DESIGNING AN INTELLIGENT SERVICE MODEL FOR DIAGNOSIS-FOCUSED PROFESSIONAL SERVICE

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Purpose
To introduce a conceptual model of intelligent service for a multi-staged and diagnosis-focused service system, which is especially common in healthcare and social sector services. The model focuses on decision-making related to proactive and adaptive process flow control, emphasizing the state of the service process (load), customer needs and flexible resource utilization.

Design and methodology
The research is based on service process-related problem analysis conducted in four different healthcare development processes in Finland. The action research methodology with full action research cycle has been applied in all development projects in order to receive the true image of the complexity related to service processes.

Findings
As findings of the study, we present a conceptual model of 'intelligent service' that focuses on the elements of proactive process control, control-related decision-making and service system coordination. A future research agenda related to 'intelligent service management' is also discussed.

Research limitations/implications
The conceptual nature of the intelligent service model is a limitation of the study, but it aims at creating new kind of theory related to service management, along with other researchers and studies.

Practical implications
As practical implications of the study, we introduce a list of common problems related to diagnosis-focused service processes and how the 'intelligent service model' would reduce the effects of these problems.

Originality/value
The study has significant originality/value because of the interdisciplinary perspective in which operations management, service system design and viable system elements are combined in order to manage diagnosis-focused, customer and labour intensive service processes more efficiently.

Keywords: diagnosis-focused service, service process control, healthcare

Conceptual Paper

INTRODUCTION

Continuous improvement of service operations is a primary objective for most service organisations both in the private and the public sector, or it should be so, but why is it so often only mentioned in written objectives, not observed in real action? As researchers we faced this challenge in four different service process development projects in public healthcare services in Finland during the years 2007-2009. As in any development project, we had pre-planned steps, reflective approaches, planned and evaluated solutions, implemented and evaluated once or twice. After a two year period we realized that something very important had gone wrong. In the development projects we were able to produce process-oriented solutions but active view of the whole service as a system was missing. It was easy to create an image of systematic control of the whole service system by using advanced process mapping tools and techniques. The illusion was perfect until the planned solutions were implemented at the activity level.

Because of the unsatisfying results, the interest in this study emerged. The case processes had many common characteristics, but some of them should be emphasized: ***a highly professional organisation*** *with* ***multiple multi-staged healthcare processes*** *utilizing* ***focused resources*** *that have* ***power to control the process flow based on a diagnosis they make.*** These four elements created a high challenge for service operations planning and control. In the case processes, it actually created a situation where the service operations planning and control were not interconnected. The missing interconnection caused two major problems: even though the process-oriented solutions were quite innovative, the doctors and nurses followed their own procedures in the flow control-related decision-making. The interconnection was missing also in the opposite direction; the service system planning did not utilize the lessons learned from decisions and diagnosis made in the processes.

The setting described above created the focus of this study, the idea of creating 'an intelligent service system' that supports the two-way interconnection between the service operations planning and the service operations control. 'Intelligence' is actually more than just a connection between elements, it is a pre-planned model for an individual service system that guarantees real-time information from operations to planning and vice-versa. Already in this phase, it is important to define why this kind of intelligence is needed especially in *diagnosis-focused professional services.* Due the high professionalism, e.g. doctors, it has been the practice, or unwritten rule, not to advice doctors in their decision-making. While the performance requirements have increased in both sectors, more improvement efforts have been focused on creating solutions that should make the operations more efficient. In practice, however, these solutions do not seem to have any effect on the activity level. This is perhaps why these so called 'fluid processes' are considered as difficult to control and standardize (Wemmerlöv 1989). The purpose of this study is to change the image of unmanageable complexity and search for relevant elements to be managed in a fluid process.

The model development in this study is partly based on observations made in four different diagnosis-focused professional service processes. Two of the processes were treatment of outpatients (process length from one meeting to several years), children between 0-7 years and 15-22 years suffering from mental and developmental disorders, parent-related drug or alcohol problems etc. The two other processes were treatment of inpatients in a primary healthcare centre in a Finnish municipality. These processes involved patients suffering from many different diseases that needed general and specialized healthcare treatment. The observations were collected during the development projects. The case observations were collected using Action Research methodology.

The study consists of three sections: i) what kind of literature is available in service operations planning and control, and how it has been implemented in the professional service process (knowledge intensive), ii) defining the conceptual model of 'intelligent service', and iii) discussion, where the model and its relevancy are evaluated and future research topics discussed. The whole process of conceptual model development is presented in figure 1.

