Published on *MTAS* (https://www.mtas.tennessee.edu) September 21, 2019

Steps to Successful Construction Project

Dear Reader:

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We hope this information will be useful to you; reference to it will assist you with many of the questions that will arise in your tenure with municipal government. However, the *Tennessee Code Annotated* and other relevant laws or regulations should always be consulted before any action is taken based upon the contents of this document.

Please feel free to contact us if you have questions or comments regarding this information or any other MTAS website material.

Sincerely,

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Reference Number: MTAS-802

The material presented in the following sections is intended to be a guide in the process of administering a public construction project. There are six critical areas where the owner (administrative board) must take responsibility:

1. Defining the construction project;
2. Procuring professional assistance;
3. Procuring financial resources;
4. Setting performance standards;
5. Administering the project; and
6. Monitoring the project.

Step 1: Define the Construction Project

Reference Number: MTAS-803

1. Define the Construction Project

The first and perhaps most important step to making your project a success is to define the project (Waldrup, Heathcoat, Sweeney).

- What is the purpose of the project?
- What do you want to accomplish when the project is complete?

These are big-picture questions. At this step, the details are not of major importance. Begin by discussing the following questions within the administrative board. You may not have complete answers, but answer as best as you can. Be cautious about jumping to the details too quickly. Specific technologies and solutions will come later, as the technical personnel add their input. Consider the following questions:

- What is the project?
- Why this project at this time?
- What problems will be solved?
- What is the expected useful life of the completed project?
- What are the long-term consequences?
- What opportunities are gained?
- When does the work need to be completed?
- Who will manage the project?
- Can the community afford the project?
- How will you describe a successful project?

Review, discuss and deliberate with your city staff. In most cases, staff members will have initiated the project, so they have already answered some of the important questions for themselves. Their involvement during the project development and decision-making stage is critically important. The people who work in the area will be able to add clarity to the questions and answers. They should be able to fill in details about current capacities, rates of usage and regulatory concerns. Their input could redefine the whole project. It may be appropriate to request that a technical-assistance provider or a regulator be part of your discussion. These professionals can frequently add direction because they can point out options to accommodate regulations or public health and environmental concerns. They also may point you to similar projects that have been successful or unsuccessful.

There may be other technical experts who could be involved in the discussion at this time. Take time to visit similar projects to discover problems encountered or processes that worked well.

Again, a word of caution about jumping to the details: These initial discussions are about general ideas and general concepts. This will be time consuming, but the time is well spent to have a clearly defined project. Consider the following questions for the next round of discussions with staff, regulators or assistance providers:

- What is the project?
- Will the project solve the problem?
- What are the long-term consequences?
- What is the expected useful life of the completed project?
- What opportunities are gained?
- When does the work need to be completed?
- Who will manage the project?
- What assistance is needed to complete the project?
- What are the regulatory considerations?
- What will the project cost?
- Can we operate it once it is built?
- Can the community afford the project?
- How will you describe a successful project?

Next, think about operations (Dr. Joe Middlebrook):

- Will a plant be able to produce the needed effluent or drinking water quality?
- Will a collection or distribution system deliver the appropriate service?
- What are the capital costs?
- What are the expected operation and maintenance costs?
- What level of operator skill will be needed?
- What number of operators will be needed?
- What is the ability of the community to support the facility or infrastructure?

The process of defining the project may take significant time. It is a circular process of asking questions of why, what, and how several times to several different groups in order to reach a consensus on what is best to meet the public needs. If this process involves all the various parties involved in design and operation, your partnership is well on its way.

Step 2: Procure Professional Assistance

Reference Number: MTAS-1249

Most SCORE members and presenters expressed concern that the expertise and experience of the individuals involved in the project contribute greatly to its success or struggles. Once you have exhausted your own resources, involve a consulting engineer. Consulting engineers serve a very important role in a construction project. It is their responsibility to match infrastructure and technology to solve a problem or improve a service. They begin with problems and concepts and add details until there is a solution. Many times they also handle much of the project administration and arrange financial packages. Project owners need an engineer who is qualified to perform these roles and who can communicate well and work well with city officials and staff.

