

The Role of Supreme Audit Institution in Efficient and Effective Public Construction Projects*

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I. Introduction

Public construction has always been of serious concern of the people. In old days, it was a symbol of severe exploitation and pitiless coercion. From the time history began, or even from pre-historic days rulers of society were never reluctant to abuse their power to build palace, tobs, colosseums and the like. Except for some rare case such as construction of river banks to protect cultivated land from the disaster of flood, people never expected any benefit

from public construction.

After democratic political system emerged in the history of human-beings, people's attitude toward public construction began to slowly change. Public construction has been justified only when its output is believed to be beneficial to the people. However, there has been controversy over the way public money is managed for construction work. People have suspected that there may be embezzlement and peculation of public money. And this suspicion has necessitated supreme audit institution to perform legality audit on financial management

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of construction work.

Things have partly changed again, however, when many countries began nation-wide effort for economic development under the leading role of government. Public construction of socio-economic infrastructure became one of the most important parts of the effort, and required tremendous amount of public money. As a result, there has been growing demand for and controversy over efficiency and effectiveness of public construction. This historical demand has been fully reflected in the newly required role of supreme audit institution (SAI).

The new role of SAI for national development is required in every aspect of auditing activities, but it is particularly paramount in the area of public construction. Thus, it is perfectly correct that public construction is the most important component of development programs and projects indicated in the beginning statement of Seoul Declaration. Seoul Declaration, which is the final recommendation from the Second Assembly and the First International Seminar of ASOSAI held here in Seoul last year, starts as follows:

“As the government of ASOSAI member countries are making major investments for socio-economic development programs and projects, As this change in the functions of governments has necessitated a change in the role, objectives and functioning of the supreme audit institution, the member countries have been increasingly more concerned to identify the new role in the national development perspective.”⁽²⁾

The new role of SAI is further clarified in the declaration to be that of supporting national

development by paying more attention to effectiveness and efficiency audit. However, it remains open yet to define and develop strategies of the new type of audit in the area of public construction.

Today, we are going to explore some strategies of performing effectiveness and efficiency audit in public construction. Starting from the meaning of efficiency and effectiveness, we will consider major difficulties involved in effectiveness and efficiency audit, and suggest some plausible strategies of performing it in the area of public construction. Needless to say, those strategies must be further modified and explored for practical application, since they are suggested in abstract forms.

II. Efficiency and Effectiveness Audit in Public Construction

1. Efficiency and Effectiveness

Efficiency is usually defined as the ratio output to input:⁽²⁾ that is, the ratio of goods produced to resources employed for the production of goods. To be more efficient means either that less resources are used to produce the same output, or that more output is produced with the same amount of input. For example, a bridge is said to be constructed more efficiently when it is constructed with less money than when it is constructed with more money. Or, it is more efficient to construct a bigger size of bridge than to construct a smaller size of bridge with the same amount of money, other things being equal. Thus, the term efficiency can be meaningful when it is used to compare competing alternatives.

(1) The Second Assembly and the First International Seminar of ASOSAI, *Seoul Declaration*, (Seoul: BAI/Korea), 1982. 4.

(2) For accurate definition of similar words such as efficiency, effectiveness, and adequacy, see O. Lynn Deniston, *Evaluation of Disease Control Programs*, March 1972, Discussion Paper, School of Public Health, Univ. of Michigan (Ann Arbor, Michigan), pp.16-29.

Effectiveness, on the other hand, is defined as the degree of goal attainment.⁽³⁾ More specifically it is the ratio of goal achieved to goal planned. For example, if a water reservoir is constructed to supply water to paddy field with the goal of increasing 1,000 tons of rice production each year, and if the actual result is 900 tons of rice production increase, then the effectiveness of the water reservoir construction is 90%: that is, the ratio of 900 tons to 1,000 tons.

2. Cost-effectiveness or Cost-Benefit as the Combination of Efficiency and Effectiveness

Notice that efficiency is concerned with the output and the cost of a project or program. Here, output is regarded as the direct result of project activities. For example, the output of a dam project is the constructed dam, while the output of highway construction project is the constructed highway, and so on. When we say that a dam project is efficient, we mean that the dam is constructed with less cost compared to other ones. Thus, the term efficiency in its narrow sense does not ask what goal we want to achieve with the constructed output.⁽⁴⁾

However, it is obvious that there will be reasons why we construct dam, water reservoir, etc. Construction project always has its goal (or goals) to achieve. A water reservoir will be constructed to supply water to paddy field with

the goal of increasing rice production. Yet, efficiency (in its narrow sense) of reservoir construction does not consider how much increase in rice production will result from the constructed water reservoir. Therefore, the concept of efficiency alone is not a sufficient criterion to evaluate the desirability of construction project.

