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Development of Advanced Management System for Social Infrastructures - Advanced Management System of Waste Disposal Facilities as an Example -

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Abstract : Infrastructures in Japan constructed mostly in high economic growth period become elder & elder, and the troubles & accidents caused by the aging increase. Though investment for the renewal is necessary, the shortage of public fund delays the action. Besides, we expect the decrease of the population that means the decrease of the engineers who take care of social infrastructures. Thus, it is necessary for us to develop Advanced Management system of social Infrastructures (AMI) to realize the efficient and economical operation. Our concept of AMI consists of using ICT, PI (Public Involvement) and establishment of O&M diagnosis system. We expect AMI will support to realize the appropriate repairing, preventive maintenance based on the actual performance, accidents & dangerous experience and education & training of the workers. In this paper, development of AMI for the waste disposal facility as a first example of infrastructures will be shown.

Key words: aging, advanced management system, ICT, PI, O&M diagnosis system

1. Introduction

White paper on Land, Infrastructure, Transportation, 2009 [1], estimates the ratio of Infrastructure going through 50 years after construction will be as Table 1.

Infrastructures in Japan become older and renewal investment, upgrading and proper O&M is necessary for keeping the quality of Infrastructures. However, Japanese public finance is in a critical situation and there is little room for the renewal investment (Fig. 1).

Besides, we face the shortage of the population and most of the private companies which are expected to manage Infrastructure instead of local/central gov't, don't have enough knowledge & experience to manage Infrastructure for long period such as several decades. Thus, it is important to establish Advanced Management system of social Infrastructures (AMI) to realize

Table 1. Ratio of Infrastructure beyond 50 years (%)

Items	2006	2016	2026
Road & bridge	6	20	47
River management facility (floodgates)	10	23	46
sewer culvert	2	5	14
Port & quay	5	14	42

(approximately estimated value)

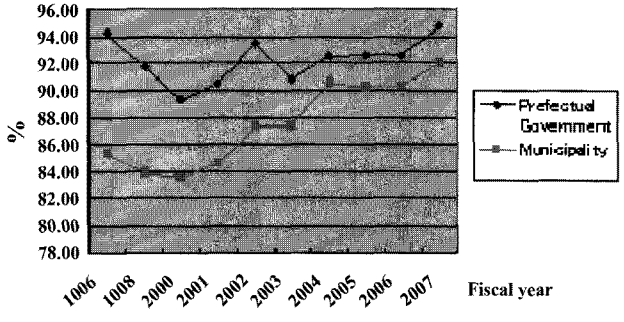

Fig. 1. Ordinary balance ratio trend.

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the efficient and economical operation. Our concept of AMI consists of using ICT, PI (public involvement) and establishment of O&M diagnosis system. We start the development AMI for a waste disposal facility as an example of Infrastructures and AMI for a waste disposal facility will be applied to other Infrastructures than a waste disposal facility in the near future.

2. Advanced Management of Waste Disposal Facility by Introducing ict (Information Communication Technology)

2.1 Concept

Most of waste disposal facilities, drinking water and waste water treatment facilities in Japan have already introduced central control system. In addition, remote control system of several treatment facilities is prepared, reflecting wide-area joint management of Treatment Facilities. Thus, ICT system was already introduced in a variety of field of Infrastructures. However, ICT system is not introduced enough and most of the related information is recorded on paper for O&M directly related work like inspection & maintenance, work for failures & troubles coming up unsteadily, repairing work and preventive action based on risky experiences. Also, spare parts & consumables are mostly recorded & managed by not ICT but papers. As a result, strategic inventory management is not realized. Considering the above situation, we developed the followings.

A. Computerized database system for the records of failures & troubles coming up unsteadily and the actions for them, which was recorded on papers before

B. Inventory management system of spare parts & consumables

2.2 Development of Computerized Database System

O&M directly related work is mainly conducted by field workers. Thus, ICT system has to be easy to be used by them. Besides, expecting the wide spread, the system will be inexpensive. So, we selected 2 candidate methods for the system; one is voice entry type and the other is tablet PC type. We compared the character of the 2 type as Table 2.

We also surveyed the field worker's tendency and decided to select voice entry type system. System structure is very simple. Workers speak to microphone and the voice is converted into digital data. The data will be sent and stored in the Database. Stored Data will be used for analysis with other existing data (Fig. 2).

System is under developing and we expect information recorded in paper before will be used more and O &M will be more efficient.

