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Implementation Difficulties of Hospital Information Systems

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Abstract: This study looks for potential sources of implementation difficulties of hospital information system in a private hospital in Turkey and provides recommendations to avoid these difficulties. Increasing cost of patient care delivery and the difficulties faced during the improvement studies of data quality and data access have increased the pressure for the use of information systems in healthcare organizations. However, due to complex workflows of hospitals, usage of information systems in healthcare brought some problems along with it. In this study, in order to find out the possible implementation difficulties, a survey was conducted in a private hospital in Turkey which was just in the stage of implementing a hospital information system. Techniques of interview, observation and questionnaire were applied for data collection. Data was analyzed by using descriptive and factor analyses. The results of these analyses showed that the potential sources of hospital information system implementation difficulties were related to organizational issues, end user profile, integration of different systems, inconsistency among different workflows of different departments and training issues whereas there was no major implementation problem related to software, hardware, planning, support, security and solution provider. Under the guidance of literature survey and the findings of the study, recommendations for achieving a successful, sufficient and efficient hospital information system implementation phase are given in terms of end user contribution, business process reengineering, hardware planning, integration of information systems, training and support.

Key words: Information systems, implementation difficulties, HIS

INTRODUCTION

In recent years, cost of providing high quality services and patient satisfaction in hospitals has increased tremendously. Using information systems in healthcare has become one of the best solutions for hospital management to decrease cost, to increase patient satisfaction, to improve hospital processes and to provide high quality services. Apart from these, payment systems and provisions from insurance companies have also encouraged the use of information systems in healthcare. As a result, usage of Hospital Information System (HIS) has become a widely used approach.

HIS is defined as a computer system designed to ease the management of all the hospital's medical and administrative information and to improve the quality of healthcare by Degoulet and Fieschi (1997). Another definition of HIS is given as the applications that support the healthcare processes by allowing healthcare professionals or patients direct access to order entry systems, medical record systems, patient information systems and so on (Ash *et al.*, 2004). On the other hand, according to Sneider (1987), HIS is a hospital wide system

or network of systems designed to support the flow of information between departments. These definitions emphasize that HIS should work in integration with non-medical systems such as human resources, accounting and inventory besides medical systems.

With the introduction of HIS into hospitals, improvement in patient care as well as hospital management, collection and retrieval of accurate and complete medical information, lower operational and treatments costs, less time to reach patient medical data, interpretation of clinical data and warnings for exceptional medical cases such as drug interaction were expected from HIS. However, most of the first generation HISs of 1960's and early 1970's did not succeed to make these expectations actual. The second generation of HISs, which started in the middle of 1970's and ended at the end of 1970's, mainly served financial systems and their main purpose was to transmit information from end users to financial systems. They did not save any information related to patients and patient visits; they were only used to retrieve and transfer information. Third generation of HISs, which started in the late 1970's, was influenced by database technology, which was introduced in early

1980's and focused on patient care planning and departmental solutions such as laboratory and pharmacy. On the other hand, the main feature of the fourth and the current generation of HIS, which has started in 1980s, is known as the integration facility of HIS with other third party systems including financial or other departmental services.

HIS implementation and adaptation in hospitals is a complicated task compared to other information systems in different business areas. System infrastructure design, requirement specification, master data collection and definition, integration with other systems, localization, training and final system test are the main activities of implementation phase. During HIS implementation phase, it is highly possible that organizations may face many difficulties.

According to the studies about HIS implementation (Ash *et al.*, 2004; Ball, 2003; Berg, 2001; Hard, 1992; Littlejohns *et al.*, 2003; Memel *et al.*, 2001; Tonnesen *et al.*, 1999; Wetzal, 2001), implementation difficulties are found to be related to:

- Infrastructure, application and organization of the implementation processes
- Management of end user contribution
- Integration of different information systems, external systems and independent physician groups
- Struggling with balance among different departments and end users
- Redundant, inaccurate, uninformative or confusing master data
- Standardization of data definitions, representation and vocabulary
- Technical requirements planning
- End user profile and resistance
- End user training
- Software immaturity
- Support after implementation
- Lack of information about HIS implementation
- Ignorance of administrative needs of hospital

To prevent implementation difficulties of HIS, recommendations stated in previous studies (Ash *et al.*, 2004; Hersh, 2002; Memel *et al.*, 2001; Hard, 1992) are as follows:

- Needs and expectations of stakeholders should be understood and planning should be started accordingly.
- Experiences in other HIS implementation projects should be utilized; their methodologies, pain areas and achievement or failure reasons should always be taken into consideration.

