

## Evaluating Web Accessibility of Organizations Related to Radiation in ICT Environment

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**Abstract:** This research is to evaluate actual compliancy of web accessibility of national agencies and associations related to radiation organizations that are expected to have frequent access with the purpose of acquiring information about radiation safety. Furthermore, statistical significance of compliancy gap among national agencies and associations will be tested. K-WAH4.4 was used as an analyzing tool and 6 items (alternative text provision, provision of a title, basic language explicit, notice of new window opening, label provision, markup syntax) among 24 items of KWCAAG 2.1, guideline for Korean web contents accessibility were chosen as evaluation items. Statistical analysis was conducted by mann-whitney test. First, national agencies showed relatively higher compliancy compared to associations. Second, both national agencies and associations showed high compliancy rate for ‘provision of a title’ and ‘notice of new window opening’ item. Third, average compliancy rate of ‘markup syntax’ item was 37.5%, significantly lower than other items. Fourth, while compliancy rate of national agencies was higher than that of associations, 3 items, ‘alternative text provide’, ‘basic language explicit’, ‘label provision’ were statistically significant in significance level of 5%. Web accessibility is an important issue for everyone. This research is further expected to improve web accessibility related to radiation safety for information havenots such as the disabled.

**Key words:** Web accessibility, radiation, ICT environment, safety, K-WAH4, information

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### INTRODUCTION

Prompt and proper action is required to minimize damage when accident occurs. In case of Korea, disaster and safety system was significantly changed with ‘sinking disaster of sewol ferry’. In the aspect of administrative structure, The Ministry of Public Safety and Security was newly organized to take responsibility of every type of disaster management like civil defense system, disaster management of sea and land, firefighting, disaster prevention, natural disaster, etc. Moreover, in institutional aspect, ‘act on Emergency Safety Management’ was amended to authorize Ministry of Public Safety and security to act as a control tower in disaster circumstances. Nonetheless, there are worries about national disaster and safety management due to imperfect disaster management and trial and error in the process of integrating disaster management system. Non-integrative legislations and regulations, insufficient information sharing among departments ambiguous division of disaster countermeasure levels, professional labor force deficiency and lack of social value about safety, etc. are typical problems (Shin and Park, 2015). Most of the problems listed are responsibility of the government but people themselves also should pay attention to social value related to safety. As so, the present government claiming ‘Government 3.0’ is

operating National Security Management system using up to date IT technologies like cloud computing, social network and big data based on mobile ubiquitous, etc. To inspire safety consciousness of national people and to help them acquire information related to safety. Naturally, internet and mobile dependency for acquiring disaster information is increasing. However, acceleration of web service system comes along with side effect of bringing down web accessibility at the same time. Especially, for information havenots like the elderly and the disabled who are weak at acquiring disaster information from internet due to digital divide, web accessibility under standard level can be act as a great risk in possible dangers (Lee *et al.*, 2015). Meanwhile, people are paying more attention about nuclear and radiation safety after Fukushima nuclear accident in 2011. Radiation is highly utilized in our daily life for the purpose of food irradiation, medical diagnosis and treatment, etc. Here, food irradiation is to improve microbiological hygiene and safety or to preserve freshness of the food by irradiating ion energy on food. Medical radiation is a radiation used for treatment in hospitals, refers to diagnosis using X-ray or radioactive isotope and radiation therapy. In spite of those positive aspects, radiation should be dealt very carefully because it might give severe damage to body if misused or overused. Therefore, adopting various information about radiation is necessary to secure safety

