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Studying the Applicability of Methods: Activity Driven Needs Analysis Applied to Maternity Pathway in Pudong, Shanghai

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Abstract
The trend of developing ubiquitous e-health services poses new demands on information systems development (ISD) methods and approaches. An alternative, activity driven approach has been developed in Finland for investigating the information needs of health workers as the first phase of ISD activities. Activity Driven Needs Analysis (ADNA) was applied to the case of "Maternity Pathway in Pudong" in Shanghai, China. In this paper we present the experiences of applying Activity Driven Needs Analysis and discuss the applicability of the approach in a distinctive context different from where it was first developed. The results contribute to the adjustment of methods to local and situational conditions.

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Studying the Applicability of Methods

Activity Driven Needs Analysis Applied to Maternity Pathway in Pudong, Shanghai

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Abstract – **The trend of developing ubiquitous e-health services poses new demands on information systems development (ISD) methods and approaches. An alternative, activity driven approach has been developed in Finland for investigating the information needs of health workers as the first phase of ISD activities. Activity Driven Needs Analysis (ADNA) was applied to the case of "Maternity Pathway in Pudong" in Shanghai, China. In this paper we present the experiences of applying Activity Driven Needs Analysis and discuss the applicability of the approach in a distinctive context different from where it was first developed. The results contribute to the adjustment of methods to local and situational conditions.**

Keywords – Information Systems Development; Methods; Applicability; Activity Theory; Health Information Systems

I. INTRODUCTION

Information systems (IS) in healthcare are mostly developed for serving the healthcare organizations' internal needs [1]. With ubiquitous e-health services the focus shifts towards citizen, but also towards new societal, cultural and geographical contexts. It poses demands both for IS producers and for IS users. The producers have to take into account the diversity of the users in their development process. The users – both healthcare providers and citizens – should be able to pronounce their needs for e-health when an e-health product is selected. It is not self-evident that traditional information systems development (ISD) methods are adequate for reaching these demands. Thus ISD methods need to be revised to address the ubiquitous nature of e-health services. Healthcare service providers are the key users of e-health systems, in the sense that they record the citizens' health related information into the systems [2]. Hence, they have a major impact on the quality and quantity of patient-related information, and furthermore, they are the ones that enable ubiquitous information retrieval.

The development of IS often starts with the specification of technological requirements [1]. With such a technological approach, broader socio-technical issues easily remain understudied. For example, the local circumstances, the situational nature of work activities, as well as the information needs of the healthcare workers and citizens (patients and non-patients) have an impact on the appropriateness and sustainability of the technological solutions. There is a need for methods for identifying and analyzing those issues as a first phase of ISD. Another problematic issue is that ISD methods and approaches are developed in one context (most often in a Western culture and in high-income countries) and then used in another context [3]. To this end, local circumstances and situations should be taken into account by those who apply the methods. The localization of generally defined methods is not a self-evident issue [4].

Our research groups have addressed three research problems that are important to the development of ubiquitous health and wellbeing information systems: 1) The information needs of the work activities in case, in contrast to the technological emphasis. 2) Changing the viewpoint from distinct healthcare activities to the ensemble of health and wellbeing services from the citizen's viewpoint. 3) The local and situational applicability of methods.

The Activity Driven (AD) approach to ISD has been developed for almost two decades in Finland [5, 6]. The basic concepts originate from Activity Theory [7], the Activity Analysis and Development (ActAD) framework [5], and Participatory Design [8]. The main unit of analysis is a work activity as a systemic entity with all its communicative aspects. Analysis can be conducted on four layers of granularity: the individual, group activity, organizational and societal levels [6]. The AD approach strives to respond to the first research problem. In recent years it has been extended in Finland to address the second research problem, too.

