

A Study on the Improvement of the Information Security System Evaluation & Certification in Korea

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Abstract— In 1993, six countries (U.S., UK, France, Germany, Canada, the Netherlands) developed CC (Common Criteria). Through a combination of rating of CC evaluation results, it can be mutually acceptable and presented to establish the future direction of the technical evaluation.

Korea, in 2006, registered to CCRA certificate authorities and has issued certification on a wide ranges information security products. However, evaluation system work based CC is done at limited agencies such as IT product development security companies, rating agencies. For this reason, relevant papers in the country and the CC certification system for the study of the problems and the lack of improvement.

So, this study derived influencing factors to again acquiring CC certification from information security companies that have received CC certification at least once since CC certification was introduced in Korea. The five variables were derived such as motivation of certification, the need for certification, discomfort of CC certification, satisfaction of certification, decision on re-certification. Based on them, exploratory model was designed and verified. By checking satisfaction and complaints about CC, find improvements.

Keywords— Information Technology Security Evaluation, Information Technology Security Certification, Common Criteria, Satisfaction, Improvements, Decision on re-certification

I. INTRODUCTION

While an information society provides convenience, it creates many risks, such as hacking, loss of privacy, and loss of confidentiality. To solve this problem, we need a variety of information security products and these products have many features and technologies. However, it is difficult for consumers of information security products to choose what they need because there are so many. Thus, a rating system against which the functionality of the product can be judged is required.

In 1993, six countries (U.S., UK, France, Germany, Canada,

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2011-0025512). This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2013S1A5A2A01017485).

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Netherland) developed CC (Common Criteria). Through a combination of rating of CC evaluation results, it can be mutually acceptable and presented to establish the future direction of the technical evaluation.

In August 2002, the Common Criteria (CC), an internationally recognized system, was introduced in Korea. In 2006, Korea registered to CCRA certificate authorities and has issued certification on a wide ranges information security products. National public institutions require that their information security products must be certified CC. However, unlike the name international Common Criteria, the CC system has almost been used domestically, as domestic security companies have prioritized the delivery of the product to domestic public agencies instead of overseas markets [26].

Meanwhile, getting a CC certification requires more than 100 million won and three or four staffs per case. It is large burden to small and medium enterprises [28]. As there are many CC certification applications, the certification process has been backlogged for quite some time. Delayed certification process causes unstable business in companies and the loopholes of public security. So, related concerns are growing [27]. Because evaluation system work based CC is done at limited agencies such as IT product development security companies, rating agencies. For this reason, relevant papers in the country and the CC certification system for the study of the problems and the lack of improvement.

This study will discuss factors related to satisfaction with the CC certification experience and factors that affect CC re-certification decisions. This study derived influencing factors to again acquiring CC certification from information security companies that have received CC certification at least once since CC certification was introduced in Korea. The five variables were derived such as motivation of certification, the need for certification, discomfort of CC certification, satisfaction of certification, decision on re-certification. Based on them, exploratory model was designed and verified. By checking satisfaction and complaints about CC, find improvements. And it will contribute a theoretical contribution and a study to determine the effectiveness of others certifications as well as CC certifications.

II. THEORETICAL BACKGROUND

A. Definition of Information Security

The definition of information security is defined in a variety of different scholars and institutions. The protection of information and information systems against unauthorized access or modification of information, whether in storage, processing, or transit, and against denial of service to authorized users. Information security includes those measures necessary to detect, document, and counter such threats. Information security is composed of computer security and communications security. Also it is called INFOSEC. See also communications security; computer security; information security; information system.

Increasing threat of information, we can't make a list all threats three are representative of the major goals of information security. Confidentiality, Integrity, Availability, and their description are following [12].

Confidentiality: An unauthorized person can't view the details of the information then the secret can be guaranteed.

Integrity: After the original data is sent, check for any signs of changes. Protect change, deletion and generation of the information from an unauthorized the third party, it will ensure the accuracy and completeness of information.

Availability: When authorized user needed data or resources of information system, it ensure that without undue delay, he will access and available to the desired object or a resource.

B. Common Criteria (CC)

CC (Common Criteria) was developed in information technology security system evaluation TCSEC for the United States, ITSEC for European and CTCPEC in Canadian security evaluation criteria. And it was developed for available in the international community by information security system ratings. In 1996, starting with version 1.0 and now 2013, version 3.1 revision 4 was released. Through a combination of rating of CC evaluation results, it can be mutually acceptable and presented to establish the future direction of the technical evaluation.