Table 1: Definition of web accessibility

terms	Definition
Web accessibility	Guaranteeing every user to access every information provided in web site, in any technological environment even without professional ability
Mobile accessibility	Expanded concept of web accessibility that everyone, not only the disabled, should be able to use the internet equally and conveniently in mobile environment
ICT accessibility	Guaranteeing accessibility of digital devices or services to make sure information havenots like the elderly and the disabled who have physical, cognitive difficulty, to enjoy usefulness of info-communication same as general people

from radiation. In informationalized society like today, web sites of the organizations are the fastest and easiest way to get that information and this could trigger another problem about web accessibility among information havenots like the elderly and the disabled to adopt information related to radiation. However, existing studies conducted on web accessibility of the elderly and the disabled are mostly like Social Welfare Organs (You *et al.*, 2011), professional sports (Choi and You, 2012), Senior Care Center (Choi *et al.*, 2015), etc., lack of contents related to radiation safety. Therefore, this research is to evaluate actual compliancy of web accessibility of national agencies and associations related to radiation organizations that are expected to have frequent access with the purpose of acquiring information about radiation safety. Moreover, statistical significance of compliancy gap among national agencies and associations will be tested. This research is further expected to provide basic data to improve web accessibility related to radiation safety for information havenots such as the disabled.

**Web accessibility and disability discrimination act**

**Web accessibility:** In information and technology centric society, utilization of information communication technology is necessary to manage social life. If not, he or she will suffer a disadvantage due to digital divide. Digital divide restrains opportunity of social participation and income creation individually, moreover becomes reason of intensifying rich-poor gap and conflict between social stratum, socially. As so, digital divide can be a significant factor maximizing and creating social, economic gap and hindering social integration. Digital divide is generated from various reasons but web accessibility problem due to physical limitation is considered to be the main factor. In Korea, disability discrimination act enacted in 2007 leaded interest and participation about web accessibility. Literally, web accessibility refers to ‘the ability to access the web’. However, concept of ‘contents’ is omitted here. To be exact, standardized, present guideline of web accessibility in nation means ‘accessibility to web contents’. That is web accessibility is web contents+access+ability. Therefore, web accessibility becomes ‘ability to access web contents’ which can be defined diversely depend on area. Table 1 and Fig. 1 is an academic definition of web accessibility (Ryu *et al.*,

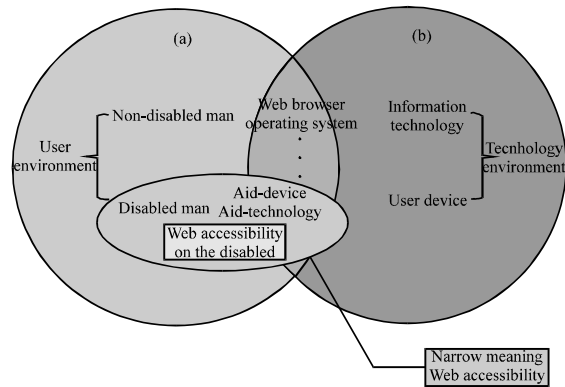


Fig. 1: Definition of web accessibility

2014). Here, definitions of web accessibility are not significantly different while having little difference depended on where does the area mainly focuses on.

Meanwhile, in nation, after enactment of Disability Discrimination Act, awareness and level of web accessibility is improving but not enough to the mobile web accessibility, still remaining at initial stage of arranging for introduction and implementation of a system (NISA., 2014). Therefore, it is better to take ICT related accessibility referring to web accessibility so far.

**Disability Discrimination Act:** Since, 1990s, many countries are enacting and implementing disability discrimination act because of the web accessibility. Main contents of Disability Discrimination Act enacted in 2007 is as. In case of Korea, several acts like framework act on national information (enacted in Nov. 2013), welfare of disabled persons act (partly amended in Mar. 2011), etc. are dealing with web accessibility, besides of disability discrimination act.

**Main contents of Disability Discrimination Act:** Act on the prohibition of discrimination of disabled persons, remedy against infringement of their rights, etc.

Article 20 (Prohibition of Discrimination in Access to Information). No individual, corporation or public institution may engage in discriminatory acts prohibited under Article 4, 1 and 2 on the basis of disability against the disabled persons when they use and gain access to electronic and non-electronic information.

