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HERITAGE DATA VISUALISATION SERVICE FOR MUSEUM STAKEHOLDERS

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KEY WORDS: Artefact data management, Heritage data visualisation, Artefact data visualisation, Digital heritage, Museum service.

ABSTRACT:

The goal of this study was to help cultural heritage administrators, curators and museum visitors apply their understanding and knowledge of artefacts in the museum and the correlations between their embedded contexts appropriately in their work and roles. This study developed the Artefact Data Management Programme and the Artefact Data Visualisation Programme specialised in cultural heritage so people can quickly and easily access the desired information through the correlations between artefacts. The Artefact Data Management Programme combines a Windows-based data converter programme and an artefact management programme that can import and utilise the files converted by the programme. Through the Artefact Data Management Programme, users can enter, modify and delete sub-attributes to manage them. Moreover, this study also allows curators to plan exhibitions from a new perspective through the Artefact Data Visualisation Programme, which converts the entered attribute information of the artefacts into visualised content and edits it. Incidentally, visitors who are non-experts can also understand the relationship between artefacts and learn information through this webpage. In conclusion, the ultimate goal of this study was to produce useful programmes that could help museum stakeholders to edit and utilise cultural heritage data.

1. INTRODUCTION

The International Council of Museums (ICOM) defines a museum as 'a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage' and 'open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing.'

The functions of museums are generally defined as collection, storage, documentation, research, exhibition, and education. The most basic and essential characteristic of them is 'exhibition'. The exhibition is completed when museum stakeholders, including curators, select a theme and organise and design an exhibition and visitors see it.

Museums around the world tend to use various digital technologies for exhibitions. Most major museums in South Korea have already adopted digital exhibition methods. Although the combination of museums and digital technology stayed only in the stage of digital collections and digital archives, it expanded its scope after COVID-19. As museums began to break the mould, the needs of visitors have diversified. In the past, visitors showed a passive viewing attitude that accepted the simple viewing exhibition provided by the curator as it was. However, in recent years, visitors pursue interactive exhibitions where visitors actively participate in the exhibition to understand the information and further acquire in-depth information.

The current museum exhibition description has the following problems. First, contextual information such as history, characters, events and related artefacts cannot be delivered. Second, museum exhibition descriptions using various digital media such as virtual augmented reality still do not provide information and experience according to the user's level and interest. Third, it does not provide user participation and interaction that can increase educational effects.

To overcome above limitations, we developed a data visualisation tool that can visualise a relation network and apply it to the collection of the National Museum of Korea to demonstrate its capabilities. The meanings of thumbnail sizes of visualised cultural heritage, the meanings of connected lines, a search function aim to enable users to access the cultural heritage information as quickly and easily as they want. In addition, this heritage data visualisation service can suggest other utilisation methods to multi-layered museum stakeholders.

Due to the characteristics of these museums, we set the main users of this service as museum stakeholders such as cultural heritage administrators, curators and museum visitors.

We would like to suggest a wide range of utilisation plan of the heritage data visualisation service developed through service design method. The core purpose of Heritage data visualisation service is to efficiently provide customised information for curators, heritage administrators and visitors and can solve the business difficulties of each museum stakeholder.

Effective Heritage data visualisation services can support and facilitate curators heritage administrators and visitors. Curators can use Heritage data visualisation services to ensure time efficiency and data accuracy for research and exhibition of cultural heritage. For heritage administrators, it will help establish a long-term heritage management system. These services also enable museum visitors to select and obtain accurate information by selecting their preferred heritage information.

2. RELATED WORKS : SERVICE FOR HERITAGE DATA VISUALISATION

Advances in digital technology have helped heritage-related organisations, such as archives, libraries, and museums, digitise and make data collections more accessible. Over the past few years, various approaches have been developed to enable the visualisation of cultural heritage data(Mayr et el., 2016).

It is crucial to effectively display information on the relationship between cultural heritage attributes in the process of using

cultural heritage data. Regardless of the field, the priority of data use is to enable the end-users to access the desired information rapidly and conveniently. Accordingly, the purpose of using cultural heritage contents visualised by visualisation tools is to support users to identify a semantic relationship among such attributes rapidly and conveniently. That is, users of cultural heritage contents are induced to connect even the secondary and tertiary relationships among artefacts beyond the primary semantic relationship among these, visualise these connections, and obtain new knowledge and information based on these connections (Windhager et al., 2019).

2.1 British Museum, 'The Museum of the World'

The Museum of the World(britishmuseum.withgoogle.com) is a service provided by the British Museum. It presents artefacts possessed by this museum in a visual form according to time and location. This platform displays artefacts in chronological order based on the present point, and categorises these according to the continents where these were located (i.e. Africa, America, Asia, Europe, and Oceania). Each continent is represented by specific colours to help users distinguish continents conveniently.

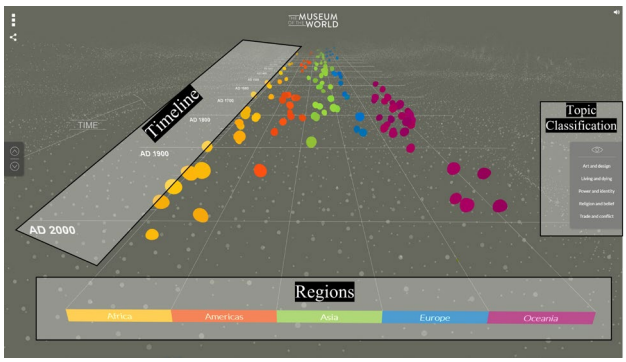


Figure 1. Overall design of the Museum of the World

A small pop-up window appears when the user clicks a point. It shows the name and image of the artefact corresponding to the clicked point. The Museum of the World was designed to connect related artefacts with lines to enable users to obtain additional information conveniently.