The same is true for effectiveness. Effectiveness, as we have seen, emphasizes the goal attainment. Its focus is on how much goal we can achieve from (the output of) project. It does not care about how much resources we must sacrifice to achieve the goal. To make the point clear, let us consider a hypothetical case, as shown in Figure I below.

Looking at Figure I, we can easily find that water reservoir B is more effective than water reservoir A in terms of the ratio of goal achieved to goal planned. We can also find that water reservoir B can attain more goal (some people use the term effectiveness in this sense, although many people use our definition). In any case, water reservoir B is more effective than water reservoir A.

If, however, the construction cost is as such as assumed in Figure I, then water reservoir B cannot be evaluated as more desirable than water reservoir A. Therefore, we can conclude that effectiveness alone is not a sufficient criterion to judge the desirability of a project.

In short, neither efficiency nor effectiveness

Fig. 1: A Hypothetical Case in Which Effectiveness Alone Is Not a Sufficient Criterion

	Goal Planned	Goal Achieved	Construction Cost
Water Reservoir A	1,000 tons	900 tons	\$ 10,000,000
Water Reservoir B	1,500 tons	1,400 tons	\$ 20,000,000

(3) Quade defined it for analytical purpose. E.S. Quade, *Analysis for Public Decisions* (New York: North Holland), 1982, pp. 95-106.

(4) Dr. Hedderich well discussed the point. W.W. Hedderich, "Problems in Economy, Efficiency and Effectiveness Audit—Approaches to their Solution," Paper delivered at the ASOSAI Seminar in Seoul, April 1982.

as a separate concept can be a sufficient criterion to evaluate project. But, those two concepts can be combined into one criterion, namely, cost-effectiveness, or cost-benefit (or efficiency in broader sense, as some people call it)⁽⁵⁾ The cost-effectiveness is defined as the ratio of goal achieved to cost needed. The term cost-effectiveness is a combination of effectiveness and efficiency in the sense that the concept of goal attainment is borrowed from effectiveness and the concept of cost is borrowed from efficiency.

Cost-effectiveness can be a good criterion to evaluate the desirability of construction project. Going back to Figure I, we can conclude that water reservoir A is more desirable than B, since A is more cost-effective than B. In other words, water reservoir A produces more rice with the same unit of cost.

3. Efficiency and Effectiveness Audit

Efficiency audit is a kind of audit which focuses on efficiency of project (or programs) or operational efficiency of audited units. Similarly, effectiveness audit focuses on effectiveness of project. Auditor performs efficiency and effectiveness audit by checking whether a project or program is run efficiently and effectively.⁽⁶⁾ So, the objective of efficiency and effectiveness audit is to encourage, and sometimes force, audited units to raise efficiency and effectiveness of project or program. We may say that efficiency and effectiveness audit aims at promoting

the cost-effectiveness of project or program.

Strictly speaking, efficiency and effectiveness audit does not care about whether a project or program is run illegally or irregularly. It cares only about efficiency and effectiveness. Thus, the focus of efficiency and effectiveness audit is quite different from that of the traditional legality or compliance audit.

The traditional legality audit usually emphasizes the legal aspect of financial management and accounting. The major objective of legality audit is to ensure that the audited units use public money for purposes specified in laws and regulations, following detailed legal procedures.

Laws and regulations may sometimes require efficient and effective implementation of public construction.⁽⁷⁾ For example, a regulation may state that the governmental agency in charge of public schools must construct school building in such a way as to maximize the educational goal of the building and to minimize the cost (as well as that wages be paid, the contractor be decided in such and such a way, etc.) The goal maximization and the cost minimization are two essential elements of efficiency and effectiveness. Thus, laws and regulations may include elements of efficiency and effectiveness. Therefore, literally speaking, there is no reason why legality audit cannot embrace ingredients of efficiency and effectiveness audit. But, in practice, those ingredients of efficiency and effectiveness in laws and regulations have normally been regarded as elements which guide the adm

(5) For broader meaning of efficiency, see A. Wildavsky, "The Political Economy of Efficiency: Cost-Benefit Analysis, Systems Analysis and Program Budgeting", *Public Administration Review* (December 1966) pp. 7-14.

