A feasibility evaluation on the outsourcing of quality testing and inspection

Minsoo Choi a,*, Michael Brand b,1, Jinu Kim b,2

a CERIK (Construction and Economy Research Institute of Korea), 11th F, Construction Building, 71-2 Nonhyun-dong, Kangnam-gu, Seoul 135-701, South Korea
b School of the Built Environment, The University of New South Wales, Sydney NSW 2052, Australia

Received 3 April 2007; received in revised form 9 October 2007; accepted 8 November 2007

Abstract

This paper evaluates the feasibility of outsourcing testing and inspection activities in construction work, based on a survey of interested parties and an evaluation using the Analytic Hierarchy Process (AHP) with experts on quality control. For the AHP, five criteria were adopted and a number of pair-wise comparisons were performed in two stages. Finally, the weighting coefficient to approve the outsourcing was calculated at 0.606, suggesting it more reasonable to permit rather than prohibit outsourcing. Outsourcing of testing/inspection is necessary to enhance the objectivity and expert skill, despite the reduction in the sense of responsibility among the testing technicians and inspectors. However, to initiate outsourcing, it is necessary to first separate the 'quality testing and inspection' activities from the 'quality control' activities at the job site. Furthermore, the project owner should preferably make the decision to outsource testing and inspection activities and select the testing agency.

Keywords: Outsourcing; Testing and inspection; AHP; Testing agency; Quality control

1. Introduction

Quality control (QC) of construction work is an important process for the construction industry and has been systemized thus far in Korea. However, the recognition of the importance of QC is still low. Thus, there is a tendency for the QC to be performed perfunctorily, with the employment of unqualified persons lacking any direct relation with QC. The appropriation of quality management costs and independence of the quality management organization is still unsatisfactory. In addition, a social Career Development Program for personnel in quality management is insufficient.

In general, QC activities include planning for quality management, examining design drawings, checking specifications, purchasing, inspecting and testing. Inspections and tests are fundamental to the quality management process [3,7].

As the scales of construction projects have expanded recently, the QC work load including quality testing and inspection at a job site is on the rise. As a result, there is a growing tendency for construction companies to outsource labour-intensive quality testing and inspection activities to external specialized testing agencies [4]. Accordingly, the number of such specialized testing agencies that perform quality testing and inspection at job sites is also on the rise. According to Williams [15] and Schenayder [13], outsourcing of QC is relatively common place in many countries such as the United States, Japan, Korea and Taiwan.
Construction companies gain by being faithful to their inherent QC activities by outsourcing their testing and inspection activities. On the other hand, there exists some concern over the decreased sense of responsibility in case of outsourced quality testing and inspection. Moreover, there is an opinion that outsourcing is not desirable since QC is an inherent part of a contractor’s business [1,2].

The purposes of this research are to evaluate the feasibility, effectiveness and necessity of outsourcing tests and inspection works using the Analytic Hierarchy Process (AHP), and to propose policies in connection with the outsourcing of testing/inspection activities.

2. Review of arguments for and against outsourcing

According to the results of a survey undertaken by Choi [5] of construction engineers in Korea, 42.2% of the survey respondents indicated that outsourcing of testing and inspection activities might enhance the specialized skills of testing technicians and inspectors. Building constructors (20%) tended to emphasize the importance of outsourcing tests and inspections for downsizing manpower at job sites. The survey respondents (18.9%) indicated that outsourcing is desirable in order to separate labour-intensive testing and inspection works from QC activities.

Conversely, if tests and inspections are outsourced, 27.8% of respondents replied that the testing technicians from the testing agency might be subordinated to the prime contractor. Moreover, 18.9% indicated that outsourcing might lead to a reduced sense of responsibility among testers (see Fig. 1).

3. Feasibility evaluation of outsourcing by the AHP

3.1. Outlook of the analytic hierarchy process

The AHP (Analytic Hierarchy Process) is a structured approach to decision making developed by Saaty (1995). The AHP is a weighted factor-scoring model and has the ability to detect and incorporate inconsistencies inherent in the decision making process. Therefore, the AHP has been applied to a wide variety of decision making problems, including the evaluation of alternatives.

Accordingly, this study introduces the AHP to draw reasonable conclusions in coping with the above mentioned controversial points, particularly regarding whether the outsourcing of testing/inspection is reasonable or not.

For the AHP, a questionnaire survey was undertaken in March of 2006 of 22 experts on quality management in Korea. The experts comprised public servants (×2), professors (×3), researchers (×4), construction engineers (×4), graduate students (×3), building material makers (×3), a project owner, a constructor and a public testing institute. To ensure the objectivity of this survey, we excluded specialized testing agencies from the survey. Furthermore, of the 22 experts surveyed, a total of 16 had experience in working for construction companies or as QC engineers.

