Fiscal 2005
Verification Research of Interoperability in Medical Information System of the Ministry of Economy, Trade and Industry

Showcase-type Verification Research of IHE-J Interoperability in Radiology Department

Research Result Report (Summary)

March, 2006

Incorporated School Saitama Medical University

I. Overview of research

1. Background

Until now in this research, we have adopted IHE-J guidelines and demonstrated interoperability to a certain level even in the multi-vendor system configuration by increasing the efficiency of the work concerning specification decision, etc. and without compromising convenience or smooth information connection.

Moreover, in order to allow many medical institutions to easily consider adoption of IHE-J guidelines when they introduce the information system, we have published, as much as possible, the verification results and the know-how to build the system, and have been very active in publishing information.

The concrete result of the research undertaken until now is summarized as follows.

(1) We used the technique of IHE-J for the first time in Japan. We actually operated the information system in the radiology-oriented department where interoperability was ensured to a certain level even in the multi-vendor system. Thus, we were able to show the usefulness of IHE-J guidelines.

(2) We completed facilities and visitor acceptance arrangement to allow visitors to see "the system in which interoperability was realized through adoption of IHE-J guidelines and which is actually working". We played a showcase-role of IHE-J guidelines, and received visitors mainly from medical institutions.

(3) We encouraged some institutions interested in interoperability to adopt IHE-J guidelines, and we contributed to the sound growth of information system market and to the spread of IHE-J.

This project must look toward the future, promote interoperability in the non-IHE-J sector now existing in the radiology department and enable the whole system to use, in a collective manner, the accomplishment of interoperability in the radiology department. At the same time, we should enable the departments other than radiology to use, as horizontal deployment, the know-how cultivated in the radiology department. We need to further study such technologies that can be implemented in common across all the departments. For this purpose, the verification research was to be further advanced in this fiscal year.

2. Purpose

The next important step of this research is "to increase the number of medical institutions that want to realize interoperability using IHE-J". We need to build such environment that facilitates many medical institutions to decide introduction of the inexpensive, good-quality system that conforms to IHE-J guidelines. We need to make preparation so that they are more interested in interoperability.

Therefore, this research aimed at providing information and completing implementation by IHE-J with the following main steps. This research intended to study and implement the spread and promotion of IHE-J, and thus to contribute to the spread and promotion of interopearability using IHE-J.

(1) The goal is to further ensure interoperability in the medical information system. In the radiology department where planning is advanced, we must complement such sectors that do not conform to interoperability (IHE-J).

(2) Based on our operation experience, we select the important implementation issues of higher clinical priority. We collaborate with standardizing

organizations, IHE-J Committee, etc. About the integration profile that conforms to the workflow in Japan, we build the system based on IHE-J guidelines. Although some issues have higher clinical priority, they have not yet addressed by IHE-J Committee. Although other issues are not included in the technical framework of IHE, they are deemed to be important technologies (connection) of operation of the medical information system in Japan. About these issues, based on our operation experience, we submit a proposal to IHE-J Committee.

(3) The technology, etc. cultivated in the radiology department prior to other departments should be interoperable for other departments and IT infrastructure itself. We should pay attention to the horizontal deployment and social framework, study the technologies, propose the utilization method and contribute to the spread of IHE-J guidelines.

(4) We publish the interoperable system that was realized by the verification research made so far, upon request from medical institutions and provide information to those medical institutions that study introduction of IHE.

(5) To enable medical institutions located even in remote areas to fully confirm the accomplishment of this research and advantage of interoperability, we establish the website on Internet to publish information and make an effort for popularization/education of IHE-J centering on the accomplishment (know-how) of the verification research.

(6) We take advantage of being the medical institution ourselves that has basic IHE-J system, and make an effort to find out any problems that cannot be analyzed before actual buildup of the system. Thus, we provide the field of verification of new technologies, and provide information upto the clinical operation about the integration profile, which IHE-J Committee is planning.

3. Overview of implementation

3.1 Implementation aimed at the interoperability completion in the radiology department

With this research, we aimed to complete the interoperability in the radiology department using IHE-J. New issues include mutual connection within the radiology department, connection with external medical institutions and results (images, reports, etc.) of examinations produced within the radiology department. These issues are transactions for which improvement is much desired in the whole of the radiology department. We implemented these transactions preferentially and aimed to complete the interoperability in the radiology department.

The items conducted in this research are as follows.

(1) Incorporation images from external medical institutions

We assumed to incorporate the images provided from external medical institutions into our own system, based on PDI integration profile (PDI: Portable Data for Imaging). Thus, we realized the off-line information connection.

(2) Complying with the reporting workflow

By complying with RWF integration profile (RWF: Reporting Workflow), we realized the mechanism to create such reports that use the transactions that are more similar to the on-site workflow.

(3) Delivery of image/report by electronic medical record

We use WADO (WADO: Web Access to DICOM Persistent Objects) technology described in XDS-i, and establish the universal technology for connection with the electronic medical record.

(4) JJ1017 code connection between Order Filler → Modality

For the first time in Japan, we conducted JJ1017 modality connection (JJ1017: Guidelines for reservation, accounting, irradiation record information connection between HIS, RIS, PACS—Modality) (Ver. 3.0).

