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ABSTRACT

This document reports the experience of the laboratory in applying the principles of construction management and fast-track scheduling in the planning and construction of the only noncampus facility in the United States constructed solely for educational research and development. The benefits resulting from the use of these techniques are set forth, together with suggested changes in the flow of decisions that should be incorporated into future projects of a similar nature. (Author)

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This document reports the experience of the Laboratory in applying the principles of "construction management" and "fast-tracking" in the planning and construction of the only non-campus facility constructed solely for educational research and development in the Nation. The benefits resulting from the use of these techniques are set forth together with suggested changes in the flow of decisions that should be incorporated into future projects of a similar nature.

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FAST-TRACKING FEDERALLY-SUPPORTED CONSTRUCTION OF EDUCATIONAL RESEARCH AND DEVELOPMENT FACILITIES

William H. Hein, Jr.

Fast-Tracking and Construction Management Generally

Stated most simply, fast-tracking is a set of procedures that permits the various activities involved in the planning, design and construction of a facility to proceed on multiple parallel paths as contrasted with a single linear path. The technique is becoming more common in both the public and private sector, but before the SWRL project, it had not been used in federally-supported construction of educational research and development facilities.

Construction management is an important facet of fast-tracking. Under such an arrangement a construction manager (preferably a licensed general contractor) is retained in a consulting capacity by the owner as early as possible in the planning and design stage of the facility. The construction manager consults with both the architect and owner through planning, design and construction. Among other things, he advises on costs of various design alternatives so that this information is available well in advance of the bidding stage at which time changes in plans and specifications are expensive and time consuming. During construction, he may enter into construction contracts as agent of the owner with firms that otherwise would be subcontractors to a general contractor. Thus, the project may have up to fifty general contracts with various trades and subtrades with the construction process being managed by the construction manager as the owner's agent. The advantages of fast-tracking are immeasurably increased if it is possible to award contracts and start construction in phases as the plans and specifications for each phase are completed.

Laboratory's Selection by FECA to Use Fast-Tracking and Construction Management

The Laboratory received its construction grant on June 30, 1970. The grant's conditions were those usually contained in one contemplating a singular linear path for planning through design and construction. The experience of four other institutions that received construction grants with similar provisions one year prior to the Laboratory's strongly indicated that probable move-in would be minimally three or four years away. Since SWRL was incurring costs of $100,000 to $150,000 in operations funds for each month of design and construction (rentals in four locations, construction cost inflation, program inefficiencies, etc.), it was clear that appreciable savings of public funds would result if the three to four year period could be shortened.

At the August 1970 meeting of the Board of Directors, Mr. Gerrit Fremouw, Director of Facilities Engineering and Construction, made a presentation describing the advantages of fast-tracking and construction management. He also expressed FECA's willingness to cooperate with the Laboratory in using these advanced techniques in an experiment to ascertain the extent of savings in costs that could be realized. The Board of Directors agreed, and the staff was directed to cooperate with FECA in this effort.

SWRL's project had several features that made it ideal for the experiment FECA wished to conduct. First, the Laboratory was the last of seven institutions to receive its grant. In fact four, including two in California, received grants a year before SWRL. Thus, the base rate provided by these institutions constituted a convenient means of evaluating the more modern techniques. Second, the FECA West Coast Offices are recognized as among the best, if not the best, and most forward thinking in the Country. Third, the Laboratory had engaged an outstanding firm of architects with experience in fast-tracking and construction management. Fourth, there were outstanding construction firms skilled and experienced in construction management in Southern California. Fifth, SWRL's facility, is the only off-campus facility to be constructed solely for educational research and development. Thus, the anticipated success of the new techniques would be even more apparent since there were no precedents upon which to draw for the planning, design, and construction. In addition, the high visibility of the new Laboratory for external audiences would help publicize the cost savings resulting from fast-tracking in educational facility planning, design, and construction. Sixth, SWRL is well-recognized for its efforts in documenting and refining the "how-to-do-it" aspects of research and development in the interests of developing a technology that can be replicated by other institutions wishing to engage in similar efforts. The SWRL mission could without difficulty accomodate new procedures in facility construction (e.g. see Hein and Schutz TM-1-71-3).

Advantages of Modern Techniques

SWRL's experience with fast-tracking and construction management has conclusively demonstrated their value in planning, design and construction of educational research and development facilities. Using these modern techniques, the Laboratory will move into its new facility well in advance of all six of the other institutions that have received grants. In addition, the project is being completed two months ahead of the original construction schedule, making a total savings in time of between 14 to 18 months. The resulting cost savings in the Laboratory's operations funds are between $1,500,000 and $2,000,000. Moreover, the total design and construction costs were well under the grant award.