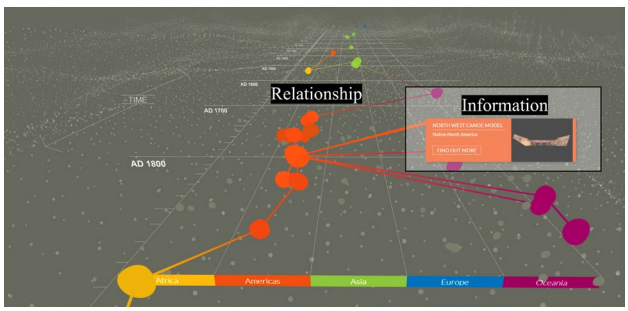


Figure 2. Descriptions and relationships of artefacts displayed when a certain artefact is clicked

Users can obtain more detailed information than a description indicated in the small pop-up window by clicking the FIND OUT MORE icon. The interface of the page connected to this icon is designed to provide explanatory text for the target artefact, an audio file for the text, information on the original of the target artefact and relevant artefacts, and functions to share such information on social media and the Web.

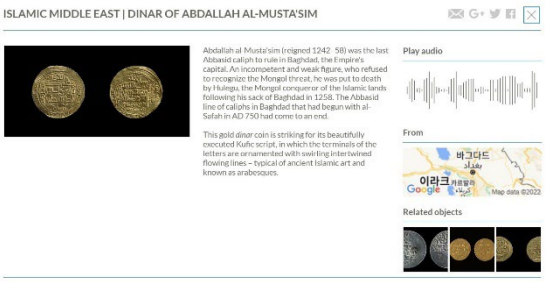


Figure 3. A window that displays detailed information on the selected artefact

2.2 UNESCO, 'Dive into Intangible Cultural Heritage'

Dive into Intangible Cultural Heritage(ich.unseco.org/en/dive) is a collection of intangible cultural heritage attribute provided on UNESCO's Intangible Cultural Heritage website. It presents relevant concepts based on keywords in the visualised form. Each concept is represented by specific colours, and the size of each concept increases in proportion to the frequency of relationships. With regard to the representation method, users can click keywords that appear in circles to narrow the range of keywords and ultimately reach individual cultural heritage attributes. The images of these cultural heritage attributes are presented in circles. The name of the target appears in a box when the user places a mouse cursor on the image of the target.
This webpage also shows diamond-shaped and hexagonal points apart from circular ones. A green hexagonal point indicates a wide region, and a green diamond-shaped point indicates a country. A black diamond-shaped point refers to the potentially related World Heritage site.

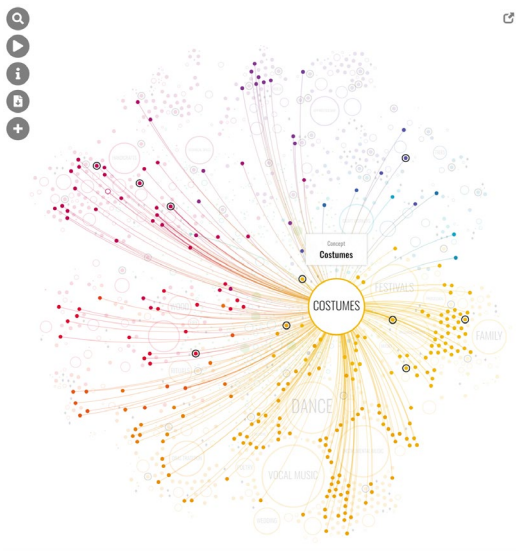


Figure 4. Heritage attributes related to 'costume'

When the user clicks the '+' button located below a circle filled with an image, a pop-up window including information on the target cultural heritage appears. This page provides an explanatory text for the target cultural heritage, relevant images and videos, and a hyperlink that is connected to the UNESCO website. When users click an icon located at the bottom of the

pop-up window, they can examine visualisation data rearranged based on keywords, such as Sustainable Development Goals (SDGs; these are directed by the UN), Domains, Biomes, and Threats.

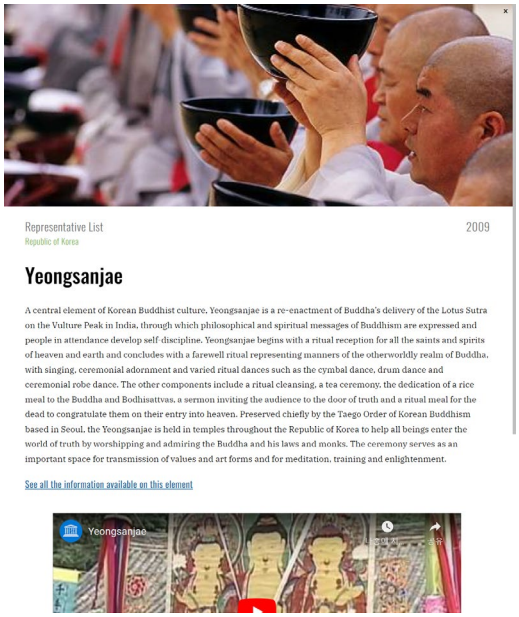


Figure 5. Description of Yeongsanjae, the UNESCO intangible cultural heritage, a relevant video, and a hyperlink

3. METHODOLOGY

3.1 Service design of museum stakeholders

As the amount of accessible information such as big data and artificial intelligence has increased dramatically in recent years, the importance of service design that can most intuitively provide users with the information they want is also emerging. It tends to prefer personalised services that provide services specific to individual users and service designs that provide experience through direct participation, rather than simply providing information in one way.