3.2. Discussion of criteria

In order to evaluate the feasibility of outsourcing test and inspection works by the AHP, the first step was to define the criteria by which feasibility was to be determined. In determining the appropriate criteria, discussions were undertaken with 6 of the 22 experts who took part in the questionnaire survey. As a result, criteria were proposed under the following five questions:

1) Can the testing and inspection work be conducted systemically?

Since quality testing/inspection is an integral part of QC, there is some dispute as to how testing/inspection can be separated from QC. Accordingly, provided that the testing/inspection is outsourced, we should examine whether or not the quality inspection and tests can be conducted systemically.

Fig. 1. The reasons for and against outsourcing testing/inspection [5].
(2) Is it possible to enhance the expert skills of testing technicians?

There are many kinds of testing activities that demand specialized skills and experience specific to the testing and inspection of construction work. Accordingly, we should review whether or not outsourcing can enhance the expert skills.

(3) Can outsourcing improve the objectivity of testing and inspection?

The purpose of quality testing and inspection is to determine whether supplies of services conform to contract requirements [9]. Therefore, objectivity is essential in conducting tests and inspections [15]. Accordingly, the researchers ought to determine whether or not outsourcing improves the objectivity and independence of testing and inspection.

(4) Can outsourcing enhance the sense of responsibility of testing technicians and inspectors?

Provided that the testing/inspection activities are outsourced, some arguments that there is a possibility that the sense of responsibility as a testing technician may deteriorate if the individual is not attached to the prime contractor. However, there are some counterarguments that the sense of responsibility hardly deteriorates because most tests/inspections are conducted under the supervision of QC managers belong to a prime contractor. Accordingly, the researchers should examine whether or not outsourcing can enhance the sense of responsibility of testing technicians.

(5) Is it possible to enhance the status of testing technicians?

Most testing technicians and inspectors tend to be employed rather as project-specific temporary workers than as regular workers. This may lead to lower the social position of testing technicians and QC standards at construction sites [5,11]. Consequently, the systemic training of testing technicians and the enhancement of their status should be taken into account.

3.3. Criteria and hierarchy

In order to evaluate the feasibility of outsourcing tests/inspections, this study adopted the following five criteria: (a) the possibility of conducting tests/inspections systematically; (b) enhancement of the expert skills of the tester/inspector; (c) improvement of objectivity; (d) securing a sense of responsibility; and (e) improvement of the testing technician’s status. The hierarchy of the problem was designed with two levels, as seen in Fig. 2. The five criteria for the AHP and the corresponding items for evaluation are shown in Table 1.

3.4. Pair-wise comparison

In order to determine whether outsourcing should be permitted, a number of pair-wise comparisons were necessary, conducted in two stages. First, each pair of criteria was mutually compared with respect to the goal. Second, each pair of alternatives was compared with respect to each criterion at the upper level of the hierarchy.

Comparisons of all elements of the hierarchy, that is, the criteria with respect to the goal and the alternatives with respect to the criteria, were made on both levels of the hierarchy. Weighting coefficients for all the criteria with respect to the goal were derived in turn as a sub-result of the procedure. Weighting coefficients for the two alternatives were derived by the AHP with respect to the goal.

After 10 comparisons (i.e. $(5 \times 4)/2 = 10$), a comparison matrix was obtained, as shown in Table 2. The results were the value of each matrix calculated by integrating the answers of ten experts from the QC field and by using the geometric mean instead of the arithmetic mean to avoid being affected by outliers [8]. After the comparison matrix for criteria vs. goal was completed, weighting coefficients and the ranks of the criteria were calculated on the basis.

![Fig. 2. Hierarchy of the problem for the AHP.](image-url)
of the procedure described by Saaty [12]. The results of that calculation are shown in Table 2. The weighting coefficients represent the relative importance of each criterion in making a decision.

As a measure of inconsistency, the AHP uses a method to calculate the inconsistency index. According to Saaty [12], the originator of the AHP, if the inconsistency index is lower than 0.10 (that is, 10% inconsistency), the AHP results are acceptable. The inconsistency index obtained here is 0.028; therefore, the AHP results of this study are very acceptable.

From the evaluated results, the element ‘improvement of objectivity’ was ranked as relatively the most important criterion. Judging from the results, it could be concluded that the experts on QC attached greater importance to the inherent role of testing technicians and inspectors than to stable employment or the specialization of skills.

### 3.5. Decision of alternatives

As a second step, following the same procedure as above, the AHP was used to compute weights for the two alternatives (permit outsourcing or prohibit it) with respect to the five criteria shown below. After $5 \times 2 = 10$ comparisons, the five matrices were generated, which are shown in Table 3. Here, each vector consists of the alternatives’ weights; for each criterion at a higher level, there is one vector of weighting coefficients for each of the alternatives. The overall vector of alternatives’ weighting coefficients is the final result of comparisons made on both levels of hierarchy.