(6) Operational Audit or Management Audit, and Efficiency and Effectiveness Audit are used interchangeably. See, for example, John W. Cook and Gary M. Winkle, *Auditing* (Boston: Houghton Mifflin Company), 1980, pp. 388-396 and Martin Garrido A., "Operational Auditing — A Systematic Approach," *International Journal of Government Auditing* (April 1980), pp. 11-13.

(7) For example, Items 20 and 33 of Korean Budget and Accounting Law.

ministrators' activities, but which are not legally binding. Put in other words, they have been regarded as elements which are in the area of administrators' free discretion. As a result of this reasoning, those elements of efficiency and effectiveness of construction project have generally been excluded from the scope of legality audit.

It is rather a well known fact that the traditional legality audit forces the audited units to show up their innocence and honesty in dealing with financial matters and to strictly comply with legal procedures and requirements, without paying attention to efficiency and effectiveness of project. The legality audit does not encourage creative thinking which may promote efficiency and effectiveness, rather it sometimes discourages innovative efforts which may deviate from legal procedures. In such a way, the strict legality audit sometimes becomes obstacles to efficient and effective utilization of valuable resource.⁽⁸⁾ It is doubtlessly an urgent expectation that supreme audit institution (SAI) be an important vehicle for governmental drive to rapid national development. Therefore, it is also urgent that SAI must put more emphasis on efficiency and effectiveness audit.

III. Strategies of Efficiency and Effectiveness Audit in Public Construction

1. The Importance of Efficiency and Effectiveness Audit in Public Construction

Efficient and effective construction of socio-economic infrastructure or public utilities is so important that it deserves some repetitive

discussion here.

Most ASOSAI member countries do their best to accomplish rapid economic and social development, which requires a lot of valuable and scarce resources. Governments of those countries play leading role in the developmental effort. Public money is given to private companies in the form of loans and subsidies and is used for the construction of major economic infrastructure such as highways, roads, railroads, bridges, dam, water reservoir, etc. It is needless to say that with its limited amount, public money must be spent effectively and efficiently. Highways must be built to maximize the goal of fast and safe transportation, agricultural water reservoirs must be built to maximize the goal of increasing rice production with as less money as possible, and so on. If all public projects are carried out efficiently and effectively, we can not only save valuable and scarce resources for other purposes, but also stimulate optimal allocation of resources in private sector as well, such that maximum national development will be achieved with limited resources.

The same logic is true for the case of constructing public utilities such as parks, office buildings, school buildings, etc.

Efficiency and effectiveness audit focuses on whether public construction is efficient and effective. In this way, it encourages and sometimes forces audited units to promote efficiency and effectiveness of public construction. As a result, it can encourage technical innovation which will increase effectiveness and efficiency. And thus, it can direct audited units toward more rational use of valuable and scarce resources for maximum national development.

Whether SAI of any country will put more emphasis on efficiency and effectiveness audit

(8) BAI/Korea, *Comparative Review Papers* (for ASCSAI Seminar in Seoul, April 1982), pp. 3-48.

depends upon many factors (such as SAI's function and responsibility, auditors' expertise and the like). And whether efficiency and effectiveness audit can successfully promote efficiency and effectiveness of public construction also depends on many factors (such as the power of SAI vis-a-vis other governmental units, existence of other policy evaluating units in government, etc.).⁹⁾ However, it is doubtless that a small change in the direction of efficiency and effectiveness audit will greatly influence attitudes of audited units towards efficiency and effectiveness.

2. Difficulties in Efficiency and Effectiveness Audit in Public Construction

It is not enough to know why we must put more emphasis on efficiency and effectiveness audit in the area of public construction. What really matters is how auditors can perform it. There arise many insurmountable difficulties which must be clearly understood before we try efficiency and effectiveness audit. In order to clarify the nature of those difficulties, we must go back to the concept of efficiency and effectiveness again.

