do. Years of business experience is captured in these repeatable processes for the production side of the business. Projects, however, by definition, are not repeating processes. Yet project teams are given a process description document and subject to periodic project audits for compliance like other company departments. Unfortunately many projects fail while following the process explicitly and passing all their audits. The process may then be declared flawed, the individuals responsible for the failure are exonerated, and a task force is commissioned to examine and fix the process.

Inside Project companies need to cultivate expert project teams and rely on their teams' experience and good judgment as do the contractors. Projects should be assessed based upon adherence to detailed project plans instead of project management process documentation.

7. Control Project Cost and Schedule

Outside client contractors do project accounting. From detailed project plans they establish time based cost accounts for each project activity. They track project performance in terms of earned value. This enables them to determine whether their cash outlays and work are taking place earlier or later than planned and control both expenditures and schedule.

Most inside client companies organize their cost accounts by department and budget on an annual basis. Project expenditures flow through to the departments of the individual project workers and are difficult to see, let alone control. Inside project companies need to establish a project cost accounting system in parallel with the departmental accounting system in order to understand and control project costs. Project books close at project completion, not at the end of a calendar time period.

Unique Projects are vulnerable to losses due to their inability to accurately estimate work that has never been done before. Outside Client contractors minimize the number of unknowns by breaking the project up into many small phases and making each phase a separate project with its own contract. One of the deliverables of each phase is a revised plan for the rest of the project from which the client can update their Cost/Benefit Analysis and decide whether to continue with the next phase. A software contractor, for example, will sign a contract to perform a system requirements analysis and preliminary high level design. This project will deliver the design, an estimate for the prototype phase, and an estimate for the remaining five phases of the project. It is recommended that internal unique projects establish the same multiphase approach for unique projects using real costs.

Summary

Those responsible for inside client projects should look carefully at the practices of outside client project companies like contractors. There is much to learn from these seasoned professionals who earn their living by performing projects for others, and the potential savings are significant.