Transforming the Archives of the Great East Japan Earthquake into Global Natural Disaster Archives

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Abstract. Soon after the devastation brought by Great East Japan Earthquake (GEJE), a variety of Japanese agencies and organizations began to build digital archives of the disaster. Seven years onwards, over fifty digital archives collect and release millions of earthquake records. These earthquake disaster digital archive created for the Great East Japan Earthquake have the potential to lead the way for more general measures and countermeasures to reduce the impact of future ‘natural’ disasters. We also believe that the records and knowledge of ‘natural’ disasters must be systematized and shared worldwide. As a first step, this research sheds light on examples and subjects of the digital archive of GEJE and report on basic knowledge that serves for the development of digital archive of ‘natural’ disasters in the future.

1. Introduction

The Great East Japan Earthquake that occurred at 14:46 on March 11, 2011, was the largest ever recorded in Japan with a magnitude 9. The epicentre was located off the coast of northeast Japan and caused a massive tremor in the Tohoku region. The observation of seismic reported intensity between 1 and 2 in the distant Kyushu island. Literally, the whole of Japan shook that day. Within an hour of the earthquake, a great tsunami struck across the Tohoku region. The residents of many coastal cities and villages evacuated but the people and the buildings left behind were washed away. The Fukushima Daiichi Nuclear Power Station located in Okuma Town and Futaba Town in Fukushima Prefecture was hit by the tsunami causing serious damage to the facility and the worst outcome possible: its meltdown. The widespread evacuation began in the municipalities neighbouring the nuclear power plants from one morning to the next. Some people cannot return to their homeland seven years on. Among the 19,620 precious lives lost the Great East Japan Earthquake, 2,569 people are still counted as missing. Even after seven years, the search for missing persons is being held in the coastal areas of the Tohoku region months after months.

Mirroring the magnitude of the catastrophe, a tremendous effort was observed among the various agencies and organizations that started to put together digital archives to preserve the records of the Great East Japan Earthquake occurred. Seven years since the earthquake, more than 50 digital archives

¹The authors understand that there is no such thing as a ‘natural’ disaster. All disasters are unequivocally the result of social processes as well as environmental hazards. For the sake of intelligibility, we use this sentence to refer to all disasters which are tied or induced by natural hazards (i.e. earthquake, tsunami, typhoon, hurricane, drought, storm, flood, and so forth).
are currently operating in Japan. Together, they gathered and manage millions of earthquake records. Based on our observation and contribution to this effort, we argue that the digital archive built after the Great East Japan Earthquake will serve to establish measures and countermeasures to protect human populations from future ‘natural’ disasters. Also, we believe in the necessity of preserving the records and knowledge of natural disasters that will occur in the future worldwide. To this end, this research intends to discuss examples and subjects of the digital archive of the Great East Japan Earthquake to report on basic knowledge necessary for the development of digital archives of natural disasters in the future.

2. About the disaster archive of the Great East Japan Earthquake

2.1. About the Disaster Archives
The discussion about the ‘disaster archives’ in this paper includes disaster-related knowledge and teachings, as well as the collection, preservation, and utilization of these records. A term similar to disaster archives is ‘disaster big data’. Disaster big data refers to the body of information necessary for disaster prevention and mitigation, and emergency treatment and restoration from the time immediately following the disaster. The main difference between disaster archives and disaster big data is the respective nature of the data handled. Disaster archives manage digital records including SNS, photographic and video footage, as well as analogue documents including record magazines and publications, and handles relics and physical remains. In contrast, disaster big data deals only with digital records and is a component of disaster archives. The latter handles all information from disaster big data that focuses on data from the time immediately following the disaster, as well as records from prior to the disaster to the revival.

The concept of disaster archives was not recently created. In fact, we can refer to the collections in libraries and museums of disaster-related documents such as books and record magazines as disaster archives. Following the trend in recent years that has seen the evolution of the internet and an increase in digital material, the move toward material storage to digital archives is becoming mainstream, and the institutions implementing this are beginning to exceed the frame of libraries and museums.

2.2. Earthquake Disaster Archive Trends in the Great East Japan Earthquake
Following the GEJE, a Reconstruction Design of Seven Principles was proposed at the Reconstruction Design Council on June 25, 2011. Principle one states: “We shall record the disaster for eternity, including through the creation of memorial forests and monuments, and we shall have the disaster scientifically analysed by a broad range of scholars to draw lessons that will be shared with the world and passed down to posterity.” [1] This principle saw the construction of a number of disaster archives. Examples include disaster archives built by the library group centred around the National Diet Library[2] and disaster-stricken areas, research institutions such as Tohoku Gakuin University[3], Tohoku University[4], Iwaki Meisei University[5], Japan Society of Civil Engineers[6], and the National Research Institute for Earth Science[7] and Disaster Resilience, media such as the Japan Broadcasting Corporation (NHK) [8] and Kahoku Shimpo Publishing Co. [9], private enterprises such as Google[10] or Yahoo! JAPAN[11], municipalities such as Tagajo City in Miyagi Prefecture[12], Miyagi Prefectural Library[13], Koriyama City in Fukushima Prefecture[14], Kuri city, Noda village, and Fudai village in Iwate Prefecture[15], and Iwate Prefecture[16]. Contrasting with previous practice, the present framework for disaster archives takes into consideration a number of factors. These include the scale and severity of the damages caused by the disaster, the challenges for a single system or institution to collect all earthquake-related records, people’s desire to transmit lessons to future generations beyond Japan, and the large number of earthquake records that were created due to the spread of digital technology.