Article 21 (Duty to provide legitimate convenience in telecommunication and communication, etc.). Public institutions, etc. shall provide support as required for the participation and communications of the disabled persons in any event hosted or supervised by themselves such as sign language interpreters, text or vocal interpreters and hearing aids.

All public institutions and corporations should mandatorily apply the web accessibility gradually by the year 2015 from 11th, April, 2009 (public institutions) and 11th, April, 2013 (corporations).

**MATERIALS AND METHODS**

**Evaluation tools:** Evaluation of web accessibility can be largely divided into automatic-evaluation and manual-evaluation. Despite of flaw that automatic evaluation might be slightly inaccurate due to mechanical check, it is widely utilized in various areas because it can check a large number conveniently. Typical evaluation tool for web accessibility K-WAH, OPEN WAX, CCA, WAT, etc. are provided for free from national information society agency. It hHas been updated up to version 4.4 until now, K-WAH checks compliance rate of guideline of Korean web contents accessibility 2.1. Specific items for the test provides compliance rate of 6 items from total 24 items as shown in Table 2.

**Collecting data:** To evaluate web accessibility of radiation related organizations, national agencies and associations chosen is as (Table 3). The 8 organizations including nuclear safety and security commission, Korea Foundation of nuclear safety were selected as national agency while 9 organizations including Korea association for radiation application. The Korea society of radiology were selected as association. Investigation was conducted from 27th, Sep, 2016 to 17th, Oct, 2016.

**Contents of data collected:** Among 24 items of KWCA2.1, guideline of Korean web contents accessibility, 6 items had been automatically assessed. As so, based on main page of each web site selected as evaluation subject, alternative text provision, provision of a title, basic language explicit, notice of new window opening, label provision and markup syntax were automatically assessed. Here, depth was set as 3, number of page was 50 (Mun and Im, 2014).

**RESULTS AND DISCUSSION**

**Result of WEB accessibility analysis:** Clear definition of 6 items deducted from K-WAH4.4, the automatic web

Table 2: Automatically checked items in K-WAH4.4

4 principles	Automatically checked items
Identifiability	Alternative text provision
Workability	Provision of a title
Understandability	Basic language explicit, notice of new window opening, label provision
Rigidity	Markup syntax

Table 3: URL of agency and association

Division/Name	URL beginning address
<b>Agency</b>	
NSSC	<a href="http://www.nssc.go.kr/nssc/index.jsp">http://www.nssc.go.kr/nssc/index.jsp</a>
KINS	<a href="http://www.kins.re.kr/main.do">http://www.kins.re.kr/main.do</a>
KoFONS	<a href="http://www.kofons.or.kr/index.do">http://www.kofons.or.kr/index.do</a>
KINAC	<a href="http://www.kinac.re.kr:8181/index.do">http://www.kinac.re.kr:8181/index.do</a>
KAERI	<a href="http://www.kaeri.re.kr:8080/">http://www.kaeri.re.kr:8080/</a>
KORAD	<a href="https://www.korad.or.kr/">https://www.korad.or.kr/</a>
KIRAMS	<a href="http://www.kirams.re.kr/nremc/index.do">http://www.kirams.re.kr/nremc/index.do</a>
DIRAMS	<a href="http://www.dirams.re.kr/research/Main.do">http://www.dirams.re.kr/research/Main.do</a>
<b>Association</b>	
KARA	<a href="http://koara.or.kr/">http://koara.or.kr/</a>
KNTC	<a href="http://www.kntc.re.kr/">http://www.kntc.re.kr/</a>
KANS	<a href="http://www.kans.re.kr/">http://www.kans.re.kr/</a>
KANDT	<a href="https://www.kandt.or.kr/main/main.php">https://www.kandt.or.kr/main/main.php</a>
KISOE	<a href="http://kisoe.kins.re.kr/">http://kisoe.kins.re.kr/</a>
KRF	<a href="http://www.radiationsafe.or.kr/">http://www.radiationsafe.or.kr/</a>
KITE	<a href="http://www.kite.re.kr/main/main.php">http://www.kite.re.kr/main/main.php</a>
MRSRC	<a href="http://www.mrsrc.kr/Artyboard/Default.asp">http://www.mrsrc.kr/Artyboard/Default.asp</a>
KSR	<a href="http://www.radlab.org/">http://www.radlab.org/</a>

