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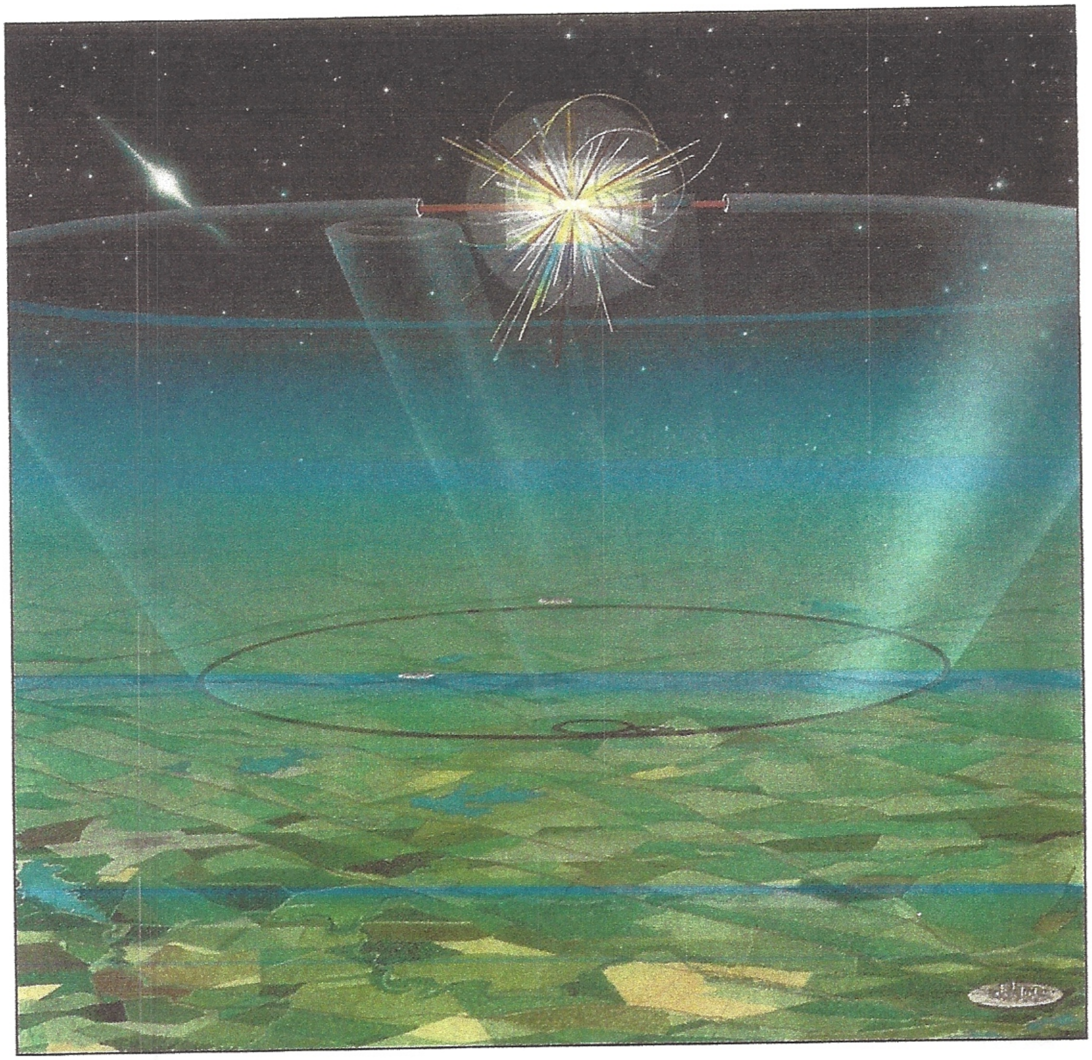


SHOWCASE PROJECT
THE SUPER CONDUCTING SUPERCOLLIDER

From the Big Picture to Sub-projects: Project Management Lessons of Every Kind on the Superconducting Super Collider

David L. Pells, Management Planning Head, Lab Technical Services Division
E. Jack Story, Associate Director (SSC) Laboratory and General Manager, EG&G InterTech, SSC Laboratory, Dallas, Texas

INTRODUCTION

The SSC project is big. It's enormous! It involves hundreds of organizations and thousands of people. It will impact millions. It involves new technology, new applications of existing technologies and some very well established technologies. It will include basic research, design, engineering, construction, start-up and operation. It even includes major manufacturing efforts. With a current estimate of eight billion dollars and a ten-year schedule, it's a mega-project to anyone. The systems engineering and integration efforts alone are huge and extremely complex. The visibility and importance of this project only add to its size and complexity.

