



IMPORTANCE OF PAST DISASTER RECORDS -A CASE STUDY OF ITS APPLICATION AFTER THE NOUBI EARTHQUAKE IN GIFU-

^aTakahiro Shimizu^{*,†},

^aDepartment of Architecture, National Institute of Technology, Gifu College, Japan

Email: t-shimizu@gifu-nct.ac.jp

*Presenter; † Corresponding author.

Abstract: The damage from natural disasters, such as earthquake, typhoon, volcano eruption, and so on, to constructions and cities has happened repeatedly in Japan. It cannot be said the sustainable society, if we just wait for the next disaster with doing nothing and rebuild the infrastructures and buildings each time. As a matter of course, we have learnt many from a lot of disasters and its damage. It is important to record, reconsider and exploit the tragedy as a valuable opportunity what we can learn from. In this study, the simple devices which was based on the remaining records of the Noubi Earthquake, individual measures with technique of trial-and-error by the general people, given to a certain residence is analyzed. To figure out achievements of our predecessors implemented promptly after damage, and to know application of traditional architectural technique to countermeasures against disaster, those are very curious and meaningful experiences. The importance of the approach that considered not only a new approach that used the latest technology but also the traditional approach that had been piled using the experience and wisdom in a word that was rooted in history and culture, through the records, it became clear in this study.

Keywords: Past Disaster Records; Countermeasures Against Disaster; The Noubi Earthquake; Traditional Architecture

INTRODUCTION

The damage from natural disasters, such as earthquake, typhoon, volcano eruption, and so on, to constructions and cities has happened repeatedly in Japan. The Noubi Earthquake, an 8.0 magnitude earthquake, occurred in Gifu on October 28th, 1891. It was a devastating earthquake killed more than 7,000 people and injured more than 17,000 people. And it was also reported about 140,000 buildings totally collapsed and about 80,000 buildings half-collapsed. Table 1 shows the fundamental data of the Noubi Earthquake. It cannot be said the sustainable society, if we just wait for the next disaster with doing nothing and rebuild the infrastructures and buildings each time. As a matter of course, we have learnt many from a lot of disasters and its damage. It is important to record, reconsider and exploit the tragedy as a valuable opportunity what we can learn from. In this study, the simple devices which was based on the remaining records of the Noubi Earthquake, not big countermeasures against disaster by the country and specialists but individual measures with technique of trial-and-error by the general people, given to a certain residence is analyzed.

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Table 1. Data of the Noubi Earthquake

Date	28 October, 1891
Magnitude	8.0Ms
Epicenter	Nishi-Neo Town (present Motosu City), Gifu Prefecture
Casualties	More than 7,000 dead
	More than 17,000 injured
Building damage	approx. 140,000 total collapsed
	approx. 80,000 half-collapsed

MATERIALS AND METHODS

First of all, we overviewed of the disaster records about not only the Noubi Earthquake but also various disasters around Gifu City. Obviously a lot of detailed information and the situation afterwards can be confirmed from the newspaper and the architectural magazine about the damage of the Noubi Earthquake. On the other hand, the records about other disasters, for example typhoon and flood that more frequently hit the region for research than earthquake, show only Public Record of the simple numerical data. In such records, the detailed information of individual constructions and the situation afterwards until restoring all things are scarce. Thus, not only objective information but also more important records by the person concerned are collected and analyzed. For instance, Figure 1 shows the description from diary of chief priest at Shinryu-ji Temple in Gifu.

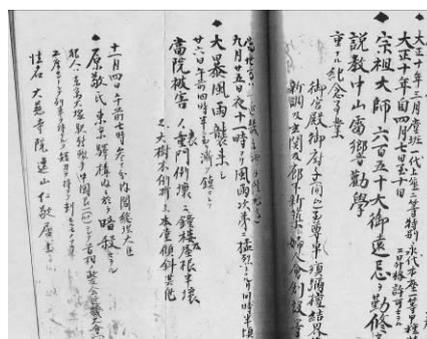


Figure 1. Diary of Chief Priest at Shinryu-ji Temple

“Wind and rain gradually became severe from 11pm on September 25th, 1921. At half past 11pm a big rain storm had come. And then it had calmed down at half past 4am on September 26th. The damage of our temple are as follows: 1. Main gate collapsed. 2. Bell tower and roof are half-collapsed. 2[sic]. Giant tree collapsed. 3. Main hall is leaning.”

That is a kind of record a person concerned only knows. As an individual damage case, it is also important to know which building collapsed or what building survived.

REVIEW

There are many previous research about the Noubi Earthquake (e.g. [1]-[3]). Most of them are a research on the mechanism and the active fault of the earthquake, and a document

that chiefly recorded casualty toll and damage situation. The early studies referred in detail about disaster record of construction, and countermeasures afterwards are known (e.g. [4][5]). After long periods of time, for example Nishizawa reevaluates the records and facts (e.g. [3][6][7]). These are all important studies, but all of them are based on records by third party such as government agency and general architects. Meanwhile, in this study records by the person concerned are also analyzed.

PUBLIC DISASTER RECORDS

Recently, information on the disaster is immediately transmitted around the world through TV, the newspaper, the Internet, SNS, etc. with texts, photos, or videos. On the other hand, things were recorded by texts, pictures, and word of mouth until early modern period. Therefore it was not widely shared. The Noubi Earthquake is located in transition period. That was the first big earthquake which modern Japanese society faced. It was also the first disaster to investigate by specialist and record the damage by photograph. Moreover through the newspaper, the damage information was reported to all over Japan comparatively in a short term. After the Noubi Earthquake it is known well that a lot of leading specialists and researchers of that time proceeded to the stricken area from Tokyo and surveyed and analyzed. And then the results were published in an academic journal and used for architectural designs, and it contributed to the control of the expansion of the Great Kanto Earthquake(1923) damage. Concretely, because of wide spread of information about fall of Nagara-gawa River Iron Bridge (Figure 2, [8]) and damage of Nagoya Postal Telegraph Office which was a two-story brick building (Figure 3, [8]), the earthquake engineering of iron bridge and especially brick construction had developed.



Figure 2. Fall of Nagara-gawa River Iron Bridge
(Source: *Photo book of the Noubi Earthquake* [8])



Figure 3. Damage of Nagoya Postal Telegraph Office
(Source: *Photo book of the Noubi Earthquake* [8])

On the other hand, naturally a lot of wooden buildings were struck by the earthquake. A public record and the news report do not necessarily show a complete and correct realities because it is sometimes likely to be given priority to a grasp of various circumstances and overall trend, and priority to the interest in sensational phenomenon. The large majority of wooden buildings where they had lived collapsed much more than the brick construction. Countermeasures for the wooden buildings (not for the brick construction, however it was impulsively destroyed) were more serious problem for victims. That is to say, it was more important for them to improve earthquake resistance of wooden buildings rather than brick construction.

Therefore, it became clear that a true situation of victims on the site cannot be understood and connect with appropriate countermeasures if only public disaster records are used. In a word, the record by the person concerned is extremely important in the disaster records.

PRIVATE DISASTER RECORDS - COUNTERMEASURES AND THE RESULT-

The Hayakawa Residence is located on approximately 9,000 square meters site beside the approach way to a famous shrine, Chiyobo-inari Shrine, at Kaizu city in Gifu. This region is placed between two big rivers, so it is influenced by a lot of natural disasters such as flood damage and the typhoon that occurs one after another, and also earthquake. The epicenter of the Noubi Earthquake is only 40km away. Shuzo Hayakawa was born as the first son of a wealthy farmer, the Hayakawa family, in August, 1863. He became a prefectural assembly member in 1890, concurrently worked for a local bank as an executive, and was elected to a member of the House of Peers in 1897. He played an active role in politics and industry.

The members of Kawata laboratory, Nagoya Institute of Technology and Shimizu laboratory, National Institute of Technology, Gifu College investigated the buildings, the records and materials at the Hayakawa Residence in July and September, 2012. Figure 4 shows a current floor plan drawn by using the measured data.

