

EEW for Tokai industrial region - application to the manufacturing industry and these effects

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1. Tokai industrial region and EEW

Tokai region (Aichi, Mie, Gifu and Shizuoka Pref.) has the large industrial complex and is characterized by the automobile industrial cluster (the share of industrial output: 19.1%(2006)). The huge automobile companies such as Toyota, Honda, Suzuki have very great influence on the region through their production systems (Fig. 1). The automobile production system is consisted by large number of parts suppliers. And there is an efficient method to control parts production and delivery called Just-in-Time (JIT) system originally introduced by Toyota. This system brought spatial agglomeration of subcontractors in this region (Fig. 2), and it is characterized as a unique than other automobile manufacturer in Japan (Mair, 1992)

The region also has high possibility of big earthquakes like next Tokai and Tonankai earthquakes (magnitude 8 to 8.2, and the possibility is 60-70% in the next 30 years (The headquarters for earthquake research promotion, 2008)) and the companies located in the region have great fear that these earthquakes will damage the industrial complex in the region.

Recently, the automobile manufacturers and the parts suppliers take the anti-earthquake measure as a part of Business Continuing Planning (BCP). Most of the decisionmakers of these companies think that no injury of the factory workers and low damage of facility and equipment from the huge earthquake will be the starting point for the business continuity of the region. The EEW is now introduced to such companies, for the business continuing purpose.