Nearly everyone working on the SSC consider it the opportunity of a lifetime —to contribute to a project that could one day fundamentally change our world. And everyone working at the SSCL is learning; lessons abound in nearly every aspect of the project. Related to project management, lessons of every kind exist on the SSC. Some lessons are huge, of strategic importance to the SSC. Others are day-to-day , related to planning or managing sub-projects or tasks or task forces. Every manager has a set of opportunities and challenges. At the SSCL every manager is also a project manager, so many individual lessons learned are of interest to others.

This article discusses a few of the major lessons that have emerged so far on the project. We focus on key strategic and operational issues and try to provide perspective on project management challenges. Because we are still in the early stages, learning will continue in the years to come. These paragraphs shed some light on what is involved in managing a large, complex project like the SSC.

> *The SSC is as exciting a project as landing on Mars. But much more fundamental.*
>
> April 18, 1988
>
> T. D. LEE
> Professor of Physics
> Columbia University
> Nobel Prize in Physics, 1957

MAJOR STRATEGIC LESSONS

The Importance of External Stakeholders

External stakeholders include organizations, groups and individuals external to the SSC Laboratory who have a direct interest in SSCL activity. For the SSC, those stakeholders include local citizens and government bodies in Ellis County and the Dallas/Ft. Worth area, individuals and organizations associated with the state of Texas (including the Governor's Office, state senators and other congressional members, the Texas National Research Laboratory Commission, etc.), the international high energy physics community (including physicists at accelerator laboratories around the world and at major universities), strategic U.S. National Science Policy Groups (i.e., DOE, the President's Science Advisor's Office), the U.S. Congress, the President of the United States and several key industries.

Because there will be some displacement of citizens in Ellis County along the "Footprint" of the Super Collider ring, it was important to contact those individuals as early as possible. Any one of those displaced citizens could be the source of negative press coverage or lawsuits, which could potentially delay the start of construction activity. To date those problems have been avoided. The future location of various SSC facilities are of great interest to local schools and cities due to tax revenues. For those reasons the mayors, city councils and school boards in five towns located in Ellis County have requested frequent status information on SSC plans and activities. Establishing and maintaining a good public outreach program directed at citizens and government bodies in Ellis County have helped the SSCL establish very positive public opinion and support in those areas.

The economy of the entire Dallas/Ft.Worth metroplex will benefit greatly from SSC activity. The arrival of the many scientists and professional personnel associated with the SSCL has received considerable positive press coverage. Businesses, industries, schools and many other organizations will benefit from the impact of the hundreds of millions of dollars spent on the SSC. By paying attention to local politics, the SSCL has facilitated acceptance by local communities, improved relocation services for employees, improved general press coverage and promoted longer-term relationships with a multitude of local organizations.

The state of Texas, which has committed to providing hundreds of millions of dollars to the SSC, is interested in nearly every aspect of the project. The Texas National Research Laboratory Commission (TNRLC), the primary organizational interface point for the SSC, receives reports and briefings on a regular basis. Because Texas wishes to control those facilities and items to be constructed or procured with "Texas money," SSC project management can factor that into the decision making process, which allows more options for scheduling and planning project tasks. For instance, if Texas chooses to finance the construction of the SSC office buildings in Ellis County, the SSC project might accelerate construction of magnet development and test facilities.

Because of the scientific nature of the SSC laboratory, Texas schools want to take advantage of the opportunity offered by the SSC. The SSC is promoting the educational nature of the lab in many ways, and establishing relationships with every major Texas university in the process. For instance, the University of Texas at Arlington has offered the SSC a number of faculty positions in its science department. Again, these efforts add to the positive public image of the SSC.

The SSC needs the support of the International Physics Community. A High Energy Physics Advisory Panel (HEPAP), including 15 of the worlds leading physicists, representing national laboratories and universities from around the world, provides independent advice to the U.S. Secretary of Energy. This group of scientists reviews SSC plans, policies, and detailed designs, providing feedback, guidance and general acceptance of major SSC technical decisions. The formal support and "buy-in" by this group provides tremendous weight and credibility to the SSC Lab in its presentations to DOE and Congress. The SSC will be built with the concurrence and support of leading international high energy physicists. That support propels the project forward.

