**Research Disposition**

**The Challenges on the Critical Vulnerabilities Plague of South Korean ActiveX Plug-Ins.**

**An empirical approach to evaluating website vulnerability in South Korea**

Submitted in a proposal for the Bachelor Thesis *2022*

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# Introduction

According to Park (2014), Korea’s government offices and nationwide banks have received a backslash for the forced usage of the Internet Explorer’s Active X. For instance, Civil Service 24, a wide-ranging civil service portal site the Korean government offers, entails ActiveX. A few government sites involve lower security levels designed for web browsers. Significantly, South Korea’s compatibility problem is what Former President Park Geun-Hye mentioned as a concern during the regulatory reform debate (Park , 2014). End users are instructed to international direct-purchase sites to avoid downloading ActiveX or going through an additional ten steps to complete a transaction. It is because, unlike in South Korea, international websites allow customers to pay with one or two clicks. (Lee , 2014). Compared to Switzerland, the websites seem somewhat outdated. Further, it raises the question of the cause of poor web engineering. Or what took so long to react? According to Cho (2014), South Korea is the only country in the world that requires Internet Explorer and that online purchases use ActiveX and public certificates. If we look at the problem globally or even consider Switzerland, it directly disrupts domestic shopping malls’ websites (Cho , 2014). It was due to constraints on the exportation of cryptography from the United States; standard 128-bit SSL encryption was unavailable in Korea. Web browsers were only accessible to Koreans with reduced 40-bit encryption. Further, in the later 1990s, the Korea Internet & Security Agency built its own 128-bit symmetric block cypher known as SEED and used ActiveX to mount it in web browsers. It soon became a domestic standard, and the country’s Financial Supervisory Service used the technology as a security screening standard. ActiveX spread rapidly in Korea. In 2000, after lifting export restrictions, permitting the use of full-strength SSL anywhere in the world. Most web browsers and national e-commerce systems adopted this technology, while Korea continued to use SEED and ActiveX (youknowit, 2009). A fact, which Cho (2014) left unnoticed, according to Kim (2018), mentioned that the increased Internet Explorer utilisation In the 2000s, Netscape, IE’s only competitor, failed, and Microsoft’s “insert operation” led to the virtual success of the Windows operating system.[8] In Korea, people buying PCs and the Internet at home increased sharply, and Internet Explorer gained share. Most websites depend on Internet Explorer. ActiveX began abused because many web programmers were mass-produced through information service education in Korea around 2000 when ActiveX was widely taught (Kim , 2018).

Therefore, this research examines the ActiveX phenomenon in South Korea. According to Lee (2017), in 2010, various solutions were removed, but the removal of the public certificate is still far from being implemented. As of 2010, after introducing various solutions, the elimination of the public certificate, the core of the problem, is still far from being realised (Lee Y.-m. , 2017). In addition, in December 2017, the South Korean government opted to eradicate ActiveX from the year-end tax agreement, but the .exe file should still be installed (Lee S.-w. , 2017). In addition, in 2018, W3C’s WebCrypto was used as the foundation for safety technologies such as public certificates based on HTML5 in e-government services and banking (Ahnlab, 2015). It ensures variety in operating systems and web browsers (Ryu , 2008). Moreover, Joon (2014) stated that most Koreans incline toward the discontinuation ActiveX software program abandoned, citing trouble making electronic transactions, corresponding to a survey by the Federation of Korean Industries. The federation, a lobbying group, said yesterday that it questioned 700 people nationwide ( Joon, 2014).

Figure 1 Trend chart of Korean respondents’ inclination toward the ActiveX use (Joon, 2014)

According to Joon (2014, as cited in Korea JoongAng Daily, 2014), ActiveX from Microsoft is a plug-in software framework that permits end users to see several files and data on the Internet. Running specific programs using Microsoft’s Internet Explorer must be installed. Nevertheless, while ActiveX has become a fundamental part of the nation’s online environment, it has been problematic for users of different browsers similar to Chrome, Safari, and mobile platforms ( Joon, 2014). Figure 1 clearly shows that 78.6 per cent of the respondents said they wanted the ActiveX software discontinued, while only 6.7 per cent opposed the idea ( Joon, 2014).