- There should be always a balance between organizational targets and regional/governmental needs. Some of the organizational targets do not match regional and governmental needs.
- Information technology training of end users is essential for a successful HIS implementation. This should include continuing education of physicians, nurses and department secretaries. Training should link information systems to actual clinical scenario.
- Physicians' resistance should be overcome by using several techniques such as encouraging physicians to use system for inquiring result reporting and patient information instead of order entry, providing personal computer lounge of physician and devoting one person for one-by-one training of physicians.
- End users should be involved in the implementation process and features of benefit should be provided to them.
- Hardware infrastructure should be planned effectively during HIS implementation.

MATERIALS AND METHODS

As mentioned before, many problems may be faced during implementation of HIS projects due to various reasons and if those reasons can not be identified and/or cannot be avoided, most of the projects may fail. The objective of this study was to determine the possible implementation difficulties of HIS projects together with their reasons and then give some recommendations to overcome these difficulties to guide other hospitals and HIS solution provider companies.

Choice of organization: The survey was conducted in a private hospital in Turkey that was established in 2005 with the aim of providing highly qualified health services. This private hospital belongs to a foundation, which was established 25 years ago and has completed over 40 projects such as hospitals, health offices, schools, dormitory buildings and sports complexes. The reason for choosing this hospital was that it passed through the all necessary steps for implementing a HIS.

In mid 2003, hospital management started to search for a HIS which would meet the complete hospital requirements including clinical and back office procedures. They prepared Request for Proposal (RFP) to define their needs. Candidate HIS provider companies responded to this RFP and gave their offers to hospital management. Hospital management made an assessment for HIS provider companies using the functionality,

company profile, hardware, deployment and training, price and general cost criteria. Each company was scored as low, medium and high for each criterion. After this assessment, hospital management selected one HIS solution provider which is an international company providing both medical and other industrial solutions.

The study started with the Kick-off meeting. HIS project team consisted of six clinical information systems specialists (three members from HIS solution provider company and three members from hospital information systems team) and two project managers (one from HIS solution provider company and one from hospital).

The first step of the study was requirement analysis. There were two teams involved in this step: hospital team and HIS solution provider company team. Hospital team consisted of the nursing director, chief operational officer, hospital project manager and clinical information systems specialists. HIS solution provider company team consisted of clinical information systems specialists, project manager and also consultants from foreign countries in which the system was being developed. When hospital team and solution provider company team went over the RFP document, it was seen that there were a lot of new requirements to be included in RFP document such as new functions, new facilities and localization issues. After the update of the RFP document according to the new requirements, a new scope document was prepared which led to some updates on HIS software. After the update of the software with new functionalities and localized functions, testing was done to verify the presence of new requirements in the system and also for reporting the bugs in system. After these activities, the system was ready to be used.

During implementation, the project team also worked together with the end users to collect the master data from hospital management. After collecting master data from end users, project team checked the validity of the master data and uploaded them to live database. Project team also took place in the study of integration of HIS to other departmental information systems such as radiology information system, dosage based drug management system and smart cards.

Training was one of the important issues of the implementation. Trainings were planned both for core team, consisting of nurses, physicians and department secretaries and also for the other end users. First, hospital core team was trained; the aim of this activity was to get their help in end user trainings, decide on scenario that would be applied in training sessions and also get first impression about the software. Each training session

was five half days. The first three days of the training sessions were theoretical training and the last two days of the training were hands-on sessions in which end users applied actual clinical workflows in the system. The other end users also had similar training after the core team. Hospital master data was used in trainings to make end users familiar with it. The training sessions did not cover the training of all of the current end users since they were not being recruited at that time.

After one year from the start of the implementation, hospital was opened to service and the HIS was started to be used. Project team provided two months support for the system. Each member was assigned to one location in hospital and helped the end users in their responsible location.

Preparation of the questionnaire: In order to be able to prepare a functional questionnaire for the survey, interviews were made with chief executive officer, chief information officer, chief operational officer and patient relations manager of the hospital. The aim of these interviews was to collect information about history of the hospital and the project, to find out the HIS implementation difficulties observed by hospital managers and the precautions they applied to prevent perceived difficulties together with their previous experiences.