CC certification is to understand the security requirements of consumer for developers, to broaden the width of choice for users who want and allow you to express requirements for security features. And by presenting standardized information security system criteria for the evaluator, he can conduct the evaluation which is ensured reliability and safety.

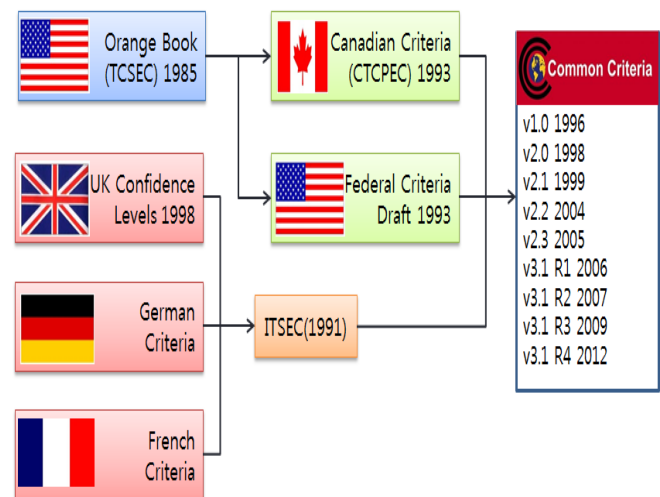


Fig. 1 Development history of CC

C. Studies on Quality Certification Systems Subsection

In firm's competitiveness, perceptions of quality and its role have changed dramatically over the past 30 years. Consumers and businesses demand high quality products [1]. Thus the role of quality in a firm's competitiveness has evolved into a strategic one [7]. So, quality is an essential that no firm can ignore.

There are many studies about quality certification. Studies on quality certification systems can be divided into positive effects and difficulties on the performance of the companies. Obtaining quality certification can have positive impacts on an industry. Because, acquiring certification maybe a method of direct evaluation. However, certification process involves a lot of unexpected difficulties. So, unwilling factors and difficulties can be verified in obtaining quality certification. In this paper, we analyze previous studies related to quality certification.

D. The positive effects of Certification

Gavin (2000) researched The International Standards Organisation, National Accreditation Registrars claims for ISO 9000 certification brings business performance improvement.

ISO is careful not to make explicit claims:

Therefore, organization that implement ISO 9000 voluntarily are doing so because they expect these standards to help them to do things better and to provide real benefit (ISO, 2000).

The American Registrar Accreditation Board (RAB) make claims for internal and external benefits from implementing a quality system. Including is:

increasing operational efficiency, cost savings from less scrap and rework, cost savings from fewer warranty claims, a competitive edge, perceived higher quality, and increased market share (RAB, 2000).

Mei Feng, Milé Terziovski and Danny Samson (2008) studied organizational performance dividing two dimensions, namely operational performance and business performance. Operational performance related to organisations' internal operation, such as productivity, customer satisfactions and

product quality. Business performance related to financial and marketing, such as market share, profitability and sales growth. In conclusion, ISO 9000 certification has a positive effect on operational performance and business performance.

Inaki Heras, Marti Casdesus and Gavin P .M. Dick (2002) identified quality certification and business performance. There are four business performances.

- Quality management system:

The approved quality assurance system brings an increased emphasis on quality and how it may be achieved consistently.

- Quality improvement:

Less waste and duplication of efforts (internal). Quality received by customers improves (external).

- Business performance:

Reduced costs improve competitiveness. Fewer customer defections so sales increase. Badge of quality opens more sales opportunities.

- Profitability:

Cost of sales reduced leading to increased profits. Profitability benefits from scale economies, and lower sales acquisition costs.

And Inaki Heras, Marti Casdesus, Gavin P .M. Dick (2002) showed average profitability compared with ISO 9000 certified companies and non-certified companies.

