

EXPERT KNOWLEDGE, TECHNIQUE AND METHOD REQUIRED TO AUDIT E-GOVERNMENT, AND METHOD TO OBTAIN THEM

I. Traditional Audit of IT System

The IT system that supports an electronic government is comprised of HCI (human computer interface, user interface), a “visible face” for users such as a nation, and a data-processing system, the “invisible face” in the back-office. Traditionally, audit of the data-processing system has been, at all times, conducted in SAI-Japan. The scenario, as outlined below, can be assumed to be correct.

1. Selection of telecommunication line

A system exist that shares aircraft flight information by connecting all airports in Japan via private lines. Flight information is made for each aircraft’s flight based on the flight plan submitted by the captain of the aircraft, and includes information on the call sign, airport of departure, places en route, destination, expected departure time, expected arrival time, etc. The air-traffic control officer gives flight permission to each aircraft based on this information. Flight information is intensively managed by the air-traffic control center, which is connected with each airport through private line. Each airport and air-traffic control section outputs the flight information from the terminal installed in that facility, and the air-traffic control officer gives appropriate instructions to each aircraft based on the flight information. The instructions that the air-traffic control officer gives to each aircraft include: push back, taxiing, taking-off, departure route, altitude, direction of flight, scheduled contacts with the air-traffic control officer, frequency for contact, change of air route, and position notification instructions.

An auditor pays attention to the private line used for this system. The authorities concerned explained that the reason the authorities used the private line was because they judged that the private line was a safe, stable communication medium, an important factor as this system assumed responsibility for air-traffic safety. The auditor’s thoughts are outlined below.

Each terminal exchanges only a small amount of data in this system. Are there any other more economic forms of communication media? A private line is expensive, but is suitable for a large amount of high-speed communication because a broadband can be used for communication between two specific places. When the amount of communication data is small, a contract fee may be comparatively high. On the other hand, telecommunications companies provide a packet communication service. The packet communication service is that a plurality of nodes are connected like the Internet, data is divided into a certain packet length, a communication channel is selected for each packet, and the packet is delivered to a receiver. Although communication speed with packet communication service is low, a fee is charged according to the amount of

communication data, making this service more advantageous when the amount of communication data is small. Moreover, this service has a fail-safe system in which, even if some degree of failure occurs to some nodes or to the communication line, another communication route is selected so as to continue communication automatically. Furthermore, since one piece of data is divided, and the divided data is transmitted by each individual route, there is less risk of the data being tapped or altered.

The knowledge required for such an audit includes:

- line service characteristics and a connection method;
- method of calculating the amount of communication data;
- method of processing communication data provided by auditees;
- programming the calculation and analysis of the amount of communication data for each line;
- estimating the number of working man-hours required to change a communication method, and
- judging the level of security needed.

2. Artificial satellites tracking and control service

A company is entrusted with artificial satellites tracking and control service. The purpose of this service is to receive telemetry data from an artificial satellite in a tracking and control center, confirm the state of the artificial satellites and transmit a command directing the artificial satellite to an appropriate orbit. Since it is necessary to become well-acquainted with the orbital theory of artificial satellites, analytical dynamics and computer operation in order to carry out this service, it was determined that those workers with the highest level of skills and technical knowledge should be engaged for this service. When estimating the contract fee, the authorities concerned decided to apply the highest level of unit price to those workers whom they will engage in the service based on the above-mentioned position. An auditor carried out a field audit and found that about 1/3 of the total number of workers had the necessary technical knowledge and experience; other workers did not have sufficient technical knowledge and experience. The auditor confirmed their technical knowledge by interviewing the workers and observing the way in which they did their jobs. With regard to their experience, he confirmed, following an interview with the workers, that he had asked them about their professional career. Knowledge required of an auditor is as follows:

- outline of analytical dynamics;
- judgment of the knowledge level required of the workers for the contracted service;
- parts to which a load applies during computer operations;
- an ordinary SE unit price, and
- technology required of an ordinary SE.

