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Relative Importance Analysis of inter-evaluation items in Korean IS Standard Audit Checklist Using Decision making Techniques

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Abstract

Korean Government has introduced and legislated IS Audit System since 2006. IS audit is executed by auditors on the basis of standard audit checklist. As IT environment and technology are rapidly changing, it is inevitable that the improvement of the audit quality is followed by change or modification of items in standard audit checklist. To do this, this paper applied AHP and MOGSA decision making techniques and drew weights and priority of inter-items in standard audit checklist. Derived weights and priority can be used as a basis to modify and change evaluation items in standard audit checklist. The same priority has been obtained from used two methods and two decision makers' groups. As a result, it was demonstrated that derived priority has high reliability.

Keywords: *IS audit, IS audit checklist, decision making technique*

1. Introduction

As Information System (IS) development for social function directly related to life and safety of people such as electronic information, culture, land and transportation, *etc*. is increased, efficient management and utilization of information resources have emerged as important issues [1]. Especially, demand to improve of users' satisfaction and service has been increased because information system had big impacts on life and property of people [2].

The Korean government has introduced and legislated IS (Information System) audit system (South Korea) to improve efficiency and ensure safety of the information system since 2006. According to this law, every company that develop programs for any Korean government branch over $500,000 is required to be IS audited [3].

This IS audit system has formed an essential means to prevent problems that may occur during IS project is developed by examining overall IS plan, efficiency on development and operation of IS, data reliability and data safety are examined[4].

Korean IS Audit is executed based on standard audit checklist which is suggested by IS project type in 『IS audit criteria』 noticed on the basis of decree of Electronic Government Act (5 Clause in 57 Article). Stakeholders for audit is composed with Owner, IS development company, Audit firm and auditors. Owner is the party that contract IS project to IS development company in order to achieve objectives of organization. IS development company is the party that receives and then develops IS project from Owner. Auditors in Audit firm submit audit plan to owner first, and then check and evaluate outputs developed by IS development company comprehensively.

Auditors should check outputs comprehensively with professional concerns and objectively based on standard audit checklist which is intend to use in audit plan which was

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submitted to owner so that they improve IS efficiency and ensure IS safety. They then submit the final audit result report with checked document to owner [5].

However, current standard audit checklists were made in 2006, so problems has been emerged that it does not meet IT environmental and technological changes. In particular, there is bad case such that other types of standard process framework has been applied for auditing because checklist of Development firm is not matched with development method, or it has been pointed that current audit framework is not suitable to apply for a new IT. Also, it has been requested that checklists for SW architecture and security must be more concreted as they were too abstract [6-10].

Despites of problems in audit standard checklist, little research on improvement of audit quality by changing audit standard checklists has been conducted. To modify and change audit checklist, it would be desirable to replace with new items or modify items with little significance according to importance degree among audit standard checklists.

Recently, Hee-Jun Cho and *et al.*, [11] suggested how to derive relative weights and priority among standard checklists by using MOGSA and 100 scale measurement. It is necessary to suggest validity of derived priority by comparing with various methods.

In this paper, importance degree among standard checklists was derived by using two decision making technique, MOGSA and AHP, and priority was assigned according to derived importance degree. To verify assigned priority, priorities between applied decision making technique and priorities between respondents-groups were compared.

Chapter 1 describes introduction of this paper, and Chapter 2 describes audit framework of information system, and Chapter 3 describes decision making techniques, Chapter 4 presents priority measure and analysis on audit standard checklist according to decision making techniques and Chapter 5 suggests summary and conclusion of this paper.

2. Standard Audit Checklist by IS Project Type

According to Art. 23 in『IS audit criteria』, National Information society Agency (NIA) published 『Practical Guidelines for IS Audit』which defines the detailed audit procedures and methods, standard audit checklists, format of IS audit plan and report *etc*.

Standard audit checklist (SAC) defined in 『Practical Guide for IS Audit is classified into 7 IS project type, IT architecture, IT Strategic Plan, IS development, DB construction, system operation, Maintenance and Project management [12] and cover recommendations to be checked during auditing. Therefore, checklist can be selected by considering objectives of audit, scale and features of IS projects and selected checklist and evaluation for IS project development result based on checklist will be contained in final audit result report.

Standard audit checklist divided by IS project type consists of audit time, audit-area and detailed audit items as indicated in Figure 1.

