INFRASTRUCTURE COSTS IN HOSPITALS: A PROCESS ORIENTED ANALYSIS OF FACILITY MANAGEMENT SERVICES AS BASIS FOR STRATEGIC PLANNING

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ABSTRACT

Through the implementation of the German Diagnosis Related Grouping (DRG) system and the resulting cost pressure, the need for optimized use and operation of the spatial resources in hospitals is growing. In the DRG system, the provision of ready to use infrastructure is treated as fixed costs and is allocated to patient cases by a single cost driver. In reality, very different services are needed to provide ready to use functional space. A primary activity based cost model for Facility Management services in relation to functional space units in the hospital is developed. Using process and cost data of an empiric research study from four German hospitals, a model is developed for a key functional space unit in the hospital, the operation unit. The relevant Facility Management services structured by a product oriented approach are determined by real data. For these services, process figures are derived and implemented in a basic cost estimation model. The cost estimation model is compared to the cost approach of the DRG system. Depending on the time spectrum of operations great differences between the approaches can be determined. One way for hospitals to face the consequences may be the optimization of relevant Facility Management services. The model can be used by hospitals for strategic planning of the Facility management costs and services in relation to the capacity and utilization of the operation unit. The impact of changes of the primary performance portfolio on the utilization of corresponding infrastructure can be simulated. Thus cost data can be made available to support strategic decisions

KEYWORDS: facility management cost, hospitals, primary process relation, strategic planning.

INTRODUCTION

Through the implementation of the German Diagnosis Related Grouping (DRG) system and the resulting cost pressure, the need for optimized use and operation of the spatial resources in hospitals is growing. The link between primary processes and facility management services though is missing. Basis for this research is the investigation of interdependencies between facility management performance and costs, and primary processes in the hospital. A theoretic cost model is being developed and exemplary adapted to the functional area operation based on the data of four German hospitals. The model may be used to estimate facility management costs in relation to the capacity use of functional areas for different scenarios based on real time data. The results can be used for strategic planning in hospitals.

METHODOLOGY

In the first phase, processes in the hospital are being defined. Primary, and infrastructure processes – it is facility management processes – are differentiated and structured hierarchically. In the second phase the functional areas in the hospital are defined and structured in to units in accordance to the German DRG system for cost accounting. Based on these definitions a process oriented cost model for the hospital is developed. Basis of the research is the linkage of infrastructure process costs to primary process parameters. The cost model is tested by using empiric research data for the primary process operation and the connected infrastructure process "provision of the functional unit operation". The empiric research is based on the cost and performance data of four German hospitals for the period 2005 or 2006.

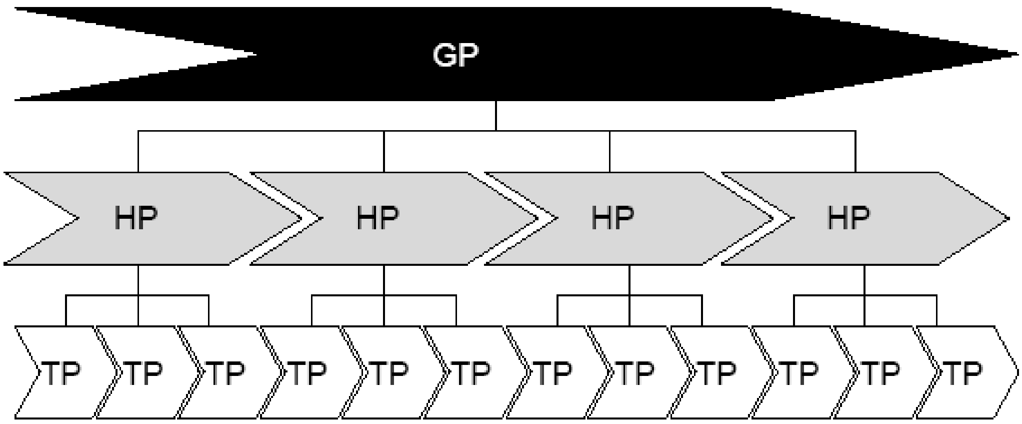
DEFINITIONS AND MODEL

In the following sections, the processes, cost and spaces in the hospital are being defined and set into relation as basis for development of a theoretic model. As the model seeks to derive strategic advice on "the implications on costs by changes of capacity use" the structure of fix and variable costs and processes is being used. (Wöhe 2002, p.1089)