T.C.A. § 12-4-106, establishes that professional services for local governments should be procured based upon recognized competence. Engineers, architects, accountants, lawyers and other professionals should be chosen by qualification-based selection (QBS). In this process, a city or utility requests that persons or groups wishing to provide the specified service submit statements of qualification to the city. From those statements and through interviews, the city selects qualified people

or firms. Once a qualified applicants is selected the city then requests proposals on a particular project or job. In some cases, cities will prequalify contractors before they are allowed to bid on projects.

The QBS process is beyond the scope of this paper, but additional information can be obtained from MTAS-760, Qualification Based Selection Process [1].

After selecting an engineer, outline the project definition derived in Step 1. Consider repeating the same set of questions with the engineer that you covered with your staff and regulators. Ask for ideas, recommendations and a timetable of activities. At this time, cost questions are difficult to answer. Initially the answers may be only estimates or relative costs, but as the project progresses more accurate estimates will emerge.

Always remember that the engineer works for the city. The city owns the project; the city will pay for the project; and the city will have to live with the project for many years. The engineer is the person who will take your general ideas and needs and convert them into a detailed project based upon either your guidance or his preferences and according to Tennessee Design Criteria for Sewerage Works or Design Criteria for Water Works and engineering standards. Make sure the treatment options, materials, and equipment chosen by the engineer are affordable, that they match local conditions, and that they will actually do the intended job. Do not let operators, engineers, or others push you into work that is inconsistent with the mission of the utility. Be leery of unproven technology and misapplied technology. Make certain the solution fits your needs and resources. The newest equipment or latest design that worked in another community may not fit your situation.

A very important consideration is having “errors and omissions” insurance as a requirement for either statement of qualification submission consideration or the successful candidate. Quite often, the firm or individual will be working on a project whose cost will exceed the annual revenue or even the net value of the firm or individual. In the event of errors or omissions, the firm most likely will be able only to correct the design work if the corrections are not too extensive or expensive. The costs of actually constructing the corrections would likely be beyond the ability of the firm or individual to bear. The inevitable lawsuit springs to mind, but you “can’t get blood from a turnip.” If they don’t have the financial resources, then they just don’t have them. The city would be left holding the bag. THAT is when errors and omissions insurance comes into play. This insurance would provide the financial means to protect the city from a nonfunctional or otherwise unsatisfactory project.

Most engineers provide a review opportunity at the point where design is 30 and 60 percent complete. Project owners must take this opportunity to accomplish two objectives. First this is an opportunity to develop a closer relationship with your engineer and second, it is a time to closely look at the design concepts and details. At these review times changes are far easier to make than later in the project. Make sure you can answer all the questions posed in the previous section called “Define the Project.” Also give your operational personnel an opportunity to closely look at the plans.

After the project has been designed by the engineer and approved by the owner and regulatory and funding agencies, seek bids from contractors. The consulting engineer usually provides guidance and evaluation through this process. This person will prepare contract documents, drawings, and specifications and assist in evaluating bids. Before accepting bids check all references and make sure you are not getting a contractor known for cutting corners. Accept the lowest responsible bid. The lowest responsible bidder is defined with respect to state purchases as a person who has the capacity in all respects to perform fully the contract requirements and the integrity and reliability that will assure good faith performance, T.C.A. § 12-3-201(6). It also was said in *R. G. Willmott Coal Co. v. State Purchasing Commission*, 54 S.W.2d 634, 635, 246, KY, that in determining who is the lowest and best bidder (the) purchasing commission must consider not only the amount of the bid but also the business judgment, capacity, skill, and responsibility of the bidder and the quality of goods proposed to be furnished. The definitions of lowest responsible bidder and lowest and best bidder in other jurisdictions are similar. If you are going to reject a bid as irresponsible, have adequate documentation to make that decision. When a bid is significantly lower than the others, use caution as there is a high risk of problems in these cases (Waldrop).