In this paper we discuss the third problem in the light of our experiences in applying Activity Driven Needs Analysis (ADNA) in the case of the China-Finland e-Health Partnership (Cn-Fi eHP) project (2007-2008) in Shanghai. The aim of this paper is not to describe the detailed findings of the case study but to focus on the planning and field study phases from the viewpoint of the applicability of the ADNA methodology. In addition, the ideas and results from previous projects were further discussed and refined in the SOLEA (Service Oriented Locally Adapted Enterprise Architecture) project which studied localization and applicability of Service-oriented and Enterprise Architectures methods.

To justify our reflections, we first review literature related to the success factors of modeling, ISD methods development, and methods engineering. Next, we briefly describe the

This paper is based on research conducted in ActAD-HIS project funded by Finnish Work Environment Fund and ZipIT, China-Finland e-Health Partnership and SOLEA projects, funded by the Finnish Agency for Technology and Innovation Tekes and several companies.

previous methods development and its results, to clarify the starting point of the case study. Then we describe the case study activities and outcomes. Finally we discuss the experiences in the light of methods development and the contribution of the case study as well as point out further development ideas.

II. LITERATURE

Modeling the real life is a highly important success factor of ISD projects. Bandara et al. [9] divide the modeling success factor into project specific (stakeholder participation, management support, information resources, project management, and modeler expertise) and modeling related factors (modeling methodology, modeling language, modeling tool). The main modeling considerations, namely the modeling concepts and the modeling procedure, are project related and goal oriented factors [10, 11].

As participatory working principles are emphasized in ADNA, we shortly discuss the possible pitfalls of the participatory approach. According to Chambers and Mayoux [12], the use of participatory methods has several challenges, both project and model related. Because of the attempt to a holistic view, several information sources should be used. This causes a project-related challenge of arranging timetables. If this is attempted to be overcome with e.g. group interviews or workshops, this may lead to biased data due to dominant participants. There is a need for an in-depth understanding of the context to prepare the actual research actions. A model-related challenge is that the diagrams used for communication should be understandable. The above-mentioned issues increase the work load in modeling [12].

Adapting a method in a situational fashion means that the methods are not taken as such, but adjusted according to the information needs and local circumstances. Method Engineering (ME) is defined as "engineering activities related to methods, techniques and tools" [4]. The purpose of ME is to help modelers to tune the method palette according to the situation at hand in their projects. To enable situational method engineering, the method must have standardized building blocs (both models and working practices), and a repository of project characterizations, according to which the method will be tailored with a specific process for the best fit to the needs at hand [4].

Drawing from the literature above, we comprise the following issues as important aspects in reflecting on the applicability of a method. What *concepts, models* and *working principles* are useful, and what modifications are necessary? What causes the need for modification?

III. MATERIALS

A. Previous research and the starting point of this research

In this section we provide background information about our previous research projects and their outcomes relevant to this paper.

The activity-driven approach to information systems development has been developed in several research projects. Within the applied intertwined research projects ActAD-HIS (2004-2005) and ZipIT (2004-2007), eight pilot cases were conducted in the AD fashion. Seven software companies and four healthcare facilities were involved as case-hosting organizations in Finland. The research was conducted by a multi-disciplinary research group sharing the interest in IS development, but having different kinds of basic education (e.g., qualified nurse, Master's degrees in software engineering and health informatics, PhD degree in IS). The partners in the case studies represented the different professions in healthcare (e.g., nurses, physicians, physiotherapists, home care nurses) and in health informatics (e.g., data administrators, IS project leaders).

The main result of the ZipIT project was the AD ISD Model as an analytical framework for collaborative information systems development in the healthcare domain [13, 6]. In addition, 11 target-specific reports (in Finnish), several articles in international conferences and six theses of different levels were produced. The full list of publications is available in the project website (www.uku.fi/zipit/).

Meanwhile a part of the research group started applied research cooperation with Chinese counterparts in two other projects, Export HIS and e-Health Partners Finland (2004-2007) in which relationships were built between Finnish and Chinese counterparts.