Service design is defined as a 'holistic multi-disciplinary integration field' that improves or innovates existing services to enable organisations to deliver services efficiently and effectively in order to provide useful and attractive services to customers (Moritz, 2005). Moreover, the goals of service design are to deliver more positive values by allowing an organisation to create effective, efficient, and unique services and create better experiences and make customers useful, convenient, and hopeful (Xin and Cao, 2014).

This importance of service design also extends to museums. The role of museums is shifting from presentation to education and communication, and providing visitors with meaningful experiences has become an important task for cultural heritage organisations (Wang and Junjie, 2017). Visitors also want an environment that allows them to appreciate collections from a variety of perspectives, rather than just seeing arranged collections. Wickell (2014) conducted a survey and found that online museum visitors wanted easier search filter functions and read the information on the relationship between exhibits and artefacts.

Along this flow, many museums are riding the tide of change. Museum websites, which used to have a one-way communication structure, have prepared digital archives to provide various types of services online and are striving to provide a range of new experiences to visitors with digital content using them. They tend to diversify the ways they provide information by digitising their collections and provide services allowing visitors to create secondary content using these materials by themselves.

As such, 'born digital' content, which has been produced in digital form from the beginning, has been explosively increasing in recent years. These digital objects can be divided into individual objects, such as text, images, or sound files and composite digital objects, such as websites and databases. With the growth of digital-format records, museums need digital curation, which is a new way to preserve, manage, and utilise content created in digital environments. Digital curation aims to provide efficient and personalised information to both curators and visitors, and it is the process of enhancing the value of data by making it more accessible and utilisable. Therefore, it is an ideal way for museum services to pursue.

This study aimed to provide digital curation services through visualisation to help visitors understand the context of heritage and obtain new insights by making museum stakeholders provide digitised heritage data and information through the semantic correlations between heritage objects in the midst of these changes. This study referred to the Curation Lifecycle Model published by the Digital Curation Centre (DCC) during the development process. The DCC argued that 'digital curation involves maintaining, preserving and adding value to digital research data throughout its lifecycle' and published the Curation Lifecycle Model consisting of full lifecycle actions, sequential actions, and occasional actions. They explained that it would be possible to define roles and responsibilities by mapping detailed curation functions in the model by utilising the model and build a framework of standards and technologies to implement them. The digital curation service we developed can be utilised mainly in the sequential actions phase of this lifecycle model, which has 15 steps. Specifically, it specialises in the 'conceptualise', 'create and receive' and 'access, use and reuse' steps (Higgins, 2008).

This study set museum stakeholders as 'heritage administrators, curators, and museum visitors', the main participants and targets for these actions. Each stakeholder can use the Artefact Data Management Programme and Artefact Data Visualisation Programme developed by this study for their own purposes.

3.1.1 For heritage administrators: 'Heritage administrators' refers to all those who are engaged in tasks such as preserving, interpreting, promoting, maintaining collections hold, establishing and furthering knowledge and operating as suggested by the ICOM Code of Ethics for Museums (ICOM, 2017). The 'Cultural Heritage Standard Management System', the origin and a representative of the Korean heritage digital archive of artefacts, has managed only administrative information on cultural heritage, such as collection numbers, information, and location history. Since then, the National Museum of Korea has provided an online archive service for its collections (eMuseum (www.emuseum.go.kr)) on its official website, which specialises in building and operating a digital data management system (DAMS), building, producing, and managing museum archives and databases of related materials, establishing collection archives, and acquiring and managing high-quality image archives. However, both the Cultural Heritage Standard Management System and NMK's eMuseum service cannot discover the meaningful relationship between cultural heritage, a limitation, because they are closer to records that provide information rather than the stories of artefacts.

Until recently, digital archiving has been conducted at the level of the collection of an enormous amount of distributed data. To elevate the digital archiving system to an advanced level, archive management institutions should establish an environment where users can perform tasks as archivists. To achieve this, these institutions should develop a user experience design that enables users to access data based on desired keywords, data use measures for creating content, and a metadata management system for controlling data input by users. Accordingly, these institutions should continuously provide users with information on digital archiving and nurture experts who can design and develop various types of archiving content that promote the direct participation of users in archiving.

Therefore, we developed a data converter programme for metadata management of artefacts for administrators, we also plan to present a plan to utilise the two programmes in conjunction.

3.1.2 For curators: Curators are the key personnel who organise the museum's exhibitions. They carry out the main tasks of the museum, including academic and general affairs, data organisation, data collection, the spread of education, exhibition planning and operation, and casting. Exhibition planning, one of the curators' core tasks, is composed of theme establishment, conceptual design, detailed production planning, and implementation design.

A survey conducted by our research team on 22 curators working for the National Museum of Korea in 2020 and they responded that they had a difficulty in planning new exhibitions because they already planned and operated exhibitions on various themes with limited artefact resources. Above all, curators needed integrated data including a wide range of related words associated with a single artefact, related data analysing keywords in reports and art brochures, and past exhibitions at other institutions, rather than just simple records in a list format. They also hoped to secure image search and emotional association search functions.