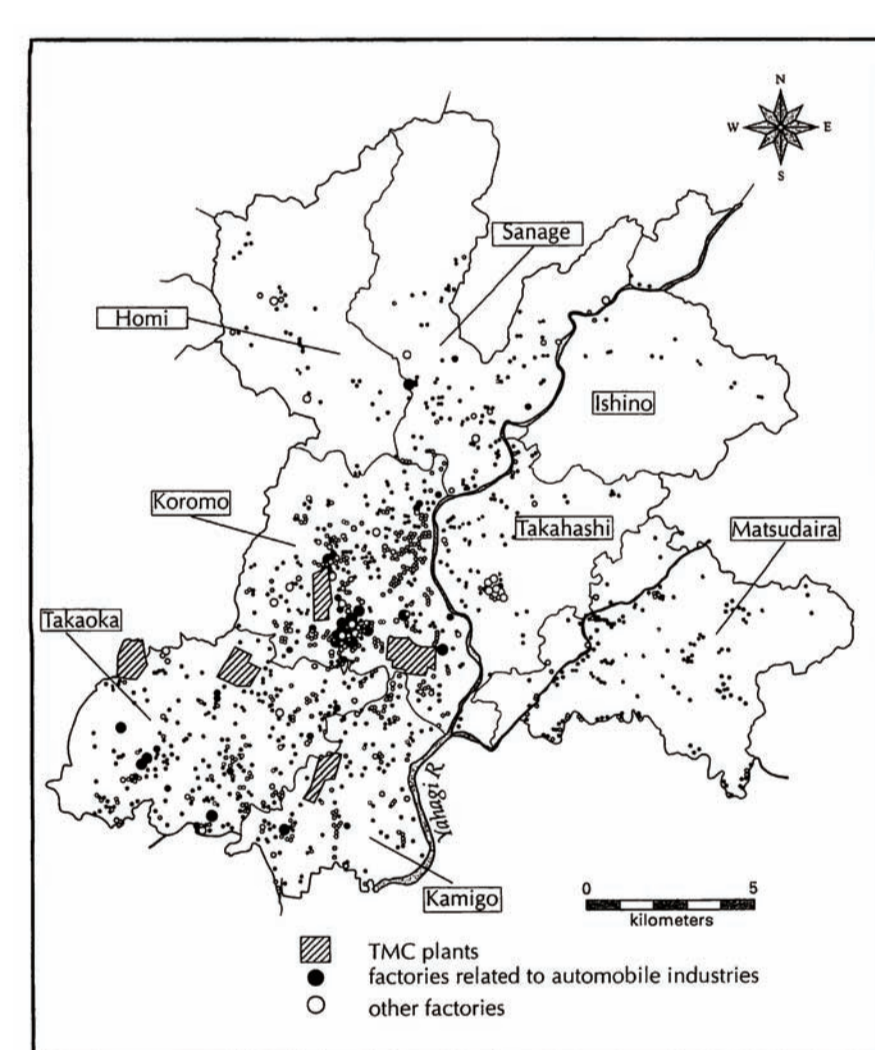
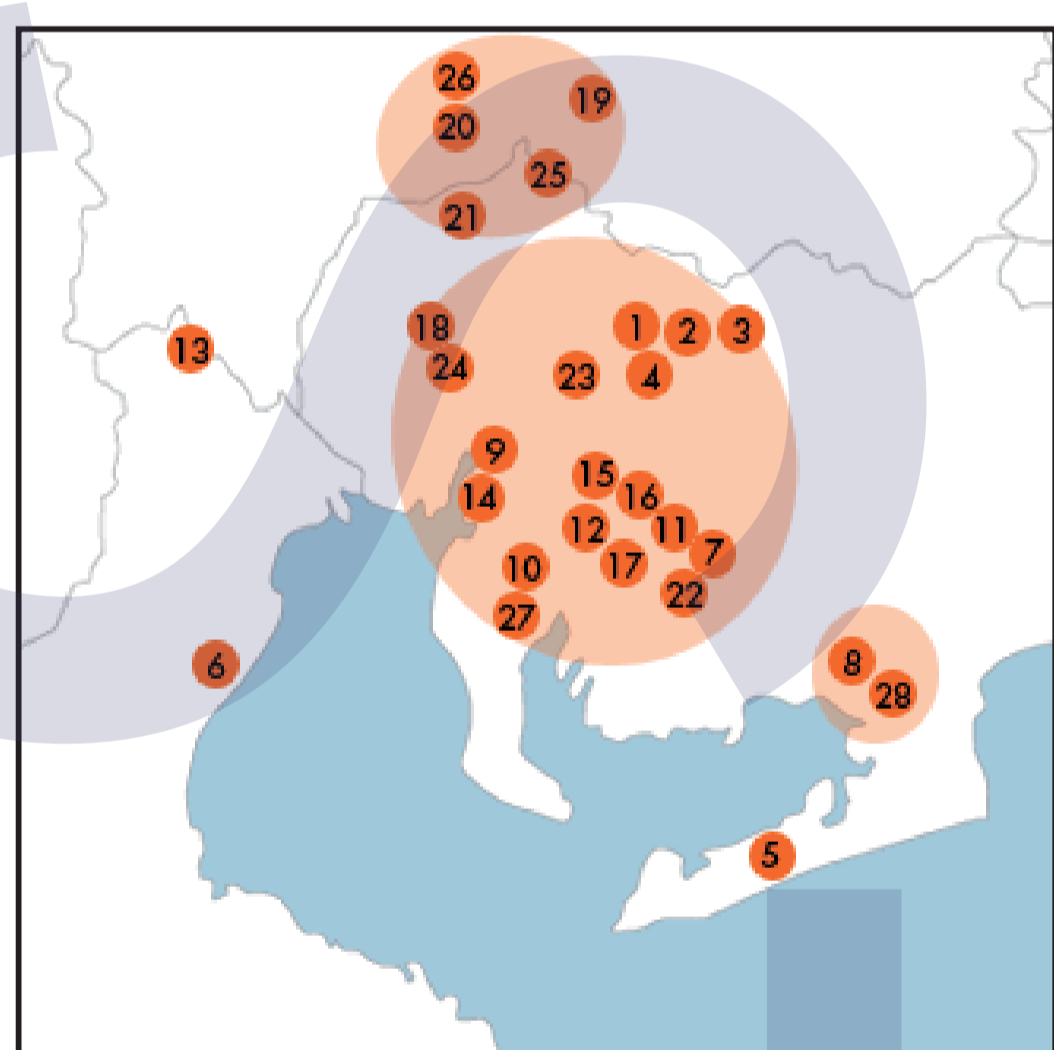


Fig.1 : the location of final assembler and headquarters of main suppliers (28 sites) in Tokai region
(http://greaternagoya.org/html_en/ind_map_01.html)

Fig.2 : industrial complex in Toyota City (1982)
(Nishimura and Okamoto 2001)

