

FHWA Demonstration Project No. 89 Quality Management and a National Quality Initiative

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Quality assurance specifications and programs in the highway construction industry have been evolving since the 1960s. Within the last decade there has been increasing attention to promoting quality products and services throughout the U.S. economy. There has also been an increased level of interest within the highway community. Although there is currently significant interest and many independent activities associated with what has now become known as quality management, there is a need to coordinate these many activities. There is also a need to increase awareness in and build support from upper management, and to provide technical skills and tools to those responsible for implementing quality management programs and specifications. A coordinated effort among the Federal Highway Administration, the American Association of State Highway and Transportation Officials, the highway construction industry, and others is being formulated to provide oversight and direction toward increasing emphasis in quality management and other construction quality and performance issues. This effort has been termed the National Quality Initiative. FHWA's Demonstration Project No. 89 Quality Management can provide the vehicle to implement the activities under the initiative. This paper describes the development of these activities and their current status and plans.

There has been a conscious effort within the United States over the last decade to promote a correlation between American products and quality. In general, this effort has primarily been focused in the manufacturing industry. Congress has promoted the concept of American quality through the initiation of the Malcolm Baldrige National Quality Award (1). This award has received significant publicity from the recent recipients: Federal Express, Cadillac Motor Division, and IBM. Total quality management (TQM) is the subject of much discussion. Quality has become an important factor in maintaining global competitiveness.

Quality in the highway field is not new. Indeed, highway engineers have always been concerned with providing a quality roadway for the traveling public. The first use of formal quality assurance (QA) programs and specifications may be traced back to the AASHTO Road Test in the early 1960s (2,p.3).

EARLY FHWA EFFORTS

In the 1970s, FHWA aggressively promoted QA programs through promotional and training efforts. Demonstration Project No. 2 made in-field side-by-side comparison of highway materials test results using innovative project sampling

and testing programs and QA specifications. Early training included a course entitled Statistical Quality Control of Highway Construction for state highway agencies on the development of statistically based specifications. This effort was followed by Demonstration Project No. 42, a series of workshops that were designed to provide hands-on experience for state middle and upper management on development and implementation of a QA program.

The original FHWA policy guidance on QA programs stated: "The purpose of this directive is to establish a program to attain the widespread use of formal quality assurance techniques in highway construction by 1980" (3).

Early perceptions of QA significantly hampered progress in attaining widespread use. For example, the Associated General Contractors of America (AGC) in 1977 stated: "One of the major purposes of the use of statistics is to provide a formula for reduction of payment. . . ." (4,p.8) This perception was perhaps, and still may be, the greatest hindrance to expanding the use of quality management (QM) techniques today. In response to the AGC position, the then Chief of the Construction and Maintenance Division of FHWA, Sanford P. LaHue, stated (memorandum to Regional Administrators, Oct. 4, 1977): "These techniques are not limited to statistical specifications, but include such things as rapid testing procedures, improved process control, establishment of performance-related quality criteria, and the development of acceptance sampling and testing plans."

Today there is an even broader view of the subject of quality assurance. "Construction QM" is a broader term for the overall process of ensuring construction of quality products. It not only encompasses contractor process control and owner acceptance issues, including statistical quality control, but also such items as personnel qualifications, training, and certification programs; information management systems such as materials control systems and links to pavement management systems; performance-related specifications; innovative contracting practices to achieve quality; incentive-disincentive provisions to encourage quality attainment commensurate with the value received; performance recognition systems for quality projects and personnel; improved materials, tests, and equipment; and quality improvement techniques for both external and internal quality "customers."

CURRENT NEEDS

A few states have made significant progress in developing and implementing QM programs including specifications that rec-

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ognize materials and construction variability, revised sampling and testing programs, assignment of process control responsibility and activities to contractors, and training of contractor and state personnel.

Many of the state highway agency management personnel who directed the development and implementation of the early QM programs are now retiring and are being replaced by younger personnel who lack sufficient training in statistical quality control. In some states, personnel who were trained during the early FHWA efforts are now becoming managers and are expecting to change their QM procedures. At the same time, states are increasingly being pressured to adopt QM programs because of reductions in the level of state staffing, desires of the contracting industry, improved management practices, or all three.

