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Information-sharing Systems and Inter-organizational Power: Implementation of an Electronic Patient Record System for Regional Cooperation

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Abstract

This paper explores the way in which different types of information and communication technologies are positioned among healthcare provider networks in different regions within Japan. Preliminary research indicated that two different types of communication and information sharing systems storing e-patient records are currently in use in Japan; one is an e-patient record system under the ASP (Application Service Providing) model and the other is a non-ASP type of communication and information-sharing system, which can be described as a kind of 'enriched' e-mail system over a secure network. This paper focuses on a number of case studies that revealed that the acceptance of, or resistance to a certain type of e-patient record system is largely due to the interaction of technological design and inter-organizational relationships among healthcare providers.

Keywords: Electronic patient record system, ASP model, Inter-organizational power, Communication media

1. Introduction

Today, many countries look upon electronic patient record systems as an important tool for communication and information sharing as well as an effective data store for healthcare service providers. These systems allow primary care physicians and special doctors to share patient records more effectively and provide better treatment to patients. The Japanese government is currently promoting such a system, which would encourage active communication and cooperation among doctors in regional clinics and hospitals.

Having carried out some preliminary research around the country, I discovered that two different types of such systems collecting e-patient records are currently in use in Japan. One is an e-patient record system under the ASP (Application Service Providing) model and the other is a non-ASP system of 'enriched' e-mail over a secure network. Although the Ministry of Trade and Industry (METI) had previously promoted an ASP-based system trial implementation in 26 regions, most of them discontinued using it after the implementation trial period had ended. On the other hand, non-ASP type of system recently has been promoted by the Tokyo Medical Association and other urban regions.

One research task was to try to understand the lack of popularity of the ASP system. To explain it I carried out case studies exploring how different technologies are employed as an information-sharing tool among doctors in different regions.

The following chapter looks at the rationale and the direction of information technology in the healthcare sector in Japan. Chapter 3 reviews some key theories to supply an analytical framework, which are theories on information systems, inter-organizational relationships, and communication media. Based on the theoretical framework, multiple case studies, shown in Chapter 4, are designed and conducted. This paper argues that acceptance of, or resistance to the ASP-based information system is largely due to the prevailing inter-organizational relationships within the regional healthcare unit.

2. Japanese Healthcare Reform and Implementation of E-patient Records

The recent Japanese healthcare reform program can be viewed in the context of demographic change toward an aging society associated with rapidly increasing medical expenditure.

The Japanese National Health Insurance (NHI) system was initiated in 1961 to furnish citizens adequate access to healthcare, providing a fee-for-service system for medical services, benefits in kind, and free access to any medical institution. Unlike in most western countries, NHI and other types of corporate insurance do not require the insured to have a primary care physician. People have long enjoyed unrestricted access to any medical institution of their choice, including general hospitals and medical specialists. Some economists have been criticizing that this system is at the root of inefficient resource allocation and concomitant increases in medical expenditure (Yashiro 1999; Innami, 1997). They insist that unrestricted access of patients to hospitals of their choice should be limited.

Short of any effective access control system, the official policy is to encourage people to consult a primary physician who works as a ‘gatekeeper’ and to persuade hospitals to increase specialization (e.g. emergency services, acute diseases, rehabilitation, elderly care, etc.). The system for reimbursing providers for medical services under the NHI has in fact encouraged medical institutions to specialize. Hospitals providing specialized medical care for specific diseases are being complemented by clinics staffed by general practitioners. It means, in effect, that at large hospitals the ratio of outpatients to inpatients is restricted to 1:2 if these hospitals wish to qualify for additional credit. Likewise, clinics can get additional credit if they refer their patients to specific hospitals. This change in payment policy appears to lead to greater cooperation among various types of medical institutions.

In December 2001, the Ministry for Health, Labor and Welfare (MHLW) announced a ‘Ground Design’ for bringing the healthcare sector forward into the information age, suggesting the use of the e-patient record system as an effective communication and information sharing tool equally benefiting patients, clinics and hospitals, while restraining total medical expenditure. The aim was for the system to penetrate 60% of all hospitals with

more than 400 beds and over 60% of all clinics by 2006. Since ‘Ground Design,’ promotion of cooperation among medical institutions has become a national policy.