Step 3: Procure Financial Resources

Reference Number: MTAS-1250

Water and wastewater utilities are very capital intensive business enterprises. Developing a plan for covering construction costs as well as operation and maintenance is a major part of a manager's job. The decisions made in the plan are basically a way of balancing the answer to the Step 1 questions Dr. Middlebrook posed:

- Will the project be able to meet the regulatory or water quality requirements?
- What are the capital costs?
- What are the expected operation and maintenance costs?
- What level of operator skill will be needed?
- What is the ability of the community to support the facility?

Sources of Funds

There generally are three sources of funds for new construction: equity financing, loans and grant monies. Where there is a long-term capital plan, utility rates can be set that will allow the utility to save funds for future projects. Although this is the most economical way of paying for new construction, it often is impossible to save the amount of money needed for a major capital project. In this case outside funding will be necessary.

There are several sources of outside funds for utility construction in Tennessee. Grant monies are available from the Department of Economic and Community Development in the form of Appalachian Regional Commission and Community Development Block Grants. Sources of grant assistance are your local development district office, as well as private grant administrators. Grant/loan combinations are available from the Rural Development Administration. Low interest loans also are made for both water and wastewater projects through a state revolving loan fund program administered by TDEC, State Revolving Fund Loan Program.

Other sources of funds include the Tennessee Municipal League Bond Fund, your local bank and general obligation municipal bonds. Often large projects will use a combination of funding sources. Occasionally a county will allow a municipality to use the county's grant entitlement that could not be used by the county.

In small cities and towns, the consulting engineer will handle much of the paperwork associated with the financing. His or her experience with various lenders can be a great help. Larger utilities will have more experienced financial personnel and will handle their own financial work. If you choose to let your engineer coordinate the finances, oversee that work. A review of the financial package by someone who understands the options and their short- and long-term effects on rates and operations may be helpful. In addition to the five previously stated questions, an additional one is "How does the financial package affect the total or life-cycle cost of the project, which includes the construction costs and the operation and maintenance costs?"

Single Source or Proprietary Suppliers

Utilities often desire specific types of equipment for operational & maintenance considerations or because of performance goals. The choices may be more expensive and thus not match the goal of choosing the lowest responsible purchase price. In some instances long-term goals such as standardized maintenance and repair parts or meeting complex regulatory standards may be more important or economical for the users than low purchase prices. Single source purchases should be clearly justified. Often performance specifications are written very tightly to assure the purchase of the desired equipment or process. The Water Environment Federation's Water Leadership Institute provides some guidance for negotiating with these suppliers(Alfonso). The first recommendation is to know the market and the supplier. Understand the technology, the alternatives and what others are paying for the technology. Clearly discuss the alternatives including situation where the desired technology may simply be unaffordable or for some other reason out of reach. Clearly specify warranty details, training, service and when appropriate (software) updates and the suppliers ability to meet these long-term commitments. A word of caution regarding the "newest" technology. Carefully research new equipment and technology for successful performance in conditions substantially similar to those that exist in you city, and always be cautions about purchasing equipment with a serial number of 001. The first unit can easily have many unforeseen problems.

Step 4: Set Performance Standards

Reference Number: MTAS-1251

Having clearly-stated performance expectations at the beginning of a project follows closely with defining the project. The project owners should clearly describe to the engineers, contractors, managers and staff what is expected and what success looks like. The formal conferences that occur throughout a project are the times to have these discussions. Generally there are pre-design, design review, pre-bid, and pre-construction conferences as well as regular meetings throughout construction. Discussions with these groups at the various conferences should focus on how the work will meet the short- and long-term goals of the project. Listen carefully to what is said. If there is industry-specific language or jargon you don't understand, ask for clarification. Use good communication skills. Repeat vague sentences in your own words and seek support or redirection. Take good notes at the meetings. If problems go to litigation, whoever has the best documentation usually wins.

