“Waju” and Its Evolution with Urban Technology – Japanese sustainable community for disaster resilience

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Abstract. Global society is pursuing sustainable community and city which are integrated and resilient against great disaster. This paper insists that traditional wisdom cultivated in Japan here should be reappraised in such modern contest. “Waju”, or “circle and collaboration” is a traditional and vernacular culture in Aichi, Japan. In this field, autonomous sprit has developed for some hundred years, independent of government by Kyoto and Edo – giving birth to global automotive industry today. Historical citizens in Waju community have promoted autonomy for disaster prevention and local supply of infrastructure and logistics for adaptation to hazardous environment. In fact they have built circle river levee, shared water supply inside and private ships in case of flood. This autonomous Waju spirit is realized and sustained in an advanced industry island in Aichi, with modern context of business continuity planning. 100 companies here are now collaborating for not only tsunami evacuation, self-ambulance system, partnership with infrastructure companies but also for building new bridge and road for logistics. These days, Waju sees new evolution by advanced technology. Local government and automotive companies in Aichi are now discussing holistic strategy for sustaining global automotive industry. More than 100 people are acting on large hazard map using augmented reality in the same time. They are making a circle surrounding the map, inheriting Waju spirit. Japanese community here has been struggling with disaster and making precious cultures in complete history with adaptive evolution. Traditional spirit and advanced modern technology will create Wajus all over the world in the future.

1. Global framework for resilience and sustainability

These days disaster prevention by “multi-stakeholders” is essential. For example, Sendai Framework for Disaster Risk Reduction 2015-2030 by UN (Figure 1) claims for collaboration by multi-stakeholders. In the framework, not only central government or local government but also companies and citizens should autonomously collaborate for risk reduction against tremendous and widely-spread disaster. For example, in order to execute “Regional Continuous Plan – RCP”, industrial company, infrastructure Company and logistic company should totally collaborate for continuing local industry.

Sendai Framework sets on four prioritized domain; they are risk understanding, strategic relation of stakeholders, investment for building up resilience, equipment for rapid reaction and “build back better”. The last word “build back better” means the sprit “city should be re-built with
consideration for former problem, and that city should be better than former for preventing repeated disaster.”

Countries all over the world are now endeavoring for archiving the framework. A problem is that every country, including here Japan, is seeking a model or prototype of multi-stakeholders because there is no typical project.

Here, Author think that there is an indictable knowledge in history of Japan. Japan society has traditionally struggling with disaster and created a disaster culture. Although it is implicit and sometimes forgotten in modern society, Author point out we should re-evaluate such cultures on modern context.

Figure 1. Collaboration of Multi-Stakeholders
In Sendai Framework for Risk Reduction
(drawn by author with reference to [1][2])

1.1. Resilient City and Holistic Approach

The concept of “resilience” on the world is also being expanded. For example, 100 Resilient Cities Project is a world-wide project which select a hundred excellent cities from all over the world, and project supports the selected cities by strategy and investment. The project has been promoted by Rockefeller Foundation, represents the “Resilient City Framework”(Figure 2). The framework contains not only resilience for disaster, but also the strategy, environment issues, social benefits and society. Such holistic resilience will enhance the ability for adaptation toward any type of severe shock or stress for city.

In this research, author will show examples of Waju. Although they are not selected as a “resilient city” right now, their approach is resilient and holistic in the point that it contains strategy and collaboration for both usual lifetime and disaster.
1.2. Autonomous and resilient culture

Aichi or Nagoya, globally known as a world industrial region for auto automotive industry including Toyota, has historically developed autonomous culture. This region is relatively independent of political authority Tokyo, Osaka and Kyoto. For example, after tremendous typhoon of 1959, damaged Nagoya-Port recovered by almost local power. Author is focusing on such autonomous and resilient culture in modern society today, as well as history.

1.3. Research object

Based on backgrounds above, in order to represent the model of resilience and sustainability this research reports three indicative case studies of Waju in historical and modern societies. Firstly Author introduce historical Waju, including its origin and collaborating processes. Secondly Author represents a case of modern industry region as a descendant of Waju. Modern Waju has been developed on the similar process of traditional Waju. Finally author shows the future model of Waju with emerging technology today. Table 1 simply represents these schema of various Waju.