We have already seen that efficiency and effectiveness can be combined into the concept of cost-effectiveness. We concluded that water reservoir A in Figure I is more cost-effective than B. This conclusion is based on the assumption that we "knew" the actual cost and goal attainment of both water reservoir A and B. This assumption is very critical in assessing efficiency and effectiveness of public construction.

The most troublesome difficulty in efficiency and effectiveness audit in the area of public construction is the fact that the above-mentioned crucial assumption is not valid at all. This important point merits further exploration.

Suppose the Department of Agriculture constructed water reservoir A. And suppose the DOA argues that with the budget of 10 million dollars water reservoir A was the best alternative and that it was constructed efficiently. Also suppose an auditor is checking effectiveness and efficiency of the construction.

In order to perform his job successfully, the auditor must, first of all, examine whether water reservoir A was really the best choice in terms of cost-effectiveness. This requires the auditor to calculate the actual cost and goal attainment of water reservoir A and to compare them with those of other possible alternatives. The calculation of the cost of actually constructed water reservoir A will not be troublesome.

However, the calculation of the goal attainment of water reservoir A will be very troublesome and sometimes impossible.⁽¹⁰⁾ The DOA may argue that water reservoir A will increase annually 1,000 tons of rice production in average during the lifetime of the reservoir. Notice that the argued increase is predicted one, not factually realized one. It is obvious that the auditor cannot wait till the life of the reservoir is ended to calculate the actual increase in rice production. Even when he can wait, he may never know whether the increase in rice production is really due to the reservoir or due to other factors such as increase in fertilizer usage, adoption of new rice seeds, or any other innovation in rice production.

(9) Ibid., pp. 10-15.

(10) Unreliable measurement of goals and immeasurable goals are first obstacles. But, estimation of goal achievement is still more troublesome. See for example, D.T. Campbell and J.C. Stanley, *Experimental and Quasi-experimental Designs for Research* (Chicago: Rand McNally), 1966, pp. 1-6, 8, 40.

There are some delicate and sensitive analytical methods to avoid or overcome some of the difficulties involved in the estimation of goal attainment. However, there is no general method as yet which guarantees the exact measurement of the goal attainment of public construction.⁽¹¹⁾

Even when we can accurately measure the cost and goal attainment of constructed water reservoir A (which is almost impossible, as we have seen till now), we must in addition calculate the goal attainment of "unconstructed" hypothetical alternative, if we want to know whether the construction of water reservoir A is really the most cost-effective for the increase of rice production. Imagine the case when the auditor thinks that water reservoir A might not be more cost-effective than unconstructed hypothetical water reservoir C. Since water reservoir C was not constructed at all, the auditor cannot measure its cost and goal attainment.

In short, when the auditor examines the claim that water reservoir A is the best choice in terms of cost-effectiveness, he must not only measure the actual cost and goal attainment of water reservoir A, but also compare them with those of other hypothetical alternatives which had not been constructed at all. And this comparison is logically impossible.

Same difficulties arise when auditor examines operational efficiency of construction work. Suppose auditor examines whether reservoir A was constructed in really efficient way. The auditor will ask whether the construction of water A

really needed that amount of money which constructor has spent. Was not there any other way of constructing water reservoir A with less cost? Had it costed less, if more manpower had been employed instead of more usage of machines? In answering such questions, the auditor must measure the cost of hypothetical alternative ways of construction, which is almost impossible, of course.

In concluding this subsection, major difficulties in effectiveness and efficiency audit of public construction can be summarized as follows: For the examination of effectiveness and efficiency of construction work, the orthodox method requires the measurement of the cost and goal attainment of both the actual and hypothetical alternative construction project, and the measurement of cost needed for the way of both the actual and the hypothetical operation of construction work. And those measurements are simply impossible. Therefore, we usually turn to indirect method of assessing effectiveness and efficiency of construction project.⁽¹²⁾

3. Process-oriented Method of Evaluating Efficiency and Effectiveness of Public Construction —A Plausible Strategy

One strategy to perform effectiveness and efficiency audit in the area of public construction is to focus on the process of decisions involved in construction project. This strategy does not require the measurements mentioned above, but, instead, requires thorough examina-

(11) Consider various designs and statistical models to estimate program effect, explained in, for example, T.D. Cook and D.T. Campbell, *Quasi-Experimentation* (Chicago: Rand McNally), p. 79.