The Ministry of Trade and Industry (METI) and MHLW are the key agents promoting the policy of the e-patient record system. METI allocated a budget to subsidize regional trials and experiments with the system, and required regions to develop the ASP type of system over secure network and within sufficient privacy constraints. 26 regional candidates were selected from 169 applicants. METI spent a total amount of ¥5,875 million on these 26 regions for the 15 months of the trial project, from 2002 to 2003.

ASP is a kind of system that provides applications over a network, typically the Internet, making it possible to keep overall costs low and provide a reliable service. Why did METI propose the ASP e-patient record system for regional healthcare cooperation? First, cost is relatively low and very little labor is required for medical institutions, especially small clinics. Second, information sharing among multiple players is much easier than with any existing systems. ASPs also technically allow patients to refer their medical record from their home over the net. Third, statistics concerning public health can be easily generated from aggregated patient data.

METI’s trial projects ended in March 2003 with many regions reporting that the trials had been successful. However, few regions decided to continue the project thereafter. Users were clearly unenthusiastic about the system and finally abandoned it. Conducting some preliminary research early in 2003, I found that only three regions were still fully using the ASP system while others had lost most of their participants or had reverted to exchanging patient records with alternative systems. My research also revealed that quite a few hospitals and clinics had purchased their own proprietary e-patient record systems even though still in possession of the regional ASP system.

Why have many districts stopped using the system, while some others are still operating it? Does it have anything to do with the technology, or with regional attributes? We will be able to answer these questions on the basis of case studies since such studies are particularly appropriate for the type of problems where research and theory are in their early, formative stages (Yin 2002; Roethlisberger 1977). However, we first need to put forward an analytical framework taking into account of existing theories.

3. Theoretical Framework

In this chapter, I will propose a theoretical framework that integrates information technology and inter-organizational relationships, and accounts for the structure and behavior of clinics and hospitals in a given region. I will briefly refer to a few useful approaches in the exploration of technology and complex organizations.

3.1 ‘Interaction Theory’ explaining resistance to information systems

Kling (1980) suggested some very helpful theories of resistance to information

systems, highlighting human relations and organizational politics, among others. Using Kling's concepts, Markus (1983) proposed three theories stressing people, system and interaction as determinants in resistance to management information systems (MIS). Her case study found test results pointing to the superiority of the interaction theory, which suggests that resistance to MIS is caused by an interaction between organizational factors and system factors. The basic assumption of the theory is that information systems frequently affect their key actors in terms of a particular distribution of intra-organizational power. The interaction theory leads to a model of organizational analysis and diagnosis that can be used to design systems that do not generate resistance. However, the theory provides no universal non-contingent advice to systems and therefore needs to be tested in different settings to confirm its application. While Marcus used concepts of intra-organizational power and politics, research on the interplay of e-patient record system and regional healthcare providers in Japan requires concepts of inter-organizational power and politics and an examination of the dependencies of inter-organizational relationship formation.

3.2 Inter-organizational Relationships

A variety of relevant perspectives on inter-organizational relationships can be found in the literature to date. They can be summarized as follows: resource dependence perspective (Thompson, J.D. 1966; Pfeffer and Salancik 1987), organization set perspective (Evan 1966), collective strategy perspective (Astley and Fombrum 1983), institutional perspective (Scott 1987, 1992; DiMaggio and Powell 1991), and transaction cost perspective (Coase 1937; Williamson 1975, 1981).

This paper focuses on inter-organizational power from the resource dependence perspective. It is based on the assumption that an organization enters into relations with other organizations because it has to rely on their resources in order to achieve its own goals (Pfeffer and Salancik 1978). Thus hospitals and clinics in a given region enter into relations because hospitals require the introduction of patients from clinics and vice versa in order to maximize their profit in the new regulatory environment. From the resource dependence perspective, Pfeffer (1981) describes the major determinants of 'power': dependence of others on the power holder, ability of the power holder to cope with uncertainty, irreplaceability, and ability to affect a decision-making process. If we extend these notions to the context of inter-organizational relationships, inter-organizational power can be described as the autonomy of an organization that can act without others whereas others depend on it. Therefore, inter-organizational power is often conditioned by "organization size, control over the rules governing exchange of material resources and information, the ability to choose a 'do without' strategy, the effectiveness of coercive strategies, and the concentration of inputs" (Oliver 1990). Following this logic, a large well-equipped hospital is considered to have more power than a small clinic. However, as the number of such large hospitals in a region increases, their individual power diminishes relatively because clinics perceive more alternatives to which they

can refer their patients. Therefore, in regions with many hospitals, the degree of dependence on each particular hospital is low and inter-organizational power is diffused. On the contrary, in a region where there are very few hospitals, the degree of dependence is higher and inter-organizational power is concentrated.