Phases of the disaster archives process can be divided into collecting, organizing, preserving, and exhibiting materials in a contents holder in each institution as well as a portal site operating system that allows cross-searching between contents holders. Typical portal sites include the National Diet Library’s
‘Hinagiku’ [2] and Harvard University Reischauer Institute of Japanese Studies ‘Japan Disasters Digital Archive’ [17]. The majority of others are contents holders only. The National Diet Library’s ‘Hinagiku’ has collaborated with dozens of institutions and, to date, the number of registered disaster-related documents of the Great East Japan Earthquake is approximately one million. Registered contents include materials from immediately after the earthquake to the recovery and reconstruction, including photographs, testimonies, visual and audio recordings, administrative sentences; over half of the items are photographic records. These disaster-related data serve disaster prevention education and reconstruction tourism, publications, media, and research materials. Finally, we note that there are three main types of disaster archives depending on their modes of construction: 1) disaster archives using conventional means to gather material; 2) disaster archives storing large amounts of earthquake records, and 3) disaster archives passing on disaster-related documents to future generations.

Table 1. Major disaster archive of the Great East Japan Earthquake (2017)

| Date          | Site Name (Names of institutions)                                                                 | Number of contents |
|---------------|-------------------------------------------------------------------------------------------------|--------------------|
| June, 2011    | East Japan Earthquake Picture Project (Yahoo! JAPAN)                                             | 64,993             |
| June, 2011    | Memories for the Future (Google)                                                                | 62,662             |
| June, 2011    | Center for Remembering 3.11 (Sendai mediatheque)                                               | 1,232              |
| September, 2011 | Michinoku Shinrokuden (Tohoku university)                                                       | 125,531            |
| March, 2012   | Great East Japan Earthquake Archives (NHK)                                                      | 1,803              |
| March, 2012   | Archives of agricultural, fishery and forestry cooperative organizations' activities for the restoration from the Great East Japan Earthquake (Norinchukin Research Institute Co., Ltd.) | 4,251              |
| April, 2012   | Memories of Hamadoori: Disaster Archive for the future (Iwaki Meisei University)                 | 299                |
| September, 2012 | Remembering 3/11(FNN)                                                                         | 69                 |
| March, 2013   | KAHOKU SHIMPO DISASTERS ARCHIVE (Kahoku Shimpo Publishing Co.)                                 | 127,098            |
| March, 2013   | The Great East Japan Earthquake Archives Fukushima (Keio University)                             | 18,795             |
| May, 2013     | Remembering 3.11 (Tohoku Gakuin)                                                               | 8,786              |
| January, 2014 | Red Cross Nuclear Disaster Resource Center Digital Archives (Japanese Red Cross Society)        | 1,054              |
| March, 2014   | Tagajo kenbunoku (Tagajo city in Miyagi prefecture)                                             | 24,519             |
| April, 2014   | Aomori Disaster Archive (Hachinohe City, Misawa City, Otake Town and Hashikami Town in Aomori Prefecture) | 93,514             |
| June, 2014    | Fukushima Nuclear Accident Archive (Japan Atomic Energy Agency)                                 | 112,824            |
| March, 2015   | Kujii-Noda-Fudai Disaster Archive (Kuji City, Noda Village and Fudai Village in Iwate Prefecture) | 127,415            |
| April, 2015   | Koriyama Disaster Archive (Koriyama City, Tahioka Town, Futaba Town and Kawauchi Village in Fukushima Prefecture) | 49,901             |
| June, 2015    | Great East Japan Earthquake Archive Miyagi (Miyagi Prefectural Library)                          | 222,291            |
| July, 2015    | Urayasu Disaster Archive (Urayasu City in Chiba Prefecture)                                     | 34,241             |
| February, 2016 | Radiation Medical Science Center for the Fukushima Health Management Survey digital archive (Fukushima Medical University Radiation Medical Science Center) | 1,881              |
| March, 2017   | Iwate Earthquake Tsunami Archive "Hope" (Iwate prefecture)                                     | 236,498            |
3. Problems of disaster archives in Japan

The fifty archives of the Great East Japan Earthquake contain more than four million points of data about the Great East Japan Earthquake. We know of no comparable case throughout the world, where, at most, ten archives had been devoted to a single ‘natural’ disaster. Despite these encouraging figures, the totality of four million points are not organized using a unified scheme of metadata and therefore cannot be easily and systematically retrieved by the archive end-users. Although this problem includes issues peculiar to Japan, others may commonly arise during the future construction of a disaster archive somewhere else in the world. In this section, we reveal the problems encountered by the disaster archive of the Great East Japan Earthquake and ways that may remedy to the problems of disaster archiving.