## Aim and Objectives

This paper focuses on assessing Korean website vulnerabilities from the aspect of adopting vulnerabilities rather than centring the cause of the vulnerabilities. It focuses on gathering important facts for understanding web security use in the ActiveX phenomenon context and gaining excellent knowledge of South Korea’s website security defence mechanism. Further, to assess a website’s security, a conventional approach is used to gather rich evidence on vulnerabilities, typically involving penetration testing and source code reviewing. While this approach is considerably effective in finding security loopholes in the websites’ code and security issues, this research focuses on presenting results of a throughout vulnerability testing, which in many ways is considered a way of assessing and securing a website against potential threats and cyber-attacks. It is a process that finds various security flaws. Consequently, this research thesis addresses the following research question:

**What are the critical vulnerabilities of South Korean ActiveX Plug-Ins after assessing Korean webpages through a vulnerability assessment?**

# Theory

## Definition ActiveX

Rosca & Logica’s (2007) work deals with defining the ActiveX phenomenon. The authors define the phenomenon as “an extensive new solution technology for the Internet called ActiveX” (2007, p. 1). ActiveX is a broad and powerful abstraction for Microsoft Internet Solutions. Content providers and application developers have used it as a robust and extensible framework that enabled them to develop a new generation of Internet applications. Since then, ActiveX started as an Internet strategy. Microsoft introduced the term ActiveX at the Internet Professional Developers Conference (Internet PDC) in March 1996.

In contrast to Rosca & Logica (2007), Heravi (2012) explains how the technology works; which the author explains the technology is “derived from two different components a Dynamic Data 3 Exchange (DDE), and Object Linking and Embedding (OLE)” (Heravi, 2012, p.3, cited from Automation Server Technology, 2012). Further, the technology provides a reusable framework to end-users. Rosca & Logica (2007) left unmentioned that due to the difficulty of OLE and lack of support for Microsoft Foundation Classes (MFC), Microsoft reintroduced ActiveX Controls in 1996 with a simple and easy-to-use specification. For example, ActiveX Controls use an OCX extension that was inherent from OLE. This file extension is the second generation of component architecture (p. 2). The first generation was VBX since they are in the Visual Basic language. These controls run on behalf of the client program, such as 3D toolbars, notepads, and Microsoft Excel. These controls can be maliciously provided to the client’s browser if the user navigates to a controlled website, which turns the client’s browser to be controlled by the malicious server and provide unwanted access to the client-side (p. 3).

On the other hand, Rosca & Logica (2007) describe the technology as that ActiveX became an all-encompassing term used to define everything from web pages to OLE. Further, most internet resources use less effort. For example, ActiveX Controls provided the infrastructure to add language and tool-independent extensions to web pages (Rosca & Logica, 2007).

## State of Research

Suppose we derive the context of the statements of the authors. In that case, we can find similar findings in Joon (2014), which added that in 2014 it was trendy in Korea to make purchases at local online shopping malls. The downside is that online authentication certificates, based on ActiveX, are an obstacle for local online shopping malls trying to attract foreign customers. Individuals who want to purchase goods costing more than 300,000 won ($277) at a regional online shopping mall must use an online authentication certificate service ( Joon, 2014). Figure 1 showed that 84.1 per cent of respondents want the development of a new system that does not require ActiveX, and 88 per cent said they had experienced difficulties with the program. The survey showed that 79.1 per cent of respondents cited online transactions as the biggest problem with ActiveX, while 71.7 per cent stated they had complications with banking transactions. Other top complaints included difficulty registering at local websites and for online government services and transactions involving foreign websites. ( Joon, 2014).