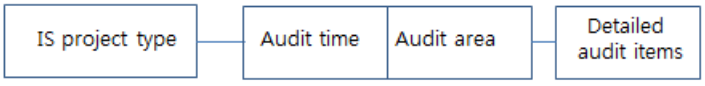

Figure 1. Basic Structure for Standard Audit Checklist

Audit time defines best time for audit by each audit area, and audit area is a subject to be audited and criteria for decisions and opinions of auditor or audit team. Detailed audit items states audit perspectives/criteria by each audit area in detail. This is to secure consistency of

audit activities and guide auditor to perform exactly what the audit checklist intends to achieve.

Table 1 indicates standard audit checklist for DB construction, which contains 2 audit times, 3 audit scopes and basic checklist contains 7, 4, and 3 for each scope, respectively, whose total is 14.

Audit time defines timeframe for executing audit by each scope, and audit scope is a subject to be audited and criteria for decisions and opinions of auditor or audit team. Basic checklist states audit perspectives/criteria for each audit scope. This is to secure consistency of audit activities and guide auditor to perform exactly what the audit checklist intends to achieve. This also describes what and why and what perspective audit is supposed to execute for each checklist.

Table 1 indicates standard checklist for DB construction, which contains 2 audit times, 3 audit areas and each audit area has 7, 4, and 3 detailed audit item respectively.

Table 2 indicates standard audit checklist by each project type, which contains 24 audit times, 44 audit areas and 239 detailed audit items for 7 IS project type. As long as the current audit standards check items continue to be applied in auditing in spite of IT paradigm drastically changes, the system development environment is consistently changing and user demands are becoming more stringent, it is difficult to improve audit quality. Accordingly, it is necessary to prepare foundation that can modify audit checklist to meet demand of users or to improve satisfaction of audit and change standard audit checklist depending on IT environment change and situations.

Table 1. Standard Audit Checklist for DB Construction Project

Audit time	Audit area	Detailed audit item
Preparation	Data collection & model implementation	1. Sufficiency of survey and selection for implementation 2. Requirements and plan for data implementation are properly established 3. Quality criteria, inspection instruction and QA activities are properly planned 4. Process of data implementation and work instruction are properly established 5. Issues on mode data implementation and solutions and data implementation process and supplemented plan are all adequate 6. Raw source are sufficiently collected and properly managed according to data implementation plan 7. Workers' education was properly conducted about work process and instruction
Implementation	Data Construction	1. Work instruction was finalized for each data type and is continuously managed 2. Work progress and workstation are properly controlled? 3. Data was correctly implemented according to Work instruction for each data type? 4. Goals of data implementation vs. plan are achieved?
	Quality control	1. QA activities are properly executed according to the plan? 2. Inspection was properly executed according to instruction? 3. Quality goals of data implementation are achieved

Table 2. Standard Audit Checklist by IS Project Type

IS Project type		Audit time	Audit area	Detailed Audit item
IT architecture		2	7	35
Information strategic plan		2	5	27
System development	structural design	5	12	57
	object oriented design	5	12	45
	QA	3	1	26
DB construction		2	3	14
System operation		1	2	14
Maintenance		1	1	7
Project management		3	1	14
Total		24	44	239

3. Hierarchical Decision Making Techniques

This paper aims to draw weights among items in standard audit checklist and to determine priority using the weights. With assumption that deciding weights among standard audit checklist is similar to make decision, hierarchical decision making techniques which are widely used in decision making were applied.

In general, decision making has such problems that optimized decision must be made under contradictory criteria, incomplete information and limited resources. Rather than prescribing a “correct” decision, hierarchical decision making technique helps people to determine one. It provides a comprehensive and rational framework for structuring a problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. They are used throughout the world in a wide variety of decision situations, in fields such as government, business, industry, healthcare and education.

Users of these techniques decompose their decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The elements of the hierarchy can relate to any aspect of the decision problem-tangible or intangible, carefully measured or roughly estimated, well- or poorly understood- anything at all that applies to the decision at hand.

Once the hierarchy is built, the decision makers systematically evaluate its various elements, comparing them to one another in pairs. In making the comparisons, the decision makers can use concrete data about the elements, or they can use their judgments about the elements’ relative meaning and importance. It is the essence of these techniques that human judgments, and not just the underlying information, can be used in performing the evaluation. These converts decision makers’ evaluation to numerical values that can be processed and compared over the entire range of the problem. A numerical weights or priority derived for each elements of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way.

Best known decision making techniques are AHP (Analytic Hierarchy Process) and MOGSA (Hierarchical Decision Model) proposed by Thomas L.Saaty and Dundar F. Kocaoglu. This paper adapted these two methods and drawn weights and priority among

items in standard audit checklists and then demonstrated validity of the priority by analyzing comparatively results obtained from two techniques.