The SSC is also establishing relationships with many leading universities in the U.S. and abroad. In the experimental systems and detector development areas, dozens of universities are involved. In order to achieve it's ultimate goals, the SSCL wants as many leading physicists in the U.S. as possible to be involved in planning SSC experiments and to be factoring the SSC into their own research plans. In 1990, twenty SSC fellowship grants were established and awarded to graduate students and faculty at universities across the U.S. These grants will be awarded annually, continuing the promotion of SSC research in the physics departments at American universities.

The SSC project is a line item in the President's budget. It represents the major U.S. scientific effort for the 1990s and is a major factor in U.S. scientific and policy decisions. The U.S. Department of Energy (DOE), the President's Science Advisor, and the Congressional Subcommittee on Science and Technology are all kept apprised of SSC progress. For the SSC project to continue to proceed as planned, the support of these offices are absolutely mandatory. In the past year the SSC Lab has been visited by the Secretary of Energy, the Deputy Secretary of Energy, five U.S. congressmen and numerous other officials of the DOE, the state of Texas and the U.S. government.

> *The SSC represents a major advance in enabling us to learn more about the universe we live in. Since it makes use of superconductivity and other advanced technologies, what is learned in its construction and operation will have an important impact on introducing technologies of the future.*
>
> April 19, 1988
>
> JOHN BARDEEN
> Professor of Physics
> University of Illinois,
> Champaign-Urbana
> Nobel Prize in Physics, 1956, 1972

Finally, the SSC will require the products and services of hundreds of companies. It's impact on some industries will be significant. For instance, the SSC will spur the development of an entire new industry, super conducting magnet manufacturing. To foster good relationships with potential supplies and to transmit information to industry, the SSC has conducted numerous vendor conferences, workshops and briefings.

In summary, SSC management recognizes the importance of its external stakeholders—to maintain support in Washington in order to ensure continued funding, to maintain the support and input by the international physics community, to maintain positive press and the support of the local community, and to establish and maintain good working relationships with industry, universities and DOE. Failure to do so with any one of these stakeholder groups could lead to major problems or even hold up the project.

The Influence of Politics

To say the SSC involves politics is to understate the issue considerably. From its inception the project has been very visible to the public. In 1987, the competition for location of the SSC involved dozens of states spending millions of dollars on studies, proposals and lobbying efforts. The selection of the current site in Texas in late 1988 did not stop the competition. Some U.S. congressional members representing states other than Texas continue to promote programs located elsewhere in the U.S.A. for funding.

There is now little argument that successful completion of the SSC should put the U.S. in the forefront of high-energy physics research in the world. On that note, the program has maintained a consistently high level of support in Washington. It has also provided another major opportunity for the U.S. to enlist the participation of many other nations in this great endeavor. All countries and organizations involved firmly believe the SSC will lead to major technical breakthroughs in a number of industries; and they want to be there when it happens.

But there is always a great deal of competition among federal agencies in the U.S. government for funding. Because of its size, the SSC is and will always be a very visible target as a potential source of funds by Congress—that is, a cut in SSC funding means money available for other federal programs. These issues lead to a variety of political pressures, concerns and maneuvering on the part of SSC project sponsors, supporters and opponents in Washington D.C.

One of the most obvious lessons from all this for SSC management is that it is in the best interest of the project, the Laboratory and DOE to minimize operational problems and maximize positive achievements in Texas.

The Inevitability of Conflicts, Reorganizations and Changes

The SSC project organization started out with a handful of people. By October 1989 there were 300 people; today over 800 people are directly employed at the SSCL in Texas. Most of the people and companies involved had never worked together before; many had never even known each other before coming to Dallas. In that environment, conflicts were inevitable.

But conflicts serve an important function in project management—they often highlight areas where key decisions are needed, priorities must be established, or roles and responsibilities should be better defined.

On the personal level, conflicts have resulted when personal and organizational goals are not congruent. For the SSC to succeed, personal objectives must be secondary to project objectives. For most project participants that presents no problem, as personal research and professional objectives are tied directly to a successful project. For others, however, it is difficult to appreciate that every key management decision will ultimately be evaluated by a team of brilliant scientists, managers and government officials with the SSC project's interests at heart, not the individual's.