In summary, the capacities of our research group in the beginning of the case study were as follows. On the one hand, we had the theoretical basis of the AD approach and experiences in several Finnish ISD cases, resulting in outlines for practical application of the AD approach, including case examples with useful models and practices. In addition, we had knowledge about the Finnish healthcare service system and Finnish healthcare information systems, based on the long-term research on those areas by our research unit. Part of the knowledge was explicitly presented in reports while part of it was implicitly 'built in' in the approach and the tacit knowledge of the research group. On the other hand, we had some previous research cooperation and established relations with the Chinese counterparts with whom we were starting the case study in the Cn-Fi eHP project.

B. Activity Driven Needs Analysis

Activity Driven Needs Analysis (ADNA) is a special case of the general AD approach. The objective of ADNA is to create understanding of the domain in case, starting from th analysis of (networked) work activities and proceeding to th information needs of the actors within them. The basi concepts of the AD approach serve both as a mental minds guiding the analysis and as models for presenting th information. More detailed background descriptions have bee published elsewhere [6, 14].

According to the basic AD principles, work systems and th information needs must be studied in their organizationa contexts in cooperation with the domain actors – the experts o the work. Participatory methods include, e.g., workshops, group interviews, patient journey walkthroughs, story-telling, and interactive writing. Careful beforehand planning of the field studies is emphasized, due to the fact of the limited time

of the domain experts. The planning includes, e.g., the selection of the informants, time tabling, and the preparation of question lists and user friendly presentations to support the communication with the domain experts.

In our previous cases in 2004-2007 the analysis followed the general phases: preliminary phase of preparations for field studies, information gathering in field studies, analysis afterwards, validation of the analysis results by the domain experts, and reporting revised results. When needed, the phases can be repeated iteratively. During each phase, certain means and principles in modeling are utilized, tagged as the AD Toolset. It is notable that the AD Toolset is not only used in the analysis and descriptions, but also in the field studies to facilitate the communication between researchers and domain experts.

The AD Toolset contains the concepts for analyzing and describing work activities in their organizational context. The tools fall into three categories: diagrams, stories and question lists. The following basic diagram types correspond with three levels of granularity. A *swimming lane diagram* is used for describing a process of one or several actors and the information flows within it (individual level). The *activity structure diagram* is used for describing a collective work activity (group activity level). The *activity network diagram*, identifying the main actors and information flows only, is used for depicting the relations between different activities within or between organizations (organizational level). The shared theoretical basis of the diagrams makes it possible to move flexibly between them. Rather than applying the diagrams to the book, common sense is used in justifying the choice of the necessary elements from each diagram. Rich pictures [15] are used for making the diagrams more comprehensible. An "activity story" (cf. scenario [16]) has proofed to be a powerful tool in achieving a shared understanding of complex activities, e.g., a patient's pathway through several organizations' care activities. Question lists, adapted from previous projects, are structured according to the background theories.

C. The China-Finland e-Health Partnership project and the case study in Pudong, Shanghai

China-Finland e-Health Partnership (Cn-Fi eHP) was a joint research project by Finnish and Chinese counterparts, aiming at better information sharing in healthcare. The research project had a Chinese sister project aiming at implementing a regional information system in the Pudong New Area district of Shanghai. The main research objective was two-folded: firstly, to support the implementation project with research, and secondly, to study the applicability of Finnish research results and methods in the context of a Chinese healthcare ISD project. Maternity care pathway was selected as the case for the research. The maternity pathway begins when a woman, who supposes that she might be pregnant, takes the first contact to a health care organization and ends when the new mother and her new-born baby have settled down at home. Two healthcare organizations, Weifang Community Health Center (CHC) and East Hospital, were selected as target organizations in Pudong.

There were altogether four research themes: 1) Needs and requirements, 2) Architectures, interoperability and standards, 3) Data set definition for electronic health records, and 4) Evaluation. The needs and requirements (NR) theme provided the material for this paper. The goal of theme was to provide the basic description of the maternity pathway's current situation and the main information needs of the healthcare professionals. The resulting description was to serve as a starting point for design and evaluation activities.