Process structure

Hessel defines, in accordance with Horváth, a process „as a chain of essential activities. These activities result in a service for a (either internal or external) client." (Hessel 2004, p.27) A client oriented process identification has been already described by the work of Gaitanides. (Gaitanides 1994, p.44) Further, Hessel suggests for hospitals a hierarchical process structure containing core processes, main processes and sub processes as can be seen in figure 1. This structure is used for the research described in this paper.

Figure 1. Hierarchic process structure with core processes (GP), main processes (HP) and sub processes (TP) (Hessel 2004, p.30)



Process identification – distinction between primary and infrastructure processes

Using a client oriented process model for an enterprise, the first question is the enterprise's purpose. Hessel translates this approach to hospitals and defines primary processes as "such processes that directly influence a patient's state of health (for example performance of an operation). Infrastructure processes (though) are relevant for the provision of necessary resources (i.e. personnel, materials) as well as responsible for the functionality of primary processes (for example maintenance)." (Hessel 2004, p.33).

Following this approach, the model described in this paper is structured into primary processes and infrastructure processes. Thus, the structure is compatible to the definition of infrastructure performance by the German Institut für das Entgeltsystem im Krankenhaus (InEK), which is responsible for the DRG data and pricing system. Table 1 shows the primary core processes on the basis of Hessel for hospitals (Hessel 2004, p.35). In contrary to Hessel the primary core processes and infrastructure core processes are separated into two categories. Sterile goods supply for example are not a primary core process and thus not displayed in table 1 but defined on the level of main processes within the infrastructure core processes (compare table 3)

Table 1. Primary core processes (on the basis of Hessel (Hessel 2004) p.35)

Primary core processes	
Number	Name
1	Admission
2	Diagnosis
3	Operation
4	Ward round
5	Care
6	Conservative treatment
7	Dismissal

Any cost in the German DRG system is allocated to the patient only by performance figures of eleven direct cost accounts (DKG (2002) p.125). The cost accounts can be translated into functional space units. The provision of these ready to use functional space units is defined as eleven infrastructure core processes, as can be seen in table 2. Provision of ready to use functional space units includes cleaning, maintenance and all services and provision of materials that are needed to perform the primary core process. Table 3 gives an overview of all possible infrastructure main processes that may be part of any of the infrastructure core processes. The definition of these processes is part of the research project OPIK, Optimization and Analysis of Processes in Hospitals by Abel (Abel, 2005).

Table 2. Infrastructure core processes

Infrastructure core processes	
Number	Name
1	Provision of functional unit ward
2	Provision of functional unit intensive care
3	Provision of functional unit for kidney dialysis
4	Provision of functional unit operation
5	Provision of functional unit maternity room
6	Provision of functional unit anaesthesia
7	Provision of functional unit cardiology/therapy
8	Provision of functional unit for endoscopic surgery /therapy
9	Provision of functional unit radiology
10	Provision of functional unit laboratories
11	Provision of functional unit for other diagnost./ therapeutical use

Table 3. Main processes of infrastructure core processes

Main processes of infrastructure core processes			
No.	Name	No.	Name
1	Waste disposal	16	Mailing services
2	Outside facilities	17	Cleaning
3	Facilities operation	18	Braodcasting and TV services
4	Bed conditioning	19	Pest control
5	Office materials	20	Security
6	IT-services	21	Catering
7	Car pool	22	Sterile goods supply
8	Technical services	23	Electricity
9	Hygienic advice	24	Telephone services
10	Building maintenance	25	Transportation services
11	Maintenance of biomedical equipment	26	Relocation services
12	Maintenance of technical equipment	27	Heating
13	Cooling services	28	Laundry services
14	Base rent	29	Water supply
15	Copy and printing services	30	Administration/controlling/other