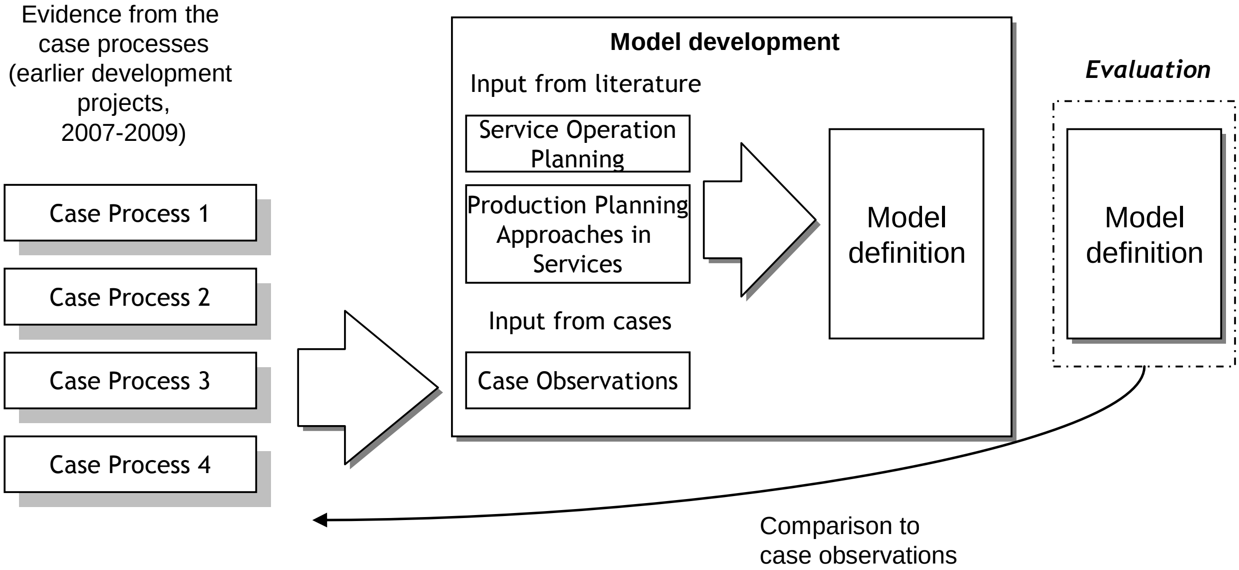

Figure 1. Structure of the study and the model development

SERVICE OPERATIONS PLANNING

Since we do not seem to have a 'best practice' available for *process planning and control for diagnosis-focused professional services*, there must be a reason for it. We began our research work by searching for literature that would give an answer to this problem. In the study the literature review was started by creating two different starting points. The first point was *operations planning and control in professional service operations,* and the second one *utilizing production planning-oriented approaches in services*.

Service operations planning in professional services

As mentioned in the introduction part, it is important that operations planning and control support the system view of services. For our focused area of service processes, we started by analysing literature dealing with the role of operations planning and control in knowledge-intensive service operations. So called 'service literature' defines the operating strategy as one step in the *service design chain* and the service delivery system (e.g Heskitt 1987). The service design literature is, however, focused on operationalizing the service concept, not on how to control the operations. This kind of definition emphasizes the marketing view in services. We do not claim that this is wrong, but it does not guarantee any results without efficient operations planning and control.

Much of the service literature is about classifying, defining and profiling different types of services and their characteristics (Johansson & Olhager 2004, Kellog & Nie 1995, Schmenner 1986, Silvestro, Fitzgerald, Johnston, Voss 1992). The service classifications are usually matrixes with characteristics for different types of service processes (by customer contact intensiveness and labour intensiveness). The most common classification is: *the service factory, mass service, service shop and professional service* (Hill, Collier, Froehle, Goodale, Metters, Verma 2002). Another important classification is focused on routing the service process, whether it is customer-routed, co-routed or provider-routed, indicating the role of the customer in the service alternative selection (Collier & Meyer 1998).

Jaakkola and Halinen (2006, 410) have analysed the literature related to professional services, and they define professional services as follows, “Professional services provision principally involves problem solving for the customer”, and “The service provider uses his/her professional knowledge to make a diagnosis of the problem and suggest a solution”. They also add one important aspect of managing professional service: “Autonomy refers to professionals’ freedom to exercise individual judgement to define problems and the means for their resolution without external pressures from clients, non-members of the professions, or the employing organisation” (op.cit; 412). Jaakkola and Halinen also state that because of a high and important input from the customer (the problem), there is no self-evident or standardised solution for different customers, but a need to customize the solution based on customers’ needs. Because of the unawareness of the customer’s problem, the time horizon to react to the problem and find an alternative (or only one) solution to it is very short.