Moreover, since curators majored in different fields such as history, archaeology, art history, anthropology, and museum studies, it is difficult for them to identify the semantic relationship between artefacts and connect it to exhibition planning, if it is not their field of study, which is an issue. The Artefact Data Visualisation Programme developed in this study implemented visualisation based on the semantic relationship between artefacts. Therefore, it will help curators to investigate materials, set themes and plan exhibitions. In addition, its overall services (e.g., artefact information visualisation, artefact search function, artefact relationship visualisation, bookmark function) can be used for exhibition planning.

3.1.3 For visitors: The museum provides various exhibitions and educational programmes for visitors, and visitors visit museums to appreciate and participate in them. It is reported that 1,262,562 people visited the National Museum of Korea (NMK) in 2021 (NMK, 2022). The statistics of the Ministry of Culture, Sports, and Tourism's weblog analysis system show that 4,137,940 people visited the NMK website in 2021, which is a 36.5% increase compared to the previous year. In addition, another survey of 900 domestic visitors revealed that they mainly acquired information through online channels such as internet posts (41.1%), museum webpages and newsletters (40.7%), and social media (20.0%). On the other hand, a visitor survey conducted at the National Museum of Korea's webpage showed that 'content diversity' was the lowest (80.8%) among the factors that constituted service quality. From the results of surveys, The NMK (2022) confirmed the need to provide more diverse and personalised services by securing online content diversity as people were more interested in museums and online access to information was increasing.

With the advancement of technology and social changes, exhibitions are being planned in a way that visitors can directly participate and think, rather than the one-sided explanation and presentation by curators in the past. Visitors can check the information of artefacts obtain in-depth information through the media wall and kiosk installed in the exhibition hall. It can also be accessed via the website before or after viewing the exhibition and can be used for contactless learning.

Visitors can be expected to learn deeper knowledge after viewing the exhibition through the curation function in artefact data visualisation programme that we developed. Moreover, it is also expected that it will induce a greater learning effect by interacting with the 'e-museum curation' function that is being offered on the e-Museum, a website under the National Museum of Korea.

3.2 Visualisation of the NMK Artefacts

Prior to visualisation, we developed a "Data Converter" and "Artefact Management Programme" for curators and artefact managers, and an "Artefact Data Visualisation Programme" web page. The data used for visualisation consists of 549 items from the National Museum of Korea's 'Curator's Pick Collection', which has established metadata and assured information source. We also determined that this data was suitable for use as virtual exhibition content, given that the curator's curation themes and contents were already in place. As a result, the metadata structure of the artefacts was adopted based on the classification provided on the National Museum of Korea's website.

3.2.1 Artefact Data Management Programme: We collected information about the visualisation targets through web crawling and organised it into a spreadsheet. Using search filters and artefact information on the NMK site, we organised the metadata of each artefact into the following categories: 'artefact type', 'curation theme', 'artefact name', 'artefact name (in Korean)', 'artefact description', 'other names', 'nationality/era', 'classification', 'material', 'artist', 'size', 'designated cultural heritage', 'collection number', and 'e-Museum link'. Afterwards, subfolders were made for every attribute related to each condition, and within each subfolder, further individual folders were created. These folders contain photographs of the artefacts.

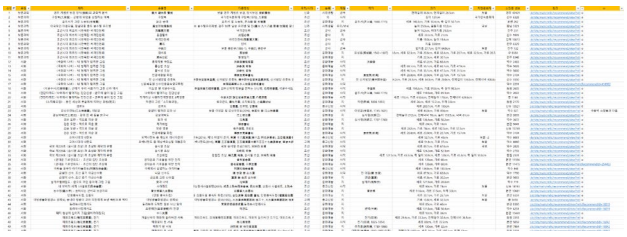


Figure 6. A spreadsheet to organise artefact data

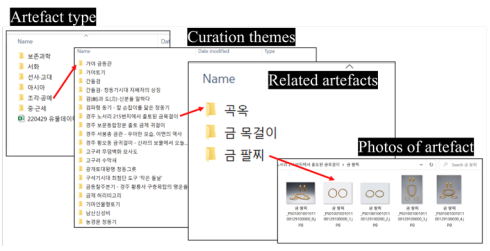


Figure 7. Create folders by property and artefact

We developed a Windows-based data converter programme using Visual Basic NET to convert the organised spreadsheets

into usable data. The programme can convert other formats in addition to the Excel format after saving them to CSV files. It is possible to import and covert a file by clicking ‘Search’ under ‘Excel File’ at the top of the programme.

Figure 8. When the organised spreadsheet imported to the data converter programme

It is possible to import and utilise the file converted by the ‘data converter’ in the Artefact Data Management Programme. This programme can manage the sub-attributes of ‘type’, ‘theme’, ‘nationality/era’, ‘classification’, and ‘property’ that are ‘artefact conditions’ in visualisation programme (light blue icons at the top). A user can enter, edit and delete sub-attributes directly by using the interface on the left side of the programme. Figure 9 shows the screen that appears when the user selects ‘classification management’. A user can confirm the list of sub-attributes entered in the ‘classification’ category of the spreadsheet, and each sub-attribute is assigned a unique management number.