Advantages in addition to time savings accrued through fast-tracking result from the fact that the construction manager is not in an adversary position to the owner and architect. In other words, he directly represents the owner as a consultant, not as general contractor representing a host

of subcontractors. Since the savings accrued through this relationship are more subtle, they warrant consideration in further detail.

An administrator with experience on projects where the general contractor has a financial interest in change orders increasing the cost of construction cannot help but be favorably disposed toward a situation where the construction manager carries the burden of negotiations with subcontractors over the necessity and cost of change orders. This can be contrasted with the usual arrangement with a general contractor. In disputes arguing whether certain work is included in the plans and specifications, a general contractor frequently adopts the position that the controversy is between his subcontractors and the owner and he, as general contractor, is a neutral bystander. The owner, then, receives no expert help from such a general contractor in attempting to keep construction costs within budget. The situation for the owner is not improved by the fact that a general contractor usually receives a designated percentage of each extra on a change order as an extra fee.

Another advantage of construction management that is particularly important to administrators with experience in dealing with general contractors who are "low bid" is the owner's ability to select the construction manager from a pre-selected list of highly qualified general contractors. In many instances, reputable general contractors will not submit a competitive bid on public work because less qualified competitors will bid below the legitimate cost of the job and be awarded the general contract under the requirements of the law. They will then attempt to make the necessary profit by cutting corners on the project, escalating the costs of change orders and forcing subcontractors to accept subcontracts below the amounts bid by various illegal tactics termed "bid shopping". Needless to say the process is repeated by the subcontractors with the second-tier subcontractors. The owner is then faced with a construction project in which unhappy subcontractors are forced to find cheaper ways of performing their part of the work in order to avoid financial loss. This type of general contractor is not sufficiently concerned with building a reputation for efficiency and good performance to be of much help to the owner in maintaining construction schedules essential for program. On the other hand, a construction manager is dependent for future business solely on his performance since construction management contracts will be awarded to the firm with the best record in managing construction. The myth that a general contractor who is low bid in open competition is necessarily the most efficient contractor and will bring the job in for the least real costs has long since been dispelled among more experienced construction administrators.

Several other advantages result from the fact that a construction manager works with the architect on the plans and specifications from an early stage of design. This makes cost information available to the owner and architect on a periodic basis so that design alternatives can be evaluated on cost data during design rather than after receipt of bids. Moreover, upon completion of the working drawings and specifications, the

firm that will manage the project has detailed knowledge of the plans and specifications. This will help eliminate those mistakes in bidding that would be made by a general contractor hurriedly working with plans and specifications that he is seeing for the first time. Moreover, suggestions from a contractor's point of view have been made and incorporated into the plans and specifications throughout design of the facility. And finally, the construction manager, based on his knowledge of the plans and specifications, can be of considerable help in pre-qualifying the contractors who are sufficiently skilled and experienced in performing the various contracts for portions of the work.

Decision Flow in Fast-Tracking and Construction Management

The cost savings realized in the SWRL project were effected in spite of rather than facilitated by the conditions of the grant award. It is absolutely essential on future projects to work out an efficient and workable flow of decisions among the owner, funding agency, architect, and construction manager in order for fast-tracking to accomplish the maximum savings possible. The following recommendations are based on SWRL's experience in working within a grant framework designed for a flow of decisions to be made on a singular, linear path. In such an arrangement there is insufficient regard for the serious cost consequences that are caused by delays in the entire project while waiting for reviews and decisions on relatively routine matters.

In designing the decision flow, the following principles must be kept in mind by all parties.

1. Any unwarranted delays in arriving at a decision can directly reduce the cost savings achievable in fast-tracking where the completion date is directly or indirectly delayed.

2. All parties must realize that the entire project must be viewed as a complete and single system. Thus, delays in decisions on one part inevitably affect and can delay the entire project. This can be termed recognition of "system integrity" by all parties. In other words, the total project cannot be divided into many subparts and managed as if each subpart were an independent project. An example of extremely poor practice is the dividing up of the total cost of the project into arbitrary "budget lines" and pretending that each is a totally independent item without consequences for the total project. The cost benefits of the modern techniques can be completely lost if any party looks on the project as a series of several independent ones reflected in several budget lines. Moreover, the fact that there are up to fifty general contracts raises the nightmarish prospect of 600 points (50 contracts X 12 budget lines) at which decisions can be postponed, thus delaying the entire project with consequential loss of public funds.