Larsson and Bowen (1989) have focused more on uncertainties in service operations, and according to their framework for ‘the design and coordination of service interdependencies’, the elements can be divided into three categories: i) input uncertainty (diversity of demand, customer disposition to participate), ii) interdependence patterns (division of work incl. front and back office employees and customers, customised vs. standardized interdependencies, and iii) portfolios of coordination mechanisms (different mechanisms, main locus of the portfolio). On the basis of their framework, they suggest that in the medical care process, the front office coordination of service interaction should be based on communication and agreement; the front-back-office service coordination should be based on adjusting customer orders and input to agreed performance; and the back-office coordination of support processes should be based on planning. This brief literature review (service operations planning in professional services) offers already a significant amount of information needed in service system planning and control.

The missing link in the service literature is still the interconnection of planning and control. We claim that the system should be controlled as a system, not just by utilizing self-managed professionals in unmanaged interrelated process paths. In the industrial world, planning and control have been a standard procedure for decades, and it is necessary to analyse if there are some concepts or elements that could be utilized in the service context as well.

Utilizing production planning approaches in professional services

The second part of our literature review focuses on studies related to organising the service operations planning and control in an ‘industrial way’. In the operations management and service operations management literature, the production planning in services is often referred to as resource planning and scheduling (Krajewski, Ritzman, Malhotra 2007). The examples are typically taken from the healthcare sector, airlines, banks and hotels; and in general they do not offer any breakthrough solutions. Therefore, in this study we focus only on the healthcare sector, as it offers a wide variety of studies already since the 1990’s. Roth and van Dierdonck (1995) have created an extensive framework focusing on hospital resource planning. Their framework consists of six different elements: (1) task complexity, (2) performance measurement, (3) product-line focus, (4) organisational structure, (5) standardization, and (6) information systems. They utilize so called *Diagnostic-Related Groups (DRG's)* that include 23 different major diagnosis categories which are used to determine the service the patient needs, and controlling the administration of patient group-related services. Usually the planning and control systems in a hospital consist of the tri-level structure: strategic, tactical and operational. According to Roth and van Dierdonck, the medium-range planning consists of demand forecasts by a case-mix, patient admission planning, staffing, and budgeting for expected utilization and allocation of materials and resources. Short-term or operational planning includes the daily problems of assigning the patient to the services and related dispatching, scheduling and sequencing decisions. Roth and van Dierdonck have analysed the analogues to manufacturing planning, e.g the feasibility of utilizing MRP-type systems in hospitals. The main focus in their study is how to organise and operate resources most efficiently, but they also mention the idea of 'Hospital Resource Planning' and how it should support the feedback system and data collection from true resource utilization. This is an example of how planning and control are interconnected.

A more recent study by Vissers, Bertrand and de Vries (2001) deals with the same subject, 'a framework for production control in healthcare organisations'. They characterize the control setting in hospitals as follows: (1) demand is larger than supply, (2) restrictions on supply defined by contracting organisations, and (3) high patient expectations on service quality. Their solution is to maximize the utilization of resources with acceptable expectations on service quality. Their planning framework for hospitals is presented in table 1.

Table 1. Production control functions distinguished in the planning framework for hospitals (Vissers et al. 2001, 593)

Decision focus
1. A range of services markets and product groups, long-term resource requirements, centrally coordinated scarce resources, contracted annual patient volumes, target service level
2. The number of resources available at annual level to specialties and patient groups, regulations regarding resource use
3. Time-phased allocation of shared resources, involving specialist-time, detailed number of patients per period
4. Urgency and guidelines for service requirements planning per patient group
5. Scheduling of individual patients, according to guidelines, at patient group level and resource-use regulations at resource level.

Vissers & al. (ibid.) summarize the key terms of planning and control as: i) market performance, ii) resource acquisition, iii) control of patient flows, and iv) use of resources. Although their result is interesting, five important levels of planning and control in hospitals (*Patient Planning and Control, Patient Group Planning and Control, Resources Planning and Control, Patient Volumes Planning and Control, and Strategic Planning),* it seems to focus on planning procedures, which is a common 'problem' in the literature. The main idea in this industrial-oriented planning and control system is to maximize resource utilization and create the required coordination mechanisms to support it. However, we claim that it is not enough, and we need to have tools to control the service process also on the activity/task level. The input of the literature review for the model development is presented in figure 2.