## ActiveX Vulnerabilities

According to Soon & Kim (2005), minimal services can only provide to users through web pages. Access to personal computer resources using HTML and scripting languages is minimal for security reasons. The two authors came to the same conclusion as Rosca & Logica (2007), which confirms that ActiveX Control is used to overcome the limitations of scripting languages and provide various services to the end-user. The ActiveX Control runs on a scripting language with the same privileges as regular applications installed on the computer. As a result, the authors capture this as a security vulnerability. Personal computers with ActiveX Control installed can become victims after they run a malicious web page or receive an e-mail containing malicious scripts with the same privileges as regular applications. These malicious scripts can execute vulnerable ActiveX Control to perform malicious behaviour on the victim’s personal computer.

Therefore, today’s developers should identify all security issues regarding ActiveX Control. However, many developers are still creating applications using ActiveX Controls without considering these security issues. Therefore, to improve the safety of ActiveX Control, vulnerability testing by third parties is required, but related research is currently very insufficient. In particular, technologies developed abroad can be used in Korea without modification to verify general application vulnerabilities. However, it is challenging to use related technologies due to differences in domestic and foreign environments for verifying vulnerabilities in ActiveX Control. This paper describes the procedure and method of assessing webpages vulnerabilities (Soon & Kim, 2005).

## Theoretical Framework

As seen in Figure 1, the survey conducted that Korean’s sentiment toward the use of the ActiveX software to be discontinued. In summary, prior to assessing the vulnerabilities. Most vulnerability assessments are conceptual or descriptive, focusing on applications, development, and the code, not web pages. Only a few empirical studies and research data directly targeted the variables that influence applications or assess web pages on vulnerability. Mantra et al. (2019) conducted empirical research based on collecting website data. They used a website which was widely accessible. Hence, the level of security on the website is maintained. This assessment will identify the web security threats by testing the website’s security vulnerability. The specific test techniques using the necessary data extracting tools showed several vulnerabilities. The vulnerability level affected the maturity level of the website security. The outline below is limited to two hypotheses so as not to go beyond the framework. Based on these findings, we developed the first hypothesis:

**Hypothesis [H1(-)]:** If the use of ActiveX continues, then the sentiment of the website usage will *negatively* influence the usage behaviour of South Korean end-users.

Figure 2: Survey by the Korea Internet & Security Agency (KISA) under the Ministry of Science, ICT and Future Planning between 2013 and 2014

According to Soon (2015), the Korea Internet & Security Agency (KISA) conducted a survey under the Ministry of Science, ICT and Future Planning between 2013 and 2014 regarding the number of active X-based plug-ins in Korea. It fell only 6% year-on-year to 1,644 as of last year. Further, the top 100 websites in the private sector based still used ActiveX-based plug-ins at a high rate. The government in South Korea announced plans to convert 90% of the top 100 websites to sites without ActiveX by 2017. However, considering past trends, it is widely expected that removing most of the ActiveX plug-ins will be virtually impossible unless there is a drastic improvement plan within the next two years (Soon K.-h. , 2015). Subsequently, the quantitative research method follows Bryman, Bell and Harley (2019) to test this idea. They define quantitative research as a “*research strategy that emphasises quantification in the collection and analysis of data*” (p. 26). Accordingly, the author developed the second hypothesis as follows: **Hypothesis [H2(+)]:** The discontinuation use of ActiveX will positively affect South Koreans’ sentiment toward using Korean websites. In other words, with decreasing use of South Koreans, ActiveX is more likely to use a website instead of using alternatives to obtain their service. Drawing the hypothesis model and the boycott literature (see chapter synthesis), I propose the latent variable to be “*end user attitude*”. Thus, the “website use *intention*” is the manifest variable (Figure 4).