3. In identifying the decisions to be made and specifying the parties to make such decisions, the tendency to assign responsibility without commensurate decision-making authority must be avoided. Unfortunately, many well-intentioned government representatives are inclined to retain critical controls and decision-making authority while assigning total responsibility for the consequences of their decisions to the grantee. Such a practice simply is not tolerable in fast-tracking since an administrator without responsibility for the success of a project will be far more concerned with avoiding minor ministerial mistakes than in insuring the financial success of the project by promoting progress in accordance with schedule. This in turn will paralyze progress and escalate costs. An agency representative retaining decision-making authority without responsibility also tends to require an overkill of data to be submitted for his consideration in making decisions.

4. The project budget should contain a minimum of budget lines. The emphasis must be on total cost of the project rather than on the cost of individual budget lines. Specifying a multitude of budget lines together with maximum amounts that can be exceeded only with specified approvals from remote parties may provide the basis for bureaucratic mental gymnastics, but at the same time it insures dramatic cost escalation resulting from time delays.

5. All decision points designated together with the mechanics specified for obtaining approvals should permit progress to continue on the entire project while the decision is being made. This can be easily accomplished if the suggestions set forth below with regard to decision flow are adopted.

6. All parties must be sufficiently responsive to additional costs and savings being generated as a consequence of the particular construction grant. For example, SWRL was incurring costs in operations funds of $100,000 to $150,000 directly attributible to its facility status for each month it could not move into the new facility. Thus, delays in decisions that delayed completion of the project would have caused appreciable loss of public funds.

7. It should be realized that a general contractor has a great deal of latitude in the internal management of a construction project. A construction manager must have comparable latitude. The decision flow for construction management should, therefore, avoid a tendency to treat the fifty or so general contracts as fifty separate projects to be "controlled and managed" by representatives of the funding agency.

8. The decision-making authority of the funding agency must be assigned to persons who are trained and experienced in design and construction and who are in day-to-day contact with the project. To do otherwise requires the amassing of an undue amount of information merely to bring a remote decision-maker up to date. Moreover, if he understands little about design and construction the task is immeasurably complicated.

RECOMMENDED DECISION FLOW

With the above eight principles in mind, a workable decision-flow is set forth below.

Activity	Preparation of Information	Review and Recommendation for Approval	Final Approval
1. Functional specifications	Owner, architect, consultants to owner	Outside consultants (program oriented)	Funding agency staff (program oriented)
2. Total budget costs	Owner, architect, consultants to owner	Funding agency staff (architectural design and construction oriented)	Funding agency staff (construction cost oriented)
3. Selection of construction manager	Owner and architect	Owner and architect	Funding agency staff (construction oriented)
4. Plans and specifications	Architects	Owner	Funding agency staff (architecturally oriented)
5. Prequalification of subcontractors	Construction manager	Architect	Owner (constrained by total budget costs)

	Activity	Preparation of Information	Review and Recommendation for Approval	Final Approval
6.	Awards of contracts after competitive bidding	Construction manager	Funding agency (construction oriented) contracts officer (for compliance with grant)	Owner
7.	Progress payments to contractors	Construction manager	Architect	Owner
8.	Change orders (within scope of project)	Construction manager	Architect and funding agency (construction oriented)	Owner
9.	Change orders (outside scope of project)	Construction manager	Architect, funding agency (construction oriented)and owner	Funding agency (program oriented)
10.	Acceptance of contractors' work and release of retentions	Construction manager	Architect, funding agency (Construction oriented)	Owner
11.	Job audit	Construction manager and architect	Funding agency (construction oriented)	Granting authority

This decision flow incorporates all of the principles set forth above. Most importantly it assigns decision-making authority to those parties who are responsible for the success of the respective activities. The project manager in the funding agency acts principally as a coordinator or expeditor of activities by other persons with specialized knowledge in the required areas. His main activity would be to keep the project running by obtaining necessary federal approvals in the most expeditious manner.

Summary

The SWRL fast-track project has been extremely successful in spite of the existence of a decision flow that was designed for a linear type of planning, design, and construction process. Considerable savings of public funds have been realized because of the foresight of HEW-FECA in

seeing the possibilities of the more advanced techniques in construction of educational research and development facilities. The Laboratory's architect and construction manager and the West Coast FECA personnel demonstrated great patience and cooperation in meeting together periodically through the design stage to resolve potential problems before they became incorporated into the plans and specifications. The California OAC checked and processed the plans and specifications in about one-fourth of the time desired in the interests of validating these modern techniques. The project officer and grants officer, although burdened with a decision flow mechanism designed for other purposes and consequently inappropriate for the SWRL project, did all in their ability to insure continued progress throughout the project. Without the contribution of any of the above, SWRL could not have moved into its new facility until 12 to 18 months after the actual move-in date. The savings in public funds resulting from these persons' efforts will result in direct cost benefits to the taxpayer. They will aslo result in better instructional products reaching the nation's classrooms earlier than would have been possible under the traditional methods of constructing educational facilities.