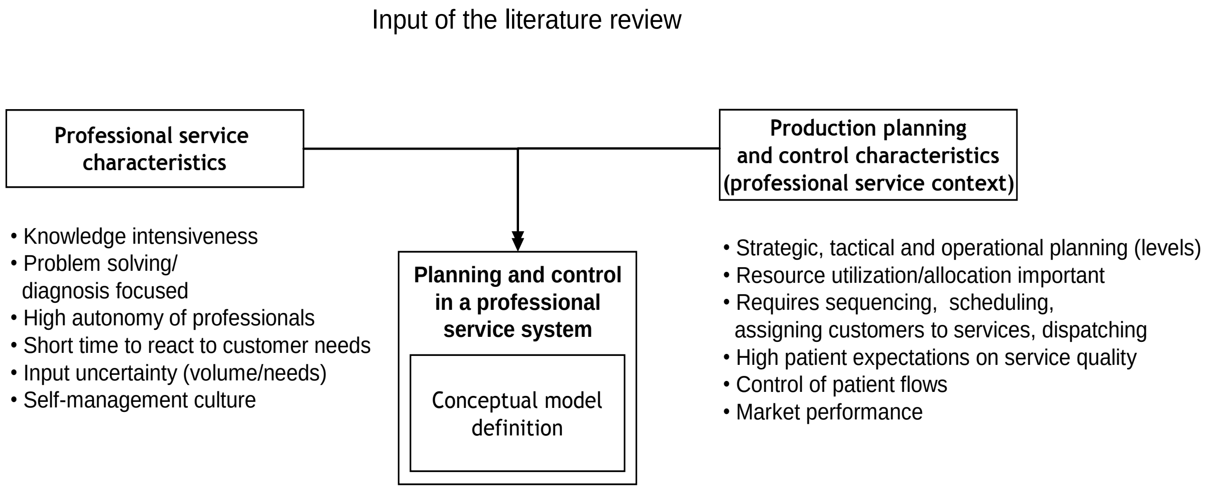

Figure 2. Input of the literature review for the model development

Our intelligent service model utilizes the characteristics of professional services (planning and control requirements), as well as resource planning and patient flow control elements. We add activity control (task level) to the model and connect it back to the planning procedures, so that the planning can benefit from the previous control decisions, and the system becomes a learning one.

CONCEPTUAL MODEL OF INTELLIGENT SERVICE

The conceptual model is presented as a requirement specification. Although the model is a conceptual definition, we wish to emphasize the elements of the model that add something new to existing models. The model definition consists of three different parts: i) prerequisites for the model, ii) layers of the model, and iii) the feedback loop included in the model.

Prerequisites for the model

Based on the literature review and the observations made in the case processes, we have defined the prerequisites that the model must fulfil in the diagnosis-focused professional service context. The prerequisites consist of seven major factors (table 2) that separate the professional service process planning and control from the other service systems, or even more, from the industrial systems. In table 2, we do not present those factors that were already listed in the literature review, including customer problem solving, resource planning and customer involvement in the service process.

Table 2. Prerequisites for an intelligent service model

Prerequisite	**Why is it needed?**
1. Must enable quick reaction	Both planning and activity control must be controllable but enable a quick reaction, especially if the process loads, process flows, or resource supply/demand change.

2. Must support real-time information of system loads and process flows	The most vital element of the system is so called real-time information about the system 'state'. It enables making a process control decision based on the real state of the system (or at least the decision maker is aware of the state) and avoid unintended flow control decisions that are only based on medium-term planning.
3. Must support flexible resource utilization (including multi-professional teams)	One of the main challenges in healthcare systems today (based on the cases), is the static resource problem: the service systems seem to include static resources (to be controlled) even though their professional know-how would enable a much larger scale of tasks (main course professional culture and achieved autonomy).
4. Must support Engineer-to-Order service	The system must enable Engineer-to-Order thinking, meaning that the system (resources, flows etc.) has a capability to adapt to fulfil varying customer needs.
5. Must be adaptive in terms of volume variability	The system design must support changing volumes, and this element should be included in both planning and activity control.
6. Must support process flow data collection for planning purposes (for scenario construction)	One element that seems to be missing from many planning and control systems; this element enables system intelligence, because the planning can be based on scenarios that are based on actual experience from previous diagnosis/decision making situations.
7. Requires good operation management skills (planning and control) on managerial and activity level (not just diagnosis-focused professional skills)	One question that should be raised in the discussion are the operations management skills in professional service systems; system control cannot rely on the self-management of individual professionals.