3.3 Communication Media

Inter-organizational communication refers to the exchange of information between organizations, which requires a shared semantic structure even though a variety of media may be used such as telephone, document, e-mail, and so on. According to Media Richness Theory a communication medium can be ranked by its ability to handle message equivocality and uncertainty (Daft and Lengel 1984). The criteria of the degree of richness are (a) the availability of instant feedback; (b) the capacity of the medium to transmit multiple clues such as body language, voice tone and inflection; (c) the use of natural language; and (d) the personal focus of the medium. Daft and Lengel (1984) studied this theory in its classical positivist form. Subsequently, Ngwenyama and Lee (1997) gave it a critical social theory perspective with an emphasis on the importance of organizational context in communications. In practice, situation requirements matched against media characteristics as well as social and organizational factors influence media choice. In other words, media differ in the perceptions they generate among users with respect to social presence, communication effectiveness and communication interface. If the chosen medium does not match a specific task or objective and the degree of richness required by that task, the task performance and satisfaction of the users of the medium will be low and as a result, the media is likely to be abandoned.

Key theories indicated here generate an analytical framework on interactions between organizations and information technology in the field of regional healthcare in Japan. Inter-organizational relationships are likely to affect the implementation of certain types of information systems and communication media. It can be suspected that the degree of the concentration of inter-organizational power in a region influences the deployment of a system with a high degree of information sharing (i.e. the ASP based e-patient record system).

4. Case Studies

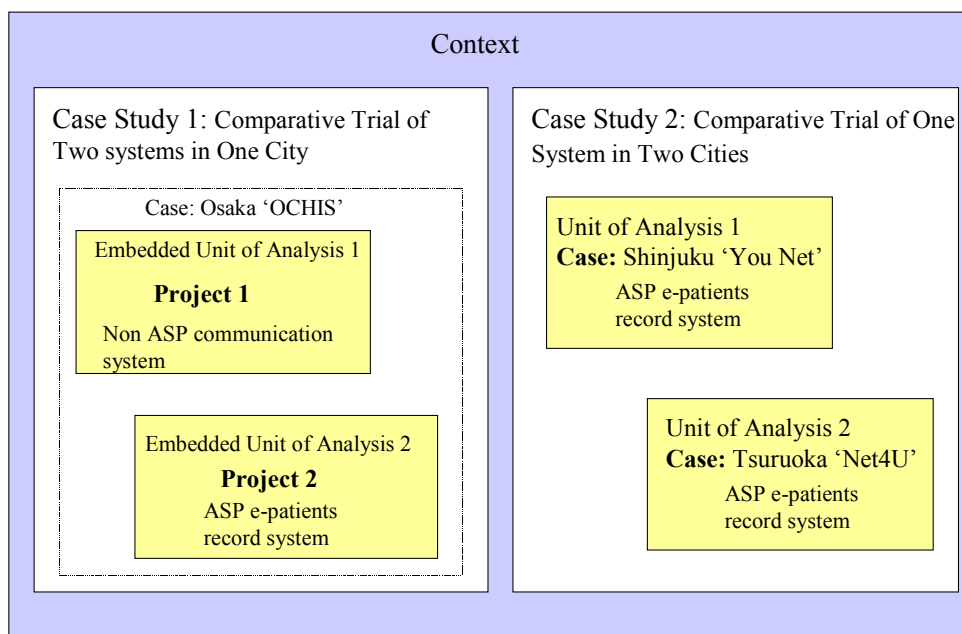
This chapter presents case studies, which seem well suited to the type of investigation where research and theory are in their early, formative stages (Bembasat et al 1987). Since e-patient record systems are in the very early stages of implementation, it is better to conduct research in an exploratory manner by asking such questions as: How do regional inter-organizational relationships (i.e. relationship between clinics and hospitals) differ? Is asymmetric power observable? Can the e-patient record system be made to work as an inter-organizational communication medium, and if so how? Does the ASP system have a potential to change the inter-organizational relationship or power structure?