3.1. Disaster Archive Guidelines

Before the Great East Japan Earthquake, there were no guidelines on disaster archives in Japan. Therefore, each agency established its own standards and its own policy for the establishment of its disaster archive. In March 2013, the Japanese Ministry of Internal Affairs and Communications formulated the "Guidelines for Construction and Operation of Digital Archive related to the Great East Japan Earthquake Disaster."[18] Disaster archives are now being established according to these standards. Nevertheless, the Ministry of Public Management, Home Affairs, Posts and Telecommunications guidelines did not have provisions such as the definition of earthquake data, the classification criteria of documents, the lexical control of material keywords, and the disclosure criteria. Therefore, each archival platform remains different and problems to unify document retrieval. Much data remain inaccessible to the public. The authors think that it is necessary to rethink the guidelines of disaster archives and to improve the legislation.

3.2. Metadata schemes

Among digital archives of disasters in Japan, a few sites designed their own metadata schemes. Most archives use the scheme the Great East Japan Earthquake Archive Metadata Schema of the National Diet Library [19] or some additional items. The metadata schema of the National Diet Library independently expanded the international metadata standard Dublin Core to include corresponding items of the Japanese language and disasters. The metadata of the National Diet Library is made up of over 300 items in terms of coverage and convenience. However, many items such as GIS information cannot be stored. Likewise, the solving of multilingual correspondence is still at an impasse. While it can be a reference for the future archives of natural disasters, the metadata schema of the National Diet Library requires revisions to meet the needs of future databases worldwide.

3.3. Vocabulary Control in Disaster Archives

Items of metadata include titles, creation dates, publication dates, file formats, keywords, document classifications, location information, descriptions of document contents, and modification history. Among them, keywords allowing access to the materials need particular attention. These terms are generally selected among the commonly used vocabulary. However, this process of selection must depend on the knowledge and vocabulary of the user and the country of origin. In Japanese, the same word can be written in three different scripts (i.e. kanji, hiragana, or katakana). For example, the word of rubble pronounced ‘gareki’ can be written 瓦礫(kanji), がれき(hiragana) and ガレキ(katakana). Even when using English keywords, the same item can be described using several words as in the case of car, motor vehicle, auto car, automobile, and motorcar. We observe further variations between the vocabulary used in the United Kingdom and the USA. The simple solution is to build a thesaurus. However, we predict that the task would meet further challenge from technical and scientific vocabularies, as they also find many equivalents. For instance, the word “tsunami” which, originally Japanese, can be described with the words tidal wave, seismic sea wave, and hydraulic bore. In other words, the plurality and complexity terminologies related to natural disaster make it the creation of a unified and universal thesaurus challenging albeit necessary.

3.4. The information about the locations of the material
For most disaster-related materials, the location information includes the name and address of the places of the object of the data. This information can be said to be useful for screening and analysing elements in many ways. However, common problems are that the location of items of past disasters might now have a completely different name and address, several places might exist for the same address, or else regional names of an area may be changed after being used for a long time. Some of these issues may be resolved by using geocodes for a given period. However, there periods cannot be defined based on some algorithm and need to be carefully considered. For instance, after the Tohoku earthquake, some areas could no longer be used or inhabited because of the area has been considered prone to tsunami and inhabitable. Some of the facilities located in these zones have been rebuilt in inland while conserving its original name. As a result, the same place may have different locations in the past, the present and possibly the future. In such instance, you cannot establish a single geocode for a building name.

With regards to location information, an additional complexity concerns the archiving of photos. Currently, pictures taken with a smartphone have their location automatically saved. The information corresponds to the location of the photographer, not the location of the scene appearing on the snapshot. Within the metadata schema of the disaster archives of the National Diet Library, there are options that allow you to access both the location of the camera and the location of the scene. However, it seems that the latter is rarely provided. The reason is that this information has to be identified and entered manually. Although it is too early to say, this issue could be resolved using automatic identification technology and artificial intelligence.

3.5. The cost of building disaster archive

The investment required by the archives of the Great East Japan Earthquake is considerable. According to our research, the cost for a single item represents approximately $13.30 or 1,500 Japanese yen. This amount includes the expenses for the collection, the receipt, the handling right or acquisition for public disclosure and secondary usage, mass categorisation and organisation, the creation of metadata, paper materials, the registration in the database, the construction cost of the system for publishing the contents and the operating and maintenance expenses. The most significant among all seems to be the classification of hundreds of materials and the attribution of metadata. In order to develop future disaster archives, we must envisage the reduction of expenses via the use of artificial intelligence and automation.

4. Conclusion

This paper examined the evolutions and some of the general issues facing the digital archives of the Great East Japan Earthquake. We also discussed the future of disaster archive and pointing out to some of the avenues or solutions to allow for better archiving of natural disaster worldwide. To develop a more general scheme for natural disaster archive, we believe that useful lessons can be drawn from the archival activities that surround the Tohoku earthquake. For instance, we mentioned that the necessity of building a thesaurus of natural disasters, create a metadata schema for natural disaster, and introduce AI for the classification and organization of information. We will continue to draw lessons from the archives of the Great East Japan Earthquake and hope to lead the way towards the internalization of disaster archives.

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