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MEGA-PROJECT MANAGEMENT BY PROJECTS: Secrets From America

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ABSTRACT

Management-by-Projects (MBP) is usually addressed as an organizational approach for organizing companies based on projects. This may, however, also be the most effective approach to organizing and managing large "mega" projects. That is especially the case where contractors set up entire new companies or organizations to work on one large project. A clear understanding of the MBP approach can help managers of large projects, and single project-oriented organizations, avoid common problems associated with creating large functional organizations first.

The Superconducting Super Collider (SSC) Project, located South of Dallas, Texas, is currently one of America's largest science projects. Officially launched in 1989, the SSC Project will cost more than $8 billion USD and have an engineering/construction schedule of approximately ten years. It is considered a mega project in every sense, involving mobilization of all project participants; participation of thousands of professionals, scientists, and organizations from dozens of countries; involving all phases of a project, including R&D, engineering, design, fabrication, procurement and construction; and requiring all aspects of project management, ranging from planning, scheduling and cost control to political risk management and cultural integration.

For such a large project, with so many complex and complicating factors, MBP can be useful for improving efficiency and productivity, especially during the detailed design and construction phases. This paper will discuss organizational issues associated with mega-projects, using the SSC Project as an example. Subprojects within the SSC will be discussed, along with the benefits to be realized from this approach. The author will discuss his personal experiences and perspectives on mega-project organizational issues, including project management "secrets" from several large American projects.

This paper is both a follow-up to the presentation on the SSC Project at the 1990 World Congress on Project Management in Vienna, Austria, and a presentation on general organizational and project management issues associated with managing very large projects. The author suggests that many problems can be alleviated through the usage of subprojects, and the MBP approach, within single Mega-Projects. This paper should be of interest to any executives or government officials struggling with the complexities of planning and managing a major program or project.

INTRODUCTION

Mega-projects are generally defined as projects with billion-dollar budgets, schedules exceeding five years, thousands of participants and other characteristics associated with large size, complexity and importance. The management of mega-projects was heavily addressed in project management research in the late 1970's and early 1980's. The use of subprojects as an organizational approach was discussed in detail in several formal presentations, including

Professor Ray Levitt of Stanford, who discussed organizational complexities and subprojects as an option, in the context of project complexities and interface requirements, in his 1981 paper at PMI's annual conference (1). Professor Levitt even suggested areas of research for further development of mega-project management approaches.

At the same conference Kelly and Morris discussed the management of very large projects (2). Few papers can be found in PMI proceedings since 1981 concerning the organization of mega-projects, and no follow-up to the suggestions of Dr. Levitt. On the other hand, very large projects have proliferated and are now launched not only in energy and infrastructure, but also sciences, telecommunications, automotive, transportation, aerospace and information systems development (and in many other industries).

Based on his experience on several large projects in the USA, the author will discuss MBP as a possible solution to several major problems which seem to be common on large projects. Recent experience on the SSC Project in Texas will be used as a point of reference.

The SSC Project is one of America's largest science projects. It was described in a paper presented at the INTERNET'90 World Congress on Project Management, Management By Projects. (3) The SSC, at present, is clearly a project. The SSC is a project to plan, design, construct and startup a new laboratory for the U.S. Department of Energy (DOE). The major component is a single integrated high-energy, proton-proton collider, with submachines, injectors and components. Also included are campus and laboratory facilities, computing and communication systems, particle detectors and experimental systems, and support systems. All of these activities are included in the SSC Project WBS and budget, will be completed at a point in time, and are part of the SSC Project.

Now, four years after project startup, a number of lessons are emerging. This paper discusses some of those lessons, especially changes which focus on managing subprojects within the SSC (within the mega-project organization).

Based on experience on the SSC and other large projects in the USA, some general issues associated with planning and managing large projects are discussed. Considering some of the most common problems, a better project management orientation is suggested, including the use of subprojects to improve and perhaps solve these common problems. Specifically, some very real benefits of the MBP approach are discussed. Some implementation problems and solutions are described. Finally some American Mega-project management "secrets" are summarized in the paper, though details are reserved for the live presentation.

MEGA-PROJECTS: THE TREND CONTINUES

Even today in our relatively weak global economy, mega-projects are announced almost daily. Here are a few, just in Texas:

o	V22 Osprey Aircraft	-	$ 2.0 + Billion
o	Local Telecable Fiberoptics Net	-	$ 2.5 + Billion
o	DFW Airport Expansion	-	$ 3.5 Billion
o	Texas High Speed Rail (TGV)	-	$ 7.0 Billion
o	SSC Project	-	$ 8.0 + Billion
o	AX Fighter Plane	-	$ 10 + Billion
o	Texas Highways Improvement	-	$ 12 + Billion
o	U.S. Space Station	-	$ 30 + Billion

There are many more examples from construction, telecommunications, energy and science. Around the world many developmental, industrial and infrastructure projects are in the multi-billion dollar range, due to economic or social necessity. Where natural resources are involved mega-projects are launched due to economies of scale or the economics of transportation of raw vs. refined products. International communications and transportation requirements are also leading to huge projects in many areas, including satellite-based telecommunications systems, country-wide communications and computing networks, new airports, railways, tunnels, highways, etc. The next century will see hundreds of these giant projects.