For example, a successful design should meet regulatory or water quality requirements at a minimum, be affordable to the customers, and be within the operational capabilities of staff who are charged with operating and maintaining the new infrastructure. TDEC will review all plans for compliance with state design criteria. Note that this does not mean the state guarantees that the design will work as you expect. A careful review of the design by your operators for ease of maintenance and operability as well as function may locate potential problems. Ask these questions:

- Will regulatory requirements be met?
- Will community needs be met?
- What are the projected operation and maintenance costs?
- Do the equipment and technology choices match local conditions and capabilities?
- What are the staffing needs and costs?

Engineers do make mistakes (Heathcoat). Review the engineer's work. Catching mistakes in the design stage saves money and stress. If developers are making expansions to your distribution or collection system, their plans also must be approved by TDEC. The state, however, does not oversee or inspect the actual construction. Inspection is a local responsibility. It is up to the local utility to inspect the construction and oversee the installation to assure that what was designed and approved is actually built. Owners also should hold designers responsible for a design that actually solves the intended problem or yields the appropriate solution.

The quality of a contractor's work generally is documented through inspection. The scope of inspection and who will perform that inspection should be decided early in the project, and the contractor should be notified prior to bidding that exact compliance with the contract will be expected. Generally, the consulting engineer provides an inspector, though many utilities are performing their own inspections, especially in water and sewer pipeline construction (McElroy). The costs of inspection can be substantial, so clear agreement about the amount and extent of inspections must be agreed upon to avoid misunderstandings and different expectations. Inspections can be general or detailed. The inspector may be working more than one job, be dedicated to one job or be part of one job. Along with the decisions regarding scope of inspections, also have a clear understanding of who can stop work for noncompliance. Roles must be clearly defined (Crutcher).

Plans and specifications will detail material quality. Shop drawings and material manufacturing specifications must be provided to the engineer for review and approval for compliance with plans and specifications. Approved shop drawings and materials then are part of the plans and specifications, and no unapproved substitutions are acceptable. Of course, after setting high standards for inspection and materials owners must support the inspector's decisions; otherwise, the inspector has no authority, and inspections become a waste of money.

Another area of performance to be discussed involves water quality when a sewer or water treatment plant is being renovated or upgraded. EPA and the state expect all water quality standards to be met throughout construction interruptions. This will require planning and coordination between operators and construction workers. Here, again, clear understanding of roles, responsibilities, and authority is critical. If the contractor needs to interrupt plant operations, the operators must be notified in advance. Also, operators need to understand that construction will disrupt their routine, and major adjustments may be necessary for the duration of construction.

A widely-known fact in public works is that no matter what type of work you have performed, no matter what its public benefits, if you leave a mess in someone's yard or damage their landscaping or flowers you are in for trouble. This is especially true of the construction of utility pipelines. The cleanup of the construction mess is vitally important. Cleanup in pipeline construction should be a daily process as the construction moves down the right-of-way or easement. If quick cleanup is expected, it should be specified in the bid specifications. It is recommended that construction easements be videotaped prior to the beginning of construction to help resolve disputes about damage.

The warranty period for new equipment and facilities often is misunderstood. Beginning and ending dates should be clearly stated as well as who is responsible for warranty work, the scope of warranty coverage, and, importantly, what is not covered. If an inspection is to be performed prior to the end of the warranty period, this detail should be specified at the beginning of the project. There also should be clear understanding about start-up and training on the use of all equipment, especially the control electronics and computers. All equipment should include operation and maintenance manuals and recommended spare parts.

In construction, always expect problems. Construction projects are major logistical efforts where even the best planning can be undermined by unforeseen events. Because of this, project budgets should have 10 to 20 percent of the value of construction set aside for contingencies. Use this money carefully. A common reason for increasing costs is "differing site conditions." This could be unknown ground water, rock, or difficulties with utility relocation. Easement costs may change, and there is always concern about inclement weather.

Many of these items will be in the various contracts, so read them. If you don't understand them or the technical language, ask questions for clarification, or change the language.

Step 5: Administer the Project

Reference Number: MTAS-1252

Managing a construction project is the critical role that will determine success or struggle. Managers must be able to understand the full project, simultaneously watch the big picture, and fit the details into the picture in a way that leads to success. They must bring together a variety of personnel, materials, and equipment, and piece them together to meet the design. This should be done in a timely manner, on budget, sometimes in harsh and unpredictable conditions, and oftentimes without disrupting current operations.