Table 4: Compliance rate

Values	ATP	PT	BLE	NNWO	LP	MS
NSSC	100.0	100.0	100.0	98.3	100.0	100.0
KINS	99.9	98.1	98.0	100.0	100.0	48.0
KoFONS	99.6	62.0	62.0	100.0	100.0	58.0
KINAC	99.9	100.0	100.0	100.0	100.0	2.0
KAERI	100.0	100.0	100.0	100.0	100.0	0.0
KORAD	98.7	98.0	98.0	100.0	94.1	60.0
KIRAMS	99.5	100.0	100.0	99.7	100.0	6.0
DIRAMS	100.0	100.0	100.0	99.0	100.0	40.0
KARA	74.8	90.0	90.0	99.4	10.0	80.0
KNTC	97.7	100.0	0.0	33.3	100.0	0.0
KANS	4.0	100.0	0.0	100.0	0.0	0.0
KANDT	0.0	96.0	0.0	96.6	0.0	4.0
KISOE	95.9	92.2	94.0	28.0	100.0	98.0
KRF	33.1	82.2	0.0	100.0	0.0	29.6
KITE	0.5	93.3	20.0	100.0	0.0	93.3
MRSRC	30.1	87.5	66.0	84.2	1.6	0.0
KSR	32.2	80.8	2.0	100.0	1.6	18.0
average	68.6	92.9	60.6	90.5	59.3	37.5

accessibility evaluation tool is as follow (Suh and Hwang, 2013). Moreover, Table 4 shows arranged result of evaluation of 18 web sites selected as analysis subject.

**Alternative Text Provision (ATP):** ATP is one of identifiability which refers to provision of alternative text to enable identification of meaning or usage for the contents not given in text. Here, alternative text should be provided in simple, short manner.

**Provision of a Title (PT):** Refers to research ability, title should be simple and short while enabling inference of the page, frame and contents block.

**Basic Language Explicit (BLE):** Means understandability, the language mainly used should be explicated and basic language of the web page needs to be clearly defined.

**Notice of New Window Opening (NNWO):** One characteristic of understandability, new window or pop up tap should not be opened without the user's recognition.

**Label Provision (LP):** Guidance of input from the understandability which refers that label informing the usage should be provided correspondently with its control to inform assistant function, near the user's input.

**Markup Syntax (MS):** Part of the rigidity, element of markup language should not have error in opening and closing, overlapping and attribution declaration.

Interpretation of Table 4 is as follow: First, compliance rate of national agencies was relatively higher than that of associations. Second, for PT and NNWO item, both national agencies and associations showed high degree of compliance rate. Third in MS, average compliance rate was 37.5% which is significantly low compared to other items. These results can be drawn also from (Fig. 2).

Figure 3 is an example of easy modification of code and factors with error on certain page when automatic web accessibility evaluation was conducted about KoFONS, using KWACG 2.1.

Meanwhile, Table 5 shows result of statistical significance test of compliancy rate national agencies and associations have, based on the contents shown in Table 4. Non-parametric method, mann-whitney U test was conducted here (Seo, 2013). From Table 5,

Table 5: Results of mann-whitney U test for 6 items

Values	ATP	PT	BLE	NNWO	LP	MS
Agency	99.700	94.800	94.800	99.600	99.300	39.300
Association	40.900	91.300	30.200	82.400	23.700	35.900
p-value	0.001	0.073	0.001	0.211	0.005	0.594