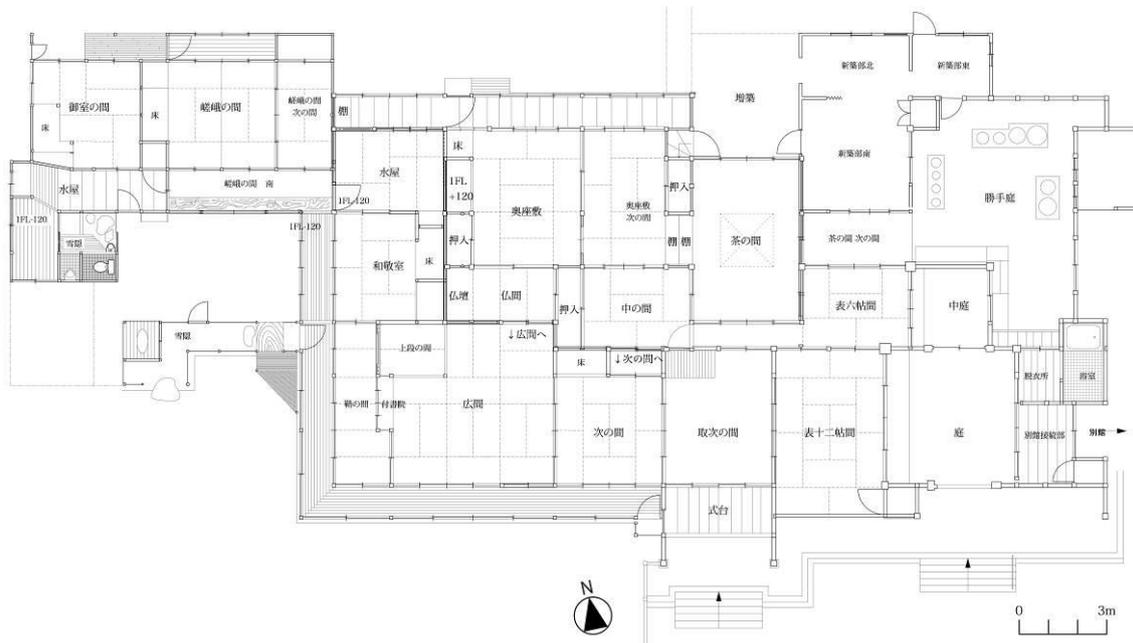


Figure 4. Current floor plan of the Hayakawa Residence

Table 2 shows a list of records confirmed by the investigation which includes eight historical drawings and four text records. Material A-D are arrangement plan of the buildings in the site before and after the Noubi Earthquake (1891). Material E-G are drawings for floor planning of a main house of the Hayakawa Residence (Figure 5) started constructing in March, 1892. It shows the transition of various buildings of the Hayakawa Residence, in particular number and shape of buildings faced the earthquake and revival situation. Material H-K are text records concerning the buildings constructed after Noubi Earthquake, and especially Material H, "Kiroku-cho -Record Note-", is the research object of this study.

Table 2. List of the records at Hayakawa Residence

code	Title	estimated year of compilation
A	site plan	1860
B-1	site plan with house physiognomy	1854
B-2		1878
C	survey drawing of site plan	1891
D	drawing of buildings and garden	1891
E	floor plan of new main house (1)	1892
F	floor plan of new main house (2)	1892
G	new main house plan with house physiognomy	1895
H	"Kiroku-cho" (Record Note)	1892.12-
I	"HontakuMinamiNiwa Syokeihi Tsukekomi-cho" (Account Book for construction of Garden)	1894.10-
J	"Saganoya Koshitsutsuki Furo Benjyo" (Account Book for construction of Saganoya)	1895.10-
K	"Saganoya Omuro Shintiku Keihi" (Account Book for construction of Omuro room)	1899.5-



Figure 5. Hayakawa Residence



Figure 6. Secondhand Wooden Material

"Kiroku-cho -record note-"

"Kiroku-cho" is a detailed Record Note about the damage of the Noubi Earthquake that Shuzo Hayakawa recorded. In the Record Note, the struck buildings are classified into three groups, collapsed, half-collapsed and undamaged. Moreover it shows the probable reason of each situation. For instance, "Because of lack of walls, braces, and beams", "By the reason why wooden shingle roofing is light", these descriptions are valuable information which only the person concerned is possible to record. The judgments of the struck buildings, such as repair, relocate and reconstruct, or demolish, are decided according to the analyzed situation. It is common in Japan to repair (disassembling a frame of building, replace a faulty member, and restructuring) or relocate and reconstruct the old traditional wooden buildings. It is also usual that even the dismantlement materials from the demolishing building are recycled as materials of new construction. There are numerous traditional architecture cases of using the secondhand wooden materials. For example, Figure 6 shows a member of roof truss of the Main Hall at Shinryu-ji Temple in Gifu. The beam located in dark and out-of-sight attic is strangely decorated. Those devices for forestry preservation and effective utilization of wood are one aspect of sustainability in Japanese culture.

COUNTERMEASURES

A main house of the Hayakawa Residence began to reconstruct within half a year after the Noubi Earthquake, "Kiroku-cho -Record Note-" showed some countermeasures created by Shuzo Hayakawa and master carpenter Ichiroji Ito. Those are as follows: I. raised ground level. II. pine pile. III. concrete on ground surface. IV. bolt. V. earthquake-beam. The construction ground was raised by approximately 750mm. [I.] It was used a lot of pine piles of 150mm in diameter and 3m in length for ground improvement. [II.] The ground was dug up to the depth of 2.4m and piling 9-10 pine piles to each of 40 holes, and poured concrete. [III.] The wooden columns, standing on the foundation stone especially supplied from the Mikawa region, were reinforced with iron materials and bolted on in the upper part of the column. [IV.] The member of roof truss that was called "Jishin-bari (earthquake-beam, two

log beams were crossed)” was installed in the back of the ceiling. [V.] Only a few similar examples are known but it is not general technology.

All of the above-mentioned countermeasures are the simple applications of the traditional techniques (, not using new technology) that two people (the client and the carpenter) devise. In some cases, it might be criticized as the hasty response. After a certain period, the effect is verified and the useless one is dumped into the dustbin.

They did not wait for the development of the theory or the enactment of the system by the government. It shows an importance of doing something, thinking what they could do at once, and making an effort individually even a little. It only repairs if there is a great difference between the countermeasures already done and the statement from government agency and researchers after a long while. Actually, the government agency for seismic disaster launched after one year from the Noubi Earthquake. After several years, they encouraged the use of bolt and diagonal bracing for wooden buildings in their statement. That was not so different from the countermeasures that had already been given to the Hayakawa Residence.

The improvement of earthquake resistance (though it might be the same for everything) based on the experience has been done for a long time, and that is rule of thumb. It sometimes needs prompt response with traditional and existing technology, without excessive expectations and persistence in new technology. Still the Hayakawa Residence is alive after nearly 120 years in use without big damage by flood and typhoon.

DISCUSSION

It is clear that it is not drastic measures of new structure, material, and construction method for natural disasters based on the public records, but devices created by one client or one carpenter based on the private disaster records is important. In addition, to decrease the disaster damage in the future, unknown private records should be collected, and analyzed. It is also important not only to collect old records but also to record a new disaster if it occurs in the future. The countermeasure is not considered if there is no record, and then the damage happens over and over again.

On the other hand, as pointed out by Nishizawa ([6]) when the disaster is recorded and analyzed it is necessary to pay attention to not only "What building broke." but also "What building remained.". Figure 7 shows Horyu-ji Temple in Nara, one of the oldest wooden buildings existing in the world that constructed over 1000 years ago. Figure 8 shows the Main Hall at Shinryu-ji Temple in Gifu that constructed about 10 years before the Noubi Earthquake. In the background of survival from various natural disasters, there are technologies and devices that have been cultivated in the history. Although it does not refer in detail in this study, effect of traditional construction method is pointed out as the reason (e.g. [9]).



Figure 7. Horyu-ji Temple



Figure 8. Main Hall at Shinryu-ji Temple

The techniques and lessons concerning construction of traditional architecture have been handed down from generation to generation by carpenters. A part of them were recorded in the Japanese traditional architectural reference books (,which had been already researched enough for many years (e.g. [10])) . The importance of any kind of records is recognized again.

CONCLUSION

To figure out achievements of our predecessors implemented promptly after damage, and to know application of traditional architectural technique to countermeasures against disaster, not to invent a new construction technology with spending much time, those are very curious and meaningful experiences. The importance of the approach that considered not only a new approach that used the latest technology but also the traditional approach that had been piled using the experience and wisdom in a word that was rooted in history and culture, through the records, it became clear in this study.

In this study, one of the different method for improvement of strength against disasters with using records was shown.

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REFERENCES

- [1] Fusakichi Omori, 1893. *Preliminary report of the Noubi Earthquake 1*, The Journal of the Geological Society of Japan: Volume 2, Pages 42-55.
- [2] Gifu nichinichi Shimbun, 1 November, 1891. *the Great Earthquake* (newspaper article), extra edition, Japan



- [3] Special investigation committee on succession of disaster lessons, 2006. *the 1891 Noubi Earthquake Report*, Central Disaster Management Council, Japan
- [4] Chuta Ito, 1891. *Earthquake and Brick Construction*, Journal of Architecture and Building Science: Volume 59, Pages 291-295.
- [5] Imperial University, 1891. *The compilation by the Imperial University about the earthquake*, Journal of Architecture and Building Science: Volume 59, Pages 303-304.
- [6] Yasuhiko Nishizawa, 2012. *Building damage associated with the 1891 Nobi earthquake and its effect on earthquake engineering*, Active Fault Research: No.37, Pages 45-51.
- [7] Masayuki Takemura, 2012. *Characteristics of disaster from the 1891 Nobi earthquake compared with the 1923 great Kanto earthquake*, Active Fault Research: No.37, Pages 39-44.
- [8] Research conference of local materials in Gifu, 2009. *Photo book of the Noubi Earthquake*, reprinted edition, Japan
- [9] *Preparatory Committee on technology of Japanese traditional wooden architecture for Intangible Cultural Heritage*, <http://dentoh-isan.jp/> (10 October, 2015).
- [10] Takahiro Shimizu, Katsuhiko Kawata, Akira Naito, 2005. *A study on the design system of tahoto pagodas in Japanese traditional architectural reference books*, Journal of Architecture and Planning: No.591, Pages 155-160.