A project organization structure was established early based on initial project needs, but also based on the individuals involved. As planning proceeded and as the project team grew, it became necessary to change the organization structure. Divisions and branches have been added and/or changed completely. As managers were hired or promoted, individual organizations changed again. In many cases, organizations were established, then managers found to fill the boxes.

During this century, the developments and the achievements of high-energy physics have been inseparably linked with the development of technology. The discoveries of high-energy physics have changed our daily life in a most fundamental and dramatic way.

To me, the most important reason to support high-energy physics is that it represents a most challenging way of satisfying human curiosity about the basic elements of nature, what we are made of, and the origin of the universe, the origin of masses, and the origin of forces.

June 1, 1988

SAMUEL C. C. TING
Professor of Physics
Columbia University
Nobel Prize in Physics, 1976

When those managers start, though, they often need to reorganize again as they better define their roles. Lower level branches and offices frequently change.

As the SSC project progresses, many changes will be seen in project plans, organization, and the design details. A very preliminary conceptual design was completed for the SSC in 1986. In January 1990, an updated and Site-Specific Conceptual Design Report (SCDR) was issued at the new SSC Lab in Texas. In June, a finalized CDR was issued to DOE. But even now the details of many subsystems and components have not been completely defined. And as designs change, so must the plans.

Another major area of uncertainty is funding. Though the state of Texas and foreign nations will contribute significant funds to the project over its life, federal U.S. funding via DOE represents the most important source of funds for the project. A major exercise at the SSCL during the first two years has been establishing realistic cost estimates and funding scenarios. As can be appreciated, availability of funds will have a major impact on project planning, and especially on the schedule. The current ten-year schedule assumes a very rapid buildup, requiring high levels of funding, which may not be forthcoming.

Sub-Projects

A large project like the SSC is, in fact, a set of many sub-projects. On the SSC, sub-projects include individual systems, subsystems and components. They include facilities, buildings, tunnels, shafts, utility lines, power stations and roads. Management systems and computing facilities are needed. Both basic and applied research projects are in progress. Hundreds of documents must be prepared, training programs conducted, and communication capabilities established.

Many of these sub-projects will cost millions of dollars, will involve hundreds of participants, and are incredibly complex. Managing these sub-projects involves all of the same approaches, methods, tools and discipline required to manage the SSC. Plans are needed for individual sub-projects just as they are needed for the overall project. Individual project managers must be assigned, detailed cost estimates prepared, organizational responsibilities and relationships established, and management control procedures defined. Ultimately, it magnifies the requirements for project management many times. In the same way, though, it points the way toward successful integration and completion. Complete the tasks and the sub-projects and the systems, buildings and tunnels will get done. Plan and manage all the sub-projects well and integrate them systematically and the SSC will come on line satisfactorily.

Time Waits for No One

This is an important factor on every project, but especially on mega-projects like the SSC. Because it is so large, so complex, and involves so many participants and resources, planning takes time. Developing a detailed design, cost estimate or schedule requires many people working for weeks or months. Just the administration of project planning is an enormous effort, considering the paperwork involved, communication needed and meetings involved. And all that takes time.

Meanwhile, work is proceeding, people are getting hired and organized and the public is watching. "Time waits for no one" means plans may not be done, yet work must begin—but without plans inefficiencies may result.

On large complicated projects more emphasis and attention needs to be placed on planning, as early as possible. Plans must be prepared faster because there's so much planning to be done. Faster planning means smart experienced managers who have done it before and staff and systems in place to support that planning. On the SSC, that experience has been hard to find because of the new technologies involved. There have been no other superconducting super colliders built to date.

OPERATIONAL ISSUES

Of particular interest to many mangers at the SSCL are issues related to the day-to-day "operations" on the SSC project. That is especially true for those involved in managing major sub-projects.

The Importance of Planning

The importance of early planning relative to time passing and schedule performance was suggested above. For day-to-day management, planning is even more important—without planning, how do you know what to do? Many of the scientists and managers at the SSCL do, in fact, know what to do. But there is another reason for planning on a large, complex project that can be just as critical—to communicate objectives, strategies, and requirements to others on the project.