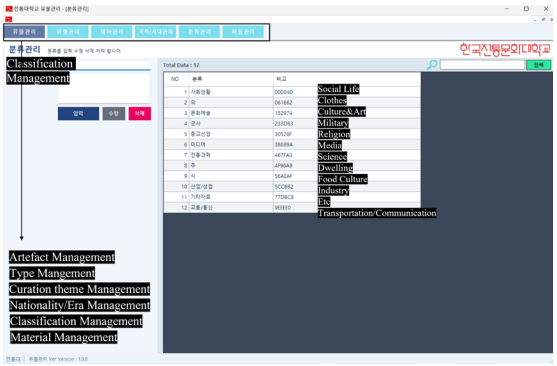


Figure 9. when a user selects ‘classification management’ in the Artefact Data Management Programme

A user can manage the data of an artefact, as well as its sub-attributes, by clicking on the ‘artefact management’ icon on the far left of the icons at the top of the system (navy blue icon). When selecting ‘artefact management’, the left side of the programme consists of the artefact's metadata. Each metadata is identical to that set in the organised spreadsheet. The sub-attributes of the artefacts managed under different icons (sky-blue icons) such as ‘Type Management’, ‘Theme Management’, and ‘Nationality/Period Management’ can be confirmed in a list in a pop-up window by clicking on the ‘Search’ icon. One can select the corresponding sub-attribute for the artefact being inputted. An image file of the artefact can be added directly, and the size of the local image data will be automatically adjusted and uploaded.

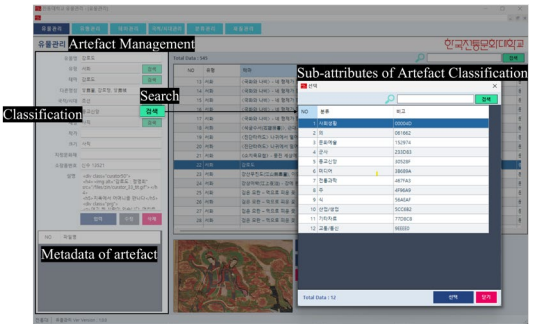


Figure 10. When a user clicks the ‘search’ in the ‘artefact classification’ field on the ‘artefact management’

3.2.2 Artefact Data Visualisation Programme: We came up with a visualisation method and have created ‘Artefact Data Visualisation Programme’, which allows curators to make use of the database created using the aforementioned process. To enable user interaction and network visualisation, we utilised JavaScript. PHP was used to establish a connection between the visualisation viewer and the database, as well as to transmit and receive data. Finally, HTML and CSS were used to build the web pages.
The primary goal of developing this programme was to create an auxiliary tool to help curators plan exhibitions from a new perspective by identifying the contextualised relationships between artefacts. As a side benefit, visitors, non-expert, can also understand the relationships between artefacts and learn information by using this programme. We used various factors such as the size of the thumbnails, the colour of the lines, and the principle of gravity for effective visualisation.

Artefact information visualisation: Users can select from five different relationship conditions using checkboxes available on the web pages developed so far. These checkboxes are located on the left side of the page. Once a user selects a relationship condition, they can click on ‘Create Relation Network’ to visualise the information about the artefacts on the right side of the page. It includes circular shapes representing each artefact and its sub-attributes. The sub-attributes are displayed as text, while the photos are displayed as thumbnails.

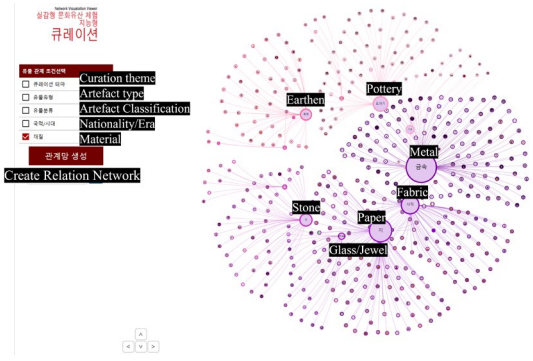


Figure 11. When a user creates relation network selecting ‘material’ condition

In each condition, every sub-attribute is assigned a specific colour, and each artefact is connected by a line of that colour. The size of the circle representing each sub-attribute corresponds to the number of related artefacts; sub-attributes with more related artefacts have larger circles, while those with fewer related artefacts have smaller ones. For instance, when the ‘material’ condition is selected, the circle representing ‘metal’ will be the

largest as it has the most related artefacts, as shown in the example in Figure 11.

When a user clicks on an artefact, a pop-up window appears containing a summary of the artefact as well as a pho linked to the thumbnail (Figure 12(a)). If a user selects the ‘View Details’ icon within the pop-up window, they will be able to access more comprehensive information (Figure 12(b)). The name of the artefact is appeared at the top of the page, while the title of the curation created by the curator and their name are displayed at the bottom. In the main text area, users can find a description provided by a curator at the National Museum of Korea, as well as information and photos of related artefacts.