TIME - SERIES ANALYSIS ON MASS MEDIA REPORT AND UTILIZATION ANALYSIS ON SOCIAL MEDIA - CASE OF LOCAL RAILWAY -

^aJun Sakamoto^{a,*}, ^bKazutaka Kubota, ^cShotaro Yada^c

^aNational Institute of Technology, Gifu College, Japan, ^bJapan Freight Railway Company, Japan,

^cCentral Japan Railway Company, Japan

Email: sakamoto@gifu-nct.ac.jp

* Presenter; † Corresponding author.

Abstract: In Japan, many local railway companies have serious problems: passenger decrease and motorization. In addition, some of them have been encountered the crisis of bankruptcy. However, they make an effort to operate for not only passengers but also cities. How has mass media reported the fact? The information provided by mass media is important to make public opinion. Also, with the development of internet, it has become easier to spread an individual opinion by social media. Especially, social networking service: SNS, is already recognized as an effective way. In this study, first of all, mass media report of local railway is analyzed. Then, utilization of social media related to the railway is clarified.

Keywords: Local railway; Mass media; Social networking service; Text mining

INTRODUCTION

In Japan, passenger decrease in local railway has been continuing in the long due to fewer children and motorization: the number of passengers decreased 17% since 1987. Many local railway companies have been struggling; for example, although the number of employees decreased 28%, 76% of companies have a huge debt and faces bankruptcy. It is said that some of them have a difficulty to do a minimum safe maintenance [1]. Under this situation, these companies have made an effort to manage: implementing a promotion of utilization, holding an event for local development with a local government and residents. However, how did a mass media report these facts? Newspaper and TV have a great power to change public opinion. According to the investigation [2], the percentage of readers of newspaper (morning paper) is 77%, and the percentage of those who refer a paper when making an opinion about an incident is approximately 50%.

In the utilization of social media, with the development of internet technology, it has become easier to spread individual's opinion. The percentage of users of internet is 82.8% in 2013 [3], and it will increase in the future. Especially, SNS: Social Networking Service, such as Facebook and Twitter, new social media, the number of users has been dramatically increasing. It can be possible to communicate among users and to spread information easier; in short, its function is different from weblog and website. It is expected to use an efficient and effective information and

communication way of city development [4]. In the report of how to support a local railway in the future, it is concluded that utilizing such a social media is an effective way to inform to visitors [5].

Hence, the objective of this study is to analyze mass media reports related to local railway in chronological order and utilization of social media presently.

TIME-SERIES ANALYSIS ON MASS MEDIA REPORT

Case Study

This chapter analyzes the tendency of mass media report related to Tarumi railway. This railway company was built in 1984, transformed from Tarumi line, a line in Japan National Railways, because of low passenger density and so on. At first, the company operated in the black because of the sector of freight transport. However, the amount of freight transport decreased; finally, it was abolished in 2005. In the sector of passenger transport, most of them are student. The number of passengers has decreased due to fewer children (Figure 1). Therefore, the company operates in the red, and five local governments along the rail line compensate it.

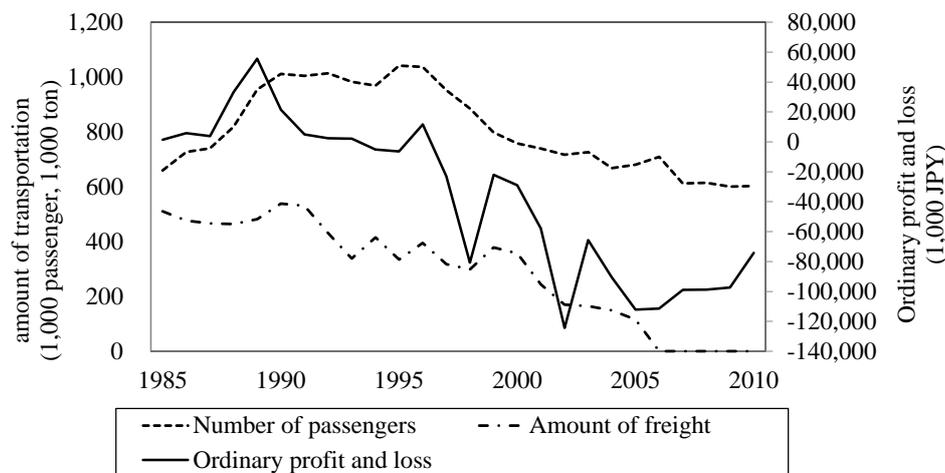


Figure 1. Changes in amount of transportation and ordinary profit and loss

DATA COLLECTION

The data for analysis are Chunichi Shimbun. This Shimbun has the most readers in Gifu prefecture: according to Yomiuri company website, the readers' share from July to December in 2012 is Chunichi Shimbun: 52.3%, Gifu Shimbun: 23.4%, Asahi Shimbun: 7.8% and others: 16.5%, respectively. The period of analysis is approximately 20 years, from January 21st, 1991 to December 11th, 2012. Data were collected by Chunichi Shimbun digital database system. This system can be used in public library. As the result of extracting the articles including the word "Tarumi railway", 667 articles were collected.

METHODOLOGY

IBM SPSS Text Analysis for surveys, an application for text mining was used in this study. It can automatically input and analyze text data from various viewpoints: part of speech, meaning of expression, name of location and institution and so on. First of all, changes in the number of article related to Tarumi railway was aggregated. Then, frequent expressions in the article were grasped. On the basis of the result, expressions which a reader can predict the contents of article were selected. Finally, what kind of articles mass media reported in the past twenty years was clarified.

RESULT

Figure 2 shows changes in the number of articles including the words “Tarumi railway”: number of articles is 667. This bar graph has four peaks, 1991, 1995~1996, 2003~2006, and 2010. Especially, the peak in 2003 is the greatest than other peaks.

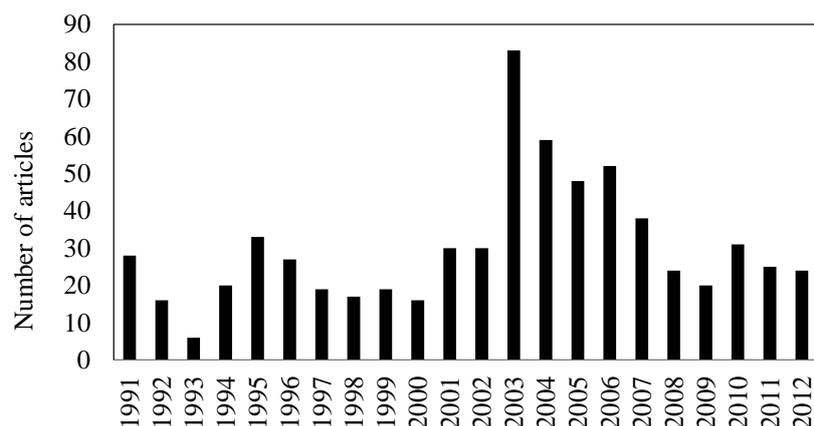


Figure 2. Changes in articles related to Tarumi railway

Rank table of frequent expressions in each viewpoint is shown in Table 1 and Table 2. As a result of be referred articles including these expressions, following facts were revealed.

- Many of the articles including “harsh”, “deficit”, and “burden”, negative expressions and “subsidy”, positive expression, were the contents of business condition.
- Many of the articles including “enjoy”, positive expression, were the contents of train events and local sightseeing resources.
- Many of the articles including “usage”, noun, were the contents of mobility: for example, promotion of utilization, students commute, and vulnerable peoples’ usage such as elderly.

- Many of the articles including “safety”, positive expression, were the contents of traffic safety event; for example, the event of safety train operation, held by Tarumi Railway Company.
- Many of the articles including “crashing”, negative expression, were the contents of traffic accident.
- “Train”, “One’s train”, “along”, and “operation”, nouns, verb, the name of location, the name of institution, and “open”, good expressions had various types of contents.

Considering the above facts, the tendency of articles is divided into four viewpoints: “business condition”, “event”, “sightseeing resources”, and “mobility”. The reason of why “crash” was not focused is that most of the articles were about the fact of traffic accident.

Table 1. Rank table of frequent expressions in each viewpoint (1)

Rank	Noun		Verb		Name of location	
1	railway	144	exist	300	Motosu city	320
2	one's train	137	become	237	Gifu Pref.	170
3	along	122	say	189	Ogaki city	80
4	operation	116	make	173	Gifu city	50
5	usage	105	tell	155	Aichi Pref.	26

Table 2. Rank table of frequent expressions in each viewpoint (2)

Rank	Name of Institution		Positive expression		Negative expression	
1	Tarumi Railway	396	enjoy	54	harsh	64
2	Third-sector company	56	open	41	deficit	59
3	Local government along a railway line	49	subsidy	21	burden	26
4	NPO	37	surplus	20	crashing	22
5	Nagaragawa Railway	35	safety	17	suffer	19

The expressions to extract articles related to above viewpoints are shown in Table 3. Although the column “business condition” has frequent expressions, the columns of

“enjoy” and “sightseeing resources” do not have frequent expressions because it was difficult to extract only the words. Therefore, the name of event train and sightseeing resources were selected as an alternative expression. The columns of “mobility” was same reason; “promotion of utilization”, “students commute”, “high school student” and “elderly” were selected as an alternative expression.