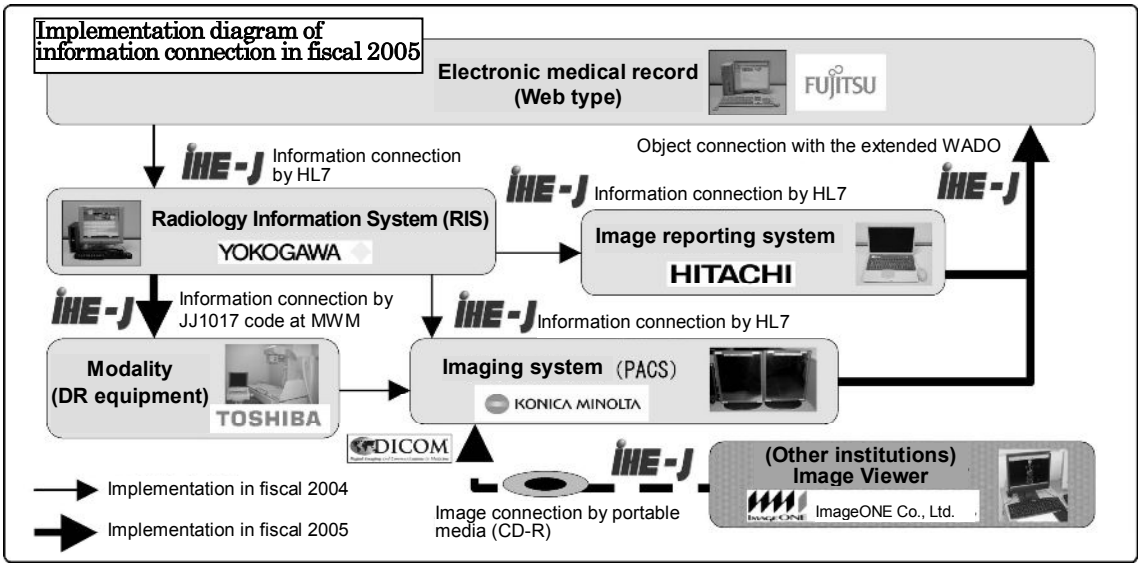

Figure 3.1: Verification research accomplishment in fiscal 2005 (that aims completion of radiology department)

3.2 Continuation and substantiation of showcase function

As characteristics of this research, we can contribute to the spread of interoperability by publishing widely the content of research and the verification accomplishment. As the techniques for that purpose, we allowed visitors to see our system in operation, and published the accomplishment of this research on the website of Internet. This website is as effective as the direct visit to our university.

(1) Maintenance of real showcase

Also in this fiscal year, we maintained the environment where we welcomed visitors mainly from medical institutions to enable them to see our system in operation. We demonstrated the highly universal, useful system that is based on the integration profile of IHE-J.

(2) Renewal of virtual showcase

We made renewal of virtual showcase so that "many people who are interested and in charge of medical information can see the system easily, and even beginners can obtain information easily". We substantiated its content so that we can send more related information to medical institutions that want introduction.

3.3 Activity and information collection to contribute to the spread of interoperability using IHE-J

We are a medical institution where the system adopting IHE-J guidelines is actually in clinical use. As such, in order to widely publish/send the research accomplishment in the past, we maintain a close connection arrangement with the related committees. Especially, in connection with IHE-J Public Relations Committee, we were active in announcing our success story as an operation example of IHE-J guideline adoption system about research accomplishment in fiscal 2004.

Moreover, we exchanged opinion positively with influential committee members of standardization-related domestic and international conferences, and with key persons in planning and spread of IHE-J technology. At Radiological Society of North America (RSNA 2005), we participated in IHE International Conference and Asia/Oceania Meeting and exchanged opinion positively with IHE secretariat and representatives of each country. Thus, we obtained important information about the direction setting of IHE-J implementation in this research and concrete techniques of technical implementation.

4. Establishment of committee

We aimed at smooth promotion of this research, confirmation of technical implementation situation and qualitative improvement of research. To obtain guidance and advice, we organized Implementation Validation Committee consisting of external experts who excelled in the technological knowledge of IHE-J guidelines. We received much advice and guidance about the method to publish findings obtained by this research, and we confirmed the final implementation situation.

5. Discussion

Our center is a regional core hospital with emphasis on the acute stage diseases. Since the last fiscal year, its radiology department has been stable in operation using IHE-J system and has successfully built the system that is based on IHE-J guidelines in a more complete form. As a result, stable operation is very significant. Among them, it is important to have contributed to summarizing realistic, system-building issues.

Especially the provisions of IHE-J guidelines had some problems in the report system. It was controversial whether the report system was sufficient including its particle size. We implemented in this fiscal year RWF integration profile related to the reporting system. IHE-J Committee studied the said profile. Based on the study result, we provided, about several use cases, information that clarifies the behavior of actual system in operation. As a result, the profile effectiveness became possible in quick cycles. It was one of the significant events.

Similarly, about PDI integration profile of IHE-J and implementation of WADO, we summarized requirements for implementation into many practical profiles. It was also significant.

Moreover, in the real showcase, visitors were able to see the actually buildup system and the actual behavior of each component. Not only that, arrangement was ready to give visitors realistic information, such as system-building issue,

procedures and general hints when visitors introduce IHE-J in their own facilities.

This is the facility where visitors can actually experience IHE-J, and collect information actively. In this research, emphasis was put on this point, and it was a success.

Similarly, the virtual showcase can provide as much information as the real showcase does. Such information is expected to be very useful when implementation using IHE-J is realized in medical institutions everywhere in Japan.

6. Approach to interoperability

The approach to interoperability in Saitama Medical School is focused to technologies that were implemented and verifiable and targeted to those that can be operated realistically, among the nationwide deployment of interoperability, especially IHE-J activities. Nevertheless, it is also a fact that many problems still remain to be solved in the implementation stage.