4.1 Research Design

The methodology employed is multiple case studies. By following ‘replication logic’ (Yin 2002), three sites were deliberately chosen to form the basis of two comparative studies (see Figure 1). The first comparative study, Case Study 1, describes one regional medical network that developed and tried two different technological systems, an ASP based e-patient record system and a non-ASP patient history/reference exchange system. This case illustrates how a region is resistant to one ASP model but not to the other. The second study provides a theoretical replication to get compelling support for the initial findings. Case study 2 looks at two different regions employing the same ASP e-patient record system but with very different outcomes in terms of participation of organizations in those regions. By using the ASP based e-patient record system as a controlling factor, Case Study 2 will show that the inter-organizational relationship is a key determinant in the implementation of the system.

Multiple data collection methods are employed. Sources and data include direct observation, interviews with over 40 doctors in hospitals and clinics, systems engineers, a variety of quantitative data from surveys, documentary evidence about systems and organizations involved, as well as devices, software and information system networks. Based on notes and materials, key findings and conclusions of each case study are summarized in the following sections.

Figure 1: Design of Two Comparative Case Studies



4.2 Case Study 1: Trial of two Different Systems in Osaka

The Osaka Community Healthcare Information System (OCHIS) was selected by METI for its trial project. Eight computer and SI firms, four hospitals and eighteen clinics jointly developed the system of that region and participated in the trial.

OCHIS had two primary goals. One was to develop a system for creating and exchanging a patient’s medical history and references over a secure computer network, given that such information exchange was still carried out manually using paper. (Note that as a communication medium, paper has very little ability to handle equivocality and uncertainty.)

The other goal was to develop an e-patient record system based on the ASP model. By using the system many clinics and hospitals can share patient information as if they formed a single organization. As noted in Chapter 2, this process enables clinics to reduce the burden of labor and maintenance cost. (See Table 1 below for a summary of these two systems.)

The ASP model was originally expected to constitute a more efficient and effective system, with doctors in clinics and hospitals being able to share patient record details highly efficiently since they can access to the same patient record in the shared database.

OCHIS installed a database server in a regional data center in Osaka city with all clinics and hospitals being interactively connected via 1.5 Mbps ADSL IP network. The data center configuration includes PKI (Public Key Infrastructure) for network security and authentication. (See Figure 2.)

Table 1: Two projects carried out by OCHIS

Project 1: Patients' medical history and reference exchange system	Project 2: ASP-based e-patient record system
<ul style="list-style-type: none"> ● Clinics and hospitals generate patient histories and references electronically and send records to other clinics and hospitals over the network. ● Participants do not need to share original patient record data in their entirety. They can copy, paste and send others whatever they think relevant. ● Participants not employing the e-patient record system can still generate a summary letter or reference electronically. ● If doctors are familiar with general e-mail, it is easy for them to take part. 	<ul style="list-style-type: none"> ● All participants have to use the same e-patient record application provided over the network. ● Database and applications are placed with data servers in the data center and accessed by terminals from each clinic. ● The patient gives permission when and by whom data can be accessed and shared. ● Once the patient allows the sharing of data, the hospital or clinic having filed the original record finds it hard to conceal the record or make changes to it. ● Doctors have to learn how to use the system and how to input patient records.

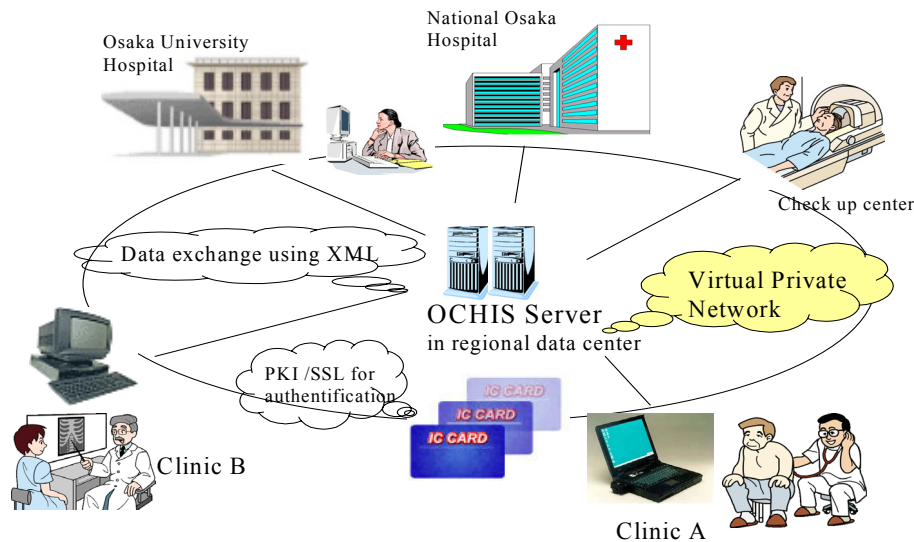
< Project 1 >

During the six months of the trial period (November 2002 to May 2003), participating clinics and hospitals generated and exchanged the medical histories of 90 patients, including references, through the network. The survey conducted by OCHIS shows that 64 out of 66 doctors involved in the trial were very satisfied with the system. The interview I conducted showed a significant improvement on the past system in terms of usability and efficiency. One doctor said that the system was much faster, secure and richer in information than paper. Another doctor in a clinic maintained that it was as easy in use as an ordinary e-mail system using a secure network.