In order to properly implement a successful QM program, there must be a substantial commitment to training long before such elements as new specifications or operating procedures are put into effect. Engineers, inspectors, construction supervisors, and construction workers all must be trained in their new responsibilities so that they can work as a team. Decisions need to be made on whether certification programs are going to be used and whether they will be in house, cooperative with industry, or by an outside agency such as the National Institute for Certification in Engineering Technologies (NICET).

Within the highway community, quality, and more particularly quality of the constructed product, has become a highly visible issue. Francis Francois, Executive Director of the American Association of State Highway and Transportation Officials (AASHTO), recently said in a letter to the Standing Committee on Highways (Nov. 8, 1990): "There is significant concern being expressed by some members of Congress about the quality of America's highway construction." In a comprehensive, four-part paper in this Record, Afferton et al. call for a national policy and leadership in QM.

OTHER MAJOR RELATED SUBJECT AREAS

Performance-Related Specifications

Although performance-related specifications (PRSs) do not have to be QM specifications, these are best suited to determine how much material is within specifications so that rational payment schedules can be developed. As mentioned before, in the past there was some sentiment that price adjustments were punitive in nature. To be equitable to all parties, price adjustments should be related to performance. Negative adjustments should rationally relate to the loss in service life and performance of the product. Relating specifications is a concept that was embraced by former Secretary of Transportation Samuel Skinner as part of his National Transportation Policy. One of the initiatives under that policy is that the U.S. Department of Transportation should "replace rigid standards and requirements with performance related criteria in Federal transportation programs" (5,p.44).

In 1990 a publication of the Transportation Research Board indicated that the highest priority research need in the nation was a project for development of PRSs. TRB said the objective would be "to improve quality control of highway construction by developing and implementing performance based

specifications" (6,p.6). Other top priorities of the TRB study that relate to this initiative are

- Priority 3: Development of More Effective Rapid Test Methods and Procedures,
- Priority 5: Improving the Quality of Work on Highway Projects, and
- Priority 7: Responsibilities for Quality Management.

Currently, National Cooperative Highway Research Program (NCHRP) Project 20-5, Topic 23-05, on PRSs seeks to determine the extent to which construction and materials specifications have been rationally linked to performance data.

FHWA has research under way to address PRSs that may eventually lead to equitable and rational pay adjustment clauses. This includes research on pay adjustment provisions perhaps more likely to give quality results—price incentives for quality. FHWA has endorsed the use of incentives for improved quality provided they are based on readily measured characteristics that reflect improved performance. There is disagreement, however, among states about the factors to be used, the pay schedules, and how multiple factors are treated.

Innovative Contracting

In order to achieve quality results, there must be sufficient incentive or motivation by the provider to produce quality products. Critics argue that one of the obstacles in achieving quality in government contracting is the low-bid process. By law, construction contracts must be awarded to the lowest responsible bidder [Title 23, U.S. Code, Section 112, Par. b(1)]. Conversely, the law also mandates award of design contracts on the basis of qualifications and experience rather than cost [Title 23, U.S. Code, Section 112, Par. b(2)]. Although this may send a mixed signal that government is more concerned about cost than quality in construction contracts whereas quality is much more important than cost in design contracts, this is the current philosophy in the public-works sector of highway construction. Methods are being used or investigated to introduce quality into the construction bidding process. One method already mentioned is the use of incentives and disincentives for quality. If a good contractor is sure that a bonus can be earned, the bid price should reflect this fact. This then should give a "quality contractor" a slight price advantage in the low-bid process. Quality could also be entered directly into the bid. Factoring time estimated to complete a project as well as cost into the low bid, known as $A + B$ or multiparameter bidding, has been used to some extent in this country. It is conceivable that quality could somehow also be factored into the low-bid determination if an equitable method for quantifying quality, possibly through PRSs, could be developed.

At present the most common method of entering quality into the bidding process is the use of contractor prequalification procedures, in which the past work quality of contractors as well as their financial abilities are considered in determining which contractors are qualified to submit bids.