3.1. AHP Model

Figure 2 presents MOGSA hierarchy model used in MOGSA method [12].

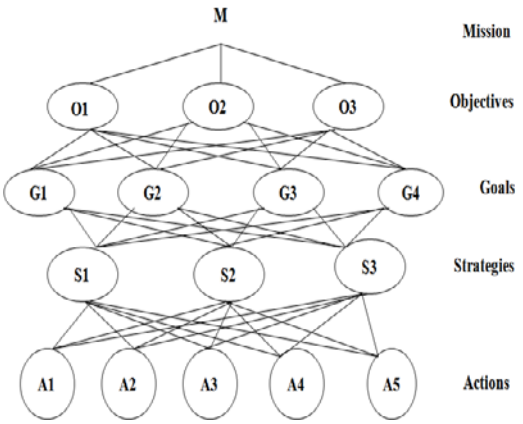

Figure 2. MOGSA Decision Hierarchy Model

MOGSA in Figure 2 stands for Mission, Objectives, Goals, Strategies, Action which are components of each level. Each element of low-level contributes decision of each element in upper level.

Figure 3 presents standard hierarchy model of AHP [13].

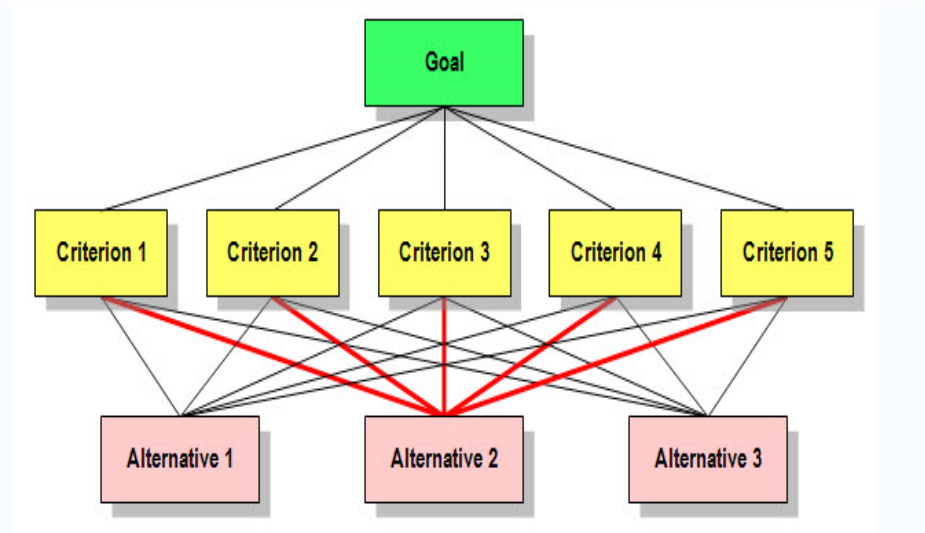

Figure 3. Decision Hierarchy Model of AHP

Standard hierarchy classifies interrelated subject matters into hierarchical order. Top level in a hierarchy indicates overall purpose of decision, and the next level consists of various elements that impact to purpose of decision. The lower the level is, more concrete is the element of the level. Also, each element in one hierarchy must be comparable.

3.2. Calculation of Relative Weights

After the hierarchy is built as Figure 2 and Figure 3 above, calculation method of weights on each element in each hierarchy are as follows:

<Step 1> Prepare pairwise comparison matrix with numbers that indicates the level of superiority against other elements under one upper level

For MOGSA, numbers of significance indicating the level of superiority against other elements are given out of 100 point scale, whereas AHP, it is given out of 9 points scale. Table 3 presents pairwise comparison measure of MOGSA and Table 4 presents pairwise comparison measure of AHP. Pairwise comparison matrix among elements in hierarchy is presented in the following formula (1).

<Step 2> Obtain normalized weights of elements at each level of hierarchy from pairwise comparison matrix.

Table 3. Pair-wise Comparison Measure in MOGSA

Significance	Definition	Description
50	Similar	Two activities has similar contribution
67	Slightly important	One activity is as twice as important than the other
75	important	One activity is as 3 times as important than the other
80	Highly important	One activity is as 4 times as important than the other
95	extremely important	One activity is extremely important than the other

Table 4. Pair-wise Comparison Measure in AHP

Significance	Definition	Description
1	Similar	Two activities has similar contribution
3	Slightly important	One activity is slightly preferred to the other
5	important	One activity is strongly preferred to the other
7	Highly important	One activity is highly preferred to the other
9	extremely important	One activity is extremely preferred to the other

To gain weights, eigenvalue method is used in AHP, whereas Constant-sum Method is used in MOGSA

<Step 3> weights of overall hierarchy which indicates relative priority of alternatives at bottom level is gained so that purposes of decision at top level in hierarchy can be achieved.