3. Unnecessary MTU (magnetic tape unit)

A reception system installed at regional offices in many locations throughout the country to perform a medical expenses payment service, which allows an itemized statement of medical expenses to be received from a hospital. Included in the itemized medical expenses statement are the following: the hospital's name, patient ID, treatment, and kind and quantity (number of times, etc.) of medicine prescribed. The government examines closely the data contents, judges its validity, and determines the amount of payment required. At present, most of the data in the itemized medical expense statements are presented in paper form. At the design stage of this system, it was unknown what kind of medium was used for a hospital to submit this type of data. Since it was expected that data stored in various kinds of media would be submitted from a variety of hospitals, the designer of the system prepared a reading device that could cope with FD (floppy disk), MO (magneto-optical disk), MT (open reel magnetic tape) and CMT (cassette magnetic tape), in order that these media could receive the data. The auditor made the following findings.

An old system, installed in a hospital, may use an MT, but the hospital may not have a system in which an itemized medical expenses statement is output to the MT. The system that can output this kind of statement to an electronic medium is new, and will not use MT media that has only small capacity and is bulky. Besides, an MTU and an MT medium are expensive. It is uneconomic to procure large numbers of devices that are likely to be used rarely. Even if a hospital submits an itemized statement of medical expenses by MT, it is enough to send the statement to the place where an MTU is installed. Therefore, installation of a MTU at just one site would be sufficient. This would enable savings to be made in the procurement, installation and adjusting of scores of MTU units. The knowledge required on this occasion is as follows:

- the amount of itemized medical expense statements;
- the format of the data comprising the itemized statement of medical expenses;
- technical and market trends surrounding an electronic medium, and
- the cost of using the drives.

II. Expert Knowledge Required to Audit e-Government

1. Particularities when auditing an e-Government

When an e-government is audited, the object of audit is largely classified into the two following aspects:

“visible face”: HCI, screens shown to the nation, services

“invisible face”: Data-processing unit

It is difficult to express the term “visible face” either objectively or quantitatively. In traditional

audits conducted by SAI-Japan, there is a case in which they paid attention to “how concert halls and sports facilities are being used”. An audit such as this is characterized in the following manner:

- the users, the people who use those facilities, are limited to only part of the nation;
- the usage rate viewed from the facilities was low;
- since the users cannot use the facilities immediately or simultaneously, the result of using the facilities for a period of two years or more after the facilities opened was included in the audit data.

However, in terms of auditing an e-government, there are some particularities that should be followed:

- the users of e-government constitute the whole nation or various overseas nations,
- it is not possible to judge whether an e-government is good or not according to the usage rate of each service. For example, an unemployment rate is low, the usage rate of an unemployment allowance payment service is low, and
- since the users can use the facilities immediately and simultaneously, it is possible to audit the facilities at a trial stage or for a short time after facility use has begun.

On the other hand, with regard to the audit of “invisible face”, the “traditional” method can be used in the IT system audit.

2. Expert knowledge required

Since there are particularities, as stated above in e-government audits, it is necessary to confirm whether a system provider correctly grasps the real needs of the end-user customer (e.g. the nation). In order to make such an audit, SAI-Japan must employ a new audit method e.g. a “customer satisfaction” survey. In addition, to accomplish this purpose, it is necessary for the auditors to acquire expert knowledge such as: questionnaires, various kinds of statistical methods for analyzing data obtained as a result of questionnaires, and a simulation method required to propose an alternative plan.

It is difficult for anyone to understand something that he (or she) has not seen yet. When someone constructs an image of something, he likens the “something” to what he has already seen. Consequently, expressed needs often differ from real needs. In many cases, the desire of the end-user customer is prone to incline toward “visible things” such as a screen design. System architects should recognize the flow of information and the flow of jobs in an extended field closely related to people’s lives without limiting these flows, or limiting them only to the government in order to increase flow efficiency. At this stage, system architects need ability to grasp the ideal and the reality from plenty of knowledge, experience and the information provided.

The government is using EA (enterprise architecture) in order to optimize various kinds of existing business systems and to determine the business system that is the object of information

systematization. Thus, knowledge of EA is also required for e-government audit. For example, under the circumstances in which EA has not been appropriately applied and the existing business system has not been adequately optimized, when an audit is carried out, in order to determine whether the system architect has unreasonably applied the system design to existing business system, knowledge of EA is of course required.

