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Task Analysis and Application Services for Cross-Organizational Scheduling and Citizen eBooking

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Abstract. In this paper, we present generalized results from the task analysis and definition of software services to support healthcare appointment and services scheduling, based on national coordination project for citizen e-services in Finland which involves several regional initiatives. The results are part of guidelines for regional-level and national-level scheduling solutions in Finland, and can be used in similar efforts. The specification of a functional reference model and software services for appointment scheduling promotes interoperability and systems adaptability for the transformation of health services and citizen empowerment.

Keywords. health information systems, scheduling, SOA, activity analysis

1. Introduction

The reservation and scheduling of healthcare services is one of the potential key factors both in the empowerment of citizens and in the process and productivity improvements in healthcare service production [1]. Using electronic scheduling services, the fluency of service experience for citizens and new possibilities for independent health management can be improved [2]. Equally, the booking, registration, and management processes in health service production can be streamlined using electronic scheduling services. Many tasks in time-consuming resource allocation, cancellation, rescheduling and administrative documentation workflows [1, 3] can be automated or given to patients capable of handling them for appointments, procedures or examinations, if these services and resources can be packaged properly. This packaging ties the appointment and service scheduling closely with the commensurable definition of health services, and many solutions related to scheduling can also be utilized in the comparison and monitoring of care process inputs, activities and outputs. In this light it is not surprising that several countries have included the development of scheduling services for citizens and across health service providers in key initiatives in the IT strategies supporting the transformation of healthcare delivery [4].

Scheduling is among the major enterprise functions of IT systems of healthcare facilities [5]. In addition, according to national surveys in Finland, the popularity of

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Internet-based and mobile services for eBooking by citizens has been increasing steadily especially for non-acute needs. Despite the increasing electronic availability of the needed information, most eBooking solutions have remained internal to one service provider, and healthcare sector has been slow to utilize eBooking [6]. In networked care, an integrated scheduling system would enable advanced load balancing, shorten waiting times, and increase citizen choice [1, 3, 4, 7]. This, however, requires interoperability between IT systems. The identification and prioritization of the needed information, services and interfaces are necessary to achieve such solutions.

2. Materials and Methods

There are major initiatives for the development of national IT services and their connections with provider systems in Finland [8] and various other countries [4, 9]. The development of shared terminology and services for healthcare processes is central in many of these efforts, and even further emphasized, as these efforts face increasing pressure to produce citizen-centric service offerings due to the productivity and public demands and workforce constraints.

The *eKat project* is a national coordination effort by the Ministry of Social Affairs and Health in Finland for seven regional or local projects developing citizen-centric welfare services between 2007 and 2009. One of the central activity areas in the project has been the development of guidelines for advancing current eBooking solutions to support eServices for citizens and process improvements for health service providers.

This article is based on these guidelines which also include recommendations for specifications and implementations. The work is based on the readily built and planned solutions in six regional projects in Finland. The goals, requirements, process descriptions and solutions of these projects were analyzed as part of this work. The recommendations and designs also utilized the results of previous scheduling efforts, including several product-based scheduling applications, and the specification of open HL7 version 3 interfaces to support the connectivity of local systems with citizen and regional eBooking services. National workshops and joint meetings between projects were arranged to collect the material and to refine the requirements for joint solutions.

The constructive design of guidelines reported in this paper includes the identification and analysis of tasks in scheduling-related processes and mapping of these activities and other requirements to functional application services. SOA-based specification and design techniques [9–12] were used to guarantee the modularity, reusability and flexibility (open interfaces, gradual and incremental development, several possible local migration paths) of the proposed solutions. In addition, we focused on action and activity levels of process modeling [13] to identify those tasks which could be automated or performed by citizens instead of professionals.

3. Results

Central questions in each scheduling task include what (service or resource types), where (provider, place), and when (time slots) services are scheduled. However, additional rules and constraints make health services scheduling a non-trivial task: distance and cost information, the evaluation of care needs, definition of care or

customer relationships, initiation and confirmation responsibilities of booking activity, referrals, structured or automated care plans, and reminders are among the factors which in some cases are involved or needed to support the scheduling activities [3, 7].