The technique of observation was also used as data collection for the preparation of the questionnaire. The aim was to understand the end users' resistance and/or acceptance of the installed HIS.

Under the guidelines of literature survey, interviews and observations, an initial questionnaire was developed. This questionnaire was applied as a pilot study to 2 nurses, 2 physicians and 1 department secretary. The final questionnaire, which was prepared by modifying the initial one, included 61 questions of which 4 were open ended. The first 4 questions of the questionnaire were related to demographic properties of the respondents. 56 of the questions were prepared following the below group headings as potential causes of HIS implementation difficulties but ordered in different sequence in the questionnaire to avoid halo effect.

- Organization (7 questions): Aims to find out the difficulties arising from organizational issues such as communication with management and attitudes of hospital management.
- Software (8 questions): Aims to find out the difficulties arising from software related issues such as software flexibility and software usability.

- Hardware (3 questions): Aims to find out the difficulties arising from hardware related issues such as the location and speed of computers.
- End user profile (10 questions): Aims to find out the difficulties arising due to the profile of end users. There are two sub groups under end user profile heading: end user profile for general computer skills and end user profile for clinical system experience.
- Integration (4 questions): Aims to find out the difficulties arising from integration related issues such as conceptual design of integration and performance problems resulted due to integration.
- Security (2 questions): Aims to find out the difficulties arising from security issues such as data loss in software.
- Planning (4 questions): Aims to find out the difficulties arising from planning issues such as planning project organization and master data collection.
- Workflow (5 questions): Aims to find out the difficulties arising from workflow issues such as different workflows in different hospital departments.
- Support (3 questions): Aims to find out the difficulties arising from support issues such as methodology and sufficiency of end user support.
- Training (5 questions): Aims to find out the difficulties arising from training issues such as methodology and duration of training.
- Solution provider (5 questions): Aims to find out the difficulties arising from solution provider such as organization of solution provider company and sufficiency of solution provider consultants.

All of the above questions except end user profile group were 5-point Likert scale (5: Strongly agree, 1: Strongly disagree). End user profile group questions were Yes or No questions.

There was also one open ended question at the end of the questionnaire where general opinions of the end users were asked about HIS implementation.

Administration of the questionnaire: The survey was conducted in spring of 2005 by means of applying the final questionnaire to the end users of the hospital. The questionnaire was delivered manually to all of the HIS users with a population of 206 in closed envelopes. 112 questionnaires were returned, indicating a response rate of 54%. The composition of the population according to their occupations is presented in Table 1.

Data analysis approach: After collecting the questionnaires from end users, collected data was entered

Table 1: Occupations of the population (N = 206)

Occupation	Frequency
Physician	73
Nurse	79
Department secretary	40
Technician	7
Management staff	3
Pharmacist	4

to SPSS for further statistical analysis. The following analyses were applied to the data groups:

- Descriptive statistics for demographic characteristics of the respondents
- Factor analysis for set of questions under each group and then the descriptive statistics for redefined variables of each group.

RESULTS

Descriptive statistics: Most of the end users who replied the questionnaire were nurses and physicians. Related to gender split, the 67% of end users were females and 30% were males. In terms of age, there were a considerably higher percentage of younger people, with 67.9% lower than 35 years old. The level of education was high. Out of 112 respondents, 94 of them (83.9%) were university graduates. Demographic information about the respondents is given in Table 2.

Factor analysis: Factor analysis was applied to each of the groups in the questionnaire besides demographic characteristics. As a result, variables of each group were redefined dropping the total number of variables under these groups from 56 to 22.

Related to Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO value), if KMO value is greater than 0.5 and significance is 0.00 then the results of the factor analysis can be accepted as valid.

KMO values and total variance explained for each group, given in Table 3, indicate that the factor analyses are valid for all of them.

Table 4 and 5 show the descriptive values of resulting variables of each group item. Names of the redefined variables, mean, maximum and minimum values of each group and its redefined variables, calculated on the basis of their corresponding original variables, are illustrated in the tables. Mean values, less than 3 in Table 4 show unsatisfied responses and are evaluated as implementation difficulties in this HIS project.

As given in Table 5, 1 is maximum value and indicates satisfied responses for general computer skills and for clinical system experience whereas 0 is minimum value and indicates unsatisfied responses for both groups.