Discontinuation of ActiveX

Emotions Emotions

Emotions

H2[+]

Intention on visiting a website

(I-V01)

End User Attitude towards ActiveX Control
(A-X01)

End User Attitude towards ActiveX Control
(A-X01)

Usage of ActiveX

(U-S01)

H1[-]

Figure 3: Hypothesis Model

# Method

This study uses a medium-scale survey to gather information about the attitude toward websites used in South Korea. Therefore, we will create a questionnaire with tailored questions from scratch. Further, we will collect secondary data from other researchers who mainly collected the attitude toward website quality for other purposes. A Korean version of the questionnaire was administered in Korean since the official language is Korean (see Appendix B). In the interest of this study, the appendix will also contain the translated English version (see Appendix A). Two Koreans proficient in English will translate the English version into Korean to conduct the survey.

## Study Population and Sampling

This work aims to test two hypotheses and create a questionnaire foreseen to be developed and distributed from October to November 2022 by the author in the Korea University Campus (고려대) in South Korea. The study’s objective is to collect data from the pool of survey respondents. The survey will question respondents based on a representative population. The examination will conduct with a targeted total of 50 participants using the proportional allocation sampling method, which develops based on population, gender, age, and area of residence. For the convenience of participants, the survey provides online. Participants receive alerts about the questionnaire via e-mail and give informed consent before participating. To measure participants’ intention to visit a website (based on the design), ask them to choose from various website design functionalities(see appendix for details and measured variables). A 5-point Likert-type scale (1 = strongly disagree, 5 = strongly agree) employ for all measures.

## Analysis

This study will conduct a reliability analysis, factor analysis, frequency analysis, mean analysis, paired t-test, and regression analysis. The factor and reliability analyses will conduct to verify the scale’s reliability and validity, while the others will analyse the end users’ responses toward attitude. The end-user characteristics will be analysed using descriptive statistics with borrowed existing measurements from secondary data, while website visiting behaviours levels will analyse through a paired t-test. We will test the ten South Korean websites to gather frequent vulnerability characteristics. Because of the website’s security, URL t The idea is to find vulnerabilities with the websites and include the risks in the survey. Mean and standard deviations will be analysed to confirm experience levels, website intentions, and user attitudes. The factor ActiveX affects end users’ intention to visit websites will be analysed using multiple regression. It includes several independent variables covering website design, security, usability, multifunctionality, and user attitude—the intention to visit websites is the dependent variable. Moreover, to answer the second hypothesis, the dependent variable was set as the discontinuation of ActiveX. We will conduct all analyses using professional analysis tools.

## Timetable



Figure 4 Bachelor thesis timetable 2022 - 2023

# Outlook

This study expects to gain information about the main influences on the attitude on websites using ActiveX and without and their intention to visit websites. Moreover, analyse the vulnerability’s effect with webpages and conduct the effect of discontinuation of ActiveX. We expect the main findings to be analysed in website visiting intention and attitude towards ActiveX. We will set these as significant, influential variables in the study. On the other hand, we set emotions and the website design as the independent variables depending on user attitudes toward ActiveX. The strengths are having a lot of vulnerability studies available in the context of application development.

In contrast, the challenges in this study are the empirical data available in the context of ActiveX phenomena. There is a belief that the South Korean government has entirely stopped ActiveX, but many websites still have poor quality and use legacy technology like ActiveX. Thus, focusing on whether the attitude towards visiting websites with the continuation of HTML 5, CSS and other related technologies relations is reducing because of this phenomenon can be considered a follow-up study.**References**

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# Appendix

Data matrix



Figure 5 Example Datamatrix

Scale development first idea

We developed a modified scale to include questions related to website visiting intention (10 items), anti-sentiment (7 items), boycott participation (10 items) and the intention to purchase Japanese products (2 items) (Table 1). We will compile and measure the following previous studies. We measure, aside from sociodemographic characteristics, all items on a five-point scale (1 = “never visit” or “strongly disagree,” while 5 = “must buy” or “strongly agree”).