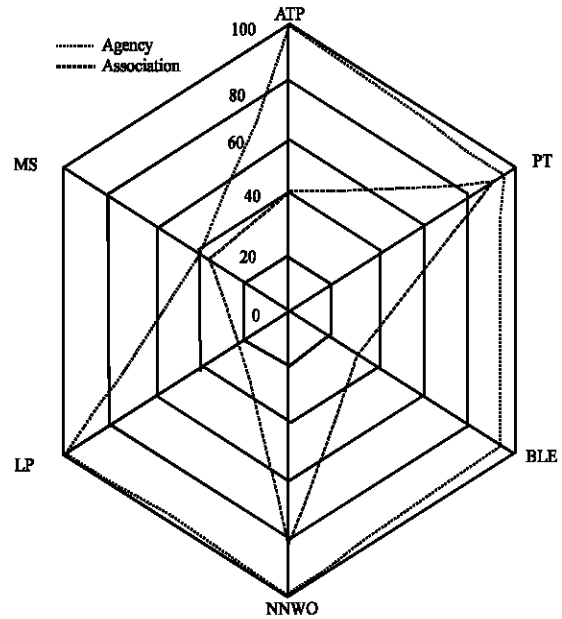


Fig. 2: Grape of average compliance rate

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1041 </rom>
1042 </header>
1043 </div>
1044 <div class="java-board-list board-list in-table">
1045 <table class="jw-tl-table jw-tl-scroll nsf-listclass-list" data-action="/INTRODUCE/egovHistory">
1046 <thead>
1047 <tr>
1048 <th class="in-ws_90">번호</th>
1049 <th class="in-ws_a isMobile">제목</th>
1050 <th class="in-ws_90">파일</th>
1051 <th class="in-ws_140">작성일</th>
1052 <th class="in-ws_90 isHideLine">조회수</th>
1053 </tr>
1054 </thead>
1055 <tbody class="nsf-list-body">
1056 <tr class="nsf-list-rows">
1057 <td class="rows-NO"></td>
1058 <td class="agLeft isMobile"><a class="rows-SUBJECT" onclick="bbs_detail();" href="">
1059 <!-- <td class="rows-FILE_YN"><a href="/FOFUF/pdf_pop.do?PDF_URL=http://kofons.vma
incorporation.pdf&embedded=true"></td>
1061 <td class="rows-INSERT_DATE"></td>
1062 <td class="rows-HIT">0</td>
1063 </tr>
1064 </tbody>
1065 </table>
1066 <div class="pagination-base">
1067 <div class="in-pagination nsf-listclass-pagination">
1068 <span class="group group-first jw-pgt-groups jw-pgt-prev">
1069 <a href="#GROUP_PREV" class="in-btn group jw-pgt-group">처음</a>
1070 <a href="#PREV" class="in-btn page jw-pgt-step"><span>이전글</span></a>
1071 </span>
1072 <span class="in-pagination-body nsf-pagination-body">

```

Fig. 3: An example of providing error of alternative text in KoFONS

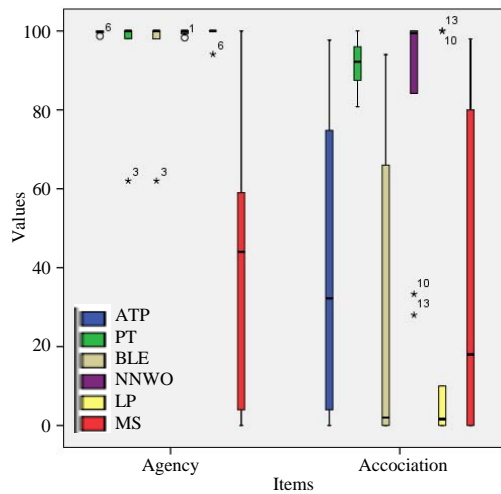


Fig. 4: Box-plot for the compliancy rate of 6 items

national agencies have higher compliancy rate than associations in all 6 items. The 3 items, ‘alternative text provision’, ‘basic language explicit’, ‘label provision’ were statistically significant in significance level of 5%. Moreover, Fig. 4 is a box-plot informing descriptive statistic of compliancy rate for 6 assessment items.

### CONCLUSION

With generalization of the internet, web is widely used in almost every area including politics, economics, society and culture. Due to that, informationalizing ability to access and use the information with web became an important factor indicating competency of individual or organization. As informationalizing ability using web came into the picture, digital divide between social stratum reared up as a severe social problem, especially for the elderly and the disabled who are in structurally weak position. Government is endeavoring to resolve those problems with various legislations and laws and many improvements had been achieved. Particularly according to the Disability Discrimination Act enforcing to comply with web accessibility by 2015, all public institutions are maintaining high level of web accessibility. However, web sites operated by private organizations have relatively low web accessibility and this could bring about severe problem to information havenots like the elderly and the disabled in the case of web sites are related to national safety. Recently raised social problem, radiation or nuclear safety issue can be an example because still, many people are depending on web sites operated by private organizations to get information related to radiation safety. Therefore, this research evaluated actual