The factors presented above are not dramatically new, but according to the literature and the case processes, they seem to be missing or forgotten when planning and control systems are constructed. On the basis of the cases we participated in, we can state that one major obstacle for changing the system design are the 'locked elements' that according to the actors cannot and should not be changed. This is, however, quite a strange opinion, if we try to improve a system that is based on utilizing different resources in as an optimal way as possible. New information technology offers already today very efficient tools for planning and control, but they do not help if the system is 'locked'. In the case processes, however, the situation was even worse; information technology was not planned to support 'service production planning' at all, it was there only for patient record keeping.

In the case processes, the service system was quite adaptive, and an analogy to Engineer-to-Order thinking existed. We considered this as a capability to form an adaptive service system in the professional service context. The only problem was that the adaptive system was not planned, measured or controlled. The so called self-management of professionals worked in some cases, but the patient process was not as efficient as it would have been if it was organised. However, we found it interesting to find out whether the system would be adaptive and planned at the same time.

The prerequisites mentioned above do not create any system, defining them is only the first step. The second step is to connect them to a systematic procedure that links planning activities to activity control and again back to planning activities. In the next part, we define the layers of an intelligent service and their roles, time intervals, information needs, and decision-making situations.

Layers of intelligent service

We utilize and adapt the analogy created in earlier studies by Roth and van Dierdonck (1995) and Vissers et al. (2001). It is necessary to identify the layers of planning and control, and how they interact with each other, the part that actually creates the intelligence. Because we do not want to limit our study only to healthcare systems, it is essential to form a more general starting point than DRG's or other patient groups, as in the earlier studies. More importantly, it is necessary to create a system that is adaptive and capable to satisfy varying customer needs. The intelligent service model consists of four different layers: Service Offering Planning (SOP), Service Production Scheduling (SPS), Service Requirement Planning (SRP) and Service Activity Control (SAC).

Unlike in the previous models, we also want to utilize the service concept, although it was mentioned above that it is indirectly or loosely connected to service system control. Bullinger, Fähnrich and Meiren (2003) define the key parts of the service concept, which in our opinion are also the key parts of the intelligent service system: *provision of internal production factors (structure), customers involvement in the process (external factor), combination of production factors with external factors (process), impact on the customer or object (outcome dimension).* In this phase we combine these parts with layers of planning and control, so that we have the major components for each layer.

The integrating part in our model is to define the *information needs (input and output)* and the *decision-making needs* on each layer. The information needs are not only connected to each layer, but interconnected between the layers. This should help to avoid a common feature in planning procedures of no interaction between the layers. If instructiveness can be realized, then the planning horizon on each layer will not be so static and the reaction to changes will be quicker. In any case, the time horizon of each layer should be much shorter than in the traditional production planning procedures because of the quick reaction requirement. The conceptual model of intelligent service is presented in figure 3, and in table 3 each part is further explained.