Table3. Expressions to extract reports related to the article of each viewpoint

Category	Expressions included in the report	Number of articles
Business condition	deficit, burden, harsh, suffer, subsidy, and surplus	374
Event	event train, gourmet train, healthy train, casserole train, herb train, Ayu dish, and traffic safety event	188
Sightseeing resources	cherry, hot spring, and persimmon	197
Mobility	promotion of utilization, students commute, high school student, and elderly	194

Changes in above contents are shown in Figure 3 ~ Figure 6. The number of articles related to “business condition” is much greater than others. At the same time, its tendency is similar to all the articles one, in Figure 2. Therefore, what mass media reported in the period of four peaks, 1991, 1995~1996, 2003~2006, and 2010 is examined in following subsection.

First period (1991)

There are some articles of deficit in Figure 3; however, they are about the situation of other local railway companies in Chubu area. Most of the articles related to Tarumi railway are good news; for example, persimmon and cherry trees which are sightseeing resources, and the train event of Ayu, a Japanese fish. There are shown in Figure 4 and Figure 5.

Second period (1995~1996)

As shown in Figure 3, the number of articles related to business condition spikes upward. One of the reasons is that Tarumi railway had an ordinary loss for the first time in the era; however, most of articles are the business condition of other railway companies in Chubu area. Many of the articles related to Tarumi railway are good news; for example, event train of medical herb health and the event of sightseeing

resources.

Third period (2003~2006)

The number of articles related to Tarumi railway, in 2003 and 2004, is the greatest in the twenty period. As Figure 3 and Figure 6 are shown, “business condition” and “mobility” are also similar trend. In the articles of business condition, many of them are about discussion of abolishment of the company due to harsh business operation, inauguration of supporting group, and promotion of utilization. The content is as follows.

- In the fiscal year 2002, Tarumi railway had a largest-ever deficit operation. Since residents along the rail experienced the abolishment of other local railway, Nagoya TetsudoTanigumi line which was also located around the area, in 2000; therefore, in order to prevent further abolishment of local railway, some of the residents established the institution to support Tarumi railway. Then, the institution started some activities: collecting signatures to demand local governments, along the rail, to support financial aid, and changing a crosstie as a volunteer and so on. Finally, beginning 2005, these local governments started to compensate the company’s deficit.

In the contents of mobility, many of them are related to the matter of survival: for example, railway is important for children and elderly.

Fourth period (2010)

From 2003, the number of whole articles related to Tarumi railway decreases. However, in 2010, it spikes again. As Figure 3 and Figure 6 are shown, the tendency of the articles related to business condition and mobility is similar to whole number of articles (Figure 2).

Many of the articles of business condition were the discussion of that whether local governments stop to compensate or not. One of the reasons was some governments hesitate to continue. As a result, it was concluded that they continue to compensate until fiscal 2011 (However, even now, 2015, they still compensate it).

In the articles of mobility, many of them are related to children and elderly; its tendency is similar to third period. On the other hand, there is few articles of residents’ activity.

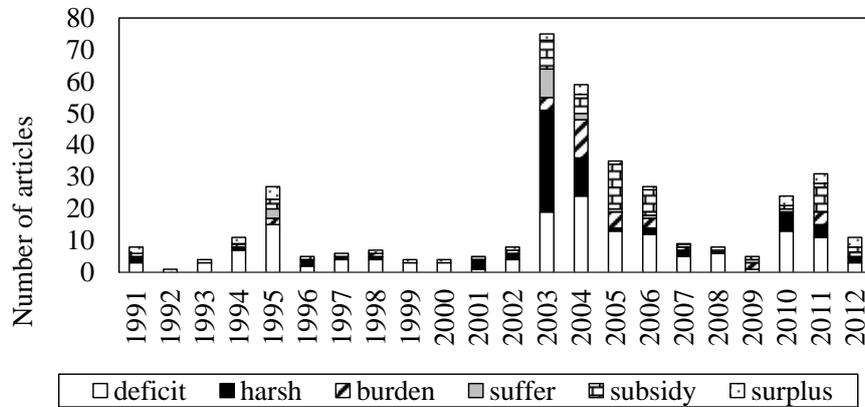


Figure 3. Changes in articles related to business condition

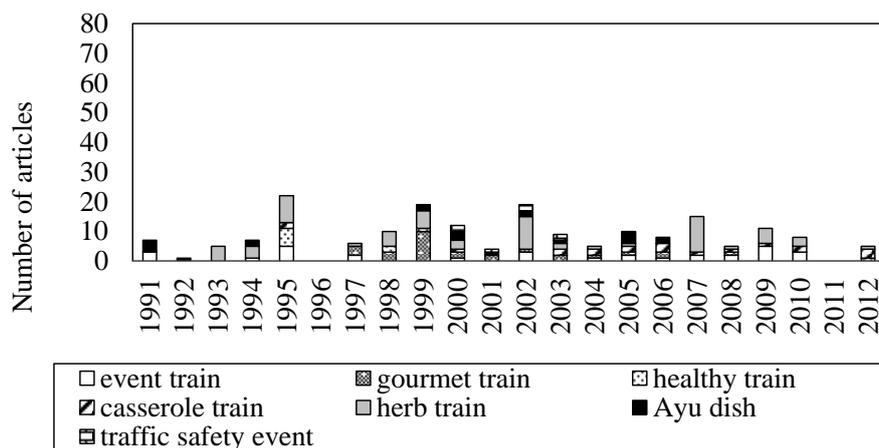


Figure 4. Changes in articles related to event

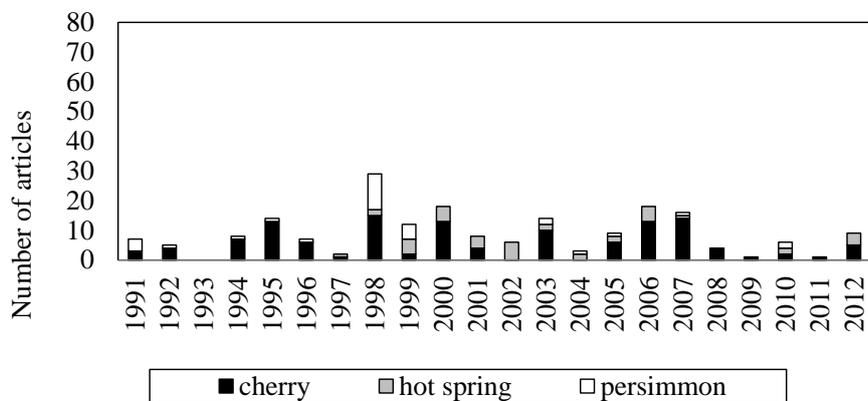


Figure 5. Changes in articles related to sightseeing resources

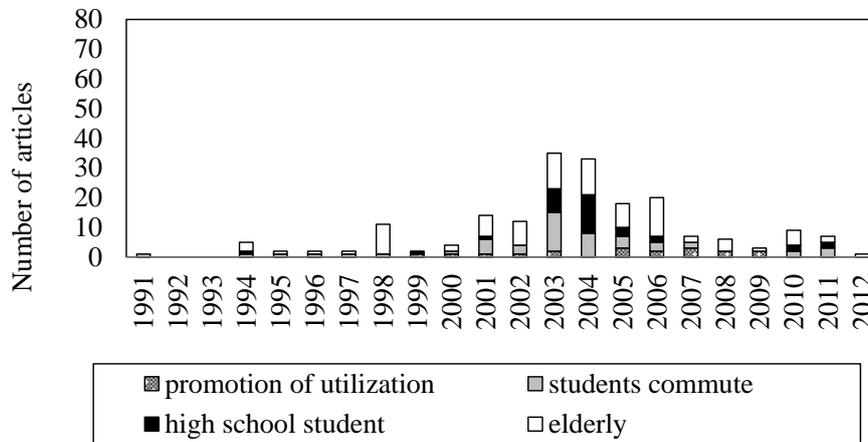


Figure 6. Changes in articles related to mobility

ANALYSIS OF UTILIZATION OF SOCIAL MEDIA METHODOLOGY

In this chapter, utilization of Twitter, a representative social media tool, is analyzed. After extracting the accounts related to local railway, the characteristic of accounts: number of tweet and the number of followers are grasped. Then, on the basis of some popular local railway accounts, followers' attribute is clarified. Such a method is already be used as a marketing strategy. In this study, two applications are used. One is Social Insight [6], provided by User Local, Inc. This tool offers the aggregated data of followers' gender, age, and living place in each account. Another is KH-coder [7]. This is a free software, and it has the function of text mining. In order to grasp the followers' characteristic on the basis of keywords in each follower's profile, co-occurrence network is developed. It is a network model, connecting related keywords.

RESULT

Utilization of social media

The result of utilization of Twitter accounts related to local railway is shown in Table 4. The columns of "management", "frequency of tweet", "picture", and "communication" in the table are evaluated by us. The number of tweet, follow and follower are checked on August 25th, 2015.