2. Application of EEW to the manufacturing industry

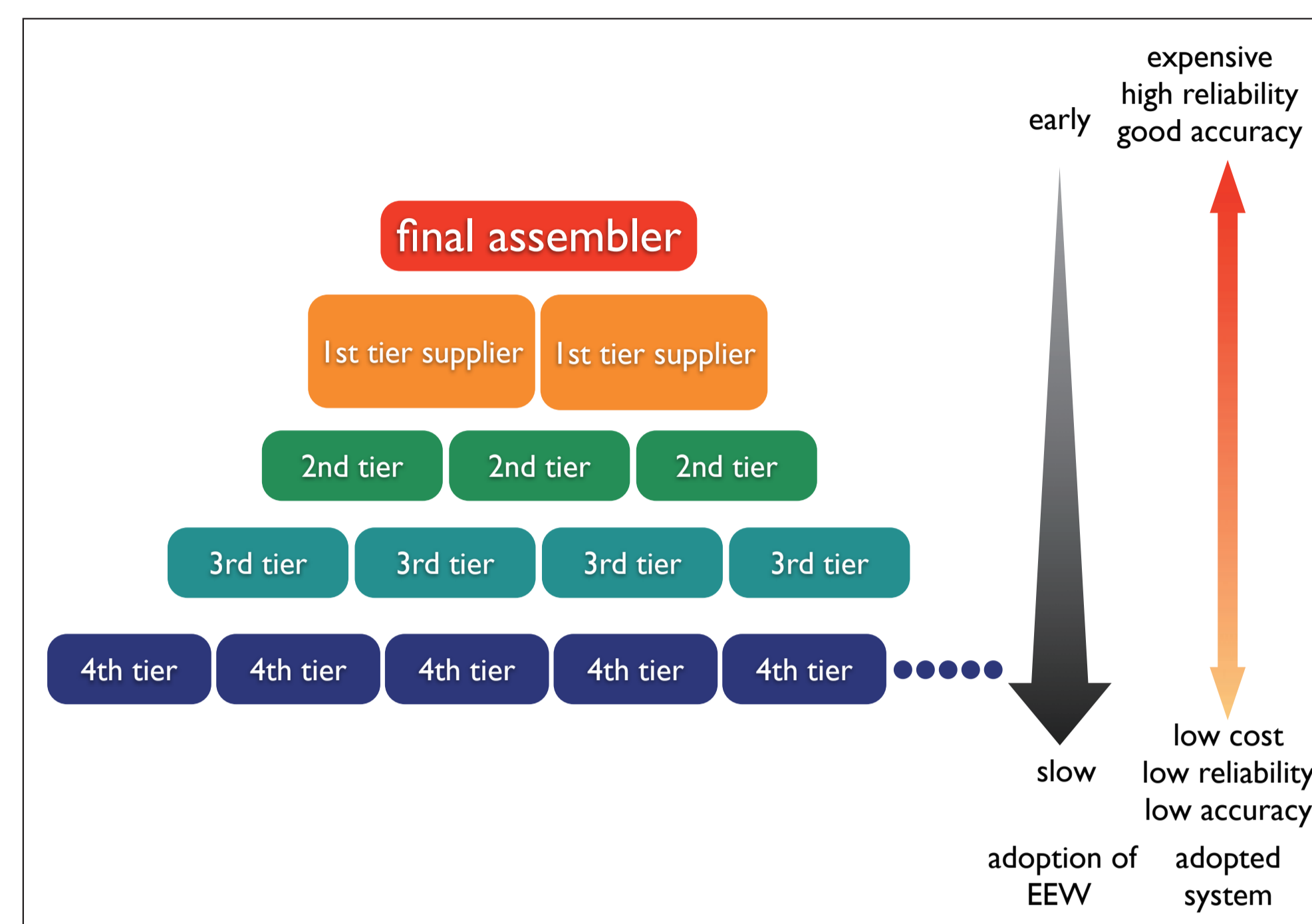


Fig.3 : supply chain and use of EEW

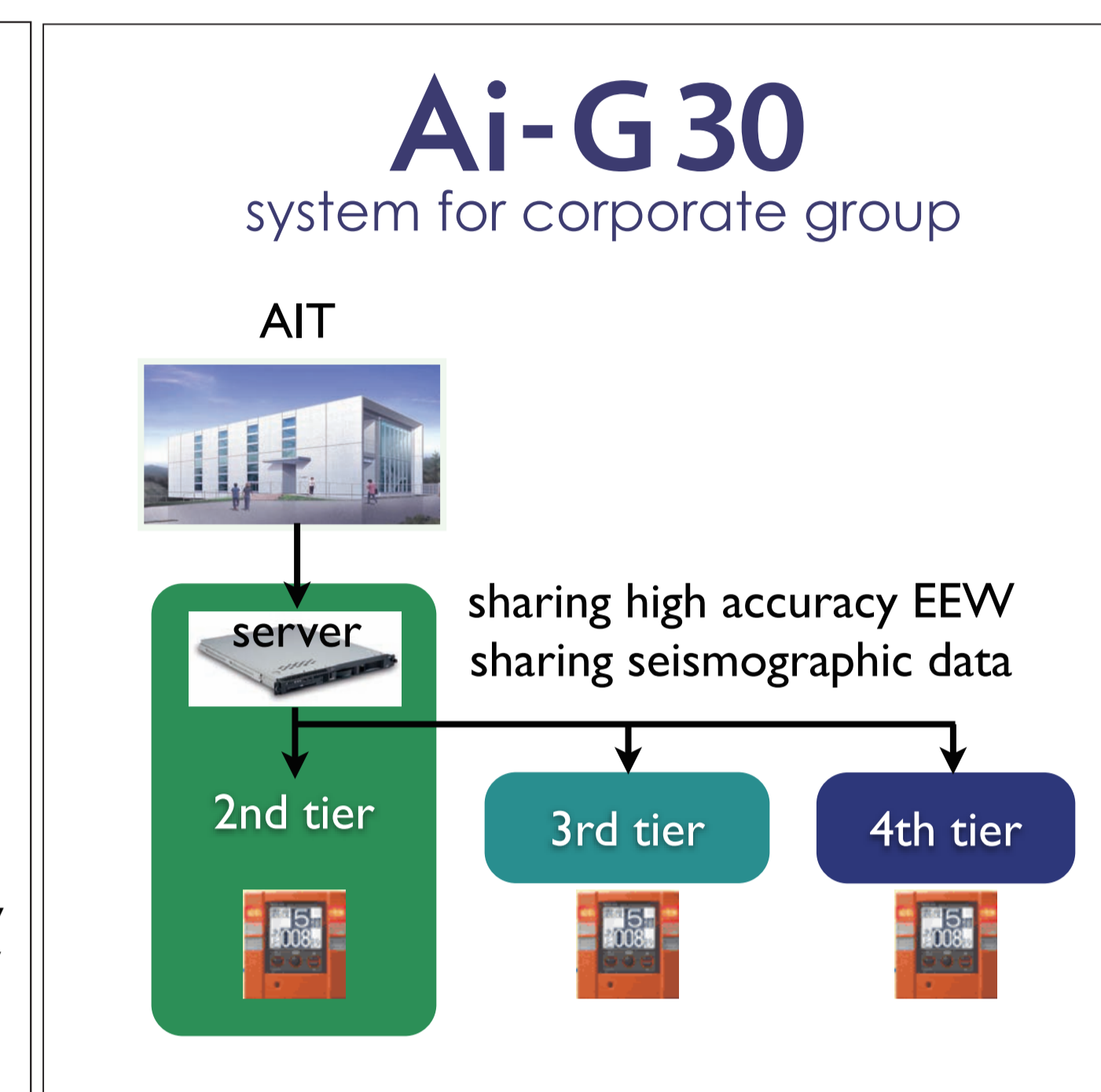


Fig.4 : Ai-SYSTEM (Ai-G30)

The application of EEW faces the problem of the adoption among vertical supply chain.

The final assembler is now introducing expensive, high-spec EEW system (like the system using satellite communication). Some of 1st or 2nd tier suppliers cannot introduce such expensive system for the reason of the cost, and use another systems using Internet. Much of 3rd or 4th suppliers use the system for home use (with low accuracy) or cannot use any systems (Fig.3).