After the trial period had ended, all participants continued using the system. Another three hospitals joined the network after the trial. In fact, as the Figure 3 shows, the number of

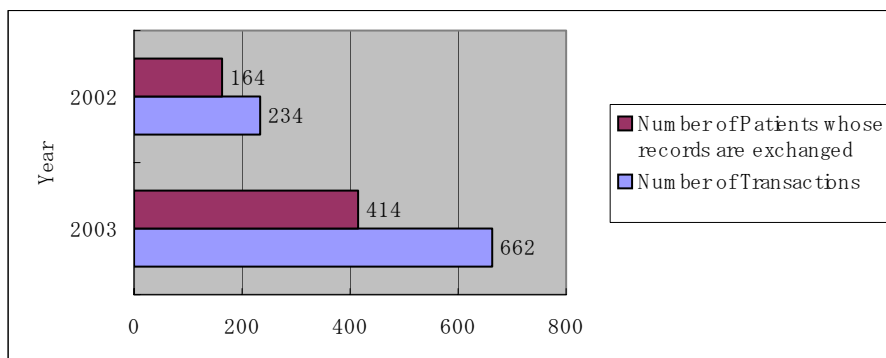
patients whose records are exchanged over the system increased from 164 in 2002 to 414 in 2003. The number of transactions increased from 234 to 662. The medical history of 99 patients has been exchanged in the first two months of 2004 alone. This data shows that the system of Project 1 has been in active use and that the network is growing.

Figure2: Image of OCHIS network



4 hospitals and 18 clinics are connected to the network

Figure 3: Number of Patients involved and Transactions in OCHIS



< Project 2 >

The e-patient record under an ASP model was a modified version of NEC’s application, which was originally designed for National Osaka hospital. Functions were specifically selected for clinics to enable easy use. During the six months of the trial period, three hospitals and six clinics tried to use the ASP e-patient record system, however, only four patients’ medical records were exchanged between clinics and one hospital as they were the only ones who allowed their data to be shared by both their GP and hospital doctors. Three out of six clinics reported dissatisfaction with the downloading speed. Four found filling in the

record stressful and answered that it took longer than the previous method. One doctor confessed, “to be honest, it was really stressful to fill in the unfamiliar form appearing on the screen. I was not used to fill in so many details as doctors do in hospitals.” Another doctor said, “I was reluctant to use the system because I felt I was controlled or somehow monitored by the hospital which I was to share the data with. Project 1 is better because I can communicate and exchange data with any hospital, even if the hospital doesn’t have the e-patient record system. But Project 2 allows only few hospitals to share the data.”

After the trial, two hospitals withdrew from this project because they had a proprietary e-patient record system already running in their organization. For them, running two systems proved inefficient. Clinics thought it was not worth implementing the system if there was only one hospital in the network. Thus, OCHIS decided to abandon this second project completely.

<Discussion of Case Study 1>

The result of the case study is that clinics were well disposed toward Project 1, while they were resistant to Project 2. Let’s look at the reasons for this result. First, Project 1 was much easier for clinics to participate in as the system allowed members to communicate with one another and share information, albeit partially, even if they didn’t employ e-patient record system. Second, usability was superior to the system developed in Project 2. Third, and most importantly, clinics felt it was no use to operate a system that allowed them to share information with only one general hospital. Clearly, the degree of dependence of clinics on the National Osaka Hospital was not very high. There are other many big hospitals in Osaka, which clinics wanted to refer their patients to. Thus, the communication medium they needed was one allowing them ad-hoc connections.

4.3. Case Study 2: Comparative Trial of Same System in Two Cities

Case study 2 is a comparative study carried out in two different regions which experimented with identical ASP e-patient record systems.