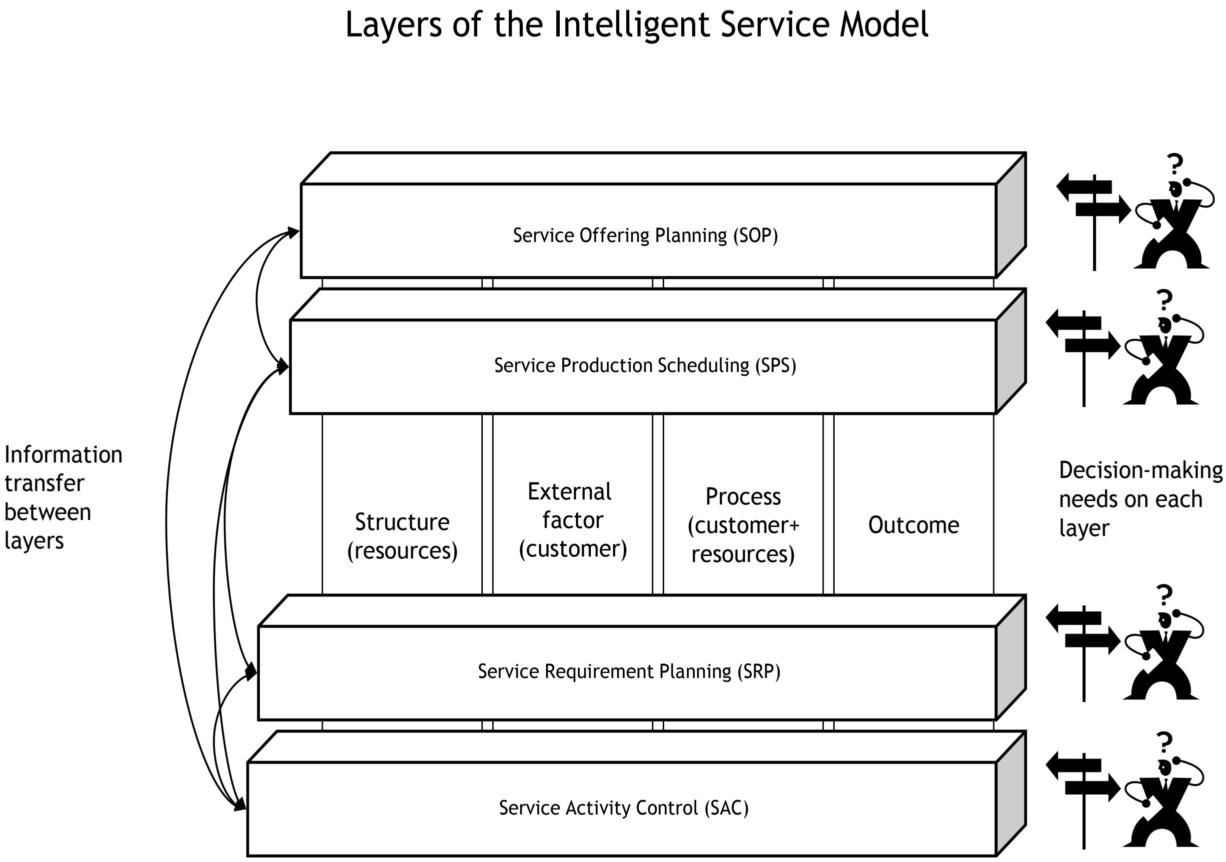

Figure 3. Layers of the Intelligent Service Model

Table 3. Intelligent service model, planning and control layers and detailed explanations

Model layer	***Focus***	***Time horizon***	***Structure***	***External factor***	***Process***	***Outcome***	***Information needs***	***Decisions***
Service Offering Planning (SOP)	Long-term service offering planning, what kind of services will be offered	3-24 months	Resource needs in long-term, resource development needs, outsourced resources	Defining customer segments and customer needs	The typical needs of customers and how they can be fitted with resource utilization	Service definitions	Customer needs on aggregate level, resource availability, data from actual processes	Service offering, adding new services, removing services
Service Production Scheduling (SPS)	Medium-term planning	Weeks up to 3 months	Resource utilization related to customer profiles/demand profiles, alternative/multi-professional resource definitions	Ensuring as many customer activity as possible (time reservations, scheduling)	Creating customer profiles based on service offerings	Based on service definitions, defining service requirements (quality, time consumption, skills etc.) for services	Customer preferences and needs, customer satisfaction, reports from resources (successful utilization or not)	Customer segments, customer analysis, resources, service requirements,
Service Requirement Planning (SRP)	Short-term planning, resources	Days up to 1 week	Defining resources, informing resources of their duties, and flow control rules	Collecting as much information as possible from customers influencing the service activity	Creating customer routing options based on active profiles, defining routing rules for short-period control	Informing the resources if the service requirements are changed, and rules for changing the requirements online	Data from true process flows (evidence), and customer profiles (working or not), changing customer scenarios	Reacting to feedback from activity level, defining the service system for a short period, routing rules
Service Activity Control (SAC)	Real-time activity control	Online	Resource utilization in an optimal way (system perspective), reaction to errors and delays, urgent resource transfers	Customer/object in the process, usually direct customer contact	Customer control, diagnosis (customer/ object), customer routing, “treatment”	Customer/object receives the service (agreed quality and performance)	Real-time system state, process loads, flow scenarios/ options, flow alternatives, resources available	Diagnosis, process flow control, reaction to urgent changes

Feedback loop – the intelligence of the model

As mentioned above the planning and control layers are not new ideas' but the innovativeness of the model comes from changing the state of planning from static towards more a active one. Even if the planning is proactive by nature, it should receive instant feedback from the real service processes, and this data should be notified in planning as soon as possible. Feedback is guaranteed by measuring the state of the service system in real time continuously. The feedback part of the intelligent service consists of four major components: 1) measuring the state information of the service system, 2) a database for process flow, resource utilization and other related information, 3) information for the activity level control decisions and for the planning layer if the customer profile, customer scenario, or resource profile need to be changed, and 4) entering the new flow control rules and alternatives for the activity level control.