In this step, overall significance of entire hierarchy is gained by multiplying weight matrix of immediate upper level over bottom level by weight matrix gained at the very upper level. This process is repeated at upper level.

4. Results and Analysis

To apply decision making techniques, hierarchy is divided into four levels: hierarchy 1 is the top level, project type, hierarchy 2 is audit time, hierarchy 3 is audit area and hierarchy 4 is detailed audit items from the structure of fig. 1. Scores for each element by pairwise comparison in each hierarchy are obtained by evaluation from decision makers, IS experts.

For pairwise comparison among elements in hierarchy, questionnaires were prepared and requested to decision makers for their response. Decision makers were 60 people and consisted of two groups: Group 1 are 31 employees from information system audit firms, whereas 29 for Group 2 are experts in information system sector (professor and developers from IS development company).The survey was conducted for about 4 weeks and all questionnaires were returned. In this paper, pairwise comparison for only audit time and audit area was conducted.

This paper has adapted two methods: one is to gain priority for all decision makers (Overall) and the other is to gain priority for two different groups (Group1, Group 2) using MOGSA and AHP decision making techniques. After that comparison and analysis between them were made.

Table 5 illustrates weights and priority among elements for each hierarch in IT architecture, Table 6 shows for IT strategy, Table 7 presents information system development, Table 8 presents DB construction, Table 9 presents system operation and Table 10 presents Project management. In table, W means weights and P means Priority.

In Table 5, “infra and current architecture” shows highest priority in Overall, Group 1, and Group 2 in Hierarchy 1. And “infra” and “Goal architecture” shows highest priority in Overall, Group 1, and Group 2 in Hierarchy 2.

In IT strategy of Table 6, “Current step analysis & strategy development” shows highest priority in Overall, Group 1, and Group 2 in Hierarchy 1. And “Task analysis” shows highest priority in Hierarchy 2.

In IS development of Table 7, “Demand analysis” shows highest priority in Overall, Group 1, and Group 2 in Hierarchy 1. And, in Hierarchy 2, “System architecture” shows highest priority in audit time of “Demand analysis” and “analysis/design time” and “DB” in “Implementation” audit time.

In DB construction of Table 8, “Preparation” shows highest priority in Overall, Group 1, and Group 2 in Hierarchy 1. And “Data collection and model construction” shows highest priority in Overall, Group 1, and Group 2 in Hierarchy 2.

In system operation of Table 9, "Operation" has only 1 element in Hierarchy 1, which makes impossible to conduct pairwise comparison, so weights are all 1. Whereas “User-service” shows highest priority in all Overall, Group 1, Group 2 in Hierarchy 2.

In Project management of Table 10, “kick-off/plan” shows highest priority in all Overall, Group 1, and Group 2 in Hierarchy 1. Every element in Hierarchy 1 has only one project management, which makes impossible to conduct pairwise comparison, so weights are all 1.

Table 5. Weights and Priority between Elements in IT Architecture

IS Project type	Hierarchy 1	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
IT architecture	Infra & Current architecture	.55	1	.50	1	.57	1	.55	1	.67	1	.58	1
	Goal architecture and Implementation plan	.45	2	.50	2	.43	2	.45	2	.33	2	.42	2
	Hierarchy 2	MOGSA						AHP					

		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
	Infra	.40	1	.40	1	.40	1	.46	1	.47	1	.47	1
	Current architecture	.33	2	.36	2	.31	2	.32	2	.32	2	.32	2
	QA	.27	3	.23	3	.29	3	.22	3	.21	3	.21	3
	Goal architecture	.29	1	.30	1	.28	1	.27	1	.29	1	.30	1
	Implementation plan	.26	2	.26	2	.27	2	.26	2	.27	2	.28	2
	Management	.23	3	.23	3	.24	3	.24	3	.25	3	.25	3
	QA	.21	4	.21	4	.21	4	.23	4	.19	4	.17	4