Let me briefly describe the ASP-based e-patient system deployed in these two regions. This system provides all application software, including a complete database containing patient medical records, references, and other related information. The main server is located in the office of the Medical Association in each district and administered by those who work there. Doctors download and use necessary information by way of an IP network configured with VPN for primary security. With today’s widespread use of broadband, the system provides sufficient network and transaction speed in the most cost-effective way. The system is designed to share a patient’s medical information only when agreement between a patient and his/her doctor has been established, and it is only made available to medical offices where patients have once visited.

The following passages describe how the system is used in two particular regions,

Shinjuku and Tsuruoka City. (See Figure 4 for their respective system and network design and Table 2 for a summary of regional characteristics.)

<You-Net: Shinjuku >

Shinjuku is one of most concentrated metropolitan areas in Tokyo with an approximate 300K population in an area of 18.23sq km. Within the ward, there are approximately 18 hospitals and 574 clinics. Viewing Shinjuku district in this study as combined with two neighboring wards, the number of medical institutions rises to 48 hospitals and 1400 clinics, serving a population of over 1.1M. Some of the unique characteristics of Shinjuku include the presence of many well-known national and university hospitals acting as ‘core’ medical institutions with leading-edge technologies. These hospitals attract a large number of people from outside Shinjuku seeking medical treatment.

In 1998 a group of Doctors started working on a project called ‘Shinjuku Integrated Regional Care System’ to promote regional medical collaboration. An ASP based e-patient record system originally designed and developed by the National Medical Center, which is one of the largest hospitals in the district. The system was first operated in 2001 involving one hospital (National Medical Center) and 15 clinics. Surprisingly, two years later the number of clinics using the system had fallen from fifteen to seven, an extremely small percentage given the total of 574 clinics in Shinjuku. The survey pointed to the fact that the vast majority of those familiar with the system found it ineffective for the reason that only if *all* hospitals and clinics were to operate the *same* system, then its benefits would in fact become evident. However, if the system were widely in use it would lock every participating clinic into one particular medical institution, and this would actually limit a doctor’s ability to refer patients to any other appropriate hospitals or clinics. This appears to be a valid concern among doctors in Shinjuku, which has many healthcare institutions that compete fiercely.