Table4. Twitter accounts related to a local railway

No.	Related Railway company	Management	Frequency of activity						URL
			Frequency of tweet	Picture	Communication	Number of tweets	Number of follows	Number of followers	
1	Aomori Tetsudo	unofficial	1	1	1	0	0	95	https://twitter.com/Arrsk
2	Sanriku Tetsudo	Official	3	3	1	3,358	30	8,062	https://twitter.com/santetsu_kun
3	Sanriku Tetsudo	unofficial	1	1	1	0	1	24	https://twitter.com/sanriku_t
4	Akita Nairiku Jukan Tetsudo	unofficial	3	3	1	13,137	648	1,230	https://twitter.com/AIZU_AT301
5	Konan Tetsudo	unofficial	3	1	1	46,296	504	331	https://twitter.com/EASTJAPANRAIL
6	Yamagata Tetsudo	Official	3	2	1	1,997	4	3,228	https://twitter.com/vr880
7	Yamagata Tetsudo	Official	3	3	3	7,755	5	5,942	https://twitter.com/vr_mochii
8	Yuri Kogen Tetsudo	Official	3	3	3	1,632	548	4,099	https://twitter.com/yuri_tetsudou
9	Tsugaru Tetsudo	Official	1	3	3	29	672	2,167	https://twitter.com/tsutetsu
10	Noto Tetsudo	Official	3	2	3	8,009	3,515	3,458	https://twitter.com/nototetsu
11	Manyo Sen	Official	3	2	1	1,873	0	1,905	https://twitter.com/Manyosen
12	Kashima Rinkai Tetsudo	Official	3	3	2	9,615	311	4,835	https://twitter.com/rintetsu_karin
13	Yagan Tetsudo	Official	3	2	3	1,452	24	2,366	https://twitter.com/yagan_railway
14	Isumi Tetsudo	unofficial	3	3	3	85,628	1,712	1,854	https://twitter.com/app_isumirail
15	Isumi Tetsudo	unofficial	3	3	3	55,939	198	266	https://twitter.com/soychicken
16	Hiachimaka Kaihin Tetsudo	unofficial	3	3	3	14,772	6,403	6,097	https://twitter.com/keha601
17	Choshi Denki Tetsudo	unofficial	3	1	1	248,893	3,936	3,570	https://twitter.com/togawabot
18	Echizen Tetsudo	Official	3	2	1	1,649	43	3,851	https://twitter.com/echizenrail
19	Tarumi Tetsudo	unofficial	3	3	1	5,056	1,704	1,597	https://twitter.com/tarutetuuiu
20	Tarumi Tetsudo	Official	2	1	1	236	66	1,764	https://twitter.com/tarumi_railway
21	Tarumi Tetsudo	unofficial	3	3	3	10,139	430	431	https://twitter.com/taru_q_s
22	Wakayama Denki Tetsudo	Official	3	3	1	6,863	1	54,761	https://twitter.com/ekichoTAMA
23	Ichibata Densha	Official	3	2	1	839	6,208	6,284	https://twitter.com/ichibatadensya
24	Nishikigawa Tetsudo	unofficial	3	3	1	1,912	1,939	1,577	https://twitter.com/Seiryu_Sen
25	Tosa Kuroshio Tetsudo	unofficial	3	1	1	432	174	450	https://twitter.com/npo_gonasen
26	Tosa Kuroshio Tetsudo	Official	3	1	1	2,178	231	1,776	https://twitter.com/tosakuro_train
27	Satsuma Orange Tetsudo	unofficial	1	1	1	0	0	10	https://twitter.com/nov333
28	Matsuura Tetsudo	Official	1	1	1	0	11	18	https://twitter.com/mrkikaku
29	Heisei Chikaho Tetsudo	Official	3	3	1	1,969	0	2,462	https://twitter.com/chikumaru
30	Kumagawa Tetsudo	Official	3	3	1	545	703	1,962	https://twitter.com/Kumatetu5011

In the relationship between management and the number of tweets, difference of management does not affect the frequency of tweets. Also, some accounts never tweet, just creating an account. (e.g. No.3).

In the relationship between management and contents of tweet, many official accounts are likely to tweet carefully. For example, account No. 23 tweets only the information of operation and event, and it never communicate with other accounts: no reply and no retweet. By contrast, some official accounts having a mascot are likely to tweet actively. For example, No.7 is an account of official rabbit mascot, Mochy, Yamagata Tetsudo. It tweets the information of rabbit, and it sometimes retweets official account's tweet (No.6). Unofficial accounts are also active. For example, No. 16 is managed by local residents. It often tweets introduce of other railway and useful information; for example, it tweets sightseeing spot with a picture. Finally, in the aspect of the number of followers, the accounts of official mascot are tendency to have

a lot of followers.

Follower's attribute

In this subsection, follower's attribute is analyzed on the basis of following four accounts: (1) Ekicho Tama, (2) UsagiekichoMochy, (3) Oraga Minato testudo ouen-dan, and (4) Yurikougen testudo because these accounts have a lot of followers. The accounts of first and second have an official mascot, cat and rabbit, respectively. Third account is managed by local residents. Fourth account is an official account, giving information of local spot. The number of followers in each account are (1) 39,497, (2) 3,050, (3) 3,508, and (4) 2,118, respectively.

The aggregated data of followers' attribute is shown in Table 5. With the regard to gender, the percentage of female is greater than male in the account (1) and (2). On the other hand, percentage of male is greater than female in the account (3) and (4). With the regard to age, the account of (1) (2) and (3) (4) is 30 years old, and 20 years old, respectively. With the regard to residential area, the percentage of Kanto and the area of each railway are greater than other areas. Overall, account (1) is similar characteristic to account (2), and account (3) is similar to account (4).

Table5. Attribute of accounts

Attribute of account		Name of account			
		(1) Ekicho Tama	(2) Usagi ekicho Mochy	(3) Oraga Minato testudo ouen-dan	(4) Yurikougen testudo
Gender	Male	44%	37%	81%	82%
	Female	56%	63%	19%	18%
Age (average): years old		36	41	26	23
District of residence	Hokkaido, Tohoku	7%	28%	6%	34%
	Kanto	41%	45%	65%	40%
	Chubu	11%	7%	10%	9%
	Kinki	31%	12%	11%	11%
	Chugoku, Shikoku	5%	4%	4%	2%
	Kyushu, Okinawa	6%	2%	4%	4%

Co-occurrence networks in above accounts are shown in Figure 7 ~ Figure 10. Account (1) has three big groups: "Railway, hobby and picture", "Game, anime and cartoon", and "Music, movie and read a book". Account (2) has two big groups: "Sightseeing, woman and animal" and "Railway and flower". Both accounts are not dominated by only railway. By contrast, account (3) and (4) have only a big group: "Railway, anime and hobby". In addition, account (3) and (4) have co-occurrence between "Cheer, fan and activity" and "Event, sightseeing and information". It implies that these accounts are followed by those who are interested in cheering and supporting activity of railway.