There are many cases in which a system design, in its current conformation, should not be matched to the existing business system. Since the existing business system is based on manual plus paper-based work, and information systematization under non-optimal business circumstances, is prone to lead to inefficient information systematization displaying unreasonableness, ineffectiveness and inconsistency. Some people are likely to make the mistake of paying attention to only those exceptional matters and incorporating their processing into a system. When an IT system is introduced, it is sometimes better to grasp the limits of the system being introduced and to change the workflow in which it is carried out. The reason is that with regard to exceptional matters, by selecting a design that a human judges and deals with businesses, the system would be easily maintainable and inexpensive.

A considerably wide range of expert knowledge, with regard to various kinds of technologies such as: network infrastructure, attestation foundation, HCI, reliability design, and security technology, is required for system design in order to examine whether a system is selected and designed appropriately, whether the system built is based on the appropriate design, and whether an appropriate operation is implemented after the system has been built.

III. Method of Acquiring Expert Knowledge

1. From public sources

Information sources for public information:

- books, magazines (technical magazines), newspaper (technical newspapers);
- association bulletins;
- brochures;
- trade fairs;
- announcement of new products, and
- electronic conference by unspecified members, SIG (special interest group).

I attach a great deal of importance to trade fairs. At trade fairs, people can see, understand and compare many commodities in a short timeframe, and can listen, in person, to explanations covering specific points of interest. Small-scale enterprises, which cannot afford to spend a large amount of funds on advertising, often participate in trade fairs, thus collecting unique technical information. Besides, information that cannot be publicly disclosed and unconfirmed reports from technical

people can be useful hints in terms of the audit. Thus, public information is the first step in accessing undisclosed information. If the auditors try to access disclosed information and get in contact, as much as they can, with the people concerned with sales and those concerned with technical development, they will be able to deepen their level of understanding and gain decision-making hints.

2. From education

What is as important as experience is continuous education. Since education services sponsored by some enterprises continually receive appraisals, as a commodity in itself, said services are sufficiently mature as an educational program to be able to offer high-quality education in a short period. In terms of providing training in individual operation, effective management and development, trainees have many opportunities for contacting product information. In terms of providing training in PM (Project Management), HRM (Human Relationship Management), etc., trainees can access the information such as the direction in which the industry concerned is proceeding as a whole as well as each company's objective. Those trainers who are engaged in this kind of education are specialists in the IT industry. An important group of people to use as an information source.

3. From specialists

A. Specialists who provide knowledge

The following people are included among the specialists who provide knowledge and technique required for e-government audit.

Design of user-friendly pages: Industrial designers and psychologists.

System directivity and configuration: System architects and system auditors.

Web designs: Web designers and system engineers.

Security maintenance: Security auditors.

Business system development: System analysts and application engineers.

For example, with regard to HCI (Web design), it is essential that the design include a simple, user-friendly menu configuration so that the governmental services can be used without any special support. For users who are used to such operations, a mechanism in which page design can be changed for each user, and personal attestation can be omitted, is sometimes wanted. Generally, a user-friendly mechanism has a poor level of security, while a mechanism with high security is difficult to use. In order to build a comprehensively user-friendly, flexible well-balanced system, a variety of technologies must be used.

B. Joining a group of specialists

It is valuable to join a variety of groups consisting of IT specialists. Joining academic societies and academic conferences would enable you to increase the amount of information that you can collect and to access the technical information trends. In order to join these groups, a certain level of qualification is sometimes required, and the learning needed in order to obtain the qualification will also be effective in terms of understanding the knowledge required. The vast majority of constituents of these groups are non-governmental IT engineers, scholars and educators, so it is possible to come in contact with different viewpoints and opinions. No matter what kind of group it is, there will always be some information that you cannot know unless you join the group, and there is also some information that is regarded as common knowledge within the group. By joining conferences of such groups, it is sometimes possible to obtain information that has not yet been disclosed and obtain material of use in terms of effective decision-making.