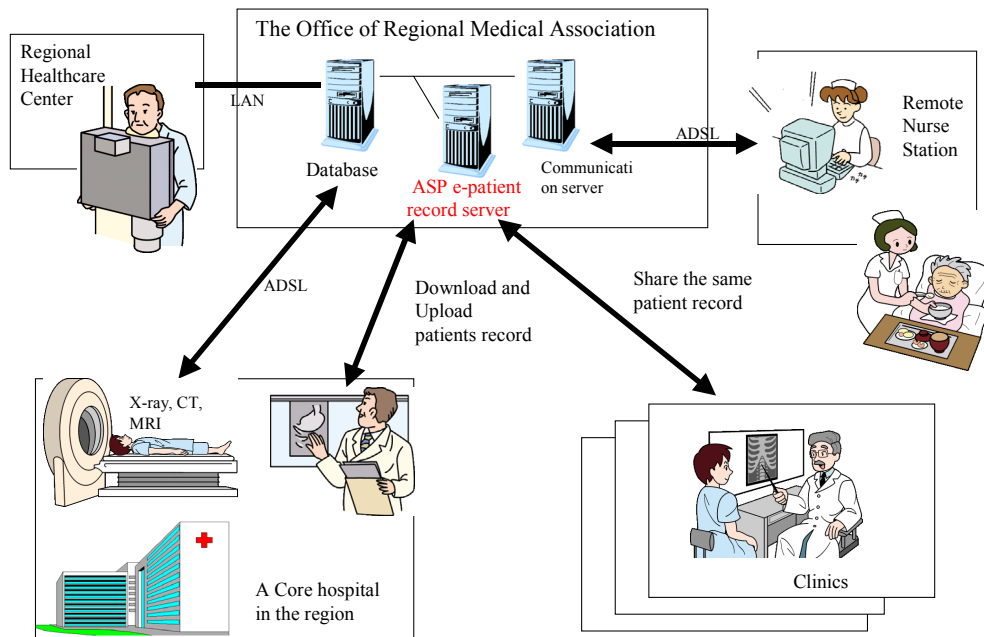
<Net4U: Tsuruoka>

Net4U is a system implemented in Tsuruoka City in Yamagata Prefecture in the northern part of Japan and follows the same ASP-based e-patient record system scheme. Within the Tsuruoka district there are 6 hospitals and 97 clinics serving its 160K population. There is only one hospital that acts as ‘core’ medical institution – the publicly operated Shonai Hospital. The system they use originated from ‘You-Net’ in Shinjuku and began operation in January 2002. Contrary to what happened in Shinjuku, the system has been very well received and has become quite successful. It enables a ‘one patient - one common record’ structure in the Tsuruoka region. Multiple hospitals and clinics are able to write to a patient’s shared file and the information can be made available to others (those who need to know, e.g. nurses) if the patient agrees. This has made remote medical treatment at a patient’s home, being an important part of medical practice in rural areas, much more effective as the patient’s medical information is not only available all the time and in one place, but is constantly being updated.

This, in turn, allows giving the patient the best possible treatment.

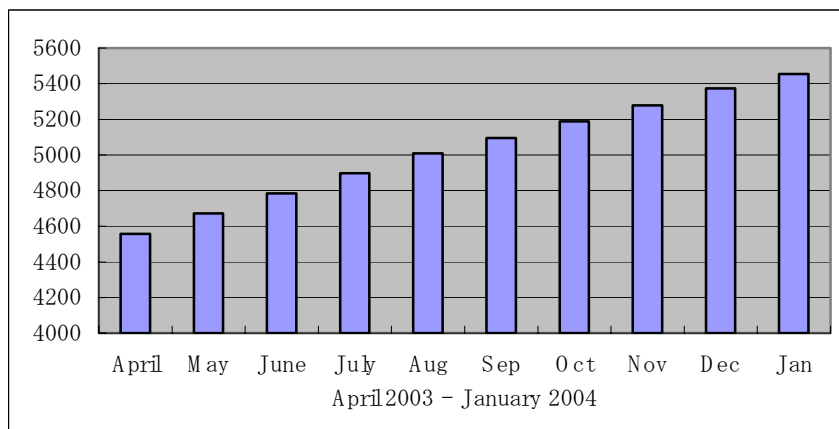
As of December 2003, four hospitals, 25 clinics, one remote nurse station, a city health administration center and three medical laboratories have joined together on the system. Since its initial operation in 2001, 5475 patients have been registered on the system and 994 (18%) are sharing their medical records. The number of registered patients continues to increase as the Figure 5 below shows.

Figure 4: ASP e-patient record system used in Tsuruoka's case



*The basic technical system is the same as the one deployed in Shinjuku, however, Shinjuku's network doesn't include the Remote Nurse Station and the Regional Healthcare Center.

Figure 5: The number of registered patients of 'Net4U' in Tsuruoka



<Discussion of Case Study 2>

It is very interesting to see quite distinct results emerging from these two study areas, though both of them employed identical e-patient record systems. It is conceivable that

influence, interaction and power relations between medical entities (hospitals, medical offices, others) as well as geographical differences (population density, numbers of medical facilities, etc.) have led to this distinction.

From a number of interviews conducted it has become clear that the incentive of employing such systems heavily depends on *everyone* using the same system. In the case of Tsuruoka, Shonai Hospital is the power-holder. It is the only hospital in the study area that has the ability to handle serious medical conditions, with other medical offices depending heavily on it. Hence the success of system implementation there as evidenced by the number of registered patients increasing year by year.

Contrary to Tsuruoka's case, in a large city like Tokyo or Osaka where many large medical facilities co-exist, dependency on any particular hospital is very low. As seen in the You-Net case in Shinjuku, the e-patient record system never became widely deployed among hospitals and clinics there. This is because 'inter-organizational power' is well distributed and in addition, each hospital and medical office already has its own established proprietary e-patient record system. For this reason, it seems reasonable to assume that such an ASP-based e-patient record system would add no or only very little value to their operation.

Table2: Comparison of 'You-Net' in Shinjuku and 'Net4U' in Tsuruoka

Summary of Shinjuku District	Summary of Tsuruoka District
<ul style="list-style-type: none"> ● Shinjuku district consists of Shinjuku ward and 2 neighboring wards, Nakano and Suginami. ● The district has population of 1.1M and area of 67.8sq km. ● The district has 48 hospitals and over 1400 clinics ● There are many large, well-equipped hospitals. 	<ul style="list-style-type: none"> ● Tsuruoka district consists of Tsuruoka City and 6 neighboring towns and villages ● The district has population of 160K and area of 1344sq km. ● The district has 6 hospitals and 97 clinics. ● There is only one large core hospital.
Summary of 'You-Net' in Shinjuku	Summary of 'Net4U' in Tsuruoka
<ul style="list-style-type: none"> ● Shinjuku You-Net first implemented by National Medical Center and 15 clinics in Shinjuku ward in 2001. ● ASP based e-patient record system was developed mainly by National Medical Center. ● Currently, National Medical Center and 8 clinics are using the system. 	<ul style="list-style-type: none"> ● Net4U started in January 2002, by implementing the same ASP e-patient record system as Shinjuku You-Net. ● Currently the network has 4 hospitals, 25 clinics, 1 remote nurse station, a city health administration center and 3 medical laboratories.