Interdependencies between primary and infrastructure core processes - model

Functional unit and direct cost account defined by InEK form a spatial entity. To each entity exactly one infrastructure core process is assigned. On the level of the primary core processes, none, one or several core processes may be assigned to each entity depending on the patient's treatment (clinical path). In figure 2 this scheme is displayed. The patient's way through the hospital follows a certain path, symbolized by the black line. Along this path the patient is using the specific functions of the different entities. In relation to the function of each entity infrastructure services are used to a certain amount, symbolized by the grey circles. On the level of space, primary and infrastructure processes are linked through the functional units. The focus is set on the patient and his presence in the functional unit. Any performance is related to his person. This relation can be described in the following formula:

$$\sum CostCP = \sum_{k=1}^{7} CostCPP_k + \sum_{j=1}^{11} CostCPI_j$$

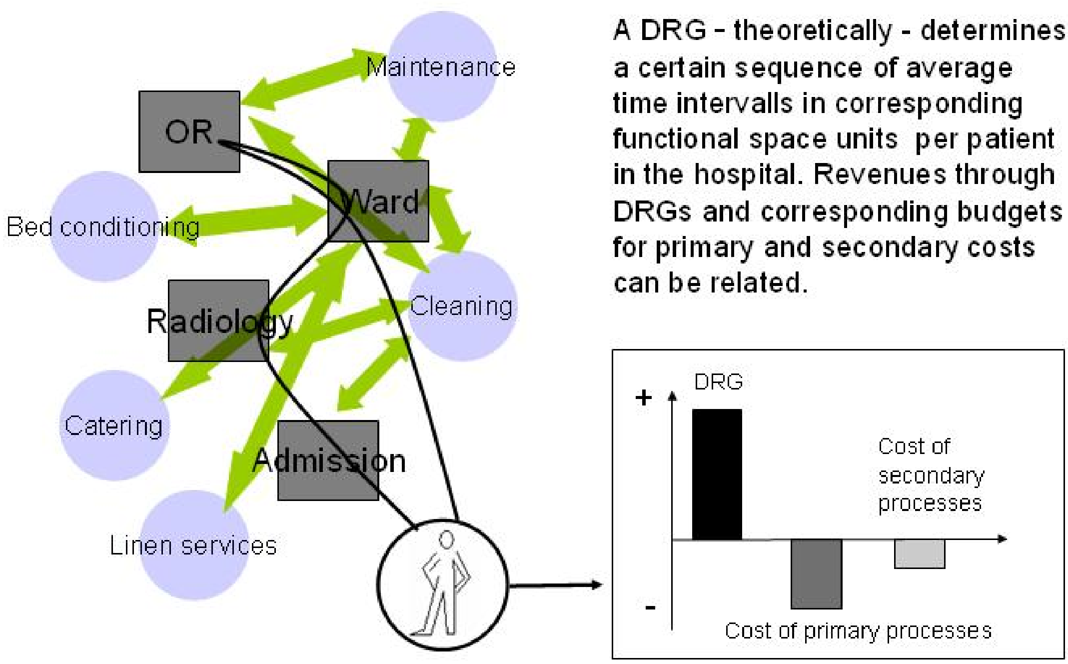
with CP = Core process
CPPk = Primary core process k ϵ K; K = {1,2,…,7}
CPIj = Infrastructure core process j ϵ J; J = {1,2,…,11}

Any primary core process a patient is obtaining can be structured on the level of main processes. The analysis of the primary main processes leads to primary process parameters P_k. To each primary core process a process parameter P_k with a value of $P_{k'}$ can be related. All pathways of a hospital's patients as a whole result in a primary process profile P. P can be specified mathematically as a map of the primary processes CPPs' sum:

$$\sum_{k=1}^{7} CPP_k \rightarrow P$$

with CPPk = Primary core process k є K; K = {1,2,…,7}
P = profile of primary process parameters

Figure 2. Patient's path through the hospital



The model's quintessence is the description of the relation of all infrastructure core processes to a primary process profile P. Thus a value P' must be assigned to each relevant main infrastructure process. The following chapter shows the development of the model for the infrastructure core process „provision of functional unit operation" on the empiric data basis of four German hospitals.