As a final step, the final weighting coefficients of the alternatives can be calculated using the following two results: (a) the relative weight through pair-wise comparison with respect to each element (criteria); and (b) weights for the two alternatives (i.e. permit or prohibit) with respect to the five criteria. The result is summarized in Table 4. Finally, by means of the AHP, the final weighting coefficient to approve of outsourcing tests/inspections was calculated at 0.606. Therefore, it was concluded that permitting the outsourcing of testing/inspection is more reasonable than prohibiting it.

The results of the AHP indicate that most experts recognize that outsourcing is necessary to enhance the
objectivity and specialization of quality testing and inspection, even though outsourcing is slightly undesirable in that it can reduce the sense of responsibility and induce conflicts between the testing technicians and construction engineers.

In conclusion, when testing/inspection is outsourced, the objectivity in testing and inspection is far greater than that when constructors carry out testing/inspection by themselves. Also, testing technicians and inspectors can be stably employed in specialized testing agencies and continually engaged in testing/inspection at job sites. Thus, it is anticipated that the expert skills of testing technicians and inspectors may be enhanced further and their employment status also more stabilized. In addition, provided that a quality manager is employed by the prime contractor, even though the testing and inspection are outsourced, QC may not be compromised.

4. Practical considerations for outsourcing

4.1. Summary of practical considerations for outsourcing

From the AHP results, it is concluded that outsourcing of tests and inspections is appropriate. For outsourcing test and inspection work, the principal questions as derived from the discussions with the experts on QC are summarized below:

(a) In order to outsource tests and inspections, is it not necessary to legally separate a tester and inspector from the quality management personnel?
(b) Who would be the most appropriate person to make decisions concerning the outsourcing and selection of the testing agency, the project owner or the contractor?
(c) Is it necessary to restrict the scale and kind of construction work that can be outsourced for testing and inspection? Which aspects of QC can be outsourced?

To cope with the argument points, this study surveyed the opinions of interested parties in Korea (131 construction engineers, 26 project owners, 30 supervisors and 24 testing agencies). The survey results are summarized in Table 5.

4.2. Separation of inspector/tester from quality manager

It is desirable that QC/QA managers at job sites be tied to the prime contractor, considering that the prime contractor should be held responsible for QC [6]. In order to support outsourcing tests and inspections, there is a need to separate testing and inspection activities from QC at job sites. Testing technicians and inspectors should also be separated from quality management personnel. According to the survey results shown in Table 5, about 68% of respondents indicated that the testing technicians and inspectors should be separated from the quality management personnel.

4.3. The decision maker for outsourcing and selecting the testing agency

There are differing opinions between constructors and project owners about who should decide whether testing and inspection must be outsourced or not. According to the survey results, the majority of project owners, supervisors, and testing agencies replied that the project owner should decide whether or not to outsource. However, as
seen in Table 5, about 56% of construction engineers indicated that constructors should make the decision. Provided that a contractor selects the testing agency, the agency is apt to be subordinated to the contractor; thus, the testing agency may have some difficulties in conducting the testing and inspection work in an independent fashion. Accordingly, in order to improve the objectivity and independence of the testing and inspection activities, it is desirable that the project owner makes the decision to outsource and also selects the testing agency.

4.4. Scope of work to be outsourced

In general, QC includes planning for quality assurance, examination of design drawings, checking of specifications, purchasing, inspection, testing, management of incongruent items, recording of QC, etc. [7]. Some experts argue that all types of QC activities, including testing and inspection, can be outsourced, as seen in Table 5. But the outsourcing of all types of QC activities is against ISO regulations [10,14]. Moreover, it is slightly difficult for testing agencies to understand constructors’ internal quality management systems and also access their computer networks. Accordingly, the scope of QC activities that can be outsourced should be limited to tests and inspections at the job site.

In general, the QC system of a small construction company is non-systematic and of a low grade. Therefore, it is desirable that all types of QC activities may be outsourced in such a small construction work.

5. Conclusions

From the AHP and survey results, it was found that outsourcing tests and inspections is necessary for enhancing the objectivity of quality testing and inspection as well as the expert skills of testing technicians, even though it may be undesirable in that it reduces the sense of responsibility. By means of the AHP, the weighting coefficient to approve of outsourcing testing and inspection was finally calculated at 0.606. Hence, it could be concluded that the outsourcing of tests and inspections at job sites is appropriate.

In order to permit outsourcing testing and inspection activities, there is a need to separate the testing technicians and inspectors from the quality management personnel, on the condition that the quality manager at the job site should be attached to the prime contractor. Moreover, it is desirable that the project owner has the authority to decide when to outsource and also to select the testing agency. The scope of the QC activities that can be outsourced should be limited to testing and inspection works, except for small job sites.

On the other hand, for qualitative improvement in QC, including the testing and inspection work at a job site, it is necessary to strengthen the specialization and independence of the QC organization. In terms of the administrative aspects, it is necessary to improve the regulations regarding laboratory or testing technicians. With respect to the management of a national technical license, it is necessary to delineate a career in quality management from a career at construction sites.

References