In this sense, a part of the present activities of IHE-J has not reached the implementation level. Of course, IHE-J was planned first in the radiology department and then was studied to deploy it horizontally into clinical examination, pathology, endoscope, circulatory organ and other field. If this structure is considered, then this fact is intrinsic and should not be called a problem.

However, IHE-J is recognized as it is now, and medical institutions and vendors hope to build a system considering the features of IHE-J. For these people, if any implementation problems remain to be solved, then this is not a negligible bottleneck. It is an undeniable fact.

Under these restrictions, implementation at Saitama Medical School is realized, even if it is limited the radiology department, without any major procedural problems and operated clinically. It has important significance.

In other words, although it is only a part of whole system of hospital, if that part is self-contained and completed, then introduction of IHE-J should be considered positively on condition that the future activities of IHE and IHE-J are expected. This is our conclusion.

The real showcase and the virtual showcase send multilaterally information of the radiology department system of our School that was built with this significance of existence kept in mind. It is important that such information makes the following issues known. What kind of actual procedures does the system buildup in IHE-J require? What influence does it have on the information system of that hospital? What merits and expandability will it have in future? This is the greatest significance of information dissemination by our two components, real and virtual showcases.

Now, in order to spread future interoperability or IHE-J, what kind of deployment of information dissemination by showcase is required? It is summarized again below.

Showcase must help medical institutions that consider system realization by IHE-J in the following two points. 1) Showcase must enable them to understand what kind of clinical, medical-economic effect does introduction of IHE-J bring in future? What kind of future expandability is maintained, including evolution of IHE-J itself? 2) Showcase must provide them with such information that is useful when they conceive the image of concrete procedures, expenses, etc. for actual system buildup using IHE-J.

Therefore, as a pioneering institution, we must endeavor to collect and publish

information, while the related vendors and experts are expected to provide information realistically beyond the limit of mere formalism.

Ⅱ. Content of implementation

1. Outline of interface buildup work

The outline of interface buildup work is described below.

(1) We aimed at implementation of interface using such standard technologies that enable to acquire simply and easily necessary information (image, report, etc.) on electronic medical record. To confirm arrival of those objects on electronic medical record, we implemented connection of status. Furthermore, we also built up the order placing screen to external medical institutions that were newly required this time. (Order Placer)

(2) Between radiology information system and modalities, not only patient information but also examination content must be registered directly to modalities. This is based on JJ1017 version 3.0 code that respects interoperability and is conducted according to connection guidelines that use DICOM standard. For this purpose, we implemented new connection.
Furthermore, in order to ensure that new orders placed from electronic medical record can smoothly collaborate, we conducted additional implementation such as examination-specific master, etc. (Order Filler, etc.)

(3) About image delivery to electronic medical record, we studied the connection technique to identify the delivered image, and image delivery technology using WADO that operates smoothly using Web. We added implementation of appropriate interface.
We also implemented status connection that can confirm arrival of object on electronic medical record.
(Image Manager・DICOM/HL7-G/W)

(4) If image information was given off line from the systems of other hospitals, then it must be simply and easily incorporated with connection. For this purpose, we implemented the media import function based on PDI integration profile. (Media Importer)

(5) About report creation system, IHE-J Clinical planning Committee Report Workflow WG studied conformance of the said report workflow in Japan, based on the report workflow integration profile. This WG and JIRA Reading Report Study Committee formed Joint Study Committee, which is Reading Report Study Committee. We respected its study result and conducted restructuring that contributed to interoperability.
(Report Reader・Report Creator・Report Manager・Report Repository)

(6) About delivery of report to electronic medical record, we studied the connection to identify delivery documents and the delivery technology. Then, we added implementation of a suitable interface.
Moreover, in order to enable the arrival of these objects to be confirmed on electronic medical record, we made a new proposal for connection of statues using GP-PPS, and studied its universality, etc. (Report Manager・Report Repository)

(7) At Acquisition Modality, as information connection specification from the information system, we used JJ1017 version 3.0 code recommended by IHE-J guidelines, and built up intelligible interface for the first time in Japan. (X-ray DR system: Acquisition Modality)

(8) We assumed image presentation from other hospitals. We built up the system that can create CD-R containing images based on PDI integration profile. We

built it on the Image Display terminal that can operate independently. (Media Creator)