The customer profile consists of customer-related information including typical service requirements, resource consumption, costs, pricing etc. The customer scenario is more process-related information where the service requirements and the resource needs are converted into process paths. The benefit of this approach is that it is possible to find alternative process paths to satisfy the customer needs, and control the process based on these scenarios. If the customer needs change, it is only necessary to check the influence on the customer scenario. The resource profile is similar to the customer profile, but includes the necessary information (skills, time) for the service provider when planning resource utilization. The feedback loop of the intelligent service model is presented in figure 4.

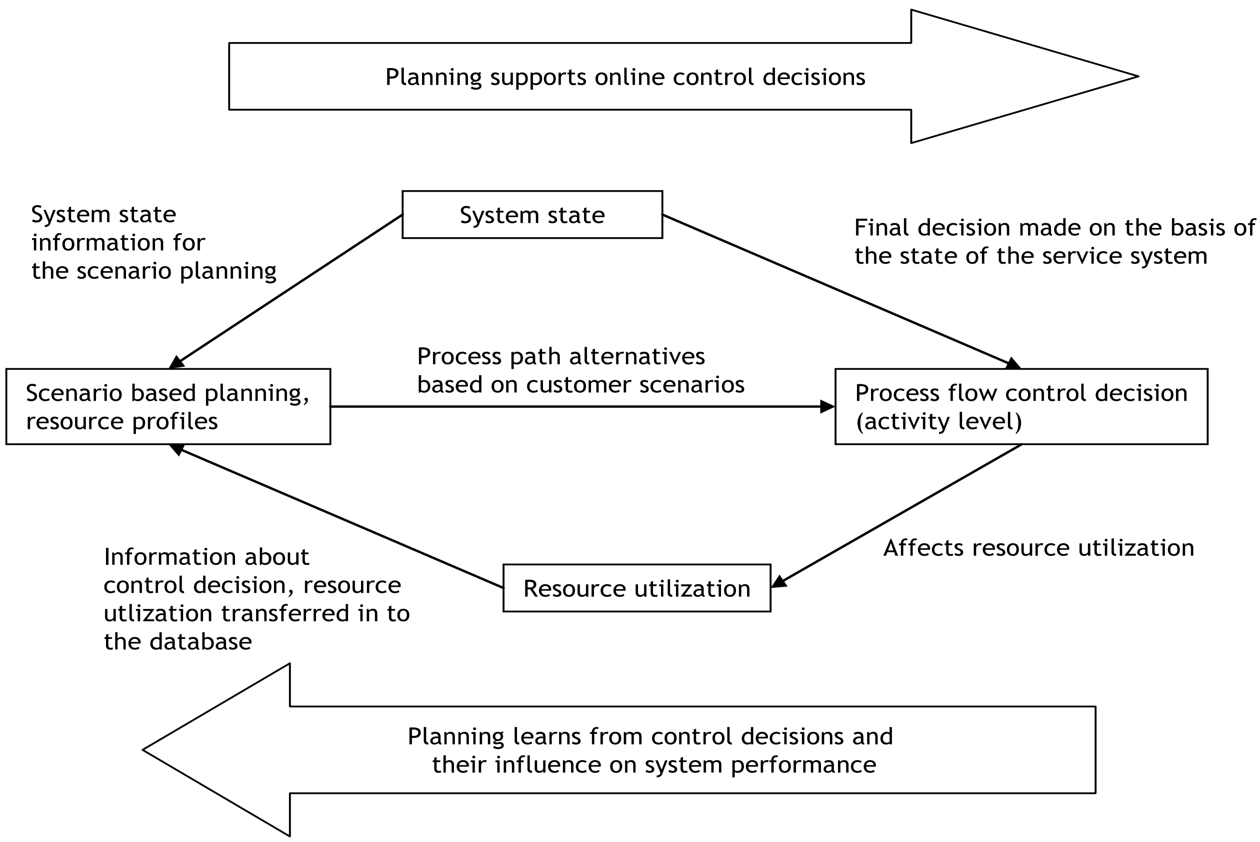

Figure 4. The feedback loop of the intelligent service model

DISCUSSION

Because of the conceptual nature of the service model, it is necessary to discuss the relevancy and usability of the model thoroughly. In the discussion part we also consider the research limitations, and theoretical and practical implications, and set focus for the future development of this model.