THE PROBLEM WITH MEGA-PROJECTS

Mega-projects tend to be very visible, so some problems are well covered by the press. In many cases, because of the large local employment on mega-projects, problems associated with management of these large projects are relatively well known locally, but they seldom get written up for national or international audiences. It is the author's opinion, in fact, that far more problems exist on mega-projects than are generally known. A number of these problems are addressed below.

Project Management as Number 1 Problem

Especially for complex scientific or technical projects, technical expertise is seldom the problem. In fact, the top management of large projects tend to be technical experts, often leaders in their fields in the world. However, after a year or two into the project, such problems as poor planning, schedule slippages, cost overruns, lack of project control systems, etc. begin to surface.

Organizational Problems

Such problems as poor communication, weak leadership, lack of clear directions, lack of teamwork, low employee morale and high turnover are not uncommon.

Information System Problems

Because of the size and complexity of mega-projects, and the need for integration, data overload is commonly encountered by data processing and management information systems. In many cases entire new project management information systems are implemented on mega-projects, which themselves can take 1-2 years to implement. Two years is too long for any project manager to not have good, detailed cost, schedule or status information.

Poor Planning & Status Information

Because of the size and complexity of large projects, planning and status information is frequently incomplete, too summarized, too detailed, or too late. Poor implementation of "top down/bottoms up" planning is common, and methods for summarizing and integrating information are often cumbersome or result in useless data.

Lack of PM Experience, Expertise & Training

There appears to be a common attitude among American executives that project management is either easy, easily learned on the job, or less important than other factors. Managers of mega-projects are often untrained, PM training is not promoted or made available, and PM expertise is not emphasized during the hiring process. This results in a functional orientation to project planning, and a lack of understanding of how to solve PM-related problems.

These problems are certainly not all inclusive but have been common on projects which the authors have knowledge of.

ORGANIZATIONAL CHOICES FOR MEGA-PROJECTS

On a number of mega-projects in the USA, both contractor companies and sponsoring organizations have been organized in the traditional functional manner. (6). In many cases, because of the size or location of project organizations, contractors have established entire new companies, subsidiaries or divisions for the mega-project work. (7) In these cases functional departments are also established along the lines of traditional engineering and administrative organizations.

Organizing and managing on a functional basis for a single project however can lead to many inefficiencies and problems, including poor planning, lack of focus or direction, poor communication, integration difficulties and other effects. (1)(2) For a single mega-project, the functional organization can be more expensive, due to added overhead and administrative expenses.

In many cases matrix management approaches are then used for allocation of functional experts to project teams or tasks. While this approach may lead to successful planning and performance, this approach can also be costly because it is very time consuming to implement, requires maximum communication and can increase conflicts.

Organization of the SSC

Initially the SSC was organized in this same functional manner. An operating Laboratory was established, with divisions representing major technical, operating or administrative functions. After two years, however, the organization was modified to incorporate a more team-oriented approach, corresponding to major elements of the project WBS.

The major focal point at the SSC for teamwork and subproject management are "Machine Leaders" and "Detector Project Managers". Corresponding to major, relatively independent, elements of the SSC Project, subproject managers have been established for the following:

- Linear Accelerator (LINAC)
- Low Energy Booster (LEB)
- Medium Energy Booster (MEB)
- High Energy Booster (HEB)
- Collider
- SDC Detector
- GEM Detector
- Test Beams
- Campus Facilities

For each of these "subprojects", cross-functional teams have been formed, critical path network schedules developed and working/statusing/reporting mechanisms have been established.

While this subproject approach is helping get the work done, however, most of the project control and reporting still occurs on a division (functional) basis, so a number of problems still exist, related to integration and communication of information.

The SSC Laboratory is now a mix of functional, matrix and project teams. The project teams established for subprojects have resulted in better planning, direction and communication for those parts of the project. For the most part this has been accomplished by establishing "Departments" or high level "informal" team organizations corresponding to the second or third level of the SSC Project WBS.

MEGA-PROJECT WBS: KEY TO PLANNING & ORGANIZING

For a mega-project, the project WBS is the key for planning and for organizing, to implement Management By Projects. A properly defined WBS will have subprojects and sub-subprojects, corresponding to various levels. Each of these subprojects can be best planned and accomplished by implementing well established project management techniques.