A: Scale development in English

Table 1 First Version of a modified version of scale items in English

|  |  |  |
| --- | --- | --- |
| **Variable** | **Items** | **Cronbach’s Alpha** |
| Usage of ActiveX  | Website Awareness(level) | I regularly visit websites that use ActiveX |  |
| I do not regularly visit a website that uses ActiveX  |  |
| I have regularly visited websites that use other technologies. |  |
| Website Visiting Intention | I regularly visit websites even with awareness of ActiveX. |  |
| I have stopped using websites with the use of ActiveX. |  |
| I have no intention of stopping visiting services even with the use of ActiveX  |  |
| Discontinuation of ActiveX | Korean websites should completely stop the use of ActiveX. |  |
| Korean websites should use ActiveX in combination with other technologies. |  |
| As the discontinuation of ActiveX decreases, Korean people should not visit websites with ActiveX. |  |
| Koreans should only visit websites using other technologies than ActiveX. |  |
| There should be a law which prevents companies from using ActiveX. |  |
| Awareness of Risks of Website | Emotions | I feel uncomfortable if I use websites with ActiveX |  |
| People around me encourage me to abstain from websites using ActiveX. |  |
| I would feel uncomfortable if people who abstain from using ActiveX would see me using websites that have ActiveX.  |  |
| I feel angry after visiting websites with ActiveX (with the need to download many apps). |  |
| Website Design | I intend to care about website security because of the ActiveX security threats, which make me furious. |  |
| I intend to avoid visiting websites with ActiveX because it reflects my attitude towards ActiveX. |  |
| I intend to visit websites with high security because I feel more comfortable. |  |
| I intend to avoid websites with ActiveX because they relate to my conscience. |  |
| Knowledge | I avoid websites with ActiveX because I have gained information about its security issues. |  |
| I avoid websites with ActiveX because I have gained information about other Koreans avoiding websites with ActiveX. |  |
| End-User Attitude | General Inclination towards websites in South Korea | I like ActiveX. |  |
| ActiveX is a good brand. |  |
| I am satisfied with websites with ActiveX. |  |
| I dislike ActiveX  |  |
| ActiveX is not preferable. |  |
| I prefer websites not to use ActiveX. |  |
| Intention to visit South Korean websites | I will not visit websites with ActiveX. |  |
| I will not visit websites with ActiveX, even after the company has removed the plug-in. |  |

B: Scale development in Korean

Coding system

|  |  |
| --- | --- |
| **Variables** | **Categories** |
| Respondent | 1 - 50 |
| Gender | 1 – Woman2 - Man |
| Age | Continuous |
| Area of Residence | 1 - Seoul 2- Other |
| website awareness level  | 1 – I strongly disagree 2 – disagree3 – neither agree nor disagree4 – agree 5 – I strongly agree |
| website visiting intention  | 1 – I strongly disagree 2 – disagree3 – neither agree nor disagree4 – agree 5 – I strongly agree |
| Discontinuation of ActiveX | 1 – I strongly disagree 2 – disagree3 – Neither agree nor disagree4 – agree 5 – I strongly agree |
| Awareness of risks with ActiveX (emotions) | 1 – I strongly disagree 2 – disagree3 – neither agree nor disagree4 – agree 5 – I strongly agree |
| Awareness of risks with ActiveX (website design) | 1 – I strongly disagree 2 – disagree3 – neither agree nor disagree4 – agree 5 – I strongly agree |
| Knowledge of risks with ActiveX  | 1 – I strongly disagree 2 – disagree3 – neither agree nor disagree4 – agree 5 – I strongly agree |
| End-User attitude (general inclination) | 1 - like2- good3- satisfied4- dislike5- not interesting6 - not good |
| Intention to visit websites | 1 – I strongly disagree 2 – disagree3 – Neither agree nor disagree4 – Agree 5 – I strongly agree |

Synthesis

|  |  |
| --- | --- |
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Declaration of Academic Integrity

I declare that this assignment is my own work, and that I have completed this work without the assistance of others. I have acknowledged all literature and sources used and have cited these in accordance with academic citation conventions.

I have not previously submitted this assignment, or any part thereof, for credit in another course, unless this has been expressly agreed with the relevant instructor.

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***20.06.2022 Darren, Odibo***

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