Five *eBooking levels* from the viewpoint of citizens were defined to provide a framework for the automation of tasks, migration and the level of citizen choice:

1. The *push model* is based on time slot suggestions from the provider which the citizen can accept or reject. This promotes the automation of some time-consuming scheduling tasks using e.g., mobile, web-based or email confirmations.
2. The *calendar model* enables the citizen to select a desired time for a given service from a number of available time slots, typically using calendar-like selection tools.
3. The *location selection model* allows the citizen to select a service provider or location in addition to time slots.
4. The *pathway model* enables the citizen to use some of the above models based on a care plan or service plan made by professionals, while the information in the plan provides the necessary constraints for the scheduling tasks. In Finland, for example, pathways are typically inter-organizational on a regional level.
5. The *automation model* gives instructions and constraints for citizen scheduling, routing the patient based on automatic, intelligent reasoning of care needs [9].

Table 1. Automation and patient empowerment potential of tasks related to health service scheduling (Pr = provider, Pa = patient, Au = automation, c = common performer, o = optional or partial performer, P = preferred performer for improvements, # = eBooking level, on and above which performed)

Action	Pr	Pa	Au
Viewing scheduled appointments and services			
1 View scheduled appointments of the patient	c	c	
2 Query scheduled appointments of the patient	c		
3 View or query scheduled appointments by health organization / service / resource	c		
Service scheduling tasks			
4 View available service time slots from calendar	c	P2	
5 Search available time slots using defined criteria (level 3: includes service selection)	c	P3	
6 Book an appointment from a calendar	c	P2	
7 Confirm an offered time slot		P1	
8 Refuse an offered time slot		P1	
9 Cancel an appointment	c	P	
10 Reschedule an appointment	c	P	o
11 Book set of related services (multiple service appointment booking)	c	o4	o
12 Book repeated appointments for one service (serial booking)	c	o	o
Allocation of available times (pre) and acceptance of bookings (post)			
13 Allocate time slots for external booking for a given reserver (pre)	c1		P1
14 Allocate time slots for external booking for any authorized reserver (pre)	c		c
15 Book internal resources needed for the service (pre/post)	c		P
16 Confirm external time slot booking (post)	c		c
17 De-allocate time slots from external booking (pre)	c		c
18 Verify identity, authorization and eligibility of external booking (pre/post)	c		P
19 Send appointment reminder (post)	c		P
Scheduling-related tasks in care planning, ordering, and queue management			
20 Send appointment booking request to the reserver / patient	c2		P2
21 Define service provider or location for the event (e.g., produce order or referral)	c		o5
22 Define service / event which will be needed in the future (appointment plan)	c4		o4
23 Receive order or referral, leading to actions 1–21	c		o5
24 Advance the queue of patients, leading to actions 1–21	c		o5

The levels were generalized based on the solutions and needs in the eKat projects and the literature. All levels require manual or automated coordination of constraints such as referrals, evaluation of care needs or eligibility or authorization queries.

Task Analysis of Scheduling Activities. The task analysis in Table 1 provides a generalized model for tasks which can be performed in scheduling-related activities by professionals or patients, or automated. Different types of users perform many of these tasks in any scheduling-related process. The relation of tasks performed by citizen or automated is closely tied to the eBooking levels described above and the main constraint strategy. These aspects are often based on regional contracts and rules. The analysis provides a shared reference model for different projects and applications for defining which tasks are performed by which actors, using which information and tools, and applying which constraints. It should be noted that instead of the patient, any "external" reserver needs very similar choices and constraints to be able to successfully and effectively perform scheduling tasks.

SOA Services for Scheduling. One of central tasks of the eKat project was to provide guidelines for the architecture and migration strategies to move towards more advanced eBooking levels. This led to the identification of application services and application types related to scheduling. In addition, the solutions were refined in relation to centralization on local (provider-specific), regional (cross-organizational on regional level) and national (nationally centralized) scope. Migration phases based on eBooking levels for each service were also defined. These aspects are summarized in Table 2. Each service was further refined using summarized service scope and functionality descriptions [11, 12].

Table 2. Identified SOA services and components related to health service reservation, # = migration phase (roughly corresponding to eBooking level) of citizen appointment where necessary or where benefits evident (0= starting point), L = local scope, R = regional scope, N = national scope, uppercase in Scope: preferred