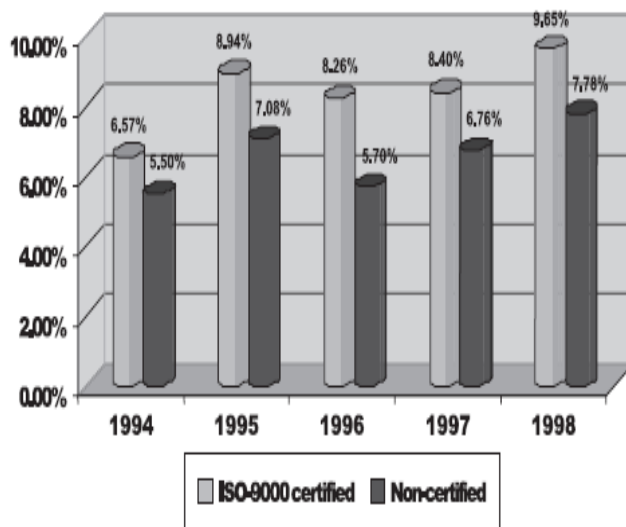


Fig. 2 Average profitability compared with ISO 9000 certified companies and non-certified companies

Note: Average profitability is defined as ROA (Net profit before tax and interest payments on assets employed)

As you see, ISO 9000 certified companies' ROA is better than non-certified companies.

Clare Chow-Chua, Mark Goh and Tan Boon Wan (2003) researched benefits items through the previous studies. It is 17 items.

Benefit Items: Better corporate image, Greater quality awareness, Better documentation procedures, Clearer working instructions or procedures, Clearer job responsibilities, Eliminate redundancy/reduce unnecessary work, Enable easy

accessible, traceable and auditable work procedure, Better customer service, Reduction in waste and inefficiency, Improve customer satisfaction, Greater competitive advantage, Helped in continual improvement, Greater staff retention, Improve profitability, Increase market share, Greater opportunity for export, Expansion to international market.

Katerina and Gotzamani (2001) reviewed literature on the standard's potential and contribution toward total quality management proved to be dichotomized. He made questionnaire and it constituted 20 items.

Certification benefits:

Improvement of internal organization and operation, Development of quality culture, Final product quality improvement, Improved customer satisfaction, Better communication with customers, Improved competitive position, Development of teamwork, Improved employee-management relationships, Less rework and waste, Improved supplier's performance, Better relationships among employees, Easier penetration to new markets, Less customer complaints, Less customer returns, Increased employee satisfaction, Increased employee participation, Higher profits, Reduction of absences.

E. Experienced difficulties during certification

On previous studies, the certification system brings many positive effects on the company. However, certification does not always bring benefits. Khalid A. Babakri , Robert A. Bennetta and Matthew Franchetti. (2003) analyzed the important elements required by American industrial companies to realize ISO 14001 certification. In particular, they pointed to the costs of certification, lack of available resources, and uncertainty about profits from certification.

Jun, H.J., Kim, T.S., (2013) suggest that product manufacturing operations certification cost is overly expensive.

Lee S.Y., Kim, O.W. and Lee, J.H. (1995) cited the difficulties in obtaining the ISO 9000 certification that lack of employee's understanding, the difficulty of obtaining relevant data and information, the employee's participation in slowdowns of the feared explosion work, high certification cost in contrast to measure economic efficiency is difficult.

Park, J.W (2013) found the problems of small business's the international standards certifications were expensive cost, complex acquisition process, a long acquisition lead-time, the lack of information about certification. In the case of small businesses, skilled workers are lack. In addition, when they use consultancy, the rate of the certification improve. So cost is expensive. Cost is big burden to small business.

F. Satisfaction for Certification and decision on re-certification

Satisfaction concepts have been introduced in marketing especially to users [12], [17], [21], [24] and was initially defined by Locke (1976). And Oliver 1981) extended this definition "the summary psychological state resulting when the emotion

surrounding disconfirmed expectation is coupled with the consumer’s prior feeling about the consumption experience.”

Repurchase concepts also have been used in marketing with satisfaction. Consumers form an initial expectation of a specific product or service prior to purchases. Consumers accept and use that product or service. Third, they compare perceived performance with original expectation. If they satisfied, on their confirmation level, it is satisfaction. Finally, satisfied consumers form a repurchase intention [18]. Consumer’s satisfaction with prior use of service determined intention to repurchase a product or continue service.

In this study, we will apply effect, difficulties, satisfaction and decisions on re-certification to CC.

III. RESEARCH MODEL AND METHODOLOGY

In this study, we reclassified factors affecting CC certification decisions using literature about product quality certification, business performance, and articles dealing with the issue of CC certification.

Motivation is thinking about the expected benefits degree of CC before to get certification. It will be associated with re-certification (H1).

The need of certification is thinking about the expected benefits degree of CC after getting certification. It will be associated with re-certification (H2).