While the SSC project includes many sub-projects, very few of those sub-projects are completely independent. Many are tied to other projects in terms of systems integration/interactions, shared resources, or information needed. Many are related in true critical-path network logic terms. Good planning information allows details of sub-projects to be communicated to other managers at the SSCL who need that information.

In addition, comprehensive, well-documented plans can demonstrate to project stakeholders that the project and sub-projects are being well planned and managed. At the SSC, with its high visibility and constant high-level scrutiny by both supporters and opponents in Washington D.C., this "evidence" of effective management is critical for continued support by DOE and the U.S. government.

Finally, for the project as a whole, comprehensive planning gives SSC project management and DOE some confidence that fewer major costly "surprises" could surface in the years to come. With a current cost estimate of close to $8 billion, the SSC project is already one of the largest ever sponsored by the U.S. government. In the current tight budgetary environment, DOE has stated that cost growth simply cannot be allowed, adding pressure for thorough planning. SSC project management is receiving those messages loud and clear.

> *The implementation of the daring proposal to build the SSC would restore this country's pre-eminence in elementary-particle physics.*
>
> *This is a very rich country, rich in resources and in talent. But it still requires men of vision to spend resources and talent wisely. As a nation, we have always shown courage and self-confidence. This must continue.*
>
> VAL L. FITCH
> Professor of Physics
> Princeton University
> Nobel Prize in Physics, 1980

Leadership, Teamwork and Communication

Many of the scientists working on the SSC are world leaders in their respective fields and disciplines. Many have gained their preeminence through individual research, publication and teaching, activities requiring independence and individual initiative. Many have come from university environments where independence and individual accomplishments are promoted. Now they are working on a project that requires a high degree of interaction and interdependence, much communication and a great deal of teamwork.

Nowhere are those incongruities more evident than during the planning process, and since plans continue to change as the project design evolves, the need for teamwork and communication is continuous. All this puts pressure on SSC management to provide leadership, direction and support. In most cases that leadership has been strong and visible.

Management Systems

The SSC project management team started out in 1989 with good strategies and plans related to implementation of management information systems (MIS). By mid-1989, however, it became apparent that confirming the conceptual design and developing a sound cost estimate were the highest priorities if the project was to proceed with DOE and congressional support. Technical planning as a basis for a detailed cost estimate received the attention of a majority of SSC managers and senior staff.

Now the interim information systems put in place in Dallas are struggling under the weight of information required by an ongoing project and a functioning research laboratory. In retrospect, continued emphasis could have been placed on implementing fully-integrated, long-term management information systems during the first two years. That emphasis is now being placed on MIS, but the task is now much greater.

The need for management information systems is now being felt by all levels of SSC managers who must establish detailed work package plans, measure cost and schedule progress, and report performance. In addition, as the level of SSC technical activity continues to grow, the need for automated document control, configuration management and quality management information systems increases. These are issues of which SSC participants are becoming more aware.

Pressures on Procurement

A major lesson that SSC management became acutely aware of in 1990 was related to the pressure on the procurement functions on such a large project. In its first year, the SSC Laboratory procured products or services from over 800 firms spread throughout the U.S. and several foreign countries. Over $58 million in contracts were awarded during the first six months of FY 1990. Since then the procurement activity has increased. The SSC procurement organization has been severely challenged several times, for several reasons.

The sheer volume of procurement actions would tax even a well-established organization, let alone a procurement staff in a new organization staffed with individuals who have worked together for only a very short period of time. In addition, procurement systems and procedures at the new SSC Laboratory had to be developed at the same time, requiring clarification of DOE procurement and contracting requirements. Due to its subcontract approval requirements, a working relationship between DOE and the SSCL procurement office had to be established.

Finally several contracts to be awarded by the SSCL during its first two years will amount to about one billion dollars—those for architect engineering/construction management services and for superconducting dipole magnet production. Those two subcontracts alone have tied up a number of the senior SSCL procurement staff during the development of contract documents, negotiation, reviews and meetings. Many other individual actions have taken an inordinate amount of time (i.e., procurement of leased office space), adding to pressure on buyers and subcontract administrators.