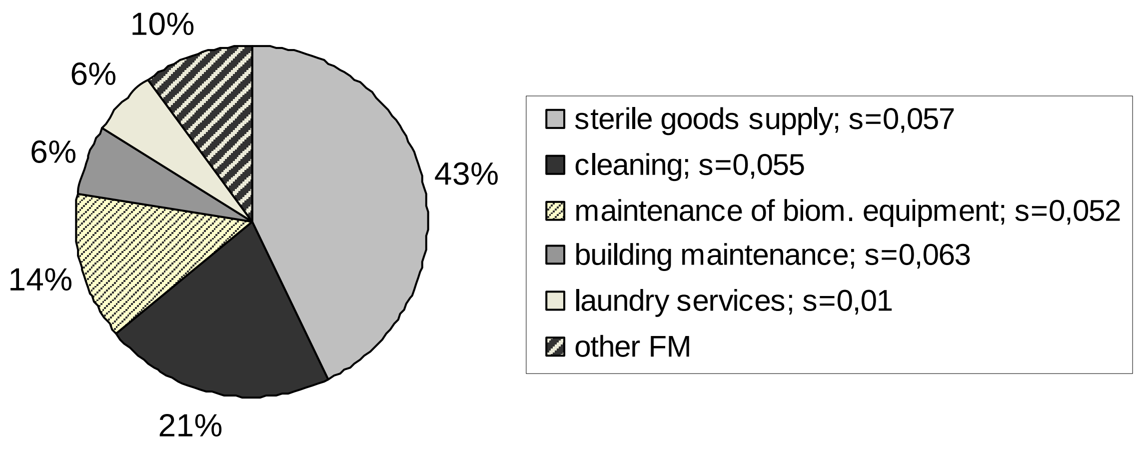
DEVELOPMENT OF THE MODEL FOR THE INFRASTRUCTURE CORE PROCESS PROVISION OF FUNCTIONAL UNIT OPERATION

Figure 3 shows the average cost shares of the relevant infrastructure processes for the operation units for a sample of four German hospitals and the standard deviations s.

43% of the cost is being related to the product "sterile goods supply". This process is dominant for the operation unit. 21% of the costs are related to "cleaning", followed up by "maintenance of medical equipment" with 14%, "building maintenance" with 6%, as well as "laundry services" with a cost share of 6%. The standard deviation for building maintenance is with 0,06 very high. These 5 products have in total a cost share of 90% of the total FM cost of the operation unit excluding base rent.

10% of the cost are related to other products which is "power supply", "cooling services", "heating supply", "water supply", "technical maintenance", "IT services", "technical services", "security", and with a minimum share "waste disposal", "outside facilities" and "office supplies".

Figure 3. Average facility management cost share for the functional unit operation of four hospitals



Power supply, cooling services, heating and water supply together have a share of 3% of the total cost. It has to be considered that in none of the hospitals the consumption is being documented by separate meters. The consumptions of heating energy and water are being allocated by space, combined with an allocation key based on number of persons, for the latter. Allocation base for power supply and cooling services is also space. For air-conditioned areas – as is the operation unit - an additional charge according to the engine performance during operation and stand by times is being made. The documentation of the actual consumption by meters would be preferable. Facing the small impact of these costs to the total cost in the operation unit, the influence of accurate consumption figures can be estimated as minor to the results of this research.

Analysis of fix and variable costs

The relevant FM products can be separated into fix and variable costs. The products "sterile goods supply", "cleaning" and "laundry services" are direct costs and have a variable cost share of 72%. When changing operation time of the operation unit from one shift to two shifts per day and assuming to have similar workload, it may be assumed that these costs will double in a linear manner. The cost for "maintenance of medical equipment" would remain the same, because the maintenance cycles are set independent to the actual utilization times. Therefore the cost is defined as being indirect.