Difficulties are discomfort degree of CC certification and it will be associated with re-certification (H3) and satisfaction (H4).

Satisfaction is feeling about CC certification.

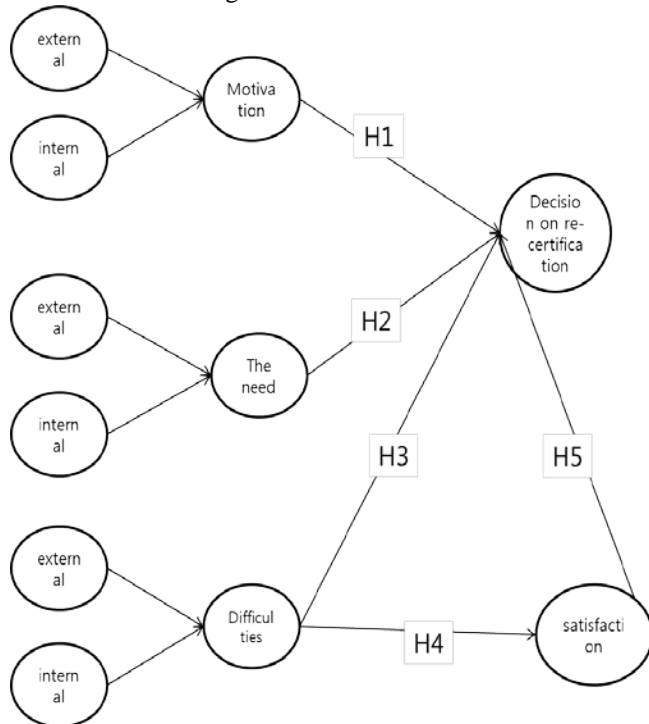


Fig. 3 Research model and hypotheses

The following hypotheses will be tested in this study.

H1: The motivation is positively associated with Decision on re-certification.

H2: The need is positively associated with Decision on re-certification.

H3: The difficulties are negatively associated with Decision on re-certification.

H4: The difficulties are negatively associated with Decision on re-certification.

H5: Satisfaction is positively associated with a Decision on re-certification.

A. Data collection procedure

In advance of the survey, one of the CC-certified information security companies to target was a pilot test. Pilot testing was conducted through an online questionnaire before starting the survey in order to verify and modify question items. This study will be conducted with the 118 information security companies that have received CC certification at least once since CC certification was introduced in Korea. Questionnaires will be distributed through advance phone calls and e-mail and question items will consist of 5-point Likert scales and descriptive questions.

Survey questions consist of the relevant questionnaires from the literature to validate the hypotheses suggested in the research model. The first section of the questionnaire covers the company’s profile with a question on the type of CC certification. The second, third section consists of 10 items of motivation and the needs measured on a five-point Likert scale (1 = not at all to 5 = very much) to assess their perception of certification on business performance. The fourth consists of 7 items of difficulties, the fifth consists of 3 items of satisfaction and the sixth consists of 2 items decision on re-certification

IV. DISCUSSION OF HYPOTHESIS TESTING AND RESULTS

Table1. Reliability analysis of model

	AVE	Composite Reliability	R ²	Cronbach's α	Communality	Redundancy	Go F
IM	0.716	0.883		0.799	0.716		0.541
EM	0.485	0.848		0.783	0.485		
IN	0.772	0.910		0.851	0.772		
EN	0.500	0.856		0.796	0.500		
ID	0.578	0.872		0.814	0.578		
ED	0.758	0.862		0.682	0.758		
M	0.470	0.887	1.000	0.855	0.470	0.258	
N	0.546	0.914	0.999	0.892	0.546	0.340	

D	0.436	0.836	1.000	0.770	0.436	0.413
S	0.946	0.972	0.668	0.943	0.946	0.525
R C	0.675	0.860	0.039	0.752	0.675	0.023

※ IM: Internal Motivation, EM: External Motivation

※ IN: Internal Need, EN: External Need,

※ ID: Internal Difficulties, ED: External Difficulties

※ RC: Decision on Re-certification

A. Reliability/Validity analysis of model

In this study, we analyzed using the PLS. PLS analysis requires internal consistency, convergent validity, discriminant validity verification for the measurement items and constructs. The internal consistency of measured questions is verified with composite reliability and AVE(Average Variance Extracted). The composite reliability values of variables are more than 0.7 and AVE are 0.5 or higher except for certified motivation (0.470), the certification of external motivation (0.485) and the difficulties experienced during getting certification (0.436). So measurement tools trustworthy evaluated.