The use of warranties and guarantees has been the subject of much discussion lately. These have not been allowed in the past for federal-aid contracts (Title 23, Code of Federal Regulations, Part 635, Section 413), on the rationale that such

requirements would indirectly result in federal-aid participation in maintenance, which has long been prohibited. The use of warranties and guarantees is currently being studied by the General Accounting Office, however, as required under Section 1043 of the Intermodal Surface Transportation Efficiency Act of 1991. FHWA has been experimentally evaluating the use of warranties and guarantees under FHWA Special Experimental Project 14, concentrating on warranty of products or features in such a manner to preclude any participation in routine maintenance.

AASHTO

The AASHTO Subcommittee on Construction has several activities under way concerning QM. The subcommittee has frequently discussed the incorporation of QM specifications into the AASHTO Guide Specifications for Highway Construction. Such incorporation was only one vote short of being accomplished in a balloting of the committee in 1978. Recently the western region of AASHTO, known as the Western Association of State Highway and Transportation Officials (WASHTO), created a task force and produced a set of guide QA specifications (7). The AASHTO Subcommittee on Construction plans to study the use of the WASHTO specifications as a basis for developing AASHTO guide specifications. The subcommittee is also developing an implementation guide for QM programs and specifications.

Another activity of the subcommittee is development of a QM data base to provide information on various aspects of QM, such as technician certification programs, use of contractor process control provisions, statistical quality control and acceptance, and use of incentives and disincentives for construction quality.

DEMONSTRATION PROJECT 89 WORKSHOP

FHWA initiated a demonstration project to gain top-level management support for QM principles, increase technical understanding, provide various references concerning specifications and implementation of QM programs, and, it is hoped, tie these separate efforts together.

As the first activity under Demonstration Project 89, FHWA sponsored a workshop consisting of top leaders in the QM field from state highway agencies, the construction industry, construction associations, academia, and FHWA. Approximately 30 leaders in the highway construction quality field were brought together on December 12–13, 1990, to discuss quality of the constructed product and to provide input into FHWA's role. The individuals attending this workshop were invited to represent a broad cross section of the highway industry.

On the first day of the workshop, a number of presentations were made on past and current activities regarding quality, followed by presentations on TQM and how much of this philosophy follows the concepts of QA in the highway industry. Other presentations and group discussions focused on specific elements of a QM program. In general, the presentations and group discussions emphasized the following key

elements that must be included in a successful construction QM program:

- Absolute commitment of top management to provision of quality products;
- Programs for quality improvement and for quality assurance, both internal and external to the organization;
- Training and certification programs;
- Well-written, sound statistical specifications;
- Use of performance feedback information in evaluating and refining specifications;
- Involvement by industry in the development of quality management specifications;
- Use of rational and equitable incentive-disincentive provisions; and
- Provision of the necessary tools and resources.

Ken Afferton, Assistant Commissioner for Design and Right-of-Way of the New Jersey Department of Transportation, suggested that the following were needed on a national level to broaden proper use of QM techniques:

1. Education in QA and QM,
2. Improved national guidelines,
3. A national policy statement, and
4. An FHWA mandate similar to that for pavement management.

On the second day, small working groups discussed and later presented recommendations on future national activities concerning quality in the highway industry. The response of the workshop participants was that the needed emphasis of QM must go deeper than a demonstration project. There must also be a long-term commitment by FHWA through policy issuance, training, and technical support.

The workshop participants concluded that there is a need for the development of a "quality consciousness" within the highway community, but no agency or organization has been willing to initiate such action. The following is a composite of specific recommendations.

- A national initiative on quality is essential.
- Top management understanding of and commitment to quality products and delivery are critical.
- A national statement of policy should be a part of an initiative in order to show national commitment. It should be developed jointly by FHWA, AASHTO, industry, and academia.
- FHWA should affirm its commitment to quality and provide the needed leadership in developing a national initiative on quality.
- One part of the initiative should be a demonstration project focused on design, construction, materials, and maintenance quality. The focus should be broader than statistical quality control specifications.
- A major emphasis should be placed on partnership among designers, owners, contractors, and suppliers in achieving quality results.
- Technical skills and tools are essential and should be provided. These include certification programs, sound statistical

specifications, and a long-term commitment to technical training.