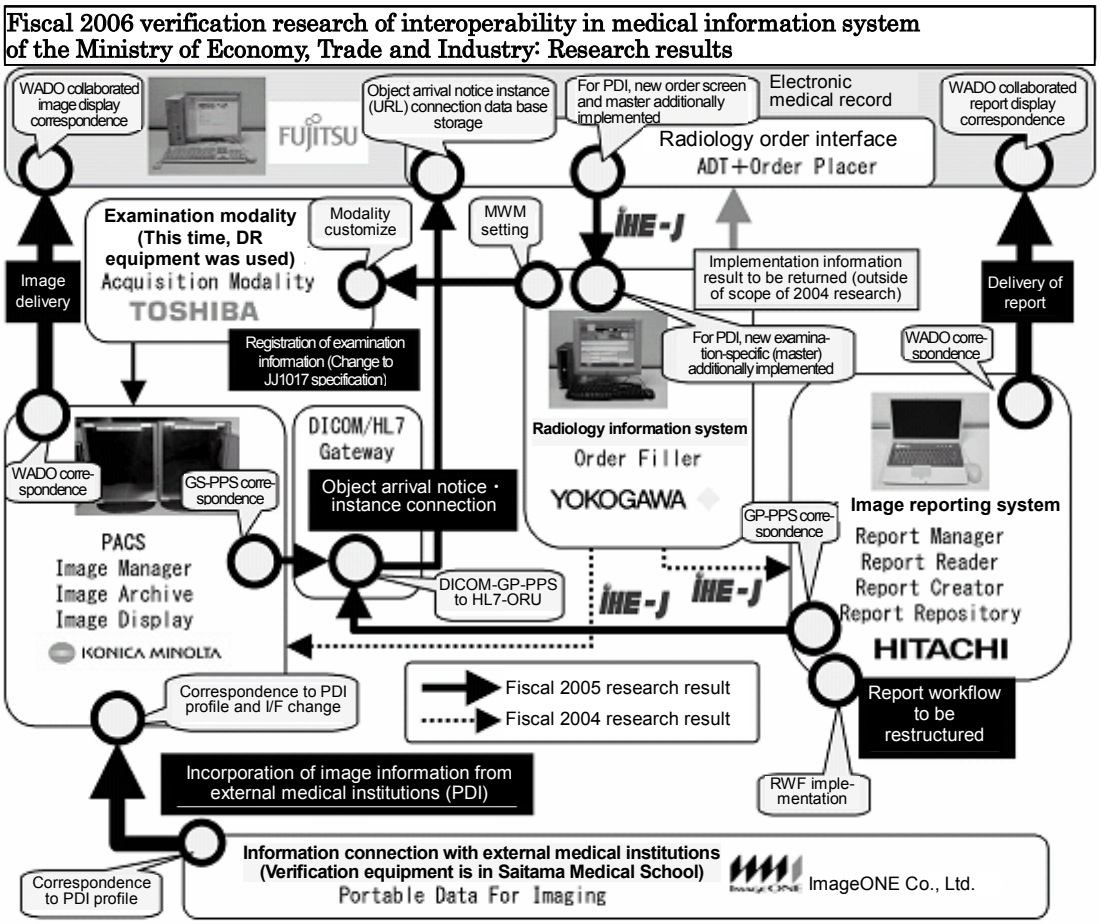

Figure 1.1: System connection situation in verification experiment

2. Continuation of showcase function

2.1 Real showcase

A real showcase refers to the multi-vendor radiology department system, etc. that realized interoperability by this research, and that was installed in an actual server room of Saitama Medical School General Medical Center Central Radiology Department to allow visitors to see it.

In the real showcase, 1) we showed visitors the multi-vendor system in actual operation in the server room, and 2) the personnel in charge gave visitors explanatory pamphlets and explained the system. These activities were conducted in parallel to the renewal work of a virtual showcase.

Figure 2.1: Real showcase and equipment

2.2 Virtual showcase

A virtual showcase refers to the multi-vendor radiology department system that realized interoperability by this research, and that was viewed through Internet.

About the virtual showcase, we built up the Internet site where almost the same information as the actual visit can be obtained, the publication environment, and the download of almost explanatory pamphlet handed out to real visitors.

Furthermore, we maintained the environment where the implementation situation of the interoperability by IHE-J can be transmitted widely. To substantiate content, we conducted, in parallel, addition/setting of each function.

3. Verification research

3.1 Incorporation of image data that was provided with CD-R based on PDI integration profile and that was taken at other institutions

3.1.1 The content of implementation

Saitama Medical School was assumed to ask other medical institutions to do PET examination. Based on IHE-J PDI integration profile, we created CD-R complying with DICOM Part 10 (other medical institutions were assumed virtually) and conducted incorporation (Saitama Medical School was assumed).

Concretely, on the Image Display terminal, we implemented PDI integration profile Portable Media Creator function. Based on DICOM Part 10, we created CR-R. On PACS, we implemented PDI integration profile Portable Media Importer function and incorporated images.

3.1.2 Test of operation

We created the image information on CD-R based on the PDI integration profile by Image creator. We incorporated it from Image Importer to another PACS. At this time, we updated the patient attributes and provided the environment where reference is possible, like patients of own institution, on electronic medical record.

3.2 About transaction restructuring of reporting system based on RWF integration profile

3.2.1 The content of implementation

In the system now in operation, we restructured non-RWF transaction as much as possible, and built up connection implementation based on the standard that is called DICOM・HL7.

Concretely, Clinical planning Committee in Japan studied and confirmed the direction of RWF integration profile in IHE. Among these, we restructured the use case 3 and the use case 7.

The major point of change this time is as follows. IHE-J surveyed the report creating workflow in Japan. Based on this survey, we changed the report content confirmation function from the previous Image Manager implementation to Report Creator implementation. By so doing, we got closer to the present procedure of report creation in Japan.

In addition, we used the same technology as image delivery and realized connection with electronic medical record. For that purpose, we implemented the report arrival notice function, by using the same mechanism as image delivery, and endeavored to make it more common.

3.2.2 Test of operation

We created the report by Report Creator and saved it Report Manager. After that, we retrieved from and displayed on Report Creator. We conducted final confirmation. On Report Creator, we changed the progress status. We implemented the approved report in Report Repository so that it can be saved. We realized system buildup that is closer to a series of clinical flow, which is creation of the reading report.

3.3 Delivery of the image/report to the electronic medical record using WADO technology in XDS integration profile

3.3.1 The content of implementation

From the electronic medical record side, the on-demand reference display of an object (image and report) based on a single technical base was enabled.

Technically, from the patient's specific order screen currently displayed by the electronic medical record side, URL connection was enabled. The object corresponding to the said order was specified. Acquirable implementation was performed.

Moreover, in response to the message about the object existence (arrival) from the object server, screen was restructured so as to trigger the object acquisition

At the image server side, we built the mechanism so as to retrieve DICOM object (image), by Web access resulting from URL connection.

Also at the reporting system side, we built the mechanism so as to provide the content of DICOM object with Text/HTML, by Web access resulting from URL connection.