Convergent validity was verified the value of factors loading. Almost value of factors loading are more than 0.7 convergent validity was confirmed (note appendix).

Discriminant validity compare between the largest correlation coefficient of construct and the smallest values of the square root of AVE. If the square root of the AVE is higher than correlation coefficient, discriminant is confirmed. But in this study, the smallest value of AVE is 0.660 and the largest correlation coefficient is 0.974. So discriminant is not confirmed.

B. Hypotheses testing results

As shown in the figure followed, the motivation of certification, the need for certification, difficulties, satisfaction for 66.8% of the decision on re-certification will be explained. It is more than 10% statistical power presented by Falk and Miller (1992), it can be determined that it has explanatory. The path coefficient is significant for difficulties, satisfaction 5% significance level.

Fit of the structural model is determined that a fit when Redundancy is positive [3]. <Table 1> the analysis of the results, Redundancy is positive therefore it can be that is a good fit. And overall fit of the model can be confirmed. Based on GoF, Communality average and the geometric mean of R^2 average were used for verification [23]. Analysis of the model, GoF is 0.541. It is larger than GoF(large)=0.36 suggested by Wetzels, M., Odekerken-Schroder, G. and Van Oppen, C.(2009), the fit of model is high.

Next, the significance of the path coefficients were verified. A path coefficient of model structure is obtained and t-value of the path coefficient was calculated using the Bootstrap provided by PLS. As a result of the path coefficient and t-values, difficulties and satisfaction effect upon the decision on re-certification.

H1. The motivation is positively associated with Decision on re-certification. (reject)

H2. The need is positively associated with Decision on re-certification. (reject)

H3. The difficulties are negatively associated with Decision on re-certification. (adoption)

H4. The difficulties are negatively associated with Decision on re-certification. (reject)

H5. Satisfaction is positively associated with a Decision on re-certification. (adoption)

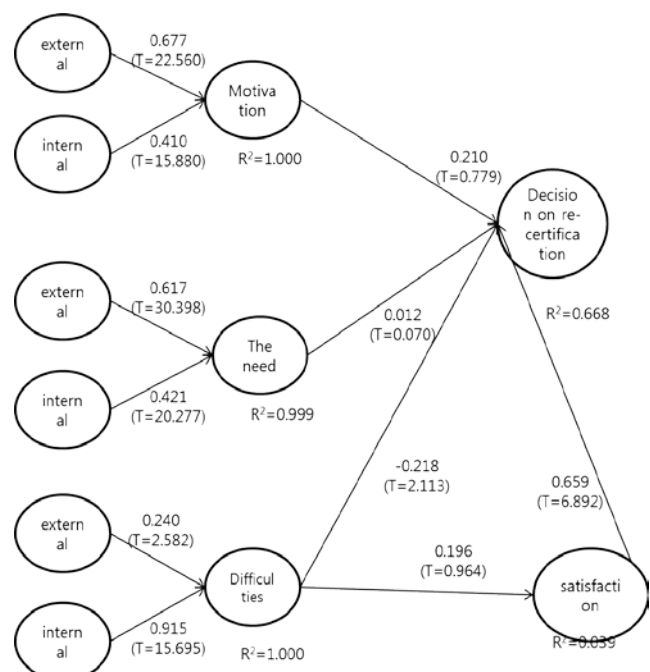


Fig. 4 Hypothesis testing result

V. CONCLUSION

In this study, decision on re-certification evaluation model was derived for the information security system evaluation and certification through a review of previous studies. Through this, motivation, needs, difficulties, satisfaction were set key variables and configuration factors to affect decision on re-certification. And through empirical research, reliability and validity of the model were verified. As a result, 2 hypotheses are adopted. The difficulties are negatively associated with Decision on re-certification (H3), Satisfaction is positively associated with a Decision on re-certification (H5).

During the survey, we knew that information security companies' real opinion on CC. Many of them weren't satisfied with CC. But they said CC is needed. There are many reasons,

but the biggest is to sell their product to public institutions, so they must acquire CC. Maybe CC certification will further increase in the future. Accordingly difficulties are improved and more information security companies participate in certification, increasing information security's level, should be improved.