C. Assessing specialists

Practical experience and continued education are required of these specialists. In order to assess and select appropriate specialists and develop a level of cooperation with them, experienced specialists must also exist amongst those who place an order. It is also effective to use the ITSS (IT Skill Standard) scale. It is important, when you select specialists, that you interview them. Having an interview is one of the best ways of confirming the technical level of the specialists. On the other hand, sometimes a high appraisal will be conferred on the individual who is good at presenting themselves. It is necessary to determine whether he is the appropriate person for the job by assessing his question and answer capabilities as well as his presentation style. The ability to intuitively understand the ability to ask questions and the quality of answers can be acquired only through practical experience. Most likely, there are two methods for this. The first is to receive as many presentations as possible and repeat as many questions as possible, thereby accumulating experience and discriminating the appropriate engineers from the others. In fact, the result is often unknown until one is working with the specialists once they have been employed. Moreover, after they have been employed, it is necessary to obtain an assessment and information about them and apply the assessment and information to your own job. The other method is to accumulate your experience with regard to the technical field that is the object of the assessment. By so doing, you can assess the specialists in very concrete terms. While you are talking in concrete terms with a specialist about the method of solving a problem with which you have struggled in the past, you will be in a position to know the level of the specialist better. At any rate, experiences are also needed on the side of the person who places an order. Leonardo da Vinci is thought to have said, "Pictures must be painted." There is no other way than accumulating experiences to improve the ability to assess.

D. Employing experienced persons

SAI-Japan has not employed any IT specialists, neither has it provided any special training for IT to anyone once they have been employed. Staff members who have some expert knowledge and experience of IT, if any, are among the following:

- those who have experienced system development or the like in an enterprise before they were employed by SAI-Japan, and
- those who have studied by themselves since they have been employed at SAI-Japan.

In the fast-moving technical IT field, they should pay attention to the most up-to-date technology in addition to the technology and experience that has been acquired in the past, and should endeavor to look ahead to future technical trends. There is a method of employing talented people with IT engineering experience. Of course, it is necessary to assess the technical ability and experience of those who may be employed. Although there remains a problem of whether at least some of the staff members have the ability to assess them, this method is worth trying.

4. Development and operation undergone in one's own organization

The proper method to accumulate experience is to “use the technology for one's job”. Even if one receives training and writes an exercise-problem level program, the program is not normally exposed to criticism in practical business situations. Those parts that are costly in terms of system development are those that are not connected to the essence of data processing. These parts are, for example, output design, screen design, a small difference in response time, and concentration of traffic.

Talking of response times, for example, it is not possible to decide whether the response time should be 0.1 sec. or 0.7 sec. Supposing that a screen does not return in an ordinary screen transition, 0.7 sec. is enough, however if it takes 0.1 sec. to turn a single page, and 1 sec. to turn over 10, the response time is felt to be too long. Therefore, it is important to understand the resources and programming techniques required. I call this the “technical feeling”. A person who has never touched soil or cloth does not understand the touch of soil or cloth. In the same way, a person who has not experienced designing, program making and operation or has not had any experience as a user of such a program does not understand these matters. This means that “the person cannot understand” instead of “the person cannot intuitively understand”.

It is possible to acquire the knowledge required to carry out e-government audit by combining the above-mentioned methods properly.

IV. Problems in e-Government Audit

Many auditors have only the minimum necessary knowledge required to highlight important

matters within a limited field and from a limited point of view. If the audit is limited to a traditional area, limited knowledge may be enough, but for the audit of an e-government, it is desirable, as a matter of course, for them to acquire all of the expert knowledge, as described above. The reason for the imbalance in expert knowledge held by the auditors is due to the following reasons:

- the characteristics of the audit division to which they are assigned after they have been employed.

The type of audit techniques that an auditor learns and acquires for the first time after he is employed, and the knowledge related thereto, differ depending on whether he is assigned to the audit division whose main task is the audit of civil engineering works, social security, taxation, or goods procurement. Moreover, the field that his senior auditor, from whom he receives his training, is conversant with affects the field of knowledge that the auditor will acquire or not.

- the expert knowledge of the auditors is affected by their special field of study in school and the field related to his previous job.