These cases should commonly indicate the new social model of disaster risk reduction by multi-stakeholders.

Table 1: Waju and its evolution

| History       | Community and Stakeholders | Core Knowledge/Tech                              |
|---------------|----------------------------|--------------------------------------------------|
| Traditional Waju | 13th Century – Today    | Residents in rice field villages                    | Circle dike and common administration inside |
| Modern Waju   | 20th Century              | Companies in industrial Area                     | Area BCP collaboration (Business Continuity Plan) |
| Future Waju   | Now developing            | Any Stakeholder in automobile Industry            | Detailed workshop with AR projection on galactic map |
2. Traditional Waju

Japanese word “Waju” originally means “Association in Circle”([4]). It was originally generated in 13th Century at Aichi and Gifu area in Japan. Waju has a circle dike around its community preventing river flood (Figure 4 left). There are crop field and residences inside the circle. It has been historically developed by local citizens after a number of experiencing flood disaster and its recovery. In the process, collaboration has been enlarged step by step. At first it was small relationship between neighbor houses. It became the collaboration of communities, and finally it has become collaboration of whole region, with binding a lot of Waju. Waju should be one of disaster cultures([5]) which spontaneously generated in region.

2.1. Collaboration in traditional Waju

Strategically Waju includes holistic functions or stakeholders inside it. Waju has its own common infrastructure. For example, there is a water supply commonly developed by local citizens. It uses natural fountain connected to underlying water. It assures internal water supplying problem, while the dike shuts down the influx of external water. Moreover, Waju has a transportation systems by residents. Residents have their own transportation by equipping a small ship under their houses (Figure 4 right). It allows them to move freely for rescue and evacuation even if flood water spreads inside Waju.

Waju has been developed by build back better. The shape of circle is created by trial and errors by long history. Besides, Waju locates historical ceremony in the place where bark has collapsed before. It has warned the danger there visually after generations and encourage more reinforcement. In fact the danger area which never to touch is believed to be religiously divine area.

2.2. Strategy of traditional Waju

As written above, Author consider Waju to be full of modern knowledge such as corporation for continuity, logistics, evacuation and triage for importance. Besides all the features are related organically and functionally (Figure 4). For building up resilience, people have deeply comprehended the risk of their resident area. For example, people have understood complex interdependent system of water flow in usual and disaster. It can enable them to properly react which was pass to stop in case of sever rain. Such mutual understanding can encourage themselves to discuss collaboration.

There remains some Waju region continuing its life community and disaster prevention activities. They say that strong motivation is their common spirit to produce good rice and to remain this traditional region. Common understanding and common purpose are essential for sustaining and enforcing community.

Figure 3. Waju (left) and private ship on the residence(right, wikipedia)
3. Modern Waju

Now Author is seeking descendent of traditional Wadu in modern society. Next case is Waju in industrial region, Akami in Aichi.

This is a portal island region including a hundred industrial companies (Figure 5). This region is located outside of tsunami bark. It means that no infrastructure can directly prevent tsunami attack. The companies have to collaborate in order to guard their own life and their own industry. Author investigated this region by research and interview for local leader there.

3.1. Collaboration in traditional Waju

Based on analysis of interview ([6]), company community of this region performs like a self-government, or an autonomy. In dependent of local government, they equipped there fire-fighting and rescue cars and necessary functions. They also develop a common evacuation space for tsunami. It is originally a private site but it is opened to every company around there.

Furthermore they are approaching to more social and broad-band issues. Limited access by road has been a bottle neck, one of the most serious problem in this region both in usual and disaster. Now they are claiming for its importance to finally prompt local and central government to reinforce the road. Community in Akami represent of new concept for self-government for not only their own private region but also improving whole region considering a social benefit. Like traditional Waju, such collaboration has been developed step by step. At first it was a trial of collaboration between some neighbor companies. After while it became a collaboration of island. Now it has been enlarged in island and whole region.
3.2. Strategy of modern Waju

For understanding the regional risk, Akemi community has started investigation of risk around there environment. For example, they researched tsunami risk and bottleneck of bridge, visualising it to their original local map. The map can be used for imaging disaster and discussing disaster reaction between different companies.