> *U.S. competitiveness in science and technology—particularly in the area of particle physics—is at a crossroads. We owe it to the next generation of Americans, as we move into the twenty-first century, to provide them with the knowledge and latest technological advances to meet the challenges of the future.*
>
> May 20, 1988
>
> WILLIAM P. CLEMENTS, JR.
> Governor
> State of Texas

High Quality and Experienced People

In technical areas the need for top-notch people has been well recognized by SSC management from the beginning. Already involving some of the most talented scientists in the world, the need for physicists and engineers experienced with magnet and accelerator technologies has only been re-emphasized.

In late 1989, SSC management established a top-level committee to review and approve all new hires for computing, engineering and other technical or management positions. That review process is intended to ensure that the very best, highest qualified individuals are added to the SSC Laboratory staff.

THE BIG PICTURE

Total Project Perspective

Top management needs broad "big picture" perspective. In that regard the SSC is like any project. Someone must know how all the pieces fit together, what the impact on the project is of various changes in the environment, how the overall project is proceeding, what could kill it, and what the general critical success factors are. Above all, though, top management on a mega-project must provide the mission—the vision of "where we are all headed." In most cases, that vision is based on understanding the "needs of the customer." In the case of the SSC, the customers include not only the DOE and the U.S. government, but the international physics community and society itself.

The SSC has been fortunate in its top leadership. The SSC Laboratory Director, Dr. Roy Schwitters, and his staff, have provided a unifying vision for the project. Through press conferences, briefings and other presentations, Dr. Schwitters has also continued to provide Congress, DOE, the public and the physics community with the big picture. For SSC Laboratory personnel working on the project, that reassurance has been needed as the details and complexities of project work increase.

Integration Role of the Project Management Office

Integration is a key role of project management. On the SSC, the Project Management Office (PMO) plays a more important integration role than on many projects. Because of its size and complexities, much of the detailed technical activity is being performed by hundreds of individuals and organizations reporting to the various SSCL divisions. The PMO coordinates integration of magnet development, accelerator systems development and construction planning activities. The PMO is the focal point for project wide communications, including monthly reporting.

The PMO pulls the project together on a daily basis—integrating planning and scheduling information, progress data and performance measurement reporting. For most project-related issues, the PMO is the focal point for interfaces with DOE. The PMO is responsible for preparation of all key project-wide plans, documents and reports, including the SSC Project Management Plan (PMP). The PMP describes the broad project scope, schedule, costs, objectives and systems to be used for managing the project.

Not only is the integration role of the PMO important, but, if the PMO does not plan well, no one else will plan well either. A number of recognized techniques for improving communication and integration for project management, including regular meetings, have been established and are being utilized at the SSC Laboratory.

FUTURE LESSONS

The SSC project is still in its early stages. Many of the key management issues addressed and lessons learned to date have been associated with project start-up. Many other important lessons remain to be learned. We are aware of many of those future lessons, so we can plan for them now. There will undoubtedly be many more stories to tell in the years to come.

Reiteration of Start-Up Lessons

All of the important lessons discussed above will continue over the life of the project, with perhaps one exception: the pressures on procurement should let up. But external stakeholders will always be important. The SSC will always involve very high-level political considerations. Changes will continue, along with conflicts and reorganizations. The SSC will always consist of sub-projects, many of which will be "critical" to the success of the SSC. Time will continue to race ahead, "waiting for no one."

Planning and replanning of project activities will continue as new subprojects are initiated, as designs evolve, as new participants get involved, and as systems come on line with anticipated system "start-up problems." There will always be a need for teamwork, communication and leadership. The need for effective management systems will only increase. Finally, high-quality, experienced technical, scientific and management professionals will always play a key role in the success of the project.

If history is any guide, physics research at the most fundamental level can be counted on to have great impact on other areas of pysical science, and it eventually generates new inventions and technologies that change our lives.... We are working at a level of reality so far removed from everyday experience that the work evokes a kind of atbleticism of technology, pushing the arts of computing and cryogenics and vacuum pumps and all that to its limits, and also an atbleticism of the intellect, forcing us to deal with concepts that are more and more abstract and sophisticated, concepts that then frequently turn out to have important applications in fields like solid-state physics or hydrodynamics...

You see, at the same time that we have been moving toward higher and higher energies and smaller and smaller structures, our theories have moved to greater and greater simplicity... a simplicity, a beauty, that is built into the universe at its deepest levels.