This study may be a little different but has its significance that quantitative measurement of satisfaction or difficulties rather than verifying the overall trend by the actual. Next study, we want to collect more samples and check quantitatively effects, difficulties of CC.

ACKNOWLEDGMENT

This research was supported by the MSIP (Ministry of Science, ICT & Future Planning), Korea, under the "Employment Contract-based Master's Degree Program for Information Security" supervised by the Korea Internet Security Agency (H2101-13-1001).

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science, and Technology (NRF-2011-0025512).

APPENDIX

Appendix. 1. Factors loading

	Internal Motivation	External Motivation	Internal Need	External Need	Internal Difficulties	External Difficulties	Satisfaction	Decision on Re-Certification
M1	0.355	0.767	0.432	0.655	0.089	0.382	0.642	0.499
M2	0.499	0.761	0.578	0.752	-0.163	0.398	0.493	0.619
M3	0.792	0.382	0.665	0.454	-0.187	0.315	0.259	0.228
M4	0.802	0.583	0.716	0.636	-0.496	-0.253	0.334	0.517
M5	0.561	0.812	0.676	0.697	-0.332	0.236	0.564	0.496
M6	0.935	0.650	0.872	0.674	-0.309	0.242	0.524	0.467
M7	0.440	0.629	0.589	0.640	-0.092	-0.081	0.372	0.398
M8	0.517	0.686	0.677	0.737	-0.171	-0.341	0.350	0.563
N1	0.301	0.761	0.431	0.646	0.187	0.368	0.657	0.508
N2	0.570	0.706	0.583	0.756	-0.225	0.483	0.558	0.614
N3	0.775	0.648	0.841	0.669	-0.276	-0.101	0.354	0.358
N4	0.736	0.783	0.868	0.789	-0.454	-0.073	0.484	0.638
N5	0.705	0.789	0.681	0.858	-0.481	-0.028	0.447	0.636
N6	0.851	0.690	0.925	0.716	-0.232	0.338	0.455	0.439
N7	0.479	0.666	0.658	0.742	-0.141	-0.190	0.299	0.430
N8	0.498	0.594	0.674	0.669	-0.332	-0.304	0.195	0.289
E1	-0.153	0.052	-0.173	-0.015	0.800	0.091	0.413	0.127
E2	-0.331	-0.146	-0.367	-0.242	0.657	0.321	-0.077	-0.218
E3	-0.084	-0.023	-0.152	-0.076	0.236	0.891	0.037	-0.218
E4	-0.351	-0.162	-0.225	-0.232	0.870	0.094	0.200	-0.060
E5	-0.453	-0.343	-0.468	-0.445	0.746	0.199	-0.083	-0.397
E6	-0.230	-0.143	-0.180	-0.203	0.712	0.232	-0.041	-0.127
E7	0.302	0.354	0.301	0.226	0.176	0.850	0.584	0.389
S1	0.165	0.526	0.238	0.464	0.440	0.337	0.700	0.470
S2	0.363	0.464	0.351	0.365	-0.064	0.339	0.837	0.691
S3	0.570	0.645	0.610	0.585	-0.037	0.151	0.913	0.670
R1	0.401	0.715	0.531	0.673	-0.144	0.117	0.743	0.973
R2	0.558	0.656	0.539	0.640	-0.188	0.024	0.717	0.972

Appendix. 2. Validity analysis of model

	Internal Need	Internal Motivation	Internal Difficulties	Satisfaction	External Need	External Motivation	External Difficulties	Difficulties	Motivation	The Need	Decision on Re-Certification
Internal Need	0.879										
Internal Motivation	0.896	0.846									
Internal Difficulties	-0.368	-0.399	0.760								
Satisfaction	0.493	0.455	0.120	0.821							
External Need	0.827	0.707	-0.296	0.573	0.738						
External Motivation	0.807	0.651	-0.194	0.663	0.949	0.734					
External Difficulties	0.066	0.109	0.239	0.333	0.074	0.174	0.871				
Difficulties	-0.317	-0.336	0.972	0.196	-0.250	-0.132	0.459	0.660			
Motivation	0.922	0.865	-0.303	0.635	0.936	0.944	0.156	-0.236	0.706		
The Need	0.941	0.825	-0.341	0.572	0.968	0.932	0.086	-0.288	0.975	0.758	
Decision on Re-Certification	0.550	0.492	-0.171	0.751	0.675	0.705	0.073	-0.134	0.684	0.657	0.973

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