(12) Similar argument appear in Y. Dror, *Public Policymaking Reexamined* (Scranton: Chandler), p. 80, pp. 33-67, especially pp. 50-52. And also see F.S. Tantuico, Jr. (Auditor General of the Philippines), "Problems in Adopting and Implementing Modern Auditing Techniques in Developing Countries", *International Journal to government Auditing* (October 1980), pp. 1-12, 17.

tion of decision process. This strategy assumes that if decision makings in construction project are rational, then construction itself is cost-effective.

For a decision to be rationally made, it must follow rationally and distinctively next four stages:⁽¹³⁾

- 1) To clarify goals to achieve,
- 2) To search for possible alternative means to achieve goals,
- 3) To predict consequences of each alternative, and
- 4) To choose the best alternative in terms of cost-effectiveness.

Construction project includes many decision points. If we want to examine whether a certain public construction is effective and efficient, we must examine whether each of decisionmakings has followed the above-mentioned stages rationally and distinctively. To clarify this point, let us go back to the example of water reservoir construction. To simplify our discussion, let us imagine that the construction of water reservoir A has four decision points, as following figure shows:

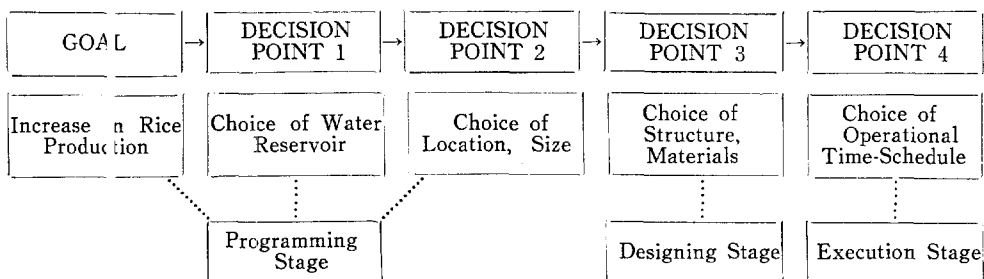
In Figure II, was can see some important

decisions involved in the construction of water reservoir A. At decision point 1, the Department of Agriculture has decided to construct water reservoir A. But, after it was decided, DOA must also decide the exact location and size of the reservoir. And this is decision point 2. Next, at decision point 3, DOA must decide structure of the reservoir and materials to be used. So goes on to next decisions. The bottom part of Figure II also shows construction stages. In order to examine effectiveness and efficiency of the construction work, auditor must examine whether each decision in Figure II was made rationally.⁽¹⁴⁾ At decision point, 1, for example, auditor will ask whether the decision to construct water reservoir A was really made. He will ask following questions:

First, what is the goal (or goals) of the construction?

Second, if the answer to the first question is that the goal is to increase rice production with more supply of water to paddy fields, then he will ask whether there is any other alternative to achieve the same goal. The alternatives may be to construct a small size of dam, to construct a long water pipeline which can supply

Fig. II: Simplified Example of Decision Points in the Case of Constructing Water Reservoir A



(13) A good summary is in E. Stokey and R. Zeckhauser, *A Primer for Policy Analysis* (New York: W.W. Norton and Company), 1978, pp.5-6.

(14) Excellent empirical findings with similar process are shown in G.R. Burggren (Auditor General of Sweden), "Effectiveness Audit-Some Notes on Problems and Experiences", *International Journal of Government Auditing* (January 1980)

water from a nearby river, or to dig large wells which can cap underground water. Have these alternatives been ever considered by the authorities in charge of constructing water reservoir A?

Third, if the answer to the above second question is yes, then the next question is: Did they predict the major consequences of each important alternative? In other words, did they predict cost and goal attainment of each alternative? At this stage of discussion, let me remind you of a simple truth that audited units are always self-defensive: that is, audited units or personnel will try to justify their decision. For example, they will argue that they have considered major alternatives and predicted their consequences. And they further argue that judging from the predicted cost and goal attainment of major alternatives, water reservoir A is the best choice in terms of cost-effectiveness. Moreover, to justify their decision to construct water reservoir, they may under-estimate the goal attainment and over-estimate the cost of a competing alternative (a dam, a water pipeline, or wells).

The fourth stage of rational decision making process (to choose the best alternative) can be almost automatically realized, if the prediction of the major consequences of each alternative is rationally carried out. Therefore, sound and reasonable prediction is the most crucial element of rational decisionmaking, and thus, the intentional under or over-estimation of consequences of alternative is a very serious and critical problem.