We wanted to propose the message connection mechanism about object existence (arrival) where a notice goes via Order Filler to Order Placer. But, the past record-related transaction of Order Filler is not fully defined. So, this issue is to be planned in the next year or beyond. This time, we used DICOM-HL7 GW and performed the similar connection. DICOM-HL7 GW might be called a virtual Order Filler that separates a partial specific function of Order Filler.

3.3.2 Test of operation

We used a universal technology of Web access, retrieved the image/report object from the electronic medical record and displayed it. Thus, we provided the environment that can be referenced.

In addition, we proposed the extension where availability of object can be recognized on the electronic medical record.

3.4 About connection using JJ1017 code between Order Filler－Acquisition Modality in SWF integration profile

3.4.1 The content of implementation

In this research, Acquisition Modality itself was to incorporate the translation table for direct understanding of JJ1017 code. The connection of examination directions content between Order Filler→Acquisition Modality was to be realized only by JJ1017 code. It was the purpose.

We carried out the following technical content.

(1) At the Order Filler side, JJ1017 version 3.0 code JJ1017-16M (16 figures of the first half portion) was set to the mark value (0008, 0100) of a reserved protocol mark sequence (0040, 0008). Connection was made to correspond to DICOM-MWM retrieval from Acquisition Modality.

(2) At the DR (Digital Radiography) system side, we restructured Order Filler－Acquisition Modality connection interface. DICOM-MWM JJ1017-16M (16 figures of the first half portion) reads the mark value (0008, 0100) of the reserved protocol mark sequence (0040, 0008) that was set. Image processing conditions corresponding to examination direction content are retrieved from the preset table and used. Such environment was built up.

3.4.2 Test of operation

The information ordered from electronic medical record reached modality connection, by JJ1017 code (version 3.0) connection, which is a standard image examination master, via Order Filler, to retrieve examination information on modality. Such environment was provided.

4. Research result (general description)

4.1 Technical bipolarization that has been visible from this research

If this research is compared with the previous verification research, the nature of research is different. Therefore, implementation of some parts became much easier, and others became much more difficult.

About these points, it is the situation near bipolarization. Countermeasures are necessary toward the spread of IHE-J in the future.

4.1.1 Parts of research where implementation became much easier

The greatest characteristic in this research is that we aim at realization of the interoperability "based on IHE-J guideline". This point has produced a large merit to buildup and extension of an information system like this research.

First of all, in IHE-J, the so-called open specifications called the technical framework already exist. Both a user and a vendor can check the same completed drawings. Naturally, the number of coordination meetings to exchange ideas and intentions can be reduced considerably.

Moreover, in this institution, we made verification research of interoperability using the past IHE-J guideline. As a result, we implemented already IHE-J, SWF integration profile, PIR integration profile, CPI integration profile and a part of RWF integration profile, which is related to this research. As a result, foundation is already prepared. If only based on IHE-J guideline, systems can be added or expanded easily. Such environment is already built up.

This time, we implemented, as IHE-J (IHE) integration profiles, SWF, PDI, RFW, and XDS-i (Cautions: it is not implementation of the integration profile of XDS itself. We cut out WADO technology described in the profile, and confirmed effectiveness when concept of connection between institutions is downsized within an institution). For every profile, the above-mentioned technical frames were ready. Connection and connection parts were built up in a short time and without any problems.

4.1.2 Parts of research where implementation became much more difficult

The greatest characteristic in this research is that we aim at realization of the interoperability "based on IHE-J guideline". This point has produced conversely the greatest problem in this research.

The main factor in problems is that IHE-J Committee has not yet completed to study each integration profile, and left some portions untouched. Naturally, the technical framework remained the same as proposed by IHE. IHE-Japan should "correspond to information system situation and workflow in Japan." But, correspondence was not complete. In other words, we promoted only the implementation of the integration profiles whose study was completed by IHE-J Committee. So, only the portion of merits preceded.

However, like this time, about the integration profile whose study has not completed yet, if we attempted implementation, then we would face many difficulties of specification coordination. Naturally, in the situation, if it is "However, if we implemented using IHE-J", even the detailed study for the clinical application which IHE-J Committee is carrying out will become scope of research. In addition, there is no guarantee that the implementation regarded as best by us becomes

Japanese standard.

In this research, we connected as much as possible each committee of IHE-J, and advanced the implementation with coordinating with the committee. To operate clinically, there is the technical specification that this research cannot help proposing as a result. It has become implementation including "extension" in a sense.

Naturally, the technical framework about the extended portion was not prepared. In the portion that was outside IHE-J, it must start from the beginning. Much trouble was brought to each vendor because we adhered to IHE-J to the last. Of course, the result of this research is to be fed back to the appropriate committees of IHE-J.

4.2 Viewpoint of economic efficiency

In order for IHE-J to affect economic efficiency directly, the measure from the viewpoint of spread is important too. Naturally, it clearly helps to reduce meetings and procedures. Also in this research, electronic mails and several meetings were all that was needed to study specifications. Significant reduction of cost is expected until introduction.

However, as long as a vendor treats IHE-J itself as a special option, these situations are not be improved. Not only that, an image may be established as a brand with high profit ratio.

These situations should be solved by the following measures. 1) To promote development of the system that takes IHE-J as a standard. 2) To replace individual study of specifications at medical institutions. 3) To substantiate and expedite the study at Clinical planning Committee. 4) To provide information of the study results. To build infrastructure and train personnel to have such know-how. To prepare foundation for introduction. And 5) To arrange connection with related organizations to prevent vendors from rejecting our proposals. At least, we did not find any reason that this IHE-J introduction (extension) described in this research becomes more expensive than the previous technique.