TABLE I. THE RESEARCH PROCESS: ACTIVITIES AND OUTCOMES

Phase (time slot) and goal	**Research**			
	Participants	***Activities***	***Tools***	***Outcome***
Preparation (Oct 2007) Goal: Understanding of the target context; action plan for the field study	Research group	Background studies, story telling, interactive writing, populating the conceptual question list with case-relevant questions	Models of diagrams, model of activity scenario with questions	Initial understanding of healthcare context in China; question list and maternity pathway scenario; detailed plan (including timetables and other visit arrangements) for a walk-through and group interviews
Field study (Nov 2007) Goal: To gather information	Research group, different health providers (e.g. nurses, doctors, midwives)	Half-day visit to both of the hospitals: group interviews and maternity pathway walk-through	Maternity pathway scenario in Chinese; question list in Chinese; camera	Questions answered, notes from observations during the hospital visits, revised scenario, photographs from the walk-through; data for extending the refined maternity pathway scenario with IS related information
Analysis (Dec 2007) Goal: To comprehend the essence of the gathered data, in a usable form	Research group	Iterative modeling and creative model tuning according to the needs and the theoretical basis. Translation of the diagrams and summary presentation	Data gathered from the hospitals; basic and applied diagrams	Initial description of the maternity pathway in the hospitals illustrated with diagrams; current-state description including spots for development in information sharing; descriptions in English, diagrams also in Chinese
Validation (Jan 2008) Goal: To assure that the research findings were correctly and sufficiently described	Researchers, health providers and CIOs from hospitals, district level manager	Half-day workshop; separate interviews	Presentation: summary and all the diagrams translated to Chinese; paper prints	Comments from local healthcare professionals and authorities
Reporting (Feb-Apr 2008) Goal: Present the results in a usable form	Research group	Constructive writing, cross checking the data and analysis results, finalizing the report	Case study materials	Report [17]

A summary of the case study is provided in Table I. The research process is divided into phases and the participants, activities, tools and outcome of each phase are presented in the table accordingly.

Data was gathered mostly in field studies in the hospitals during November 2007 and January 2008. Several healthcare professionals of both hospitals participated as informants in the study. The NR research group contained three researchers from the original AD approach development group, strengthened by a Chinese researcher who had his first degree in public health in a Chinese university and who was conducting his PhD studies in health informatics in a Finnish university. He also had the invaluable role of the interpreter between English (research language) and Chinese (the language of the hospital staff). The results of the NR group were directly useful to the other research groups.

The primary outcome of the case study is the description of the present state of the maternity pathway in Pudong, supported by altogether 19 diagrams describing the Shanghai health service system (n=2), the maternity pathway on various levels of detail (n=14), an overview information architecture (n=1), and the functional systems architecture of the target hospitals (n=2). The report [17], as well as other information, is available on the project website (http://www.uku.fi/ehp/cn-fi/).

IV. Reflecting on the Research Experiences

Although beforehand planning is a typical activity preceding most field studies, the highly different research context dictated us to pay special attention and effort to planning. It turned out that before we were able to even think about the questions for interviews, we had to clarify some basic features about healthcare in China, e.g., the service delivery system, administration, and funding schemes of healthcare. This was done in brainstorming sessions among the research group, where the Chinese researcher took the role of informant. At the same time, he became familiar with the AD approach. Only after grasping the overview of the broader context, we were able to concentrate on the actual planning of the information gathering in the case hospitals.

In requirements engineering, the lack of a common language between different professionals is a recognized risk [e.g., 16]. In our case, the risk was increased due to the greatly different contexts and languages. Translations between English and Chinese were imperative to the success of the field studies. The possibility of misunderstandings in the translations was reduced by having a member of the research group who could make the translations. He was familiar with Chinese healthcare and language, and gradually also with the AD approach. Another attempt to reduce misunderstandings was the use of the diagrams and stories as means of communication.