Table 2: Demographic characteristics of the respondents (n = 112)

Property	Frequency
Occupation	
Physician	36
Nurse	40
Department secretary	19
Technician	7
Management staff	2
Pharmacist	-
Not specified	8
Gender	
Female	76
Male	34
Not specified	2
Age group	
Less than 25	15
25-34	61
35-44	16
More than 44	11
Not specified	9
Education level	
High School Graduate	16
Associate Degree	18
Bachelor's Degree	42
Master's Degree (MS, MA, MD-Residency)	29
Ph.D Degree	5
Not specified	2

Table 3: KMO values and total variance explained for questionnaire groups

Group	KMO value	Total variance explained (%)
Organization	0.595	72.8
Software features	0.862	68.5
Hardware	0.604	59.5
End user profile		
General computer skills	0.733	59.8
Clinical system experience	0.657	66.1
Integration	0.561	85.1
Security	0.500	64.3
Planning	0.661	76.6
Workflow	0.554	66.3
Support	0.500	50.6
Training	0.558	65.6
Solution provider	0.731	51.8

Descriptive statistics show that issues related to organization, workflow, training, integration and end user profile groups have caused the main difficulties in this HIS project.

A focus on the results of descriptive analysis introduces the following outcomes:

- Related to organizational issues, the results show that there was not a sufficient end user contribution in HIS implementation and being a new hospital was a problem in this HIS implementation but there was an acceptable satisfaction of end users with the level of communication with management.
- The Workflow group variables indicate that there was not a satisfactory environment in terms of workflow definitions within the hospital and specifically, different workflows in different departments made standardization difficult and caused difficulties.

- The Training group variables indicate that the content, methodology and scheduling of trainings were not sufficient, but the contribution of the end users to trainings and duration of trainings were satisfactory.
- The Integration group variables indicate that end users believed that working with integrated systems reduced working time and enabled them to do jobs in a faster way, but they had difficulties while using those different systems as integrated due to some reasons such as learning difficulties of different systems and terminologies.
- The Security group indicates that end users mostly did not have problems with security related issues such as data loss or inaccurate data in the system.
- The Planning group variables indicate that master data preparation and end user support were organized and scheduled timely and to use HIS just after hospital opening caused no difficulties.
- The Software group variables indicate that users were satisfied with the usability issues of the system such as menu design and terminology and agreed that HIS provided well done data integrity and included most of the workflows that were required.
- The Solution Provider group indicates that the solution provider was experienced in HIS applications such as clinical terminology and needs of clinical staff.
- The Support group variable indicates that support for end users was sufficient meaning that it was well organized and had no disturbance effect on end users' activities.
- The Hardware group variable indicates that end users were highly satisfied with the hardware related issues such as speed of computers and the network.
- The End User Profile- General Computer Skills group variables indicate that end users had experience on general computer usage such as mailing, word processing and internet usage, but most of them did not use computers for presentation purposes and did not have computer usage tendency. The End User Profile-Clinical System Experience group variables indicate that end users were using computers for patient activities but not in advanced level.

Comments, given in the open ended question, show that 27 of 112 (24%) end users had usability problems with the HIS and 8 of them (7%) claimed that the system was slow.

Table 4: Descriptive statistics for potential causes of HIS implementation difficulties

	5: Strongly agree-1: Strongly disagree		
	Mean	Minimum	Maximum
Organization	2.41	1.42	4.33
Communication between management and HIS end users was sufficient	3.48	1.00	5.00
Contribution of end users to HIS implementation project was sufficient	1.65	1.00	4.00
Being a new hospital had no unconstructive effect on implementation	2.11	1.00	5.00
Workflow	2.71	1.42	4.17
HIS was sufficient on workflows	3.03	1.00	4.67
Undefined hospital workflows and inconsistency among different department workflows had no unconstructive effect on implementation	2.40	1.00	4.00
Training	2.85	1.33	4.17
Content, methodology and scheduling of trainings were sufficient	2.61	1.00	4.50
End user participation and duration of trainings were sufficient	3.09	1.33	5.00
Integration	2.86	1.00	5.00
Integrated systems reduce time of work	3.08	1.00	5.00
Using different systems together did not cause difficulties	2.61	1.00	4.50
Security	3.02	1.00	5.00
Security related issues in HIS implementation did not cause difficulties	3.02	1.00	5.00
Planning	3.14	1.50	5.00
HIS master data, workflow and support were planned sufficiently	3.18	1.00	5.00
Starting to use HIS just after the hospital opening did not cause difficulties	3.11	1.00	5.00
Software	3.19	1.13	5.00
Usability issues in software did not cause any difficulty	3.01	1.00	5.00
Manipulation of medical data and workflows in software was sufficient	3.36	1.25	5.00
Solution Provider	3.37	1.20	4.80
HIS solution provider was sufficient in HIS application	3.37	1.20	4.80
Support	3.49	2.00	5.00
End user support was sufficient	3.49	2.00	5.00
Hardware	3.81	1.33	5.00
Hardware related issues in HIS implementation did not cause any difficulty	3.81	1.33	5.00