April 7, 1987

Steven Weinberg
Josey Regental Professor of Science
University of Texas at Austin
Nobel Prize in Physics, 1979

Timely and Effective Project Control and Reporting Systems

Now that project design and engineering activities are well underway, and construction is set to begin, project control activities, including cost and schedule performance measurement and progress reporting, are becoming more important. As the level of project work increases, DOE is requesting more and more information related to progress and accomplishment. On a project the size of the SSC, proceduralized systems and automated information processing are needed. Critical path analysis will be needed as various changes and "what-if" scenarios are assessed. Just how important those systems are for the SSC are lessons soon to be learned.

Systems Engineering

SSC project management has recognized the importance of systems engineering and integration, especially during the design of the many accelerator and injector systems and subsystems. Just how important, however, may not be completely understood until these systems start to come on line and are physically integrated and tested. Some systems engineering lessons may be very painful. Hopefully, most of these can be avoided by employing the systems engineering office, which has been established within the SSC PMO.

Good Quality Program

SSC project management is serious about quality. We want no system failures and no surprises during startup. By including "Planning for Quality" and "Total Quality Management" in the early project and organizational planning, many technical problems can be avoided. A Project Quality Management Office has been established and each technical division has set aggressive quality assurance goals. In the Magnet Systems Division, a sizeable QA organization has been established to focus on the very stringent quality requirements associated with the superconducting magnets.

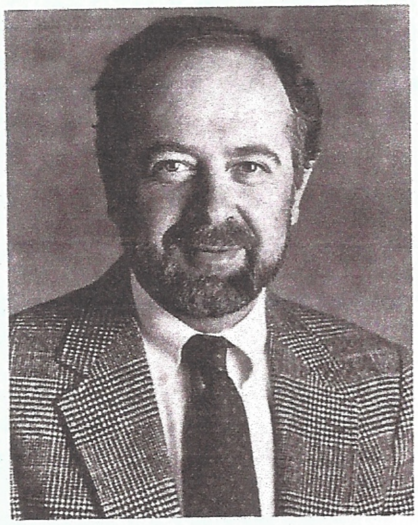
In many aspects of the project, technical performance requirements and parameters are so finely defined that even minute performance deviations are unacceptable. How well the SSC

A MESSAGE FROM THE DIRECTOR

Spectacular progress has been made in particle physics in the last two decades. Ever more powerful particle accelerators and more sensitive detectors have stimulated remarkable insights into the evolution of the universe and the natural laws that govern the behavior of matter at all times and places.

However, some of the deepest questions can only be addressed by observing phenomena at energies that are significantly higher than today's accelerators can reach. So, several years ago, we began asking ourselves how best to explore, in a timely and thorough manner, the territory richest in clues to a more complete understanding of matter and energy.

Since 1984, an exceptional group of scientists, engineers, and technicians has been designing the best instrument for conducting this exploration: the Superconducting Super Collider. Now those people, together with talented new contributors in many fields, are building this tremendous device that will enable us to resolve the subatomic world to better than a billionth of a billionth of an inch and to investigate the laws that prevailed when the universe was less than a millionth of a billionth of a second old.



Roy F. Schwitters, Director
Superconducting
Super Collider Laboratory

As Director of the SSC Laboratory, I am committed to creating a truly national resource in Ellis County that will be dedicated to the enhancement of all science. I also pledge that the Laboratory will respect the rights of all individuals, will be a good neighbor both to the people who live nearby and to the local environment, will be sensititve to the cultural needs of its employees and visitors, and strive to impart knowledge and the spirit of adventure to all who wish to learn. I look forward, with pleasure and excitement, to the task of helping to create an institution that will take its place at the forefront of discovery and learning as the new millenium begins.

Quality Program is working, and how important it is to system performance, are very real lessons yet to be learned. Hopefully, they can be learned during component testing, before systems are integrated and start-up begins.

Good CPM-Based Schedule

Critical path analysis is always important during early project planning, and it has been on the super collider. As some work gets done on schedule, some late, and some early, what happens to the projected completion date? What options will SSC project management have in order to maintain key milestones? What about near-critical activities, or critical path decisions or actions outside of SSC control (i.e., government decisions or approvals)? What about resource allocation when there are multiple critical paths? Should critical path schedules be established for sub-projects and subcontractors? These are questions and issues which will be asked many times over the life of the project.