Table 2. Comparison of 2 type of system component

	voice entry type	tablet PC type
usability	easy to be used by voice	easy to be used by pen input
work flow	Present work flow will not be changed.	Present work flow will not be changed.
cost	inexpensive	inexpensive

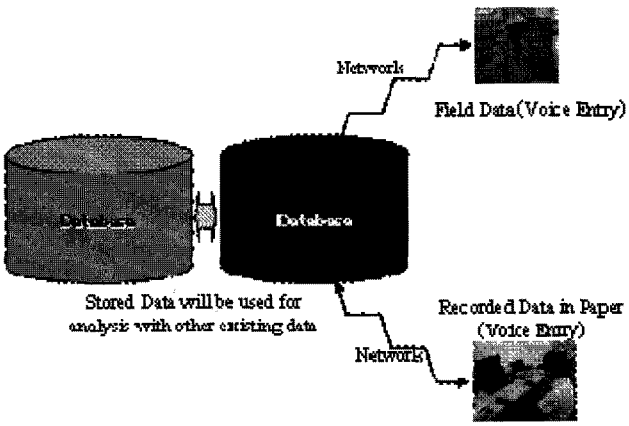

Fig. 2. Outline of System Structure.

2.3 Development of Inventory Management System

Periodical exchange of spare parts & consumables are necessary for waste disposal facilities. Generally, Japanese waste disposal facilities are owned by municipalities and spare parts & consumables are procured by municipalities by the request of operating company, which are trusted O&M work. This scheme causes the followings

A. delay in procurement
B. oblivion of the stored place of spare parts
C. stock number is unknown
D. mistake in procurement

As a worst case, the operation of the facility has to be stopped due to the above. To avoid the troubles caused by stock related problem, we started to develop Inventory management system, which is easy to be introduced, record the number of the stock, location of the stock, do not need an additional work and is inexpensive. When Inventory management system is introduced, we could calculate or estimate the lifetime of spare parts and estimate the residual time of the parts

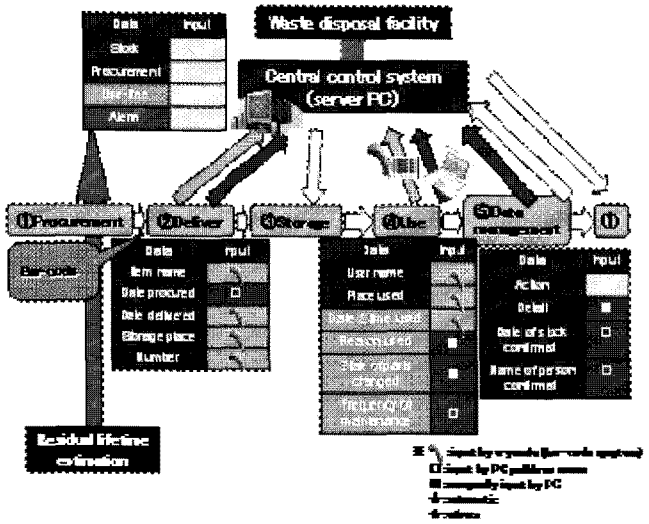

Fig. 3. Outline of Inventory Management System.

which are under operation. Thus, Inventory management system is useful for a preventive maintenance. Inventory management system is based on bar-code. Information of procurement, deliver and use/parts change is collected and analyzed (Fig. 3).

System is under developing with field worker's advise and we expect Inventory management system will decrease the trouble caused by the stock and more efficient operation will be realized.

3. Advanced Management of Waste Disposal Facility by Pi (Public Involvement)

3.1 Concept

Recently Safety and relief issue becomes hot in Japan. Waste disposal facility is usually considered as a risky/dirty facility in spite of its necessity. Thus, NIMBY syndrome is a big problem for waste disposal facility. PI is an effective way for people, especially residents near the facility to understand the facility & management way of the facility and cooperate with the operator of the facility for safe & intimate operation of the facility. We consider there are 3 levels of PI. First is disclosure (one way information flow) from the facility side. Second is communication (two way information flow). Third is participation in the management of the facility by people who are concerned or have an interest in the facility. We developed a support tool for 3 levels of PI as follows:

A. Disclosure: HPMAX (Home Page MAX), a support tool which shows the list of the information item desired by the public and the way of disclosure such as pictures with words, illustration. Home page is the base of disclosure.

B. Communication: HPMAX with SNS (Social Networking Service) or Electronic Bulletin Board, a support tool which combine SNS or Electronic Bulletin Board with HPMAX for the public to communicate by using internet.

C. Participation: CEMS (Civil-active type environmental management measurement system), a support tool for the residents around the facility could measure the environmental data which they wish to know, by themselves. Measurement tool is very simple and easy to be used by the general public. Residents who have an interest or anxiety of the facility could measure & confirm by themselves. This type of scheme which makes people measure voluntarily is expected to increase people's reliance to the facility.

3.2 Development of HPMAX

We conducted survey of HP of Waste disposal facility, interview in the street to the residents near the facility and web questionnaire. Through these studies, we extracted information items desired by the public and the way of disclosure as Table 3. We supported a renewal of HP of the company of which business is waste disposal, based on HPMAX concept and will evaluate the effect of the renewal of HP.

3.3 Development of HPMAX with SNS

We designed version up of HPMAX, using SNS. Concretely, we consider using application "WordPress", by which we add new information easily and keep security by using Password.