- A long-range plan for implementing a national initiative on quality should be developed and followed.

A smaller working group formulated the overall objectives of a quality initiative to emphasize that quality is integral to each element of the National Transportation Policy. Specific objectives would be to

1. Improve the technical quality and responsiveness to public needs of the nation's transportation systems;
2. Increase the strength and competitiveness of the U.S. transportation industry in the global marketplace through quality emphasis and improvement;
3. Advance the quality of transportation delivery systems through partnership efforts among FHWA, AASHTO, industry, and academia;
4. Maximize the use of the transportation investment through better system and product performance; and
5. Encourage technological developments and innovations through quality incentives.

An initial list of possible elements of a national initiative was also developed by the workshop participants. These were

- Marketing initiatives:
 - One- to two-day seminars for top management of FHWA and AASHTO and industry chief executive officers,
 - Mid-level manager awareness and implementation training,
- Improved NICET model and information series,
- QM and statistical training:
 - Contractor oriented,
 - State employee oriented,
- Repackaged and expanded availability of exciting reference materials and training,
- Documents containing recommendations on implementing QM,
- Development of easy, modern statistical tools.

The support for use of federal mandates was very mixed. Some argue that unless there is a federal mandate, progress will be slow and perhaps nonexistent. There is also the position that some degree of uniformity between states allows increased competition. In general, industry representatives were strongly in favor of mandates. States would be very concerned, however, about mandates' being too prescriptive.

The issue of federal mandates is always controversial. Even internal government opposition to the proposed mandatory governmentwide use of TQM brought about the demise of the proposed Office of Management and Budget Circular A-123 (8).

NATIONAL INITIATIVE

It was decided that a briefing paper would be prepared for upper FHWA management, to gain support for a national initiative and for development of a joint policy statement with AASHTO and industry regarding QM. FHWA developed an

internal position paper that included the major recommendations of the workshop. This position paper was endorsed by Thomas Larson, Federal Highway Administrator, on March 26, 1991.

The workshop participants suggested establishing a panel of top management from FHWA, AASHTO, and various industry representatives to discuss the need, form, and content of a national policy on highway quality. A national initiative would be composed of many elements, some of which can be accomplished under the auspices of Demonstration Project 89 or under the training efforts of the National Highway Institute. A general framework of a national initiative will be established and Technical Advisory Committees (TACs) formed to correspond to the major elements of the initiative. These TACs will guide the development of each component of an overall program.

Francis Francois, Executive Director of AASHTO, presented this concept to the Standing Committee on Highways (SCOH) on June 9, 1991, and SCOH voted to

- Approve AASHTO's commitment to a Construction Quality Assurance Initiative with FHWA and the construction industry.
- Authorize the SCOH chairman to appoint a task force to serve as AASHTO's representatives on a joint AASHTO-FHWA-industry steering committee to guide the Construction Quality Assurance Initiative. The joint steering committee would
 - Develop a draft statement endorsing a construction quality initiative;
 - Guide development of seminars for top-level leaders from states and industry to further the understanding of the purposes, benefits, and techniques for improving construction quality; and
 - Provide suggestions and guidance to AASHTO's committees and member departments aimed at the overall improvement of highway construction quality (9).

Solicitation of industry support was through the joint committee meeting of AASHTO, the American Road and Transportation Builders Association, and the AGC in August 1991 and by letter from Francois. FHWA under Demonstration Project 89 is developing various contracts and work agreements for seminars, technical training, and preparation of various reference documents and tools.

A COMMON THREAD AND VEHICLE

The national initiative is needed to bring national attention to the quality of construction, further the use of construction QM, and help tie together the many efforts currently under way in QM. If it is to succeed, there must be a positive, unselfish partnership among FHWA, AASHTO, and the contracting industry. Political leaders, top managers, and industry leaders must be made aware of the potential benefits of a comprehensive QM program including sound design, construction, and maintenance practices; valid and effective statistical acceptance procedures; and wise infrastructure investment policies. Demonstration Project 89 can be the vehicle to bring the quality issue to national focus and deliver

many of the necessary products. This should also reaffirm FHWA's commitment toward promoting QM and quality of construction.

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