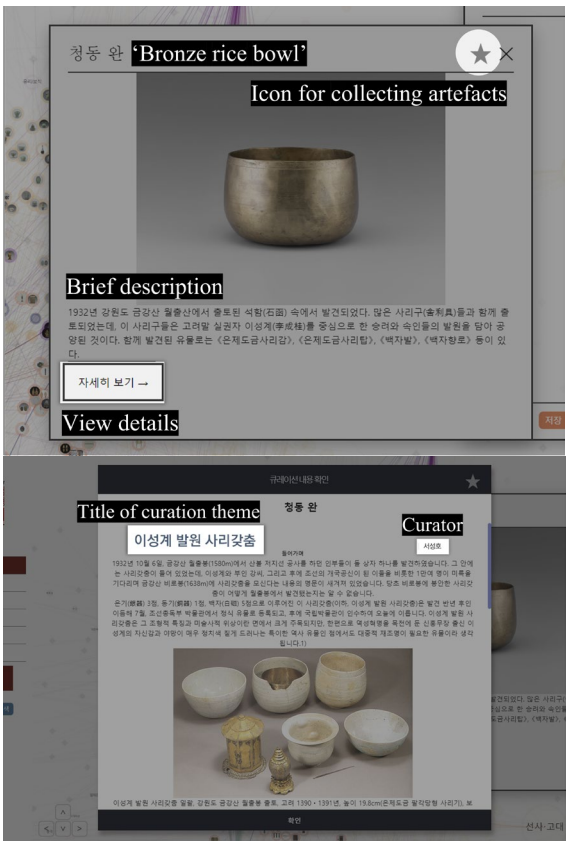


Figure 12. (a)Brief description pop-up about selected artefact, (b)Detailed information

Artefact search function: Users can search the artefacts they want to explore. First, users can enter the name of the artefact in the search box (under artefact condition) after selecting the conditions related to the artefact they want to find out. When entering a keyword in the search box, it will generate a list below that shows the cases that include the keyword in the artefact description and curation, as well as the names of artefacts containing the keyword. The attributes of the artefact are presented next to the list of search results to improve users’ convenience. For example, if a user searches for ‘Uigwe (a book that summarises all relevant facts in pictures and text for a royal family or state event in the Joseon Dynasty)’ (Figure 13), the first box from the dotted line shows cases that include the keyword in the name of the artefact, and the second box is the cases that contain the keyword in the description of the artefacts. The third box presents cases that have the keyword in the curation theme content, so users can see that there is a connection even if the keyword is not included in the artefact name. For example, ‘Sillokja large types (a type of typeface used to create annals that record the events in chronological order during one king’s reign in the Joseon Dynasty),’ located in the ninth row of the third box, does not contain the word ‘Uigwe’. However, by clicking on ‘Sillokja large types’ and checking the curation theme content, users can find a record of a sillokja that was cast to create annals in the Uigwe created during the reign of King Hyunjong. Lastly, the fourth box is when the title of the curation theme contains the keyword, which allows users to identify the relationship between artefacts that are connected around that keyword.

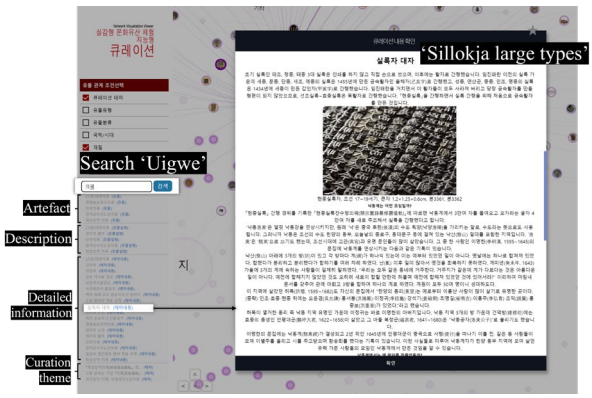


Figure 13. When selecting ‘Sillokja large types’ after searching for ‘Uigwe’

When users enter a keyword and click on the ‘Search’ button, they will be taken to the location of the searched artefact or attribute, and the corresponding thumbnail of the searched artefact, sub-attribute, or curation theme will be highlighted. This feature allows users to access visualised information about the artefact and its relationships with other related artefacts. For example, when entering ‘Daerye Uigwe (a Uigwe records that court ladies were subjected to rituals and ceremonies befitting of the imperial family during the Korean Empire)’ in the search bar (Figure 14), it heavily highlights the thumbnail of the artefact along with the artefact’s information. At the same time, the artefacts associated with ‘Korean Empire’, a sub-attribute of the ‘nationality/era’ condition associated with the ‘Daerye Uigwe,’ and the artefacts connected to the curation theme to which the ‘Daerye Uigwe’ belongs, are also lightly highlighted.

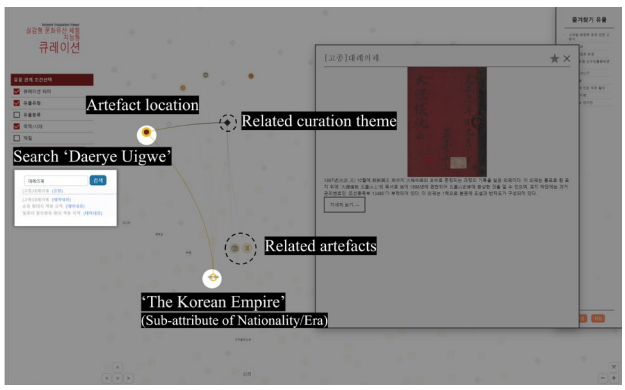


Figure 14. Highlighted target artefact and related artefacts when searching for ‘Daerye Uigwe’

Artefact relationship visualisation: By selecting multiple artefact relationship conditions, users can comprehend the relationships between artefacts. When two or more conditions are selected, various sub-attributes connected to one artefact are displayed, and related items are positioned close to each other using the principle of gravity. As shown in Figure 15, when users

select ‘artefact classification’ and ‘nationality/era’, the sub-attributes of ‘artefact classification’ appear on the right side of the screen in a circular form, while the sub-attributes of ‘nationality/era’ appear in a circle on the left. In addition, related artefacts are grouped together, and artefacts/attributes associated with the object under a pointer of a mouse are highlighted by filling the thumbnail with a colour. For instance, when hovering over one of the sub-attributes of the ‘Nationality/Period’ condition, such as ‘Goryeo’ (figure 15), it is possible to see that the items connected to ‘Goryeo’ among the sub-attributes of the ‘Artefact Classification’ are filled with colour. Through the grouping of artefacts, it can be observed that the Goryeo period artefacts are mainly connected to ‘religious beliefs (navy)’ and ‘food culture (mint green)’.