We evaluate the model and its relevancy by transferring it to the case world where certain problems would have been avoided if the planning and control were 'intelligent'. The relevancy evaluation is presented in table 4 where we list the major problems in all the four processes, the reason for the problem, and how the model offers a tool to solve the problem in question.

Table 4. Evaluation of Intelligent Service Model

Observed problem	Possible cause	Layer to be solved	Tool
Unclear role definitions (actors) and responsibilities, causing unnecessary customer transfer between actors in the early phases of the process	Unwillingness to define process-related roles (loosing acquired benefits and position)	*Service Production Scheduling (SPS), Service Requirement Planning (SRP), Service Activity Control (SAC)*	Defining the skills and resources needed (based on customer profiles), and adapting requirements if the customer profiles and scenarios change
Bottlenecks causing unmanaged queues or process stoppage	Lack of a true processual view (planning based on ideal paths which do not exist)	*Service Production Scheduling (SPS), Service Activity Control (SAC)*	Defining alternative process paths based on resource profiles and customer needs
Process flow control based on individual diagnosis	Strong professional position of individuals dominate, system view missing	*Service Offering Planning (SOP) Service Production Scheduling (SPS), Service Requirement Planning (SRP), Service Activity Control (SAC)*	System thinking is the base of the whole model, included on every layer
Incoherent planning and coordination procedures (conflicting control solutions)	Too many actors involved, focus not on process-related performance	*Service Offering Planning (SOP) Service Production Scheduling (SPS), Service Requirement Planning (SRP), Service Activity Control (SAC)*	One planning and control system for the whole service system;
Shortage of skills in applying/utilizing process-related information	Lack of service operations management skills, lack of a processual view	*Service Offering Planning (SOP) Service Production Scheduling (SPS), Service Requirement Planning (SRP), Service Activity Control (SAC)*	Training personnel to utilize relevant information on each layer, the information system should generate relevant information for the service system
Patient related information (diagnosis, previous treatments) moves slower than the patient	Unwillingness to use the computer, and information systems do not support the processual view		
Inefficient usage of resources and professional skills	Too many actors involved in the process, autonomy, strict hierarchy	*Service Offering Planning (SOP) Service Production Scheduling (SPS), Service Requirement Planning (SRP)*	Defining the resources needed and their profiles, only necessary actors/resources involved in the process

Based on the analysis above, we can state that the intelligence is relevant, and it would have prevented some of the problems completely, and at least it would have helped to create process-oriented solutions to the observed problems. As it can be seen in table 4, control-related problems are not so complicated if there is a systematic procedure to deal with them. A common feature related to problems is that the roles and responsibilities, measurements, and policies are defined for individual actors, but system thinking is missing.

The research has some limitations, and one major limitation is that the model is a concept, not an empirically tested model. However, the concept definition phase is necessary (learning from previous studies and utilizing information acquired from real service processes) and only after that can we form the model for testing purposes. As practical implications we wish to emphasize that the professional service processes are not impossible to manage, but they require a different type of approaches than other service processes. In the professional service context it is important to maintain the professional status of the individual actor. Whether it is a diagnosis in a hospital or a problem solving in the judicial court, the professional skills are not enough, there must be an additional skill component related to managing the service system (as a whole, or from the individual's perspective, a part of the system). Only after the actors have the skills to see the whole complexity related to the service system, it is possible to create a specific planning and control system for a service system. One measurement for the relevancy of the model is the possibility to utilize the concept definition in any service system.

The theoretical implications of the study focus around the intelligent part of the model. We can to state that most 'service production planning' methods or models lack the feedback loop element. Feedback is often mentioned in some phase of the model but it is not explained in detail how to utilize it. We have created an idea of joining the customer scenarios and resource profiles. It is not enough that these scenarios and profiles just exist, they have to be updated constantly. We have also formed a starting point for deeper research concerning professional service system management, a world that often seems to be seen as unmanageable chaos. The model naturally requires further development and refinement for different purposes.

The future research will focus on defining the intelligent service model layers in detail, for so called open service systems where the customers power to select services/resources to utilize, and for closed service systems where the service provider selects the services/resources for the customer. One important aspect which is not included in this study are the measurements in the service system that would produce data to indicate the state of the system. The first test of the model will most likely be a simulated model where we utilize real world parameters and situations in a computer simulation.

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