From the aspect of BCP, unless the entire suppliers use such system, the overall production system has the high vulnerability for the earthquakes. The cost-efficiency and the development the new methods for sharing high quality EEW information by all the supply chain will be the effective for the earthquake disaster prevention for the entire industrial sector. AIT disaster prevention project (2004-2009) Disaster Prevention Research Center (DPREC), Aichi Institute of Technology (AIT), Japan, have developed the new EEW delivery system (Ai-SYSTEM) for the manufacturing plants in Tokai Region. It can share the EEW information and seismographic data by the companies across the vertical supply chain (Fig.4, Fig. 5) The companies use the high accuracy EEW data fit to each site and share the seismographic data on each site. They can easily check the damage of the supply chain and allocate the resources for rapid recovery of it.

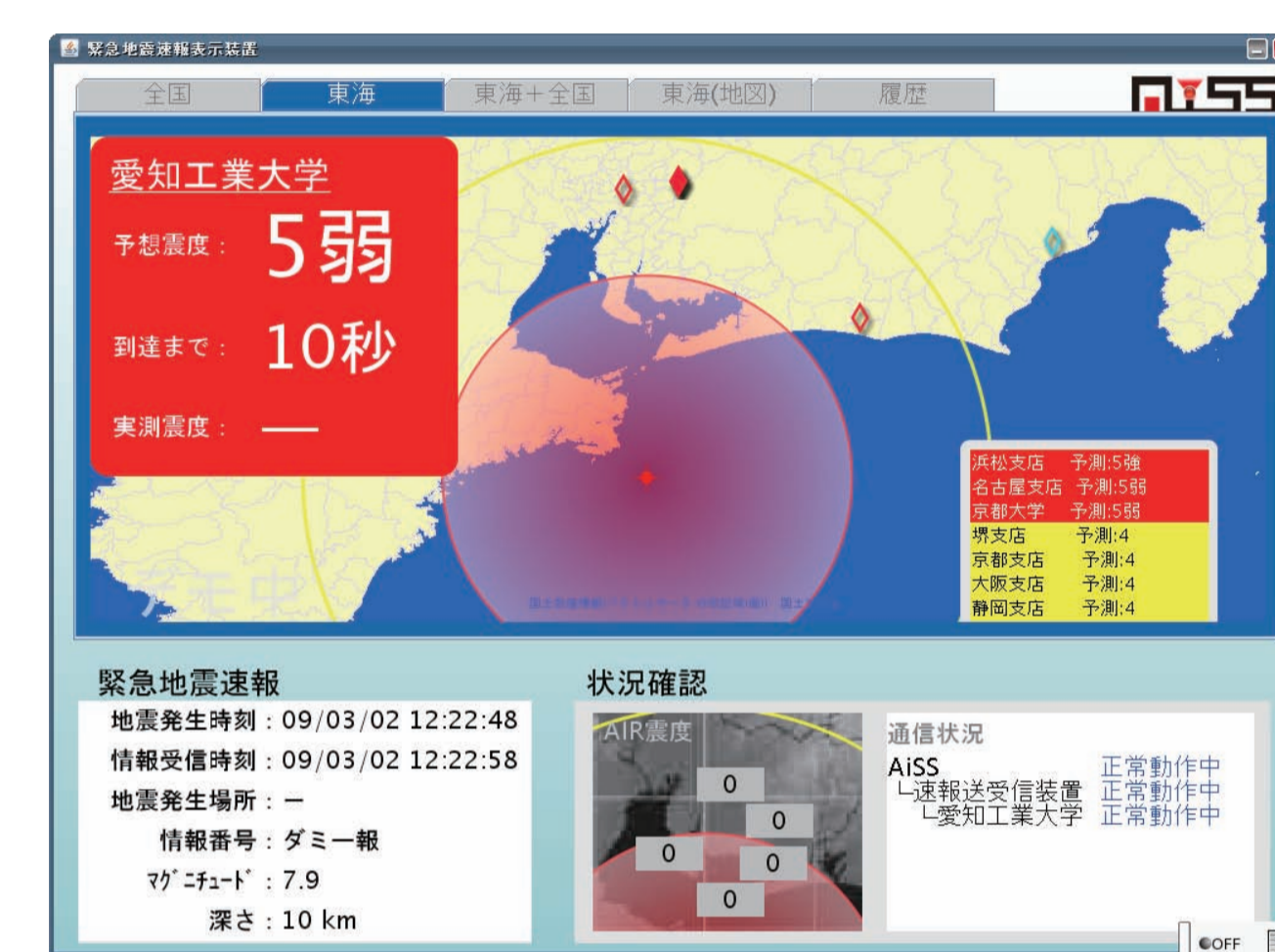


Fig.5 : Ai-SYSTEM (screen capture)