For the variable costs it is important to find the cost driver. If the cost of the product occurs once per operation with a fix amount, the number of operations is cost driver. If the cost is dependent from the length of the operation, the amount of operation time is cost driver.

Cost drivers

Allocation base and therefore abstract cost driver for the cost of the medical and non medical infrastructure in the operation unit is according to the standard by the German Institut für das Entgeltsystem im Krankenhaus (InEK) the time between first incision of the skin and last suture plus the setup time for each operation (DKG 2002, appendices S.20). This approach is simplifying in assuming that all infrastructure cost are in linear dependency to the length of the operation. Time is the only cost driver. For a transparent analysis of costs and for the purpose of benchmarking and optimization of FM products the relation between cost and cost driver has to be examined more into depth.

Does an operation of double the length really mean a doubled effort for sterilization and packing of the surgical kits? Cost driver for sterile goods supply is rather the number and the content of surgical kits, i.e. the kind of operation, than the procedure time. A problem is when large surgical kits are being opened just for the use of one or two pieces. The unused content has to be sterilized and repacked nevertheless. To avoid this senseless effort there has to be a good communication between surgeons, medical personal and the sterilisation department. For standardized operations standardized surgical kits should be not only available but also in use and the documentation should be made available for facility management purposes. In a simplifying approach the cost driver for sterile goods supply is set as number of operations.

Cleaning of the operation theatre is happening after the operation of the patient during the post processing phase. For most of the operations the effort of cleaning is the same, not depending on the operation time. On the other hand the availability of the cleaning personal is cost driver. Operational data of the four hospitals show that the personal is related to the operation theatres and possibly just waiting during operation procedure time. Thus time is cost driver.

The indirect cost for maintenance of medical equipment would fall down to half of the original cost per minute in case of a two shift capacity utilization of the operation unit instead of one. Similar to basic rent this cost is fixed. “In relation to the usage of the main processes” (Wöhe 2002, p.1159) – which is in this case the operation procedure time – these costs can be allocated to the patient.

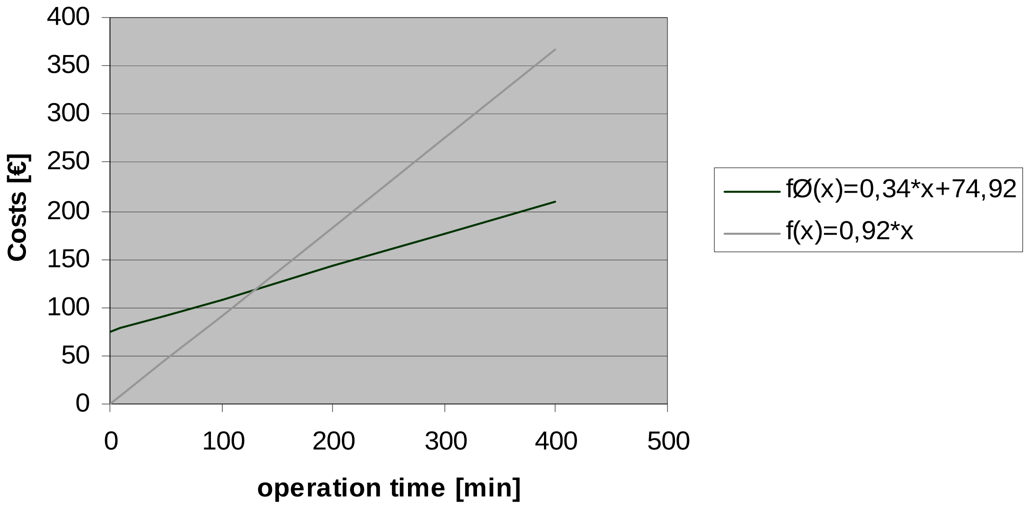
Building maintenance is dependant on the quality and the workmanship of the construction elements, as well as on the intensity of utilization (Naber 2002, p.157). The analysis of the construction elements of the operation units of the hospitals would exceed the framework of this research. Assuming that similar materials and qualities have been used in all four hospitals, and that the impact of utilization during operation time on abrasion is the same, the cost for building maintenance are deemed to be in linear dependency to the utilization time.