4.3 Interoperability using IHE-J

By execution of this research, spread and education of IHE-J guidelines or the concept of interoperability seem to have obtained a certain level of effect. As a part of programs of interoperability of the Ministry of Economy, Trade and Industry, we are the first medical institution that succeeded in clinical operation. As such, we have published information as much as possible and answered questions about actual situation of IHE-J operation. We offered the verification field and trial. We have made the utmost efforts as a private school, and we are proud of that.

However, it is also said that the number of medical institutions which have problems to be solved by a guideline like IHE-J is increasing, instead of decreasing.

This is because IHE-J still remains misunderstood or misconceived. We must take principal measures to educate doctors who have decision-making right in management and doctors in charge of medical information, so that they may know better about IHE-J and interoperability.

In parallel to it, we must study further the integration profiles, which means review of information connection in medical care.

For that purpose, we expect arrangement where each committee of IHE-J can

perform necessary clinical study, more broadly, quickly and correctly.

Especially the merit obtained by medical institutions from an integration profile is unfathomable. On the contrary, if implementation without an integration profile is faced, it will be exhausted instantly.

In order that all medical institutions may enjoy merits of being free, through use of IHE-J guidelines, from the troublesome specification decision and connection adjustment, we should quickly prepare integration profile and information exchange rules.

Ⅲ. Issues for the spread of interoperability

1. Examining evaluation by Implementation Verification Committee and finding out the issues for the spread of interoperability

1.1 Summary of the first meeting of Implementation Verification Committee

First, as technical requirements, we received high evaluation for smooth progress of work. The progress was explained in an implementation plan document and at the beginning of the committee.

If you build a system by IHE-J, then you need not write details in a requirement specification document. It saves the time of consultation. What is the actual level of agreement in a requirement specification? Some committee members asked. This information is very important for institutions that plan the system buildup by IHE-J. Clarification of details is expected.

In that case, there is a realistic difference of requirement specification level between private schools like Saitama Medical School and national and public medical institutions and universities, etc., where a bid procedure is complicated extensive. Our Center cannot grasp such information, and collection of complementary information will be studied in future.

Moreover, in determination of actual buildup range, which portion is performed by using the IHE-J structure, and which portion is performed without using it? What kind of logic is used in such determination? What are the processes? These have been requested, and they will be addressed as much as possible.

About the domains where two or more standardization agreement and standards coexist (DICOM-SR and IHE-J's RWF, etc.), many people wanted to know harmonization coordination and determination method of work scope.

As seen above, as technical requirements, it did not deviate from what was incorporated in the implementation plan document. We received high evaluation for smooth progress of work. On the other hand, we received a comment that we must coordinate to publish more extensively the concrete information about actual work of buildup.

1.2 The second meeting of Implementation Verification Committee

They discussed actively technical evaluation and implementation realization of components such as WADO/XDS, RWF/DICOM-SR, and PDI, etc.

Especially in the discussion, these profiles, standards, etc. must have the process of satisfactory growth. To build the system by IHE-J, what kind of basic policy should be adopted? About this stance, an understanding was deepened.

Moreover, they addressed IHE-J completion at the radiology department system of our Center in future and IHE-J deployment to other department systems. They addressed compliance with IHE-J framework and the buildup of practical information system in medical institutions (for example, management scopes between central departments such as information department, clinical departments, radiology department, etc.). They asked to make a proposal about basic policy in system buildup adopting standardization technology. It was approved. This proposal will be published from time to time in the virtual showcase, after stable operation of system is confirmed.

The Committee approved unanimously the whole implementation and

information disclosure arrangement being ready along the research project without major deviations.

2. Proposing toward standardization in this research and finding out the issues for the spread of interoperability

2.1 Proposal toward standardization in connection technology of electronic medical record delivery of image/report

Saitama Medical School conducted the verification research of Ministry of Economy, Trade and Industry. In this research, XDS-i integration profile specified the image (object) connection technique between institutions. A part of this technique is WADO technology, which was adopted for object connection (image/report delivery) using electronic medical record within the institution. The uniquely developed extension was used to obtain the specifications that meet the clinical needs.

Saitama Medical School uniquely proposes the solution mentioned below. This technology has a high level of flexibility. Extension can be realized to meet the needs of clinical sites. So, it can contribute to improving the function of electronic medical record in Japan. Accordingly, standardization is eagerly expected.

2.1.1 Function of connection of arrival of object with electronic medical record

(1) Gateway function to convert DICOM/HL7 (An equivalent for virtual Order Filler)
(2) The mechanism by which arrival of image at an image server is notified to the electronic medical record
(3) The mechanism by which the report completion (Verification) is informed from the reporting system to the electronic medical record

[Implementation of this time]

In the verification research of this time, we did not do independent extension to Order Filler, but separated only the specific function that is equivalent to extension. We built it as "virtual Order Filler (DICOM/HL7－Gateway)". By so doing, we connected the status of image and report to the electronic medical record.
As the function of virtual Order Filler, DICOM's GP-PPS (N-Create, N-Set) was received. HL7's ORU/ACK was issued. By so doing, we implemented/built the connection to change the progress status flag of object to the electronic medical record data base.

[Problem]

The SWF integration profile in the present IHE-J guideline has no receptors to cooperate with the progress of this delivery schedule object.
Moreover, HL7 message used this time is the field that should be essentially used for another purpose, and the classification definition of an object is not established

[Point that should be standardized]

In this case (although it is necessary to separately discuss whether this technique is optimal), the following implementation should be defined, as SWF, in Order Filler・Image Manager and, as RWF, in Report Repository (Report Manager).