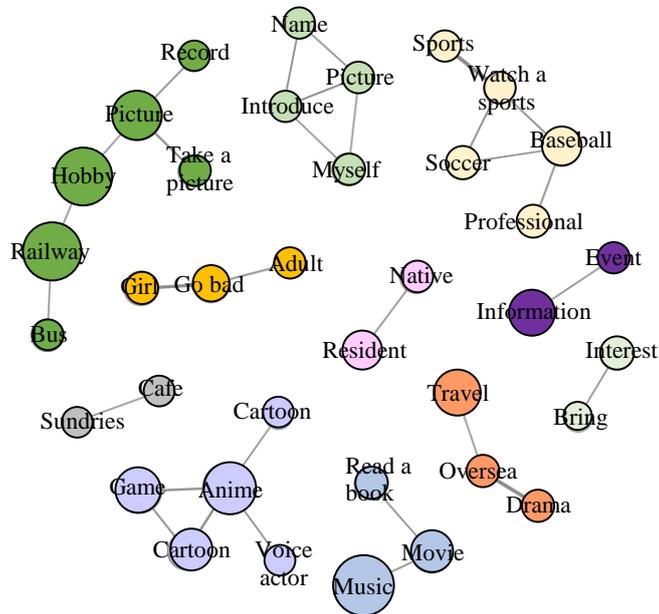


Figure 7. Co-occurrence network- account(1) Ekicho Tama

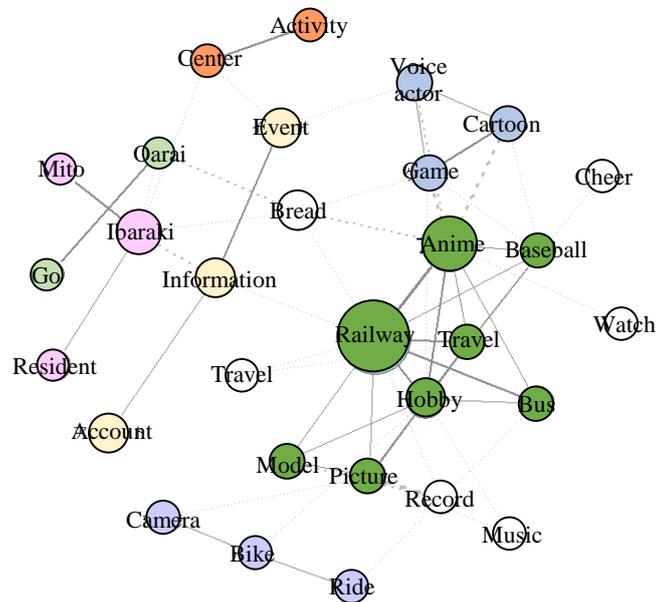


Figure 8. Co-occurrence network- account(2) Usagi ekicho Mochy

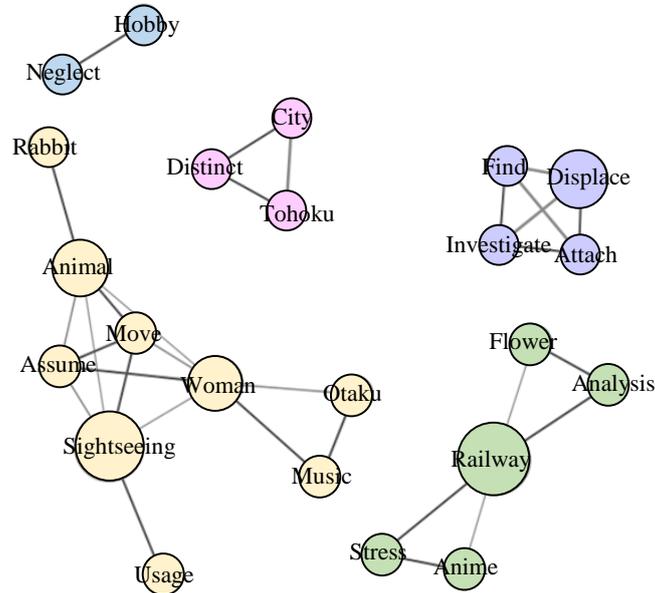


Figure 9. Co-occurrence network- account (3) Oraga Minato testudo ouen-dan

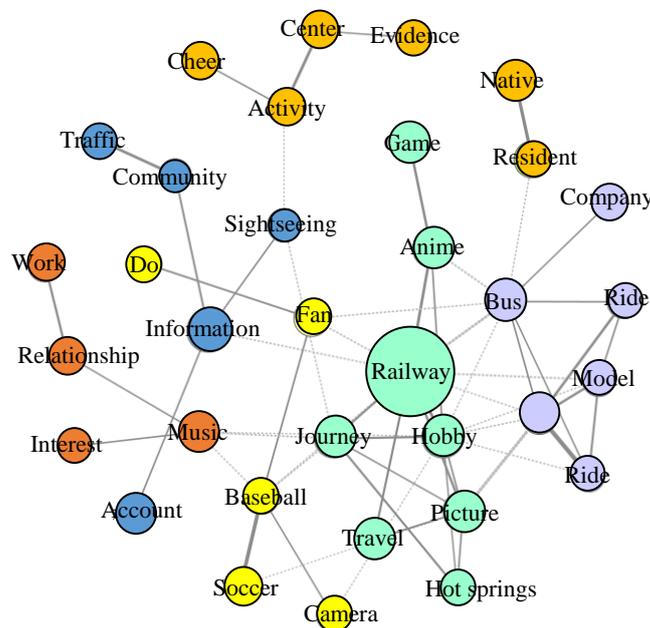


Figure 10. Co-occurrence network- account (4) Yurikougen testudo

CONCLUSION

In this research, the tendency of mass media report related to local railway in chronological order was analyzed, and utilization of social media in the field of local



railway was clarified.

As a result, in the analysis of mass media report, Changes in the number of whole articles related to Tarumi railway was tendency to be similar to the articles of business condition's one. Also, the number of articles related to event and sightseeing resources weremuch less than the article of business condition's one. It implies that readers can associate the article of Tarumi railway with the contents of a crisis of its abolishment. In addition, in the period of that the railway encountered the crisis of abolishment, the contents of promotion of utilization and residents' activity are reported at the same time. In other words, only the period of its crisis, readers cannot know such a topic. Therefore, if local governments have a plan to select such a local railway as an important public transport system and continue to compensate its deficit in the future, in order to let residents understanding, it is important to provide information of the necessary and activity of railway and the via city newsletter to residents constantly.

As a result of utilization of social media in Twitter, many official accounts are likely to hesitate to communicate with other accounts; on the other hand, accounts having an official mascot and unofficial accounts are likely to be active: communicating with other accounts. In addition, followers' attribute is different in the characteristic of accounts. For example, the accounts which support railway are followed by only railway fans' account, mainly. In order to bring in a user who is not interested in a railway;for example, it can be an effective way to create an account having an official mascot, and to communicate with other accounts.

The subject for a future study are as follows. In the analysis of mass media report, this study only analyzed the report of a newspaper company; therefore, in order to generalize the conclusion of this result, it is essential to analyze the report of other newspaper company. In the analysis of utilization of social media, it is important to grasp how to operate a famous account in other fields.

REFERENCES

- [1] Land, Infrastructure and Transportation Ministry, Actual condition in local railway, <http://www.mlit.go.jp/common/001018569.pdf>, 2015. (In Japanese)
- [2] Press Telecommunications committee, seventh public opinion research of mass media, <http://www.chosakai.gr.jp/notification/pdf/report7.pdf>, 2015. (In Japanese)
- [3] Ministry of Internal Affairs and Communications, 2014 WHITE PAPER Information and Communications in Japan, <http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2014/2014-index.html>, 2014.
- [4] Land, Infrastructure and Transportation Ministry, City Bureau, Investigation of an effective and efficient way to inform, collect and exchange information of community planning wi



- th public-private partnership, http://www.mlit.go.jp/crd/index/case/pdf/120409kanminrenkei_houkokusho.pdf, 2013. (In Japanese)
- [5] Land, Infrastructure and Transportation Ministry, Railway Bureau, Report of local railways toward renovation and activation, -all the participants support a local railway-, <http://www.mlit.go.jp/common/001002354.pdf>, 2013. (In Japanese)
- [6] User Local,Inc website: <http://www.userlocal.jp/> (In Japanese)
- [7] KH Coder website: <http://khc.sourceforge.net/en/>

A PROTOTYPE OF LOCATION INFORMATION INFRASTRUCTURE USING IBEACON FOR THE BICYCLE TOURING

Koji Tajima^{a,*}, Shinya Nakamura^b, Tadahiko Sato^c, Shigeru Kobayashi^d

^aDepartment of Electrical and Computer Engineering, ^bMedia Creations Research department,

^cTriggerDevice Co.,Ltd, ^dResearch Center for Industrial Culture,

^aNational Institute of Technology Gifu college, ^bThe Institute of Advanced Media Arts and Sciences

^dThe Institute of Advanced Media Arts and Sciences

Email: ktajima@gifu-nct.ac.jp

* Presenter; † Corresponding author.

Abstract: In recent years, there is much application that uses GPS and it utilizes the location information on smartphones. However, it is difficult to use for a long time because the GPS uses the amount of the battery power. "iBeacon" is one of the devices to get the location information by Bluetooth LE. It can get the location information passively and it can reduce to use amount of the battery power. In this paper, we describe the application for City guide or Bicycle touring using the iBeacon. We developed three types of application for different situations. In addition, we set up the iBeacon for location information infrastructure in the Mino City. Mino City has the traditional streetscape and it is difficult to build a lot of sign of the City. And the City recommends the bicycle touring. So we develop the city guide application and trial running it.

Keywords: iBeacon; Location information infrastructure; Bicycle Touring

INTRODUCTION

In recent years, there is much application on smartphones that uses GPS and it utilizes the location information. By using the location information, we can get the sightseeing information near the current place, or navigate ourselves. However, an application that uses the amount of the battery power to activate the GPS device at any time. In this reason, it is difficult to use these kinds of application for a long time.

The "iBeacon" is one of the devices to resolve this problem. This device gets the location information with the Bluetooth LE. And the operating system of the smartphones supports this device, we can reduce to use amount of the battery power [1].

In this paper, we describe the application for City guide or Bicycle touring. At first, we developed an application for orientation of our college. Next, we developed an application of city guide for the festival ground. We adjust the radio wave strength and detecting methods fit in the way. Finally, we set up the iBeacon for location information infrastructure in the Mino City. And now we try to running this infrastructure and developing an application for the Mino City guide.

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TRIAL PRODUCTION OF IBEACON

College Orientation System

At first, we develop the college guide system for orientation for a student for a day. We set up 10 beacons as figure 1. All beacons put the characteristic place or rooms of the each department of our collage. After that, we develop the application to collect the digital stamps from beacons. And this application shows the information of the department and the next place of beacons. Additionally, we need to run this application without internet connection. We add the function to download all text data from the web and keep it to the local memory.

Figure 2 shows the application of collage guide system. The main view (Fig2. A) shows the power level of detected beacons. When the user detected strongest signal of the beacon, it shows the information of the place (Fig2. B).