If an auditor has a basic knowledge that he acquired earlier, he will be able to easily acquire the knowledge of the field related to it. Therefore, the field of expert knowledge that he should acquire as an auditor will be affected by what he specialized in and what kind of techniques he used before he was employed.

- the acquisition of knowledge of those fields, for which there are no specialists in SAI, does not progress.

Since plenty of knowledge is shared via conversation in a group related to the field of knowledge, the acquisition of knowledge does not progress if there is no specialist nearby. In SAI-Japan, this tendency can be seen in the IT field, and there are few opportunities in which the auditors are able to carry out an audit right down to the design of the system.

Furthermore, in the IT field:

- technical innovation moves fast;
- there are many kinds of technologies that have been employed (such as program languages and DBMS, reliability design methods and estimation methods);
- it is necessary to look across the whole process from up-stream to down-stream, and
- particularly in terms of auditing e-government, it is necessary to continue the audit while grasping the relationship of e-government with each system in the whole government and its positioning in turn within the whole government.

Therefore, the knowledge and technique that auditors should acquire extends widely and is likely to become obsolete in a short time period. On the other hand, it is necessary to audit a

“well-seasoned technology” with high reliability. Therefore it is very difficult for inexperienced people to acquire the necessary knowledge and techniques in a short time frame.

1. Auditors who can read a particular source code will disappear

In order to conduct audits in the IT field, an analysis of a source code is one of audit techniques. A source code is a lowest-ranked design specification and the most accurate design specification, and is a part of the system (a finished product) itself. In other words, it is possible, by reading the source code, to confirm not only the detailed contents of a design but also a designer’s way of thinking with regard to the design and performance of a finished product. This is one of the basic audit activities. Besides, it is sometimes possible to confirm the complexity of the system and the ease of maintaining and operating the system by reading the source code. Such a technique is very effective in terms of audits in the IT field, consequently, auditors should endeavor to acquire the ability to read source code. If they have such a technique, they will, firstly, have no psychological reluctance to read source code, and secondly, even if a program is huge, they will be able to catch the atmosphere of the whole program quickly and grasp its key points.

It is also possible to understand the quality of the system by reading the source code. I believe that auditors need to have experience of using a plurality of program languages themselves. If they can write a program themselves, they can understand in which parts of the program there is (or there is not) a description for materializing the idea of a basic design, and their ability to understand source codes that other people have written will increase as well. Specifically, they should have experience of becoming familiar with one of the following languages:

- procedure language, such as: FORTRAN, COBOL, PL/I, C, and BASIC;
- object-oriented language, such as: C++ and JAVA;
- language using regular expression such as Awk, Perl and Ruby;
- language that controls a program and assigns a file, such as JCL and shell-script, and
- language for DBMS, such as SQL.

In fact, there are only a few auditors who have this experience, and even those auditors who do not necessarily continue to work in an environment in which they continue programming and are always in contact with new technologies. Therefore, I am afraid that the number of auditors who can read a useful document of source code will decrease and they will disappear eventually.

2. Problems with which auditors are confronted

In fields other than IT, problems can be comparatively easily understood, and since problems can be easily classified, it is easy to understand them and explain them to senior officers. For the audit of an IT system, however, in terms of hardware, not only technical knowledge about the operation of hardware but also the worldwide technical and commodity trends must be taken into

consideration. Furthermore, many systems have a short life, and it is difficult to confirm the effect of audit activities although it takes a lot of time and labor to study the validity of the audits. In terms of software, it is difficult for an auditor to confirm the validity of product selection. He must take the opinions of many users and specialists into consideration, and will need to confirm the validity of the opinions gathered. In addition, he must examine the software's user-friendliness, in which the validity of Web design and various users are presumed.

V. Conclusions

As has been described above, to tackle the audit of e-government, it is necessary to overcome various problems, for which a variety of expert knowledge is required. The age of one auditor acquiring all the knowledge and techniques necessary for the audit (IT-field audit) of e-government is passing. Therefore, systematic audit is needed, and in SAI-Japan, the organization suitable for the systematic audit has not yet been completely established. This problem remains to be solved.