There are various forms of project administration. The most common is for the owners to hire a design engineer, who designs the project, and a contractor, who builds the project according to the design. Another option is the design/build concept, where a single firm is hired to design and build the project. This arrangement can streamline the process and result in significant savings. There are questions, however, about the lack of competitive bidding when using design/build.

A third option is some variation of the construction management process. This option is common in Tennessee with school construction. The construction-manager structure results in an extra party being involved and an extra cost, but this person's involvement often results in a far better project. The cost of construction management must be weighed against the added cost. In small projects, there may be ways to receive the benefits without major extra cost.

With construction management, one person should be designated as project manager. This manager may work for the engineer or be a city employee who is dedicated to the project, or be a third party who works for the city as a contract project manager. This person is charged with the responsibility of making the project successful and should have direction, authority and resources. His or her loyalty must be to the success of the project and to the owner of the project, not to individual interests. The manager must have outstanding personnel skills along with the technical know-how to manage the construction. And, he or she must possess mediation skills and be able to communicate and organize well.

One option for project management is for the engineer to provide this as part of the design service. Advantages of this method are familiarity with plans and specifications that allow quick response to questions related to the documents. Disadvantages include the inability to be completely independent when there are possible deficiencies in the documents. If this option is desired, the scope of work must

be decided in early contract negotiations so that the additional cost can be included in the engineering fee (Sizemore).

Another method is to hire a separate engineering firm for the construction phase of the project. This gives complete independence, but it also results in a loss of knowledge and history about the design, which may result in time being lost rehashing decisions (Sizemore).

A third method for project management is generally available only to large utilities, and that is to provide the service themselves (Sizemore).

A fourth method is to hire a third-party project manager. This will add cost to the project, but many owners indicate that the presence of a manager actually saved the utility money.

Advantages to this option include review of plans and specifications and bid packages, independent cost review, experience in selecting qualified contractors, improved on-site communication, maintenance of the project schedule, and coordination of contractor and subcontractor efforts (Sizemore).

Step 6: Monitor the Project

Reference Number: MTAS-1253

A critical role for the project owner is monitoring the project. This generally is done in conjunction with the utility staff. The owners of the project, the city or utility board, along with their staff, managers, engineers and inspectors, must evaluate the project and their own performances relative to the project.

Inspection of the work is critical to a successful project. The inspector must be qualified. He or she should clearly understand the design, should know the latest construction methods and must clearly know the owner's expectations. Owners must clearly state those expectation. It is suggested that expectations should be similar to the following statement, "Construction shall be consistent with design, shall be completed with quality materials consistent with the design, shall be completed with construction methods of the highest quality in a way that preserves worker and public safety."

The design itself should meet design criteria set by the state. That design and the equipment choices should meet the approval of operations and management personnel. These people, along with the engineer, should be able to give an assurance that the design will produce a water quality that meets, at a minimum, the regulatory standards. There should be a level of comfort among the financial staff that the project and subsequent operational expenses are affordable. As construction begins, remind all personnel — from the professionals to the least experienced laborer — that a high-quality project is expected. Specified materials must be installed according to design, using construction methods that result in a long-lasting project and are on budget and on time. The contractor and inspector both should document daily activities and progress on the construction site. Payment requests will be made based on the construction progress. Make payments to the contractor quickly. If there are disputes regarding payment requests, reconcile them quickly, preferably using a previously agreed upon method.

In a four-part article in *Operators Forum* entitled "The Operator's Key to Successful Plant Upgrades," the authors recommended that a treatment plant staff person called a coordinator is key to improving relations with contractors, subcontractors, engineers, and operators of the facility. Where a third-party project manager is not affordable, this may be an alternative. Though not in control of the project, a coordinator could serve many functions of a project manager by keeping the parties working as partners and serving as the eyes and ears of the owners.

Links:
[1] https://www.mtas.tennessee.edu/reference/qualification-based-selection-process