In this trial, we have the problem to detect the beacons from long distance. We setup the detection range of beacons to “Immediate”. It can only detects the beacons within 5~10cm from the smartphone. And we sometimes cannot to detect the beacons on this range.

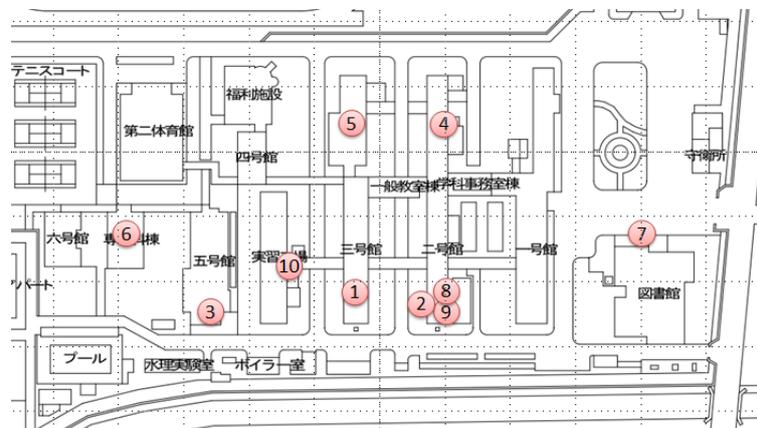


Figure 1. The Place of iBeacon in Our Collage



(A) Main View

(B) Information View

Figure 2. The Collge Guide System

Festival Guide System

For the second trial, we develop the city guide application for the festival ground. Figure 3 shows the application of we developed. This application made for the festival to introduce the locally produced foods[2]. We set up the 10 beacons to the festival grounds. And we lend the iPad2 to the guest of the festival to try to our application.

In this trial, we adjust the radio wave strength to the location of the beacon. In the application, we programmed to detect the beacons from about 10 meters distance. But the radio wave of the beacons depends on the fields and the directions of the device. We need to set up few beacons at the same place and put them for different directions to react to the exact position of the tourist spot.



(A) Top view

(B) Main view

(C) Information view

Figure 3. The City Guide System for the Festival

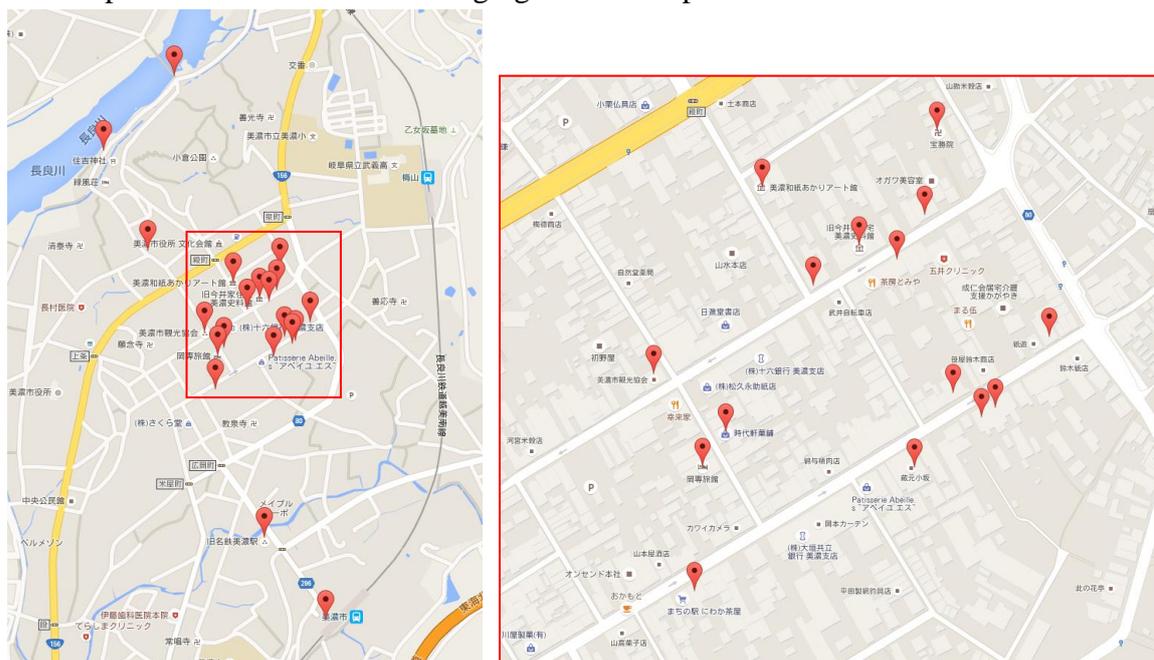
MINO CITY BICYCLE TOURING SYSTEM

About Mino City

Mino city is a city located in the Gifu Prefecture of central Japan. This city is popular for the traditional streetscape. And it is popular place to make the Japanese paper. In recent years, Mino city try to focus on bicycle touring. The traditional streetscape and a lot of nature are important sight-seeing spot of the city. In these kinds of spot, the big signboard for tourist has bad influence to keep the traditional landscape. So we use the iBeacon as a substitute for the signboard. In addition we open the set up information of beacons to make any program with any programmer. It means we set up the location information infrastructure with the beacons.

Beacon Settings

Figure 4 shows the location of the beacons. We set up 21 beacons on the center of the city. Almost beacons are put on the back of the small sign board. As the results, we can put all beacons without changing the landscape.



(A) Overhead

(B) Central of the city

Figure 4. The Location of the iBeacons in the Mino City

Application For Iphone

Figure 5 shows the application for the Mino City Bicycle Touring. This application can download from Apple app store[3]. This application shows the tourist information in response to a beacon that has been installed in the tourist spot. Tourist information page is automatically rise as we approach the tourist spot by launching the application and make the reading of the text by voice. The audio guide

announcements the tourist spot is near here, it is good for the tourist riding. They can find the sport to riding the bicycle in the city. Additionally, the user can see the beacon point on the map screen. And the information pages rises by touching the beacon point.

On the other hand, this application can shows the history of visiting the tourist spot. The beacon point reacted once, the color will change.

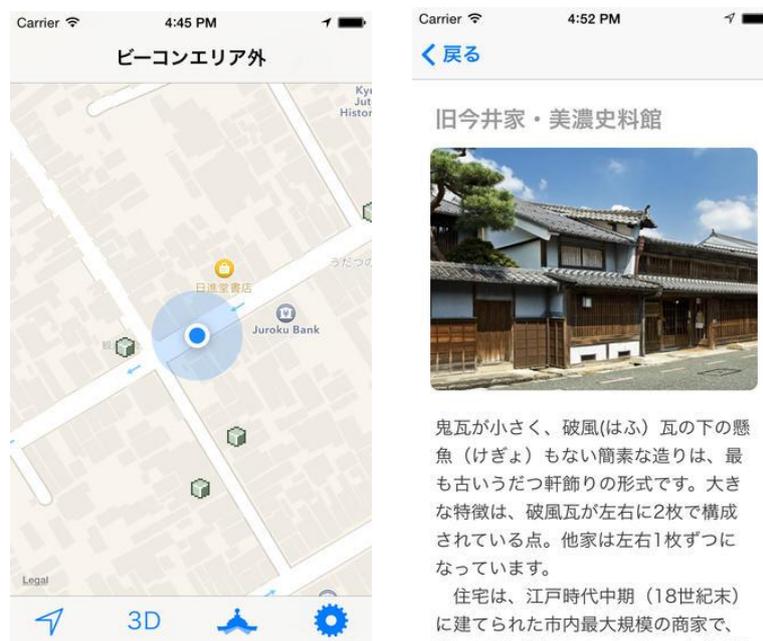


Figure 5. The Location of the iBeacons in the Mino City

CONCLUSIONS

In this paper, we describe the application for City guide or Bicycle touring. At first, we developed an application for orientation of our college. It had the problem too difficult to detect the beacons from long distance. It caused by the detecting mode of the beacons. Next, we developed an application of city guide for the festival ground. We adjust the radio wave strength and detecting methods fit in the way. But this way, the length of the detecting is depends on the device directions. We need to set up few beacons at the same place and put them for different directions to react to the exact position of the tourist spot.

Finally, we set up the beacons for location information infrastructure in the Mino City. Mino City has the traditional streetscape and it is difficult to build a lot of sign of the City. So we set up the beacon and develop the application for the sight-seeing by using the bicycle.

In the future, we increase a place of installation and we will develop the other application for example shopping, eating or learning. And we hope a lot of new



application using these beacons.

REFERENCES

- [1] Kohne, M. , Sieck, J. 2014, Location-Based Services with iBeacon Technology, IEEE Second International Conference on Artificial Intelligence Modelling and Simulation 2014, pages 315-321.
- [2] Motosu City 10th Anniversary event, https://www.city.motosu.lg.jp/shisei/10th_anniversary/event/
- [3] Mino City Beacon Guide, <https://itunes.apple.com/app/id868006031>



UPDATING PROGRESS OF THE NATIONAL SEISMIC HAZARD MAP- INDONESIA : CRUSTAL DEFORMATION PERSPECTIVE

Irwan Meilano ^{1, *,†}, Masyhur Irsyam ², Susilo ³, Hasanuddin Z. Abidin¹, Achraf Koulali ⁴ and Phil Cummins ⁴

¹Geodesy Research Group, Faculty of Earth Science and Technology, Institut Teknologi Bandung, Indonesia,

²Geotechnical Engineering Research Group, Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Indonesia

³Agency for Geospatial Information (BIG), Indonesia

⁴RSES Australian National University, Canberra, Australia

irwanm@gd.itb.ac.id

* Presenter; † Corresponding author.