Although all the models used in our previous research were not applicable as such, the theoretical groundings guided us to modify the diagrams according to the situational needs. As the object of our study this time was the maternity pathway through different health facilities, set in the time frame of pregnancy, it was natural to model the overview as a care path, a special case of an activity network. We also modified the swimming lane diagram, originally intended for describing the work flow of individual actors, to describe the main activities and related information flows between the organizations. As our objective was to analyze the information sharing needs and the spots for development from the viewpoint of the healthcare workers, it was necessary to illustrate the mapping of the following in the sequence of a work activity: actor, information entity, mediating information tool, and information storage. For this purpose we developed a new type of a diagram, which we call *activity case*.

One of the major tools in the preparation and information gathering phases was the "*maternity pathway scenario*", a written story about a fictional woman (persona) living in the Pudong district and her maternity pathway. The story was based on reality but not on any specific person. In the story we focused on the visits to healthcare organizations and especially on the information appearing within the maternity pathway (content, purpose, producers, users, form, etc.). The story was written iteratively by the researchers, one complementing the other; when we were unsure about how the story would go, we added questions for clarifications (e.g., what information is needed here? Where does the actor get it from? Who else needs this information?) The story was then translated into Chinese, and sent to the contact persons in the hospitals before the field study visits.

During the hospital visits, the story was encouraging the discussions with the hospital personnel in the group interview sessions. The story also provided the structure for the *maternity pathway walk-through*; i.e., we followed the footsteps of the fictional mother in the case hospitals, and interviewed the hospital staff along the pathway. The data was gathered by writing notes and by photographing. After the hospital visits, the researcher group had a summarizing meeting where individual notes and observations were discussed and combined.

The participatory methods applied with the healthcare professionals were group interviews and walk-throughs, and workshops with researchers. It was challenging to arrange time with professionals, thus all the materials and meetings had to be well prepared.

V. Discussion and Conclusions

The ADNA methodology is meant to be used in the early phases of information systems development when it is important to grasp an understanding of a new context. To study ADNA's applicability to new settings, the case study in Shanghai was sufficiently different indeed from the original environment where ADNA was developed.

ADNA has means to explore work activities in order to understand the information needs and also to see the direction for possible realistic solutions. For the analysis of broader scopes, the Landscape methodology [18] for instance can be integrated with ADNA. For the exploration of the narrower scope of health information systems, ADNA does not have the means for describing the technical aspects of IS, but the relations between a work activity and IS were explained via information flows and information needs. Integrating ADNA into Enterprise Architecture (EA) methodologies would improve EA design.

Except for the highly different context, the experience of using ADNA as such was quite similar to the previous cases in Finland. The AD approach gave a solid systemic basis to research activities by guiding the different phases of research. The approach was proven to be applicable in finding out the information needs (and information sharing needs) in healthcare work, highlighting the viewpoints of different professionals participating in the care activities.

AD notations accompanied by the maternity scenario were a success throughout the research process: in the beginning they opened the door for grasping the idea of the healthcare service system in China, which was a necessity for a participatory approach in the field studies. During the field activities the scenario and the diagrams served as a means of communication in the research sessions. The notations proved to be easy to understand, which was important because of the obvious lack of a common language. Using the diagrams in the field study also reduced the work load, because it took less time to translate just the words within the diagrams, compared to having to translate the same amount of information as written text.

From the Methods Engineering viewpoint, ADNA is still an immature methodology, in the sense that we do not have solid and explicitly standardized methods building blocks, or a specific configuration process. In the light of our experiences, the shared theoretical basis supported the creative and flexible use of the analysis and modeling tools. This strongly encourages putting effort on method engineering-flavored development of ADNA, in order to make ADNA adjustable to various situations, including shifting the focus towards citizen.

Another dimension for development is the integration of ADNA with other approaches and methodologies. We recognized needs for integration in two directions of granularity: in the direction of the broader scopes of societal and nationwide contexts, as well as in the direction of the narrower scope of the technical aspects of information systems. Especially from the viewpoint of developing ubiquitous e-health services in new contexts, the local adaption of the method should be started by achieving a sufficient understanding of the broader scopes.

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