You can easily guess that success or failure of efficiency and effectiveness audit in the area of public construction depends largely upon auditor's ability to check the soundness of prediction of consequences of alternatives. If auditor cannot check whether audited units are telling a lie or truth on the predicted consequ-

ences of major alternatives, he can never know whether a decision was rationally made. This is true throughout all decision points in Figure II.

Consider, for example, decision point 3 in Figure II. Auditor may suspect that less amount of expensive material and more amount of cheap material than actually consumed could be utilized to construct the same water reservoir. In order to tell the audited authorities that their combination of material wasted public money, the auditor must offer a persuasive prediction that his alternative combination will save money without decreasing the quality of water reservoir A. For another example, consider decision point 4 in Figure II. The auditor may suggest better operational time-schedule, but he must soundly predict that his alternative time-schedule will really save time.

From the above two examples, you can easily notice that expertise is of utmost necessity for sound prediction of consequences of alternatives. For reliable and accurate prediction of consequences of alternatives at decision point 3, for example, specialized knowledge in civil and other related engineering is necessary. And at decision point 4, knowledge in Civil Engineering plus Management Science (such as PERT, CPM, Inventory Control, etc) is crucial.

Specialized knowledge can be acquired not only through formal education and training, but also through experience. Good experience is very helpful for creative search for better alternatives and for sound prediction of their consequences. For example, persons who have been involved in many cases of reservoir construction either as engineer or auditor will be in better position to think of good hypothetical alternatives and to soundly predict their consequences for every decision point in Figure II.

Good experience need not be limited to domestic ones. When one country starts a completely new kind of construction project, auditors

can learn greatly from experiences of other countries. Moreover, even when a country has lot of experience in a certain field of public construction, she can learn much from different experiences of other countries. This is of particular importance, when technological innovation is in trial, since habitual inertia can easily prevail construction project. Therefore, exchange of experiences among countries is very helpful. And this is why we meet here together.

Before we conclude our discussion, let us remind ourselves of the fact that effectiveness and efficiency audit may bind policymaker's discretion or harm his leadership. This danger becomes less serious as we move from the left side to the right side of Figure II. For example, auditors may greatly harm leadership of the minister of Department of Agriculture, if they examine whether the goal of increasing rice production can best be achieved by constructing water reservoir or by constructing another alternative of a dam (of which the construction may not be in the jurisdiction of the minister). However, we can hardly say that auditors will harm minister's leadership, if they examine whether less expensive material could be used for the construction of water reservoir A (decision point 2 in Figure II). Thus, it will be a good strategy that auditors focus on execution stage (decision point 4) and designing stage (decision point 3), assuming that decisions in programming stage were rationally made.

IV. Concluding Remarks

Effectiveness and efficiency audit is a challenging function. Many, and sometimes insurmountable, difficulties arise when auditors try to perform it. There may even be danger of crippling policymaker's leadership. Audited persons may feel it additional burden which they must bear, but which they do not think they

have to. Yet, it cannot be neglected, if supreme audit institution wants a more positive role in national development.

Public construction has been of the most important components of governmental efforts for rapid national development. If it is carried out effectively and efficiently, public construction will achieve its goal with least public money and can save valuable and scarce national resources for other purposes. This possibility can be more probable, when supreme audit institution pays more attention to effectiveness and efficiency audit in the area of public construction.

We tried to find out some plausible strategies to perform the new type of audit in the area of public construction. We have seen, however, that the orthodox method of measuring efficiency and effectiveness of public construction is almost impossible. Thus, we turned to process-oriented method which examines the rationality of decision making in construction project. But the success of this method depends largely on auditor's ability to check the soundness and accuracy in the prediction of consequences of major alternatives at each decision point.

Thus, we concluded that auditor's ability or expertise is crucial. Auditing experiences in many cases of similar construction projects are very important sources of expertness. New trials in, and different technologies of, construction work and their results in other countries can be of great help for creative thinking of alternatives and sound prediction of their consequences. And this is the reason, I think, why we meet here together.

I hope, this seminar will be another epoch-making momentum in ASOSAI history to explore and develop, fully utilizing our different experiences, better method and strategies for effectiveness and efficiency audit in the area of public construction.