The implementation of PM for subprojects at all levels of the WBS can multiply the benefits of PM throughout the mega-project organization. Those benefits include better planning, more effective teamwork and communication, and more efficient work performance. (i.e. faster, cheaper, etc.)

Figure 1 displays the WBS for the SSC Project. Project teams have been established within the SSCL organization to plan, coordinate and perform the work associated with the design, fabrication, construction and startup of the "machines" identified at level three for the accelerators and levels four and five for the experimental systems.

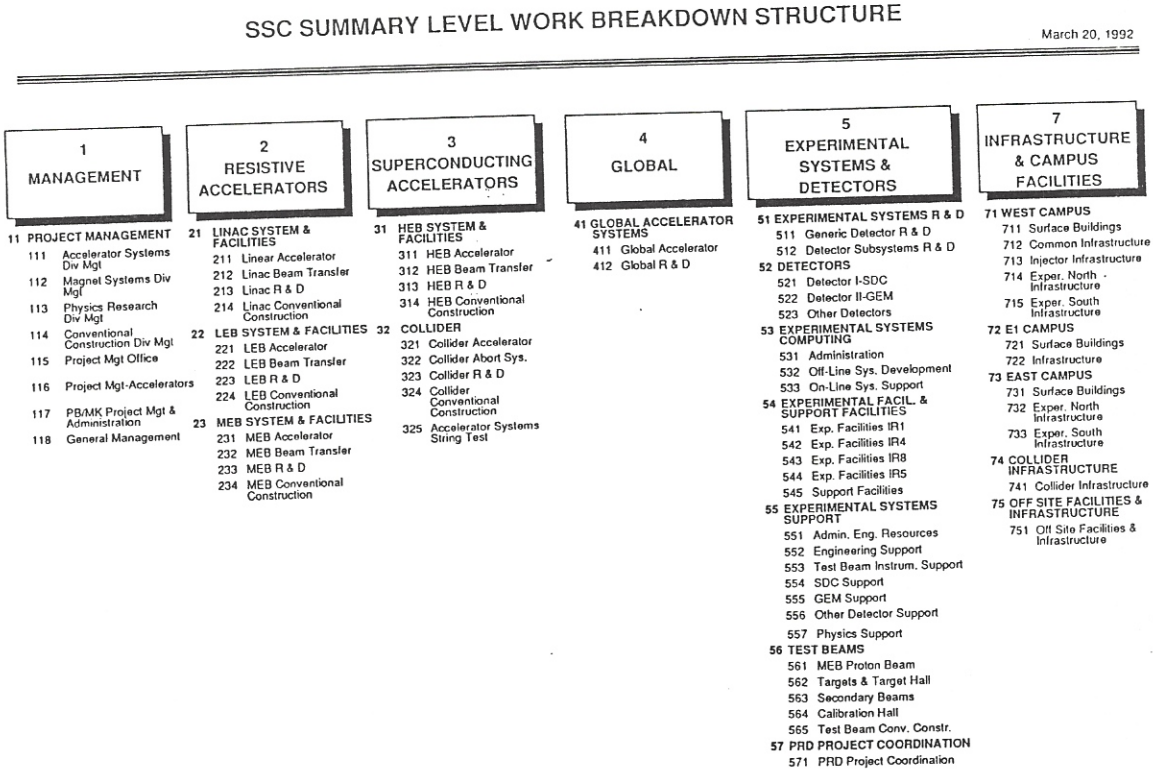

Figure 1: SSC Project Work Breakdown Structure

SUBPROJECTS: KEY TO PRODUCTIVITY & PROGRESS

Better use of the WBS and organizing by subproject teams can lead to a number of significant benefits and efficiencies. As professor Levitt and others pointed out over a decade ago, if one can feasibly and economically subdivide a large project into a number of subprojects, each subproject might then be manageable using conventional project management theories and practices (1). A few major possible benefits of this approach are discussed in the following paragraphs.

Better Planning

Subnetwork planning has long been used for schedule development. Use of the WBS is also well established for cost estimating and cost/schedule performance measurement. Subprojects can also, however, lead to much better understanding of project quality, safety, environmental, configuration management, and technical issues. Lower level personnel and resource issues can be planned more effectively, and risks can be better identified.

Better Communication

Lateral communications can be improved almost automatically, as project team members involved on common aspects of the project have immediate access to the technical information which they need. Organizational or functional information can still be summarized and/or communicated by formal systems, but project team members will tend to have immediate, first-hand access to the information needed at the working level.

Lower Costs

The subproject team approach can reduce the amount of overhead and administration required, resulting in some lower costs. More importantly, however, the focus becomes more "results oriented", frequently resulting in better schedule performance and resulting cost savings on project activities. This has not been adequately tested by research, but is another observation by the author and tends to be supported by the MBP writings of other experts.