Name of SOA service or application	Phase:Scope
National and local services and systems - already in place or in implementation phase	
Patient information systems (administration, healthcare resource management), also includes scheduling user interfaces for professionals	0:lr
Booking repository (Existing national EPR archive or new repository can be used) – for available time slots (query and replication methods can be used) – for booked appointments – for planned appointments	 0:l; 3:lR 0:l; 1:lR; 3:Nr 4:Nr
Patient eAccess service (used as a viewer for personal appointments)	2:Nr
Shared server for code sets, classifications, terminologies (national code server)	0:Nr
Core and added-value services for scheduling	
Appointment calendar service (gateway to several organization-specific calendars of available time slots)	0:l; 3:Rn
Process coordination service related to appointments and clinical pathways	4:Rn
User interface for citizen self-reservation, eBooking for health services	0:l; 3:rn
Healthcare service directory (can be extended based on the national code server [8])	3:rn
Repository of regional and inter-organizational appointment rules and contracts	4:Rn
Supporting and related citizen services	
Notification and confirmation services	1:lr
Consent management services (consent can be given as part of booking)	0:l; 4:Rn
Citizen identification services (domain-independent, e.g., banking)	0:Nl
Citizen-specific care and service relationship service or repository	2:l; 3:rn
Delegation service (delegate acting on behalf of citizen)	any:lrn
Personal Health Record System	any:lrn
Other related citizen self-wellness services (e.g., professional communication, ePrescription renewal, citizen information services)	0:l; any:lrn

In addition to these results, the eKat scheduling guidelines include user storyboards and specifications of scheduling information and conceptual models. In addition, citizen-oriented service classification terminology which was linked to the simultaneous development of professional service classification, architectural diagrams for various migration phases, and six recommended work packages for further actions are included.

4. Discussion and Conclusions

In addition to the eKat subprojects, the features of the presented models can be applied to various other scheduling efforts. There is not one "scheduling service" which alone could deliver all the features to support the benefits for citizens and service providers, but a combination of application services along with the conceptual and architectural contracts is needed. Further studies in Finland have fortified the need for the national development of many of the identified services for the next phases of the national project. These developments utilize the national IT services already under deployment.

Despite the citizen focus of various scheduling projects, advanced scheduling requires willingness for shared concepts and specifications primarily from the service providers: the vocabulary, service and interface definitions and the shared definition of tasks and functions enable reorganization of care processes also beyond direct patient administration tasks. Even though the goal is not to unify the service processes, service delivery systems or applications, a coherent and consistent basis is required for flexible application systems and services to support the transformation of networked care.

References

[1] Kimmel, Z., Greenes, R., Liederman, E. (2005) Personal health records. *The Journal of Medical Practice Management* 21(3):147–152.
[2] Nardon, F.B., Moura Jr, L.A. (2007) Software engineering principles applied to large healthcare information systems – A case report. *Studies in Health Technology and Informatics* 129(Pt 1):33–37.
[3] Laffey, J.A., Wasson, M. (2007) St Elsewhere's or St Everywhere's: Improving patient throughput in the private hospital. In Kuhn, K. et al. (Eds) *MEDINFO 2007*, Pt 2, IOS Press, Amsterdam, 920–924.
[4] eHealth Priorities and Strategies in European Countries, *eHealth ERA Report*, European Commission / Information Society and Media, March 2007.
[5] Hübner-Bloder, G., Ammenwerth, E., Brigl, B., Winter, A. (2005) Specification of a reference model for the domain layer of a hospital information system. In Engelbrecht, R. et al. (Eds.) *Connecting Medical Informatics and Bio-Informatics*, *Proceedings of MIE 2005*, IOS Press, 497–502.
[6] ICT and e-Business in Hospital Activities – ICT adoption and e-business activity in 2006, *Sector Report No. 10/2006*, e-Business Watch, European Commission, 2006.
[7] Costa, C.G.A., Leão, B.F., Moura Jr., L.A. (2007) São Paulo City Health Information System – A Case Report. In Kuhn, K. et al. (Eds.) *Proceedings of MEDINFO 2007*, Pt 1, IOS Press, Amsterdam, 377–381.
[8] Saranummi, N., Ensio, A., Laine, M., Nykänen, P., Itkonen, P. (2007) National health IT services in Finland. *Methods of Information in Medicine* 46:463–469.
[9] *EHRS Blueprint – An Interoperable EHR Framework*, V.1.0. Canada Health Infoway, July 2003.
[10] Arsanjani, A., Zhang, L.-J., Ellis, M., Allam, A., Channabasavaiah, K. (2007) S3: A service-oriented reference architecture. *IT Professional* 9(3):10–17.
[11] Mykkänen, J., Riekkinen, A., Sormunen, M. et al. (2007) Designing web services in health information systems: From process to application level. *International Journal of Medical Informatics* 76(2-3):89–95.
[12] HSSP Service Specification Development Framework, version 1.3, Healthcare Services Specification Project, 2007.
[13] Mykkänen, J. et al. (2009) Four-level process modeling in healthcare SOA analysis and design. In *Proceedings of the 10th International Congress on Nursing Informatics (NI 2009)*, Helsinki, in press.