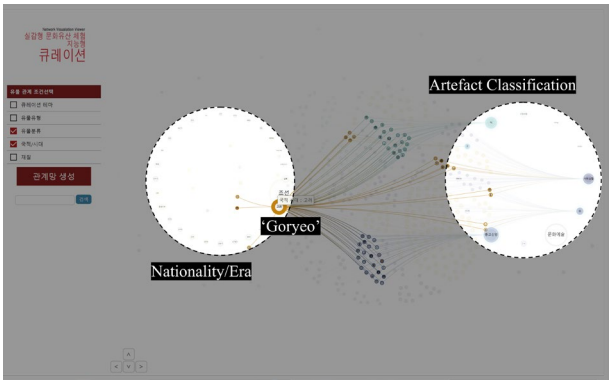


Figure 15. when selecting an artefact classification and a nationality/era condition

When selecting multiple conditions, a circle’s edge that connects to two or more sub-attributes will be coloured based on the sub-attribute with the most connected artefacts. The colour of the line will also have a gradient change. For example, Figure 16 shows that ‘bronze rice bowl’ is connected to ‘Goryeo(Yellow)’ in ‘nationality/era’ and ‘eating culture (mint green)’ in ‘artefact classification’. The number of artefacts connected to ‘eating culture’ is greater; thus, the yellow line that started from ‘Goryeo’ changes to mint green.

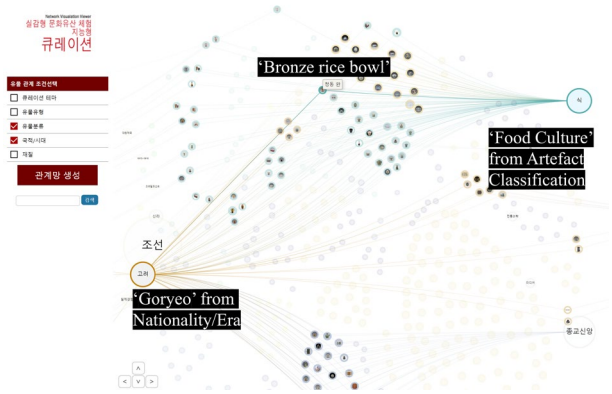


Figure 16. Visualisation of artefact relations for ‘Bronze rice bowl’

Moreover, when users hover the mouse over a thumbnail to learn more about it, only the connected artefacts and attributes will be highlighted (Figure 16). If a user clicks the artefact after hovering over it, the edge of the artefact gets thicker and fixed. Even after the mouse moves, the position can be confirmed through the thickness of the edge. To help users visually understand the relationships, unrelated artefacts are displayed in grey to create contrast. Figure 16 shows that artefacts associated with ‘Goryeo’ and ‘food culture’ are highlighted and other unrelated artefacts are blurred.

Users can also view the relationships between artefacts by selecting the curation theme that they are interested in. When hovering over the black rhombus-shaped curation theme thumbnail, only the artefacts and attributes associated with the theme are highlighted. Figure 17 shows what it looks like when a user hovers over ‘Sangpyeongtongbo’, a curation theme. The user can understand that the theme is associated with the economy of the Joseon Dynasty by seeing that the thumbnails of ‘Joseon’ and ‘industry/livelihood’ connected to ‘Sangpyeongtongbo’ are coloured. The user also can read the curated content that explains the relationship in detail by clicking on the highlighted artefacts.

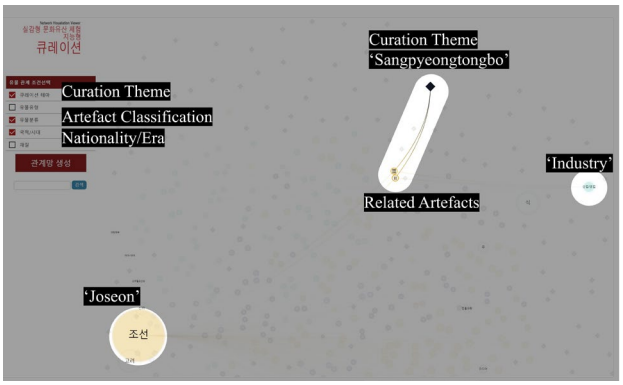


Figure 17. Visualisation of artefact relationships for curation theme ‘Sangpyeongtongbo’

Bookmark function: A user can also save artefacts of interest to their ‘bookmark artefacts’. By clicking on the ‘☆’ icon in the top right corner of the pop-up window displaying the description of an artefact (Figure 11), it is saved to the ‘bookmark artefacts’ on the right side of the page by the artefact name. While surfing the webpage, a user may save artefacts of interest and click ‘Apply’ below, only the bookmarked artefacts will remain, allowing the user to visually see the relationships between them.