compliancy of web accessibility of national agencies and associations related to radiation organizations that are expected to have frequent access with the purpose of acquiring information about radiation safety. Moreover, statistical significance of compliancy gap among national agencies and associations was also tested. Result was as follow. First, first, national agencies showed, relatively higher compliancy compared to associations. Second, both national agencies and associations showed high compliancy rate for ‘provision of a title’ and ‘notice of new window opening’ item. Third, average compliancy rate of ‘markup syntax’ item was 37.5%, significantly lower than other items, continuous effort for the improvement is needed. Fourth while compliancy rate of national agencies was higher than that of associations, 3 items, ‘alternative text provide’, ‘basic language explicit’, ‘label provision’ were statistically significant in significance level of 5%.

### RECOMMENDATIONS

In Korea, trigger for the attention for the web accessibility was disability discrimination act. As so, web accessibility in part might be seen as a tool to deal with regulation or just for the disabled. However, web accessibility is an important issue for everyone. This research is further expected to improve web accessibility related to radiation safety for information havenots such as the disabled.

### REFERENCES

- Choi, C.J., J.S. Park and W.S. Jung, 2015. Improvement of web contents accessibility in geriatric hospitals. *Korea Inst. Electron. Commun. Sci.*, 10: 959-964.
- Choi, K.H. and K.S. You, 2012. Web accessibility evaluation of professional sports clubs in Korea. *J. Korea Inst. Inf. Commun. Eng.*, 16: 399-406.
- Lee, Y.S., C.J. Choi, J.Y. Jang and J.S. Choi, 2015. An actual analysis of web accessibility of disaster response agencies using K-WAH4.4. *J. Korea Inst. Electron. Commun. Sci.*, 10: 149-156.
- Mun, H.M. and M.S. Im, 2014. Evaluation and analysis of web accessibility to special schools’ websites based on KWAG 2.0. *J. Spec. Educ. Theory Pract.*, 15: 281-303.
- NISA., 2014. A study on improving strategy for the web-app accessibility in a mobile convergence environment. National Information Society Agency, Daegu, South Korea.
- Ryu, Y., H. Ha and Y.H. Seong, 2014. *Web Accessibility*. Acorn Publishing, Seoul, South Korea.

- Seo, E.H., 2013. Statistical analysis using SPSS 21. Freedom Academy, Seoul, South Korea.
- Shin, S. and H. Park, 2015. Notes on integrated disaster management for resilient response to disaster. *J. Korean Soc. Disaster Secur.*, 8: 11-20.
- Suh, C.K. and C.Y. Hwang, 2013. Web accessibility of the welfare centers for the disabled. *J. Disability Welfare*, 21: 1-18.
- You, K.S., K.H. Choi and H.U. Shin, 2011. A study on web accessibility evaluation of social welfare institutions in South Korea. *J. Vocational Rehabil.*, 21: 21-38.