Table 6. Weights and Priority between Elements in IT Strategic Plan

IS Project type	Hierarchy 1	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
IT strategy	Current step analysis & strategy development	.59	1	.57	1	.60	1	.60	1	.61	1	.58	1
	Improvement model and Implementation plan	.41	2	.43	2	.03	2	.40	2	.39	2	.42	2
	Hierarchy 2	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
	Task Analysis	.44	1	.41	1	.44	1	.49	1	.48	1	.47	1
	Technology Analysis	.31	2	.32	2	.30	2	.28	2	.32	2	.32	2
	QA	.26	3	.27	3	.25	3	.23	3	.20	3	.21	3
	IT plan	.63	1	.56	1	.69	1	.65	1	.65	1	.67	1
	QA	.37	2	.44	2	.31	2	.35	2	.35	2	.33	2

Table 7. Weights and Priority between Elements in IS Development

IS Project type	Hierarchy 1	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
IS development	Demand Analysis	.33	1	.38	1	.29	1	.39	1	.37	1	36	1
	Analysis/design	.24	2	.27	2	.20	2	.23	2	.25	2	23	2
	Implementation	.15	3	.14	3	.16	3	.15	3	.15	3	.17	3
	Testing	.15	3	.12	4	.17	4	.13	4	.12	4	.13	4
	Deployment	.13	5	.09	5	.17	4	.10	5	.11	5	.11	5
	Hierarchy 2	MOGSA						P					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
	System Architecture	.38	1	.41	1	.35	1	.39	1	.40	1	.39	1
	Applied stem	.29	3	.30	2	.29	3	.29	3	.29	3	.30	3
	DB	.33	2	.30	2	.36	2	.32	2	.31	2	.31	2
	System Architecture	.37	1	.37	1	.38	1	.37	1	.38	1	.39	1
	Applied stem	.29	3	.30	3	26	3	.27	3	.26	3	.29	3
	DB	.33	2	.33	2	.36	2	.36	2	.36	2	.32	2
	System Architecture	.20	3	.17	3	.22	3	.15	3	.20	3	.21	3
	Applied stem	.32	2	.32	2	.32	2	.33	2	.31	2	.33	2
	DB	.48	1	.51	1	.45	1	.52	1	.49	1	.46	1
	Test Activity	1		1		1		1		1		1	
	Preparation for Operation	1		1		1		1		1		1	

Table 8. Weights and Priority between Elements in DB Construction

IS Project type	Hierarchy 1	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
DB	Preparation	.65	1	.64	1	.65	1	.60	1	.63	1	.66	1

construction	Implementation	.35	2	.36	2	.35	2	.40	2	.37	2	.34	2
	Hierarchy 2	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
	Data collection and Model Construction	1		1		1		1		1		1	
	Data Construction	.56	1	.55	1	.57	1	.649	1	.65	1	.58	1
	QA	.44	2	.45	2	.43	2	.351	2	.35	2	.42	2

Table 9. Weights and Priority between Elements in System Operation

IS Project type	Hierarchy 1	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
System operation	Operation	1		1		1		1		1		1	
	Hierarchy 2	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
	User-Service	.54	1	.58	1	.51	1	.52	1	.55	1	.56	1
	User-Service support	.46	2	.42	2	.49	2	.48	2	.45	2	.44	2

Table 10. Weights and Priority between Elements in Project Management

IS Project type	Hierarchy 1	MOGSA						AHP					
		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
Project management	Kick-off/ Plan	.43	1	.46	1	.41	1	.48	1	.47	1	.45	1
	Execution /control	.34	2	.30	2	.37	2	.33	2	.34	2	.35	2
	Termination	.23	3	.24	3	.22	3	.19	3	.19	3	.20	3
	Hierarchy 2	MOGSA						AHP					

		Overall		Group 1		Group 2		Overall		Group 1		Group 2	
		W	P	W	P	W	P	W	P	W	P	W	P
	Project management	1		1		1		1		1		1	
	Project management	1		1		1		1		1		1	
	Project management	1		1		1		1		1		1	

5. Conclusion

In this paper, relative importance among inter-items in Korean standard audit checklist was obtained. To do this, MOGSA and AHP, the decision making techniques, were applied and standard audit checklist were presented into 4 levels of hierarchical structure. Weights are obtained from pairwise comparison among elements in each hierarchy and priority is drawn based on the weights. Also, priority between decision making techniques that were used in this paper was compared and priority of two groups of surveyed people was compared. The same priority has been obtained from used two methods and two decision makers' groups. As a result, it was demonstrated that derived priority has high reliability.

Derived weights and priority can be used as a basis to modify and change evaluation items in standard audit checklist.

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