Abstract: The Indonesian archipelago is located in a tectonically active zone of Eurasian Plate, Indo-Australian Plate, Pacific and Philippine Sea plates. To its west, the Indian oceanic crust is sliding underneath the Sunda Plate, forming a trench system spreading from western Java to northern Sumatra. To its east, subduction gives way to a collision between the Sunda-Banda arc and the submarine Australian continental shelf, leading to upper-plate deformation. Source model for the National Seismic Hazard (NSH) maps is constructed using three types of data: seismicity data, paleoseismic-geologic observations on past earthquake, and GPS constraints on fault slip rates and strain accumulation rates. The model is constructed as a combination of block rotation and strain accumulation in elastic half-space that assumes each fault segment slips beneath a locking depth or in combination with creeping in a shallower part. In this preliminary model, we divided Indonesia into six tectonic blocks and 88 faults.

Keywords: Deformation Model, Indonesia, Seismic Hazard

ENHANCING CLIMATE-RELATED DISASTER RESILIENCE THROUGH EFFECTIVE RISK COMMUNICATION IN BANDUNG, INDONESIA

Farah Mulyasari^{*,†}

Research Center for Disaster Mitigation

Institut Teknologi Bandung

farah.mulyasari@gmail.com

* Presenter; † Corresponding author.

Abstract: Recent publications on climate change risk indices, such as the World Risk Index from Buendnis Entwicklung Hilft and UNU-EHS or the Global Climate Risk Index from Germanwatch, that Indonesia is at the top end of the most vulnerable country to climate change and natural hazards. This condition will exacerbate Indonesian urban areas. The 2004 Indian Ocean Tsunami is the turning point for Indonesia in rearranging its institutional framework on disaster risk reduction and climate change adaptation, focusing on institutionalizing local initiatives. The study addresses the linkage of climate disaster resilience and risk communication approaches at the local level. The adoption of Climate Disaster Resilience Index at the micro-city level (sub-district level) of Bandung City, Indonesia, demonstrates an approach to disclose the resilience of physical, social, economic, institutional, and natural dimensions of different areas within the city. The focus on resilience aims to foster actions enhancing the capacity of the city to future climate-related disasters through adequate planning decisions. Enabling this, communication envisages as the last mile of this comprehensive climate-related disaster resilience assessment on how the risk and resilience information collected at and conveyed to the public. Community-Based Society



Organizations of Bandung has the potential in conveying that information to wider communities, which would trigger them to take actions. A set of indicators in Social Institutional and Economic Resilience Activities approach is developed to characterize the delivering process of risk information by community organizations through their activities at sub-districts and wards. Results indicate that communities' organization activities in Bandung implement a certain degree of risk communication, which is embedded in their activities by involving the local government, agencies, private sector and media in the process. As the output, the study offers a model of comprehensive risk communication approach; integrating climate-related disaster assessment and risk communication processes driven by local novel initiatives in city.

Keywords: disaster risk reduction, climate change adaptation, resilience, risk communication, local initiatives

DEVELOPMENT OF EARTHQUAKE RISK ASSESSMENT MODEL FOR ROADS IN INDONESIA

Mona Foralisa Toyfur, Krishna S. Pribadi, Sony S. Wibowo, I Wayan Sengara

Department of Civil Engineering, Institute Technology Bandung

Abstract: Road network in Indonesia, which consists of 446,000 km of national, provincial and local roads as well as toll highways, are exposed to various natural hazards, such as earthquakes, floods, landslides, volcanic eruptions etc. Within the Indonesian archipelago, which consists of more than 13,000 islands, several global tectonic plates interact, such as the Indo-Australian, Pacific, Eurasian as well as the Philippines plates, resulting in a complex geological setting, characterized by the existence of seismically active faults and subduction zones and a chain of more than one hundred active volcanoes. Heavy monsoon rainfalls trigger floods, flash floods, debris and lahar flows and landslides, which often damage roads and bridges. Losses due to disasters caused by the damage of road infrastructures as well as socio-economic losses due to traffic disruption are compromising the development of the country. Risk reduction measures are essential to the sustainability of the road network, a vital infrastructure to the socio-economic activities of the country. As resources are limited, priorities need to be identified in implementing risk reduction measures to the road infrastructure. A research is conducted on the earthquake risk model for roads in the country. The objective of the research is to develop an earthquake disaster risk assessment model for road links, in terms of road segments. Assessing disaster risk is essential in order to provide adequate information for decision makers at the national and local level in prioritizing disaster mitigation works for road segments. The model is based on the development of a road disaster risk index model involving a series of risk indicators. Based on the earthquake risk index model, the risk level of each road segments within a road network can be assessed and then plotted into the road network map based on the risk level category. It is expected that with the risk assessment model, road management programs will be able to better prioritize risk mitigation measures and hence improving the network level of service. The research compares various risk assessment models that have been developed in other countries, and identifies potential indicators to be adapted in the road risk index model. The road earthquake risk index model is structured based on the definition of disaster risk factors and their components, and the indicators are selected to reflect the value of each risk factors. By aggregating those values, weighted in accordance to the importance of the factors, a risk index value for a specific road link can be established, as an indicator of its relative risk level to the other road links in the road network system.

Keywords : risk assessment, earthquake, model, road link

ON THE IMPORTANCE OF GPS SEA FLOOR DEFORMATION FOR DISASTER RISK REDUCTION IN JAVA, INDONESIA

N. Rahma Hanifa^{1,*†}, Endra Gunawan², Irwan Meilano⁴, and Udrekhan Hanif³

¹Research Center for Disaster Mitigation, Institute Technology Bandung

²Graduate Research on Earthquake and Active Tectonic, Institute Technology Bandung

³Geodesy Engineering Department, Institute Technology Bandung

⁴The Agency for the Assessment and Application of Technology (BPPT)

E-mail: ¹rahma.endra@gmail.com

*Presenter; † Corresponding author.

Abstract: Subduction zones are places where devastating megathrust earthquakes occurred, accompanied by large tsunamis, such as the 2004 M9.3 Sumatra-Andaman earthquake in Indonesia and the 2011 M9.0 Tohoku earthquake in Japan. Beneath Java Island, the most populated island in Indonesia, the Australia plate subducts beneath Sunda Block along the Java trench off Java Island. Despite its aseismic activity, in term that no megathrust earthquakes with $M > 8.0$ occurred in the last 300 years, recent study using continuous GPS data indicate that the accumulated seismic moment in the subduction plate interface is capable to host a $\sim M_w 8.7$ off southwest Java (Hanifa, et al., 2014). That study use only land GPS observation, which is 200 km from the trench, yet their model suggests a possibility of full coupling condition in the shallowest part of the trench. Occurrence of past tsunami earthquakes along the Java Trench imply capability of this subduction zone to allow rupture to the most shallow part of the trench, which may give a threat for either future tsunami earthquake or tsunamigenic earthquake. In order to evaluate a more accurate estimation of state of interplate coupling near the trench, seafloor geodetic data technology has proved it capability to estimate a more reliable state of interplate coupling (e.g. Iinuma et. al., 2015). In this paper, we show the importance to conduct a GPS seafloor deformation measurement in the shallow portion of the subduction near the Java Trench, for disaster risk reduction purpose. The methodology will employ a numerical simulation using checkerboard test to evaluate the reliability of the spatial resolution of the analysis. Geodetic data consist of combination of existing continuous GPS network in Western Java and proposed location to install geodetic seafloor.

Keywords: deformation model, interplate coupling, megathrust earthquakes, tsunami earthquakes

DEVELOPMENT OF COLLABORATIVE MODEL IN EARTHQUAKE DISASTER RISK ANALYSIS AT COMMUNITY LEVEL

Aria Mariany

Doctoral Program of City and Regional Planning, Institut Teknologi Bandung

E-mail: Aryamariany@gmail.com

Abstract: Disaster risk assessment is conducted to assess the risk level in one area. It can be used for planning issue as well as for determining the disaster mitigation effort in such area. There are many researches that have developed the disaster risk analysis methods, both top-down and bottom-up approach. At certain level of planning, the top-down approach can be used, but at community level, it can produce different risk acceptance between what researcher has resulted and what community accept. Therefore, community involvement in the disaster risk assessment is important to produce consensus on risk level in the area. This research is aimed at identifying the participation form in disaster risk assessment at community level, developing collaborative model in disaster risk



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analysis and the involvement of stakeholders, and identifying factor that influence the collaborative model in disaster risk analysis at community level. This research will contribute in supporting and enrich the collaborative planning theory, especially in disaster risk analysis and will also contribute to the new participatory approach in disaster risk analysis especially in the less disaster experienced area to produce the consensus in disaster risk at community level.

Keywords: disaster risk assessment method, disaster risk assessment