Table 5: Descriptive statistics for end user profile

	1: Yes-0: No		
	Mean	Minimum	Maximum
End User Profile - General Computer Skills	0.46	0.00	0.89
General computer usage experience	0.84	0.00	1.00
Computer usage for presentation purpose	0.47	0.00	1.00
Computer usage tendency	0.06	0.00	1.00
End User Profile - Clinical System Experience	0.41	0.00	1.00
Primary computer usage for patient activities	0.55	0.00	1.00
Advanced computer usage for patient activities	0.28	0.00	1.00

DISCUSSION

Under the light of the interviews done with hospital management and the observations made in hospital during the study, the results of the analyses given in the previous section can be interpreted as follows:

- During the interviews, it was understood that recruitment of most of the end users was done after specification of requirements, preparation of hospital RFP and even selection of HIS and specifically most of the physicians were recruited much more lately due to their high salaries. This explains why end users were not satisfied with their contribution to HIS implementation since it was impossible for the solution provider to have their opinions during the requirement analysis phase.
- Since Standard Operating Procedures (SOP) for the departments were not well defined due to being a new hospital, end users were not satisfied with the sufficiency of the workflows.
- Almost all of the end users were not happy with using different systems as integrated, since they were required to learn different screens, terminologies and different menus.
- All of the end users had difficulties with the workflows since they were forced to use a HIS with a unique SOP although SOP for each department were different within the hospital.
- Most of the end users were not satisfied with the content, methodology and scheduling of training due to the long duration between trainings and hospital opening and also the train the trainee approach.

- It was observed that the frequencies of having problems in HIS and of requesting support for HIS of the end users were high. This was due to lack of clinical computer usage experience of end users, insufficient end user training for the late recruited end users and long duration between the hospital opening and the trainings of the early recruited end users.

The results of this study showed out that the potential sources of HIS implementation difficulties were related to organizational issues, end user profile, integration of different systems, inconsistency among different workflows of different departments and training issues whereas there was no major implementation problem related to software, hardware, planning, support, security and solution provider.

Organizational issues that caused HIS implementation difficulties can be itemized as being a new hospital and the mismanagement of the hospital administration for the contribution of end users to HIS implementation.

End users profile was another reason for the implementation difficulties since general computer skills, clinical system experience and computer usage tendency of end users were not sufficient.

In the hospital that was studied, HIS was required to integrate with seven different systems and this caused another implementation difficulty due to complexity of learning different user interfaces, terminologies and workflows of different systems. This is in agreement with the previous study based on the integration of external systems to HIS (Memel *et al.*, 2001).

According to previous studies, bringing information systems to same level of implementation across the organization is a problem (Memel *et al.*, 2001). Findings of this study also supported this finding; since there were different workflows for different departments in the hospital though there was a unique workflow definition in the HIS implemented.

In one of the previous studies it was stated that sometimes, health care delivery organization cuts training programs for a new HIS for budgetary reasons (Ash *et al.*, 2004) which result in problems in HIS implementation. Content, methodology and scheduling of HIS training was also one of the difficulties in this study, since most of the end users were recruited late and the train the trainee approach was used due to budgetary reason. Another reason for the training related difficulties was the long duration between the training sessions and the hospital opening leading the users to forget what they have learnt.