If the entire program starts slipping, then significant cost growth will be unavoidable. Just how well the SSC project scheduling system provides SSC management with information needed to make timely decisions may itself be critical. Again, there are lessons that will most certainly be learned.

Relationships with DOE

A key lesson that will be appreciated more and more over time is the importance of a good working relationship with DOE and other project stakeholders. A mutually supportive relationship with DOE can facilitate decisions in Washington D.C., and can lead to open and constructive communications between SSC project management and DOE SSC project personnel monitoring SSC activity.

Good working relationships between SSC management and the scientific and university communities are especially important for developing the strongest possible high-energy physics research program at the SSCL. That relationship has already been established and is being fostered in every way possible by SSC management.

Other relationships may be equally important, especially with the state of Texas, which has committed to contributing a billion dollars to the SSC. Finally, as in any large organization, a good working relationship among SSCL managers and participants will be important to the long-term successful completion of many project activities.

The Impact of High Visibility

The high visibility of the SSC project will continue to be of concern to SSC management. More importantly, though, that high visibility also presents opportunities few other projects have. For instance, the project will continue to attract some of the most talented scientists and professionals in the world. As objectives and milestones on the project are met, the pressures to accelerate the project, to achieve the ultimate project goals, will increase. The lessons to be learned will be related to how to minimize the negative pressures caused by high visibility, and how to take advantage of opportunities presented by that same high level of public awareness.

CONCLUSIONS

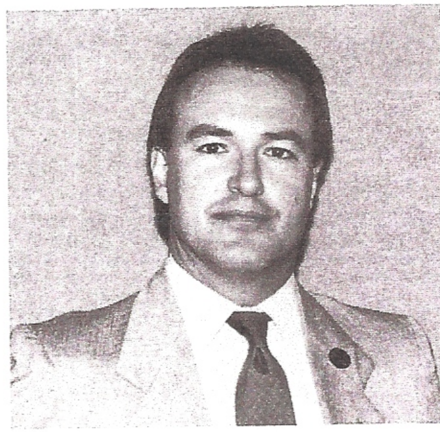
The SSC project offers tremendous challenges for project management—challenges that become lessons learned to those involved. But the project offers almost unbelievable opportunities as well; opportunities associated with developing and applying new technologies, crossing new horizons in scientific exploration, working with many of the worlds best, in many fields. Yes, lessons will be learned, at the top of the organization and at the bottom, in Texas and Washington and at laboratories and universities worldwide. The ultimate project management challenge then becomes how to apply those lessons learned to complete the project successfully, on time and within budget.

Note: Quotations in this article are from *Appraising the Ring: Statements in Support of the Super Conducting Supercollider*, Eds. Leon Lederman and Chris Quigg, Washington, D.C., 1988, Universities Research Association, Inc.

E. Jack Story *is an associate director of the Superconducting Super Collider (SSC) Laboratory and general manager of EG&G InterTech. EG&G provides technical support to the Universities Research Association (URA), the prime contractor for the SSC.*

Mr. Story brings thirty-five years of experience in management of physics research and technical support services. He has served as the director of advanced projects and chairman of the technology advisory board, EG&G, Inc. He joined EG&G in 1964 as manager of research and development programs and was later appointed to deputy general manager for EG&G's prime Department of Energy contract.

Before joining EG&G he was professor of physics, director of physical research, and director of the nuclear reactor program at North Carolina State University. Prior to that time he was a research staff member of the University of Chicago. Mr. Story earned his MS in physics from Vanderbilt University and his BS in physics from Southeast Missouri State University.



David L. Pells *is management planning head for EG&G Intertech at the Superconducting Super Collider Laboratory in Dallas, Texas, where he has worked since March 1989.*

Mr. Pells has fifteen years experience in project management-related positions, including project manager, project controls manager, cost engineer, program controls analyst and cost/schedule control specialist. He has a BS in Business Administration from the University of Washington and MBA from Idaho State University.

Mr. Pells has been the manager of project management systems development projects as well as high-tech projects for the U.S. DOE. He has been consultant to the U.S. government and industry, has taught classes on project management, planning and earned value, and has presented papers at PMI and INTERNET conferences.

David is the President of PMI's Dallas/Ft. Worth chapter and is a certified Project Management Professional (PMP).

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