3. The effects of EEW

The penetration of EEW information by industry in Tokai region leads the progress of the earthquake disaster mitigation on the workplace. EEW information visualizes the earthquake everyday and it raised the consciousness to the earthquake disaster mitigation of the workers. The company has to make the manual and earthquake drill using EEW and they would have hired other mitigation activities that reduce risk of workplace.



photo.1 earthquake drill using EEW (at AIT)

The company uses the multiple information of EEW fit to the condition of workplace (Fig. 6).

Ai-SYSTEM has the function of alarm by multiple information (cancellation, information number, residual time of EEW) and the simulation/drill function operated by the user.

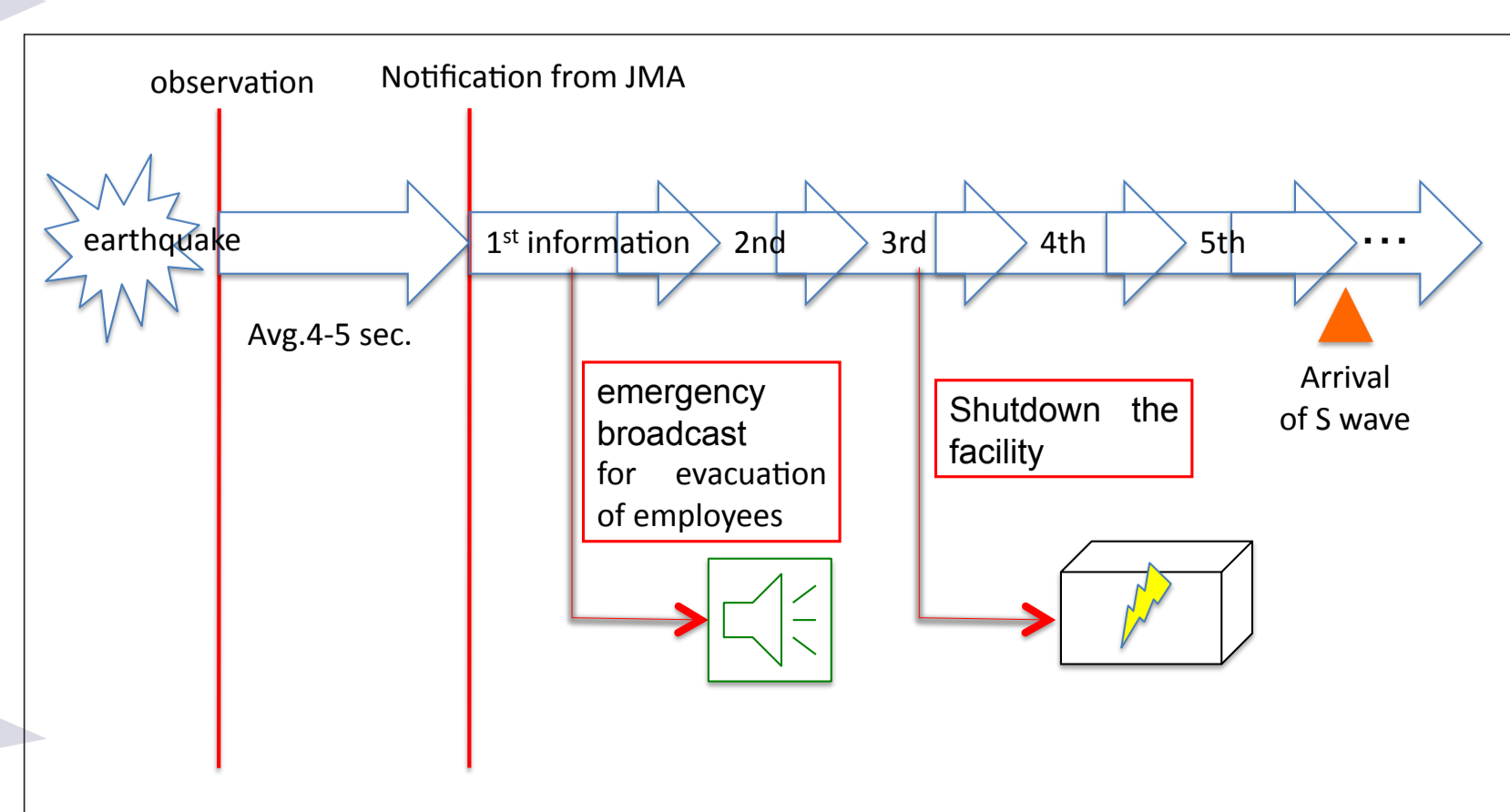


Fig6. the use of multiple information by EEW

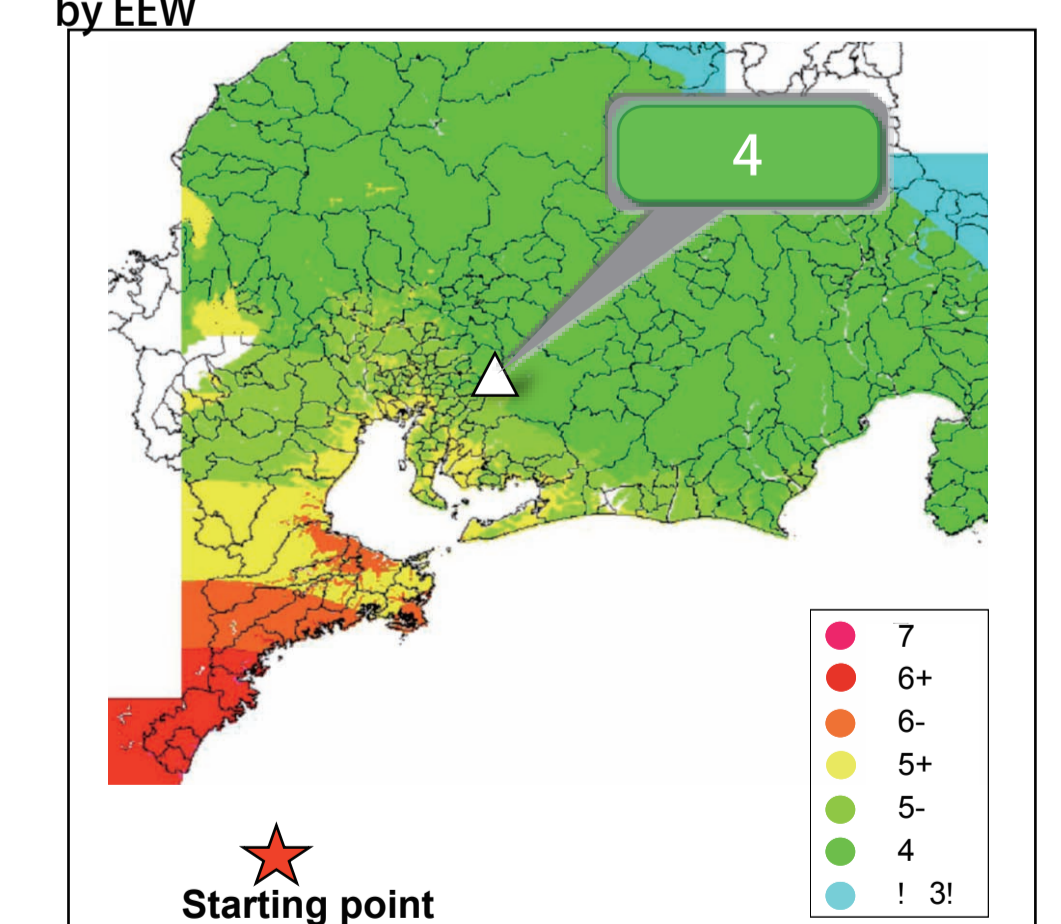
4. the problems of EEW for Tokai industrial region

The application of EEW in Tokai region also has the problem of Accuracy of estimated intensity and arriving time. Some company uses EEW information for the emergency stop of the materials like the explosives and combustibles. The low accuracy of estimated intensity will lead the use of misinformation and the risk for the waste of work-in-progress. Using EEW to Tonankai earthquake in Tokai region will occur the underestimation of intensity. It will be the deep damage especially who work at the dangerous section.