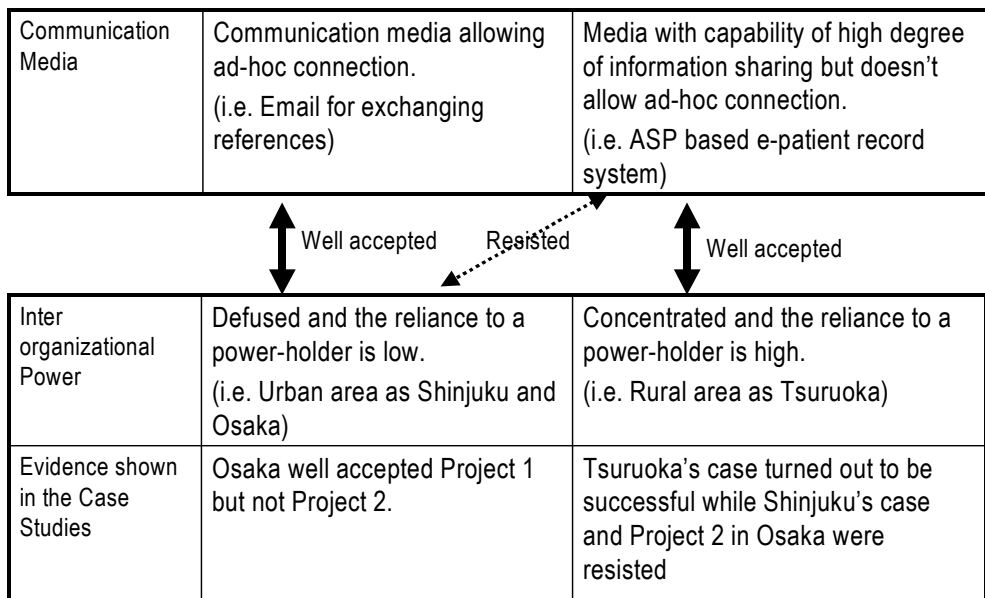
5. Conclusion

With reference to some of the implications of the present paper, I would like to address its theoretical contributions and practical implications for the use of IT in the healthcare reform in Japan.

The findings revealed that inter-organizational power is a key factor in determining the type of technological system employed in a given region. The study also clarified that information systems embody a distribution of inter-organizational power among the intended participants, which is affected by their design. As a communication medium, the ASP e-patient record system has a much higher ability to handle equivocality than e-mail because it allows to

share the original patient record itself, while the latter allows the exchange of part of the patient record as selected by the sender. However, the study shows medical institutions in urban regions prefer media that allow ad-hoc interconnections, even if they do not preclude equivocality. This is well explained by inter-organizational power relations as described from the perspective of resource dependence. (See Figure 4.) The studies in this paper supported the interaction theory, which states that resistance to information technology is caused by an interaction between organizational factors and systems factors. However, the interaction theory itself is fuzzy because it implies contingencies. This paper tried to clarify some of these contingencies to enable an understanding of how technological and organizational factors interact.

Figure 4: Findings from the Studies



The present research indicates that Japanese government policy regarding the implementation of the e-patient record system under an ASP model has neglected to measure the ways in which organizational actors have used technologies, as if the technology itself could be expected to provide active cooperation. IT may act as a catalyst for the formation of inter-organizational networks by providing a powerful infrastructure for communication and shared information. It may also put pressure on organizations to form networks, but it provides none of the social skills that networking requires. Inter-organizational networks may at times be composed of equals, but at other times may have a single powerful central player or a small elite coupled with others who rely on the central organization for resources and exchange. Thus networks vary in structure and in how power and other resources are distributed. Policy makers should not underestimate this variation and must find ways to measure inter-organizational and other social factors to achieve their goal of efficient and effective healthcare treatment of the highest quality.

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