1) Image Manager/Image Archive shall issue, at the time of image arrival, a "RAD-49 Instance Availability Notification (DICOM-IAN)" transaction to Order Filler.
2) If Order Filler receives, from Image Manager/Image Archive, a "RAD-49 Instance Availability Notification (DICOM-IAN)" transaction, then it shall issue a specific HL7 telegram to electronic medical record.
3) Report Repository (it is Report Manager in the definition in the present RWF), shall issue, at the time of report decision (at the time of the report storage by Report Repository, or at the time of report decision operation by Report Manager), a "RAD-42 Performed Work Status Update (DICOM GP-PPS)" transaction to Order Filler.
4) If Order Filler receives, from Report Repository (it is Report Manager in the definition in the present RWF), a "RAD-42 Performed Work Status Update (DICOM GP-PPS)" transaction, then it shall issue a specific HL7 telegram to electronic medical record.
5) The wording of HL7 telegram that Order Filler issues is predicted to be equivalent to "the notice of RAD-xx implementation information (HL7 ORU)". But, the present connection of Order Filler→Order Placer is inadequate. So, it is necessary to plan standardization from the following variations.
   ① To newly plan the set (transaction) of the required information connection message.
   ② To use the existing message connection and to standardize the structure of status connection that is clinically required.
   ③ To standardize the technique of embedding the said information at somewhere in the existing message connection.
6) In the message exchange of HL7, in order to establish the technique in which DICOM object classification is specified/connected, an event type needs to be defined newly as the information that distinguishes the message.

2.1.2 Function of object instance for electronic medical record connection.

Mechanism by which URL (http request) of objects such as image and report that should be acquired by WADO is notified to electronic medical record.

[Implementation of this time]

With this verification research, the system side that supports DICOM respectively uses internal logic. It transmits the patient data and Study Instance UID required to retrieve objects, at the time of N-Create, to "Virtual Order Filler (DICOM/HL7-Gateway)". The patient data is connected from Order Filler originally as ORM, and contains the patient name, patient ID, patient birthday, patient sex, receipt number and order number.

Furthermore, "Virtual Order Filler (DICOM/HL7-Gateway)" uses PPS-ID at the time of N-Set as a search key, develops various values to ORU, converts them into HL7 message and realizes connection to electronic medical record.

[Problem]

To clinically use the implementation technique in the present WADO, the electronic medical record side must grasp all URLs by which the electronic medical record retrieves necessary objects, for every event type within Order with Order as a reference. In other words, an object delivering Actor must inform the electronic medical record for every order and for every event type. Such mechanism is necessary.

If this connection were to acquire the assumed URL in advance, then response to the unexpected exchange in the way would be impossible, or timing would be shifted from arrival of object itself. Thus, such mechanism cannot be used practically. Notification should be done each time after arrival of an object.

[Point that should be standardized]

Ideally, Order Filler should take charge of this function. There are many values that are originated in ORM and connected from electronic medical record. By adjustment with use Actor, selection from these values is made with necessary particle size. Information of electronic medical record side is identified, and connected to UID of object on Order Filler. Then, necessary connection information (URL) is returned to the appropriate field of HL7. If this mechanism is standardized, then this specification will be available to many medical institutions in Japan.

2.1.3 Function to provide lists that retrieve object (mainly image, etc.)

Plural object sets (Study unit and Series unit) are gathered. The function to create the displayable list object is implemented to the service providing side. URL is originated in Study UID/Series UID, which is the displayable unit of list (which is Study unit in this verification research). Such mechanism is described here.

[Implementation of this time]

With this verification research, URL is originated in SOP instance UID as the concept of WADO. This URL is triggered directly. The Web browser (IE: Internet Explorer) is prepared as a function of the electronic medical record side. We realized connection to display images on the browser. In addition, we connected Study instance UID. We connected it with the list function that was prepared at Image Manager side. By so doing, we connected the list at the beginning, selected the image number on the list, and activated WADO. Such mechanism was realized.

[Problem]

The present standard specifies only the following procedures. The electronic medical record holds URL that is originated in SOP instance UID in all images. For every image, a simple URL connection is made.

Now, the following problems occur.

1) The electronic medical record side must grasp all the URLs that are originated in SOP. The problem occurs in connection with Order (there are several hundred images for one Order).
2) The electronic medical record must be able to grasp the instance of the image that

was generated after Order was completed. (Post-processing, additional radiography, etc.)

3) Operation of electronic medical record to display a single image does not meet clinical needs. It produces complex transactions and excessive loads.

As mentioned above, this research adopted the technique of creating a image list per Study unit. But, neither IHE-J nor WADO defines implementation on the basis of Study Instance UID. Moreover, WADO cannot deliver instances of series or study, which is a summary of images.

When kinds of objects are considered, if the object display is self-contained in a single screen like a report, then this mechanism is sufficient. But, if the display is a part (one sheet) of several tens of image sets, then the display must continue by retrieving other screens without self-completion after the original display. Such mechanism becomes necessary.

When using this technology for general-purpose object linkage in a hospital, lack of this mechanism will prevent the spread seriously.

[Point that should be standardized]

The present connection technique of object unit (SOP instance UID origin) is not enough. On the basis of the connection of object unit (SOP instance UID origin), connection of list or application must be possible. If such standard technologies and arrangements are presented, this implementation (WADO) is expected to make a great progress toward the spread.

In addition, if this application retrieval portion is standardized, then it will be possible to implement about object retrieval of electronic medical record side that does not use WADO. From a viewpoint of interoperability, such standardization is very desirable.