Taking the literature survey and the findings of this study into consideration, the followings can be recommended for achieving a successful, sufficient and efficient HIS implementation phase:

- RFP, which is a base document for HIS implementation, should be prepared by a team including a variety of analysts, end users and executives.
- Hospital management, at the beginning, should accept that there might be modifications in hospital processes and workflows, leading to a business process reengineering study.
- Since for most of the end users, the user interface is everything that they come into contact with, while using the system physically, conceptually and perceptually, consideration of the user interface should be one of the main issues in HIS selection as well as its usability, flexibility, configurability and technology. For that reason, to increase the satisfaction of the end users with the HIS, hospital management should care for the end users' opinion in this phase.
- In order to increase the contribution of end users during system implementation, joint application design approach, which is penalizing interviews conducted with analysts, users and executives to reach requirement analysis jointly, can be used. This approach will also help hospital management to share their decisions and strategies related to HIS with the end users.
- Related to hardware issues, the ergonomics of computer desks in physicians' offices should be designed in such a way that physicians' efficiency in HIS usage and the care they show to patients can be optimized. Also the capacity of the network and the speed of the computers should be planned sufficient enough to prevent waiting times of the end users.
- Related to end user profile, hospital management should provide the necessary trainings to bring all of the end users to a specific level for computer usage in order to avoid possible related implementation difficulties. Another suggestion for avoidance can be to consider clinical system usage experience of candidates during recruitment period.
- In order to avoid integration related problems, hospital management should prepare detailed conceptual design of integrations, master data definitions that will be transmitted among systems and the compatibility study of different technologies being used.

- Master data, such as service definitions, drug names, reasons of visits, diagnose codes, which are the main essentials of HIS implementation should be prepared together with the users of related specialty.
- SOP should be prepared for each department so that end users can use them as reference for daily patient activities they performed manually and then can easily adapt to HIS.
- For the continuity of HIS usage, the hospital management should provide location based end user support, continuous training and frequently asked questions derived from calls of the end users.
- Training strategies should be determined considering the end users' opinions in terms of content, methodology, location, scheduling and duration. It can be highly recommended that trainings should be given by project team instead of train the trainee approach and the duration between the trainings and HIS go live should not be too long not to cause the end users to loose their practice on the use of HIS.

In order to generalize the HIS implementation difficulties and the recommendations for the solutions, similar studies can be done in university and public hospitals in terms of various levels of HIS implementations such as beginning, migration and upgrade as well as other private hospitals.

REFERENCES

- Ash, J.S., M. Berg and E. Coiera, 2004. Some unintended consequences of information technology in health care: The nature of patient care information system-related errors. *J. Am. Med. Inform. Assoc.*, 11: 104-112.
- Ball, M.J., 2003. Hospital information systems: Perspectives on problems and prospects. *Intl. J. Med. Inform.*, 69: 83-89.
- Berg, M., 2001. Implementing information systems in health care organizations: Myth and challenges. *Intl. J. Med. Inform.*, 64: 143-156.
- Degoulet, P. and M. Fieschi, 1997. *Introduction to Clinical Informatics*. Springer, New York.
- Hard, R., 1992. Hospitals begin to see benefits of MD access to data. *Hospitals*, 66: 48-50.
- Hersh, W.R., 2002. Medical informatics: Improving health care through information. *J. Am. Med. Assoc.*, 16: 1955-1958.
- Littlejohns, P., J.C. Wyatt and L. Garvican, 2003. Evaluating computerized health information systems: Hard lessons still to be learnt. *Br. Med. J.*, pp: 860-863.
- Memel, D.S., J.P. Scott, D.R. McMillan, S.M. Easton, S.M. Donelson, G. Campbell, M. Sheehan and T.N. Ewing, 2001. Development and implementation of an information management and information technology strategy for improving healthcare: A case study. *J. Healthcare Inform. Manage.*, 15: 261-285.
- Sneider, R.M., 1987. *Management Guide to Healthcare Information Systems*. Aspen, Rockvillen Maryland.
- Tonnesen, A., A. LeMaistre and D. Tucker, 1999. Electronic Medical Record Implementation barriers encountered during implementation. Retrieved January, 2006, from <http://www.amia.org/pubs/symposia/D005401.PDF>.
- Wetzel, I., 2001. Information systems development with anticipation of change focusing on professional bureaucracies. *Proceedings of the 34th Annual Hawaii International Conference on System Sciences*, 3-6 January 2001, Maui, Hawaii. University of Hawai'i College of Business Administration, Hawai.