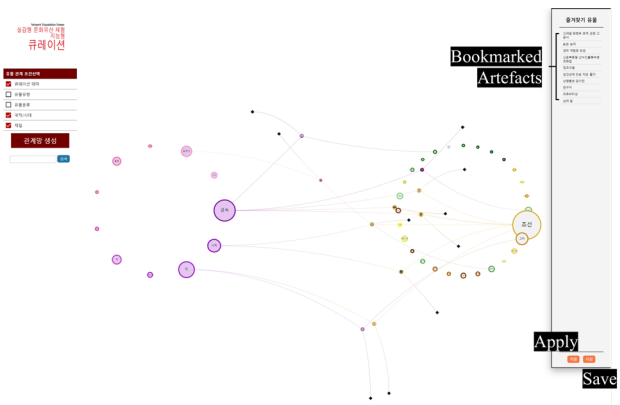
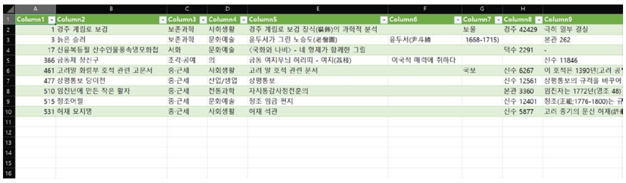


Figure 18. Showing only bookmarked artefacts after clicking ‘Apply’

Moreover, a user can save the saved artefacts to a CSV file by clicking ‘Save’. It is possible to view the metadata of the saved artefacts as text by opening the CSV file. This feature allows curators to save a list of artefacts related to the theme of the

exhibition they are planning and visually see the relationships between them. In this process, they can remove artefacts that are not relevant or add artefacts to manage the list and use it to plan a virtual exhibition.



Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9
1	경주 계림로 보검	보존과학	사회생활	경주 계림로 보검 장식(裝飾)의 과학적 분석		보물	경주 42429	극히 일부 결실
3	늙은 승려	보존과학	문화예술	윤두서가 그린 노승도(老僧圖)	윤두서(尹斗緖	1668-1715)		본관 262
17	신윤복등필 산수인물풍속영모화첩	서화	문화예술	〈국화와 나비〉 - 네 형제가 함께한 그림			덕수 2291	-
366	금동제 장신구	조각·공예	의	금동 여지무늬 허리띠 - 여지(荔枝)	이국적 매력에 취하다			신수 11846
461	고려말 화령부 호적 관련 고문서	중·근세	사회생활	고려 말 호적 관련 문서		국보	신수 6267	이 호적은 1390년(고려 공
477	상평통보 당이전	중·근세	산업/생업	상평통보			신수 12561	상평통보의 규격을 바꾸어
510	임진년에 만든 작은 활자	중·근세	전통과학	자치통감사정전훈의			본관 3360	임진자는 1772년(영조 48)
515	정조어필	중·근세	문화예술	정조 임금 편지			신수 12401	정조(正祖;1776-1800)는 규
531	허재 묘지명	중·근세	사회생활	허재 석관			신수 5877	고려 중기의 문신 허재(許

Figure 19. CSV file containing bookmarked artefacts saved by clicking 'save'

4. CONCLUSIONS

The Artefact Data Management Programme and the Artefact Data Visualisation Programme developed in this study are digital tools for helping users to understand the semantic relationship of cultural heritage.
Although the visualisation programmes developed to date only targeted the collections recommended by the NMK's curators, the process presented in this study can be applied and implemented by multilayering objects, quantities and characteristics. In conclusion, this research aims to create an all-encompassing ontology that can describe various artefacts, including people, events, architectural heritage, intangible heritage, and natural heritage. This will aid in the development of a semantic web platform that enables users to conduct integrated searches of cultural heritage. Ultimately, this tool will be beneficial for museum stakeholders to edit and utilise cultural heritage data.
Especially, an artefact metadata management system is essential for heritage administrators to manage artefacts and records at an advanced level. In this aspect, the developed Artefact Data Management Programme will be useful. Since it collects and organises artefact information through web crawling, it can be applied to other websites as well as the NMK website. The current version of the Artefact Data Management Programme is limited to managing artefact descriptions and photographs, and it will be further updated to manage videos, 3D data, and even X-ray records through further research and development.
In addition, the Artefact Data Visualisation Programme of this study will provide curators with the opportunity to present new exhibitions that go beyond the scope of their individual specialties and interests. All services of this programme, including list creation, save, bookmark and visualisation functions, can be used for exhibition planning. Moreover, our objective is to enhance the user experience and interface, allowing curators and humanities experts without technical proficiency to collect relevant artefact data and design them according to their desired concept with ease. Furthermore, researchers plan to continue follow-up research to improve the user experience and interface, enabling even those without technical knowledge can directly input data and visualise it as a desired concept.
Lastly, for casual visitors, they can be used for digital exhibitions in museums and art galleries by utilising media walls, large screens, etc. This will help the public understand the contextual information of artefacts deeper by accessing and exploring the relationships between artefacts. To achieve this, the UI and UX designs of these programmes need to be improved to make them more accessible to the public. Moreover, we will continue to work on improving the features that are currently designed for curators planning exhibitions to make them more accessible and easier to use for general online and offline visitors.
In conclusion, the objective of our studies is to develop digital tools for intelligent curation that support users in identifying semantic relationships of cultural artefacts. Future studies aim to unify the Artefact Data Management Programme and the Artefact Data Visualisation Programme to enable intelligent curation across cultural heritage, including data analysis, management, and utilisation. We aspire to create an educational tool that not only allows users to generate content but also enables them to collaborate and edit the content online.

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