Better Performance

Project management focuses on goals and end products, and the tasks, activities and issues associated with reaching those goals. That project focus can lead to better planning, status information and emphasis on progress toward objectives. This can often lead to faster achievement of tasks, at less costs, and to frequently better quality and technical performance.

Higher Employee Morale

A project-orientation simplifies things for employees, providing a clear direction, set of objectives, with associated plans, schedules, budgets and responsibilities. An emphasis on teamwork and on accomplishment of common goals has been proven to improve morale, personal motivation and performance.

Better Teamwork

Teamwork and more formal teaming approaches have received increasing attention and emphasis in recent years in project management literature and theory. Teamwork is emphasized by most project management consultants as a key criterion for project success.

This is well established in the project management world, and can be implemented and emphasized through MBP.

SUBPROJECT TEAMS: THE COMMUNICATION SOLUTION

The use of subprojects on mega-projects, and a project management orientation emphasizing MBP, can lead to the benefits described above. The use of subproject teams can dramatically improve project communications, not only by design, but because communication itself has been identified by PMI in the USA and by project management experts worldwide as a key aspect of project management. Good project management requires attention to effective communications on the project. This emphasis and attention can result from the MBP approach, and the use of subprojects on mega-projects.

IMPLEMENTATION PROBLEMS & SOLUTIONS

As most experienced project managers, and all project management consultants, know, the implementation of project management itself can be difficult. To change an organizational focus to MBP, to a project management orientation, the following obstacles must be overcome.

Lack of PM Training Among Top Management

Perhaps the single biggest challenge to project management and MBP implementation is top management. Too frequently those in charge of an organization, program or project don't really know what modern project management entails, what PM is for, or what benefits can result. They often have no idea, personally, how to implement project management or MBP. Thirdly, many have no direct experience in either managing a large project, or managing one well. Finally, few top managers take the time for adequate project management education. As a result these same characteristics are true of their subordinates. Top managers must recognize their own shortcomings if they want large projects to be successful. The necessary changes are obvious.

Exclusively Technical Planning Focus

Too frequently all the emphasis during the project planning stage is on technical issues. Just as frequently, technical issues are not the biggest problems on large projects, though sometimes they may be. As suggested above, often the biggest problems on mega-projects are associated with management issues, many of which could be alleviated by better planning in accordance with well established project management methodologies.

Poor WBS Orientation

The poor usage of the WBS is a major stumbling block for many mega-projects, leading to poor planning, poor integration, lack of teamwork and poor communication. In one fell swoop many problems could be reduced through better use of the WBS. The WBS can be used for identifying and establishing sub-projects, leading to the implementation of MBP.

Personal Resistance To Changes

Personal resistance to a project orientation will come from functional managers who will either loose responsibilities, or who perceive a loss of power and influence. This can make it very difficult to change an organizational direction after a mega-project is ongoing, unless the changes were planned for. The solution is better planning, and a clear project-oriented focus from the beginning.

Organizational Infrastructure

Project management and MBP must be supported by the infrastructure of the organizations involved. That includes management information systems, procedures, management attitudes, communication channels and personal reward systems. If project management cannot be supported by various organizational systems, and the management environment, the entire effort can be very difficult. Attention must be given to the support systems which project managers throughout the mega-project or organization must rely on.

SECRETS FROM AMERICA

Perhaps the biggest secret is really no secret. That is, that most of the problems discussed above may be very common on large projects in the USA. For example, on one project with which the author is familiar, the "Estimate at Completion" went from approximately $340 million to $480 million to $1.2 billion in the course of six months, entirely because of the lack of project orientation, and the lack of implementing very standard PM requirements. In another example, a project was six months old before a project management plan was started. On yet another project, functional divisions were established. Then division managers were told to go hire people who could plan the project "so we know what to do!"

Project management problems, or "secrets", are very sensitive issues for obvious reasons. Rather than dwelling on specific examples, the author has tried to generalize his experiences in order to focus on solutions. During the live presentation, however, real stories can be told which illustrate the issues discussed in this paper.

CONCLUSION

The trend to mega-projects will continue, but so will cost overruns and other problems with completing those projects. Lessons learned must be transformed into effective models for mega-project management. The SSC Project, while making some of the same mistakes of pervious large projects, is also now realizing some of the benefits of the MBP approach, through the use of subprojects.

The author has pointed our some of the keys to success (i.e. good WBS orientation) and some major implementation problems (lack of PM training among top management). A major conclusion is that for successful implementation of MBP, Project management skills and approaches bust be driven down the organization to subprojects and tasks, where teamwork and communications are most needed.

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