EEW need estimation time about (average) 4-5 seconds and the announcement of EEW the arrival of the main tremors is very short especially for the company near the hypocenter of next Tokai earthquake and Tonankai earthquake.

We are now developing the new function of Ai-SYSTEM that use p-wave/s-wave information by original seismometers and deliver the precise and rapid estimation and real-time checking of EEW to the users.

Estimated intensity of next Tonankai earthquake by EEW



Estimated intensity of next Tonankai earthquake (The headquarters for earthquake research promotion, 2003)

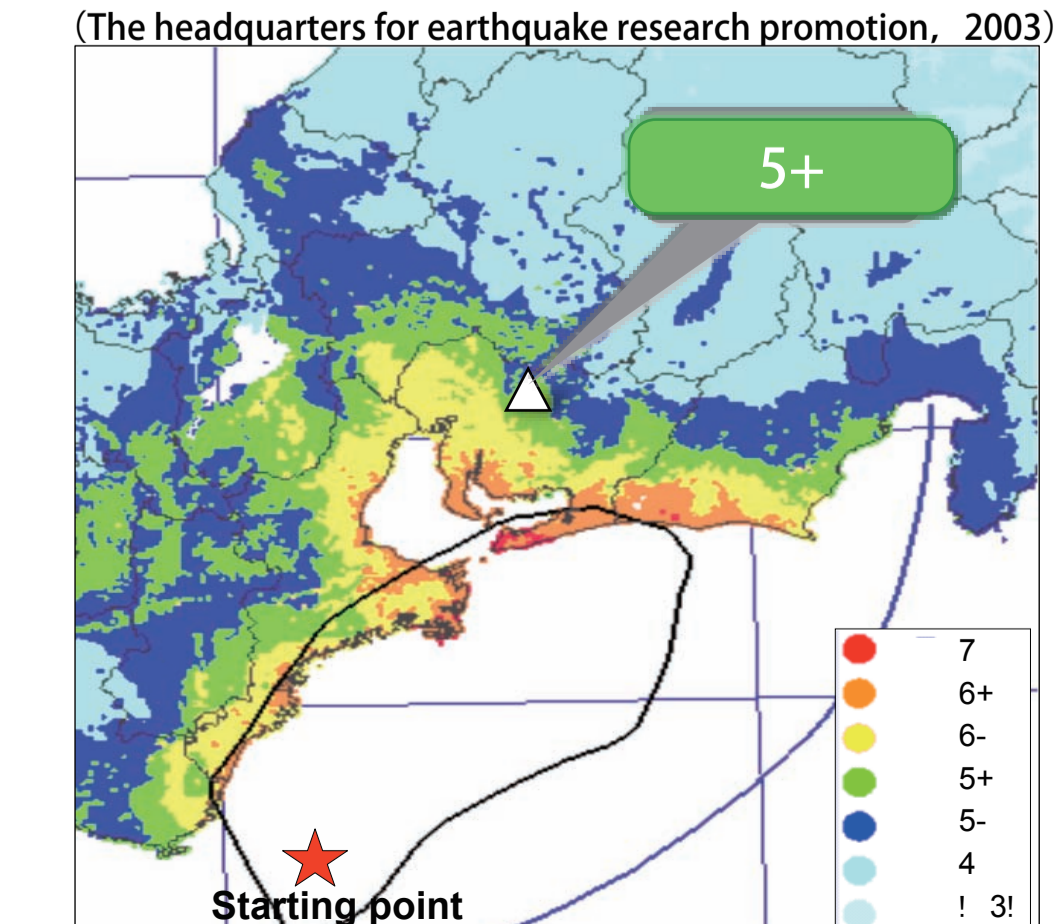


Fig7.under estimation of intensity by using EEW