2.1.4 Example of trigger URL at time of WADO connection that Saitama Medical School implemented

In this research, Saitama Medical Center, Saitama Medical School used the following URLs for actual connection at the operation test. In this case, URL for pure WADO connection is (2) below. This is a technique to directly specify an object.

(1) http Request (when Study is specified).
http://192.168.193.31:8080/WADO/app?requestType=WADO&patientID=5012344555&studyUID=1.392.2000.6.7.555

(2) http Request (when Object is specified).
http://192.168.193.31:8080/WADO/app?requestType=WADO&patientID=5012344555&studyUID=1.392.2000.6.7.555&seriesUID=1.392.2000.6.7.555.1&objectUID=1.392.2000.6.7.555.1.5440303

2.1.5 Workflow of WADO at Saitama Medical School (image delivery model)

In this research, the verification system of Saitama Medical Center, Saitama Medical School built the following transactions for actual connection at the operation test.

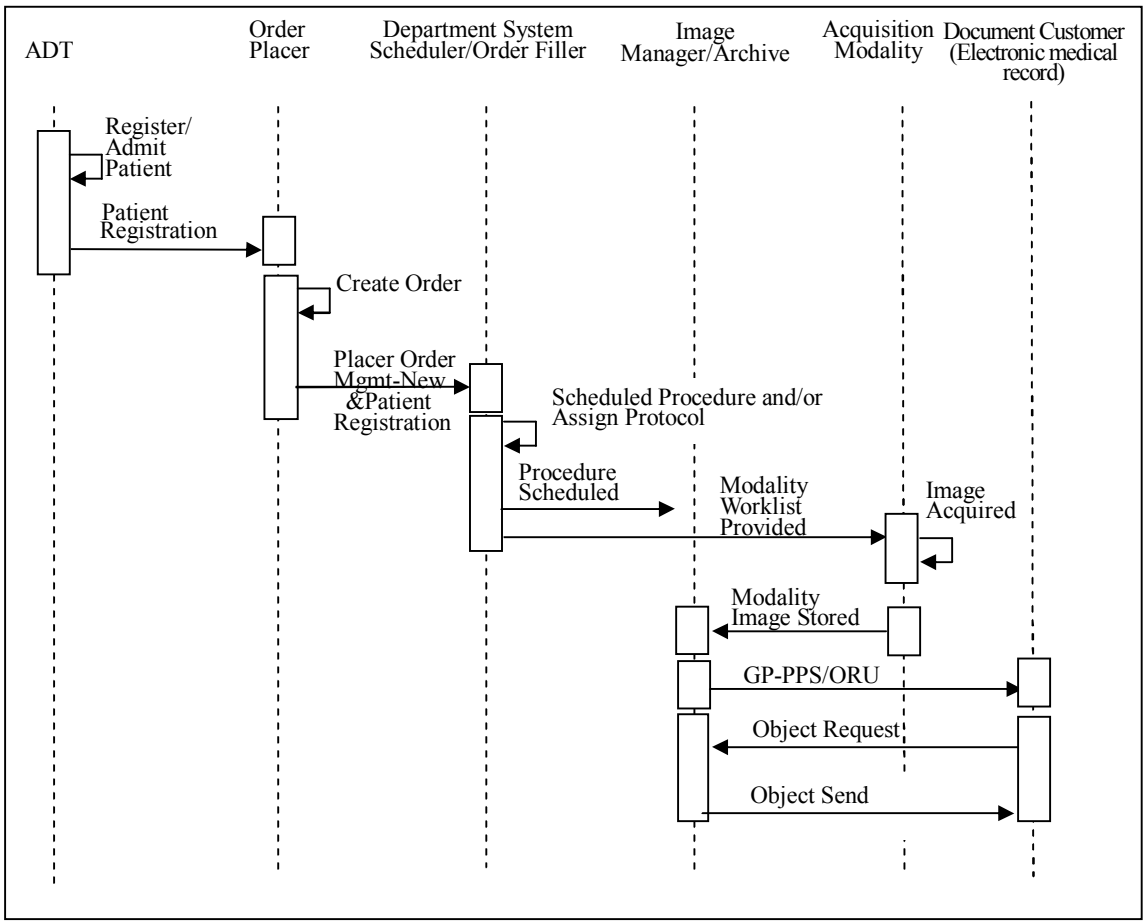

Figure 2.1: Transaction model of WADO that Saitama Medical School implemented

3. Total evaluation of this research and consideration of issues for the spread of interoperability

As total evaluation, the most noticeable matter through this research was deep significance of standardization and "50% satisfaction" due to its values. We built the system of radiology department using IHE-J as much as possible. This was our clear policy. As a result, the system buildup advanced very efficiently. The resultant interoperable system was beautiful. We felt 50% satisfaction.

Another 50% satisfaction will be felt when standardization by IHE-J is settled as the basic information technology of the entire hospital. As long as it is of real importance, the following two points are necessary. Firstly, IHE-J rules should be further substantiated. Secondly, the substantiated rules should be exemplified in clinically operating institutions. Both substantiation and exemplification are necessary like two wheels of a cart.

A series of activities of interoperability in this research were conducted a verification research of the Ministry of Economy, Trade and Industry. In a sense, this research was protected. Thanks to the protection, it has made a remarkable progress for the past several years. However, it should be mentioned consciously

here that this project cannot yet continue autonomously.

This never means that a series of research was not successful. Only because of the success made so far, further growth and promotion are greatly expected in several yeas to come. This is our way of thinking.

The interoperability centering on IHE-J has passed a risky period of infancy. How far can it extend in this period of growth? Full extension is a wish of all peopled concerned.