Based on interview, their common spirit is “autonomous industrial area” (Figure 6). They think that everything which can be done themselves should be done themselves. They need local government only for residues which cannot be solved by themselves. Social confusion in interdependence will dramatically decrease if such autonomous spirit are spread.

Author think that such autonomy will give a new model of multi-stakeholders disaster prevention. Corporations do not necessarily depends on local or central government. In fact, corporations govern themselves and surrounding environment in order to adapt the risk of region and estimated disaster, considering its improvement.

Figure 6. Flamework of Modern “Waju” in Akemi
(Drawn by Author)
4. Future of Waju – using emerging technology

Finally a case for future of Waju is presented. This case should become a model case showing a high potential of technology. Emerging technology, for example, AR (Augmented Reality[7]) is giving birth to new interface of collaboration.

Nishi-mikawa region, including Toyota city, is one of essential region for automotive industry for not only local industry but also global industry for manufacturing exporting cars. In this region, collaboration between related companies are being advanced owing to technology development and facilitation by university.

4.1. Collaboration in traditional Waju

Disaster Prevention Centre of Nagoya University has been a centre of collaboration here. As much as 40 associated researchers from local companies and local government are engaged in solving disaster problem by multi-stakeholders.

Galactic map and AR is a main tool for workshop and discussion. Galactic map is a large scaled and detailed map as much as 25m. This map includes almost all buildings and roads in whole Aichi prefectures. For visualisation, all types of risk including earthquake, tsunami and liquefaction can be projected onto the map by AR technology (Figure 7). Participants for workshop can realize the real-scaled situation of disaster by AR. For example, participants can discuss practical issues like “What road can be damaged by tsunami?”, or “What part of water supply can be damage by liquefaction?” People in traditional Waju have understood the relationship of water. Now modern society should comprehend more about social networks.

![Figure 7. AR projection on to galactic map, Visualisation and Understanding of Risk](Photo by Author)

AR data also reveals social interdependence. For example, by projecting industrial water infrastructure, water supply chain network under the ground is unknown to companies. Understanding such network will be used for strategic recovery. As much as 200 Multi-Stakeholders on company, infrastructure, logistics, construction and more have been joining in this workshop (Figure 8).
Figure 8. Future model Waju with AR technology and Collaboration, 200 Multi-Stakeholders on company, infrastructure, logistics, construction and more. (Photo by Author)

Figure 9. Total Embodiment of Framework by Workshop with AR Map As a Future Waju

4.2. Strategy of future Waju

AR visualisation on galactic map is a strong tool for understanding and discussion including virtual simulation of disaster in real sized view. In traditional community, visualization of risk is carried out by divine. Now technology can be take part of it. Also People can be a “circle” for
surrounding map. This should be a new community of Waju. They have high motivation in common to support up automotive industry for local and global economy.

In that workshop, stakeholders can detect regional risk, discuss weak points, invest or cope with them and in fact experience disaster including simulation of build back better virtually. It can realise whole framework of disaster (Figure 9).

We can see here that the new circle of Waju has been emerged in the workshop. This strong tie will be resilient relationships in case of disaster. In the history, tradition and local community have been a form of circle of Waju. Now a new technology can play a role as a networkers for Future Waju. Such collaboration associated to technology should be used in all Japan and all over the world.

5. Conclusions
In this report Author pointed out below:

- Considering global framework for disaster risk reduction, disaster should be coped with by multi-stakeholders in holistic aspects, not only government, in order to realize resilience and sustainability. The global countries are seeking a model case embodying multi-stakeholders’ disaster prevention.
- Author thinks that Japanese knowledge of collaboration, Waju, should be a global model for multi-stakeholders. In three cases represented here commonly have the characteristic that they have been developed step by step including various stakeholders.
- The key of collaboration is mutual understanding of risk. In traditional community, residences has deeply comprehended social risk of residential field. Visualization by AR will be a supportive technology from now on.
- In that workshop, stakeholders can detect regional risk, discuss weak points, invest or cope with them and in fact experience disaster including simulation of build back better virtually. It can realise whole framework of disaster.
- Such collaboration by multi-stakeholders, with cultural spirit and advanced technology, should be applied in all Japan and all over the world.

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