Laundry services in the operation unit – non sterile operation theatre linen - are direct cost. Surgeons, anesthetists, and supporting personal are changing into dresses, when (re-)entering the operation unit. In theory the daily scheduled operations could be performed in a row without major breaks. If there are breaks where personal is leaving the operation unit, or if personal is changing, additional need for theatre linen arises. In a simplifying approach the amount and therefore the cost of theatre linen is assumed to be fix cost arising once per operation. Cost driver for the product linen services is the number of operations.

7. Linkage to the primary process

According to the data of the primary performance of the hospitals for the reference year cost drivers for the relevant products have been assigned and a price per unit has been calculated. The definition of the length of the operation follows the standard by InEK, being the time between first incision of the skin and last suture and setup time. Setup time includes the pre- and post processing time of the patient in the operation unit (DKG 2002, p.135). This time interval is defined as “overall operation time“. Figure 4 shows the resulting cost functions. The approach by InEK results in a function that intersects the origin. But the approach of this paper assigns a fixed cost share of about 75,- Euro (middle value of sample, standard deviation: 17,5) to any operation. The slope of this function is less steep than the former. The functions intersect at an operation time of about 130 minutes.

Figure 4. Cost functions in relation to operation time (based on average figure of four hospitals)



CONCLUSIONS

According to the overall operation time, the two approaches assign different costs to a patient. The InEK approach is the German standard determining the hospital's proceeds. Facing real costs and dependencies, hospitals in Germany need to take into account what time wise is their spectrum of operations and the related cost risk. Taking the results of this paper into account, the optimization of certain facility management services becomes for the functional units operation of hospitals with average operation times under 130 minutes especially important.

The linkage of Facility Management processes and the primary process for the functional areas in the hospital is an important step towards strategic planning. The model described in this paper may be used as a starting point. Further research should include the other functional areas in the hospital. Also, the database of four German hospitals should be enlarged and documentation of costs, especially for cost dominant services as sterile goods supply should be improved.

REFERENCES

Wöhe, G. and Döring, U. (2002), Einführung in die Allgemeine Betriebswirtschaftslehre, 21., neubearbeitete Auflage, Verlag Franz Vahlen, München, 2002

Kristof, R. (2004), Ein hierarchisches Verfahren zur Terminplanung elektiver Operationen und Mehrressourcenbelegung in zentralen Operationsbereichen, IPA-IAO Forschung und Praxis, Band Nr. 395; Engelbert Westkämper, Hans-Jörg Bullinger (Hrsg.), Jost Jetter Verlag, Heimsheim

Hessel, M.(2004), Standardprozessmodell für Klinische Pfade in „Pfade durch das Klinische Prozessmanagement", Methodik und aktuelle Diskussionen, Herausgeber: Michael Greiling, Verlag W. Kohlhammer, Stuttgart, S.27-41

Gaitanides, M., Scholz, R., Vrohlings, A., Raster, M.(1994), Prozessmanagement, Konzepte, Umsetzungen und Erfahrungen des Reeingineering, Hanser Verlag, München, 1994

DKG (2002), Kalkulation von Fallkosten, Handbuch zur Anwendung in Krankenhäusern, Version 2.0, 31.Januar 2002; Deutsche Krankenhausgesellschaft (DKG), Spitzenverbände der Krankenkassen (GKV), Verband der privaten Krankenversicherung (PKV)

Naber, S. (2002), Planung unter Berücksichtigung der Baunutzungskosten als Aufgabe des Architekten im Feld des Facility Management, Peter Lang GmbH, Europäischer Verlag der Wissenschaften, Frankfurt am Main, 2002

Abel, J., Lennerts, K. (2005), OPIK-Richtlinie, Facility Management, Kunden-Lieferanten-Verhältnis im Gesundheitswesen, Institut für Technologie und Management im Baubetrieb, Facility Management, Universität Karlsruhe, 2005