3.4 Development of CEMS

Lastly, we designed CEMS. Since the desire of the people will change by the location, we cooperated a site where industrial wastes were illegally dumped and detoxifying of the wastes are going on. Local residents have an interest in a quality of water which go into a sea. Thus, we picked up pH, COD and water level as measured items by the residents. The trial utilization of CEMS will be within this fiscal year.

4. Advanced Management of Waste Disposal Facility by O&M Diagnosis System

4.1 Concept

Operation period of Waste disposal facility is more than several ten years. Knowledge & experience

Table 3. Information item desired by the public

Information Item	Large Item	Middle tem	Way of Disclosure
Understanding of Facility	Outline of Facility	Appearance	○
		Layout	○
		Main Equipments	△
	Process of Disposal	Flow Diagram	◎
		Explanation of Equipment	◎
	Operation Status	Content	◎
		Organization	△
		Activity for safety	○
	Garbage coming in	Quantity per month	△
		Chemical composition	△
	Discharge	Analytical result	△
		Status of keeping standards	△
		Air monitoring result	○
	Odor, Noise	Countermeasures	○
		Measurement result	△
Communication with Citizen	Web Questionnaire	Opinion	△
	Q & A	Questions	△
		Q & A	△
	Facility Tour	Tour guide	△
		Schedule	○
		Content	○
		Impression to tour	△
Announcement	Segregation Route of Acquisition	Segregation table	○
		Map	○
	Event	Schedule	△
		Outline	○
	Access	Map	○
		Access	○
	Cost of Disposal	Cost data	△
Accident, Complaint	Accident	Accident status	○
		Action status	△
		Cause	△
		Cost for action	△
		Future countermeasures	○
	Complaint	Cause	△
		Future countermeasures	○
Evolution, Growth	Design Considering Safety	Safety evaluation result	△
		Hazard map	○
	O&M diagnosis	Diagnosis result	△
		ACT, ACST	◎

(Note ◎:animated cartoon ○:picture, drawing △:words)

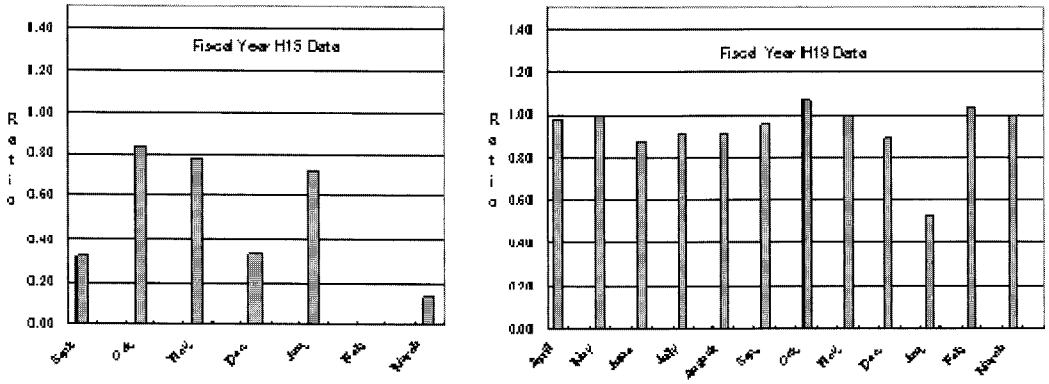

Fig. 4. rrp value (H15 & H19).

accumulated at the facility field need to be inherited and O & M work is desired to be upgraded with time. But, there are many similar works everyday and field workers tend to get into a rut. To avoid getting into a rut, it is important to introduce organized system to continuously stimulate field workers. We developed O & M diagnosis system which is an inspection by the third party other than the field workers. Third party's inspection stimulates the workers, gives the workers good stress and continuous upgrading will be realized based on PDCA cycle. Since cost effectiveness is important, our third party inspection is like an internal auditing. We developed the methodology of O & M diagnosis system and applied it to Teshima Waste disposal site.

4.2 Development of O&M Diagnosis System

Diagnosis is composed of 5 categories. First is Safety diagnosis which checks troubles, accidents and the countermeasures. Second is Compliance diagnosis which checks the level of accordance with rule, standards & manual. Third is Environmental diagnosis which checks the level of accordance with environmental rule & standards, environment impact assessment. Fourth is learning system diagnosis which checks a structure to collect data of accidents & troubles, share a knowledge & experience and educate & train workers. Fifth is effectiveness diagnosis which checks performance of the facility and cost.

Besides, we developed PI (Performance Indicator) for the facility. PI has to be easily understood by the workers and is desired to be a target or an objective for the worker's day-to-day activity. For example, we introduced a ratio of real operating time / planned operating time (referred as "rrp"). Considering the definition, rrp value around 1 means a facility is operated as planned. When we checked the value of Teshima facility, the result is as Fig. 4. We increase the number of PI based on Balanced Score Card concept.

5. Conclusion

Several methods for advanced management of waste disposal facility were developed. Those methods were applied at the real facility field and will be upgraded based on the field application result to realize efficient and economical operation.

Acknowledgments

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[2] White paper on Local Public Finance, 2008.