Facility Management cost analysis of the operation unit: using fix and variable cost for a primary performance dependent cost estimation model

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ABSTRACT

The operation room area is one of the most cost intensive functional entities within a hospital. Through the implementation of the German diagnosis related grouping (DRG) system and the resulting cost pressure the need for optimized use and operation of this spatial resource is growing. Thus activity based cost structures can be used. An important question then is: How much is the overall cost for providing the OR area according to the needs of the primary process and what is the relation between fix and variable cost?
This abstract includes results of the facility management cost analysis for the operation room areas of four German hospitals. The operational costs of the medical and non-medical infrastructures are related to Facility Management performance products and the relevance of each product is discussed. Further focus is set on the theme of cost allocation. Allocation bases are being analyzed. A cost estimation model is developed. Finally the linkage of cost to DRG performance data enables to range the role and the influencing parameters of fix to variable cost.
Motivation of this research is the primary process oriented reflection of the functional area Operation giving transparency of cost to technical coordinators, controlling and management executives in the hospital.

KEYWORDS

Hospital, Cost allocation, Process orientation

INTRODUCTION

The operation room area is one of the most cost intensive functional entities within a hospital. Through the implementation of the German diagnosis related grouping (DRG) system and the resulting cost pressure the need for optimized use and operation of this spatial resource is growing. Thus activity based cost structures can be used. An important question then is: How much is the overall cost for providing the OR area according to the needs of the primary process and what is the relation between fix and variable cost? The answer to this question is basis for a fair FM cost allocation to the patient.

METHODOLOGY

Basis for this paper is the collection and analysis of the cost for medical and non medical infrastructures in terms of personal and materials for the operation unit of four hospitals for the reference years 2005 or 2006. These costs are related to facility management (FM) products.

Also, the primary performance of the operation unit specified by amount and procedure type (ICPM-International code for procedures in medicine) is being collected, including the accounted DRG and process data in terms of primary operation time figures.
The cost drivers for single relevant FM products are being discussed and defined for a model. For two types of highly standardized operations the cost of the relevant FM products are shown based on the realistic data of the hospitals. The costs are being compared to the according legal cost targets. Two different cost functions depending on time are formulated and compared.

FACILITA MANAGEMENT COST OF THE HOSPITAL

The analysis of life cycle cost includes the overall cost during the lifetime of a building, starting with the planning and construction phase, through the operation phase and finally the phase of demolition and disposal of its components (compare [8]).
According to the function of buildings and the use of its space entities, the costs are different (compare [9]).
The research of this paper is concentrating on the operation phase within the life cycle of the operation unit in the hospital and therefore on the collection of the operation cost.
According to the definition by the German Institut für das Entgeltsystem im Krankenhaus these cost are defined as "personal and material cost for medical and non medical infrastructures" (compare [3] appendices S.20). Using a product oriented approach (compare [1]) the operation costs are related to 29 Facility Management (FM) products. Table 1 is giving an overview of the products.

Table 1: Product list

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		

The product „basic rent" is special. The investment cost of hospitals in Germany are - following the model of a dual financing (compare [2]) – separated from the other cost because it will be covered by the state and not by health insurances. Basic rent includes as main part the depreciation of the asset, as well as charges for insurances and taxes. The share

of basic rent of the overall Facility Management cost volume is in average 40%. The cost for basic rent is exclusive of the reimbursement of cost by the German diagnosis related grouping system (compare [3] S. 43).

Figure 1 shows the overview of the average cost share of the facility management products for a sample of 15 hospitals for the overall asset. The cost of basic rent has been excluded. 10 products of 29 have a cost share of over 5%. In total their share is 75% of the total FM cost. The highest share with 14% is the product “catering”, followed up by “cleaning” with 12%. Technical and building maintenance, as well as maintenance of medical equipment have in total a share of 26%. Though, the costs for maintenance of medical equipment are fixed cost, independent of operation time or intensity of use. Maintenance and servicing cycles are for the most part fixed to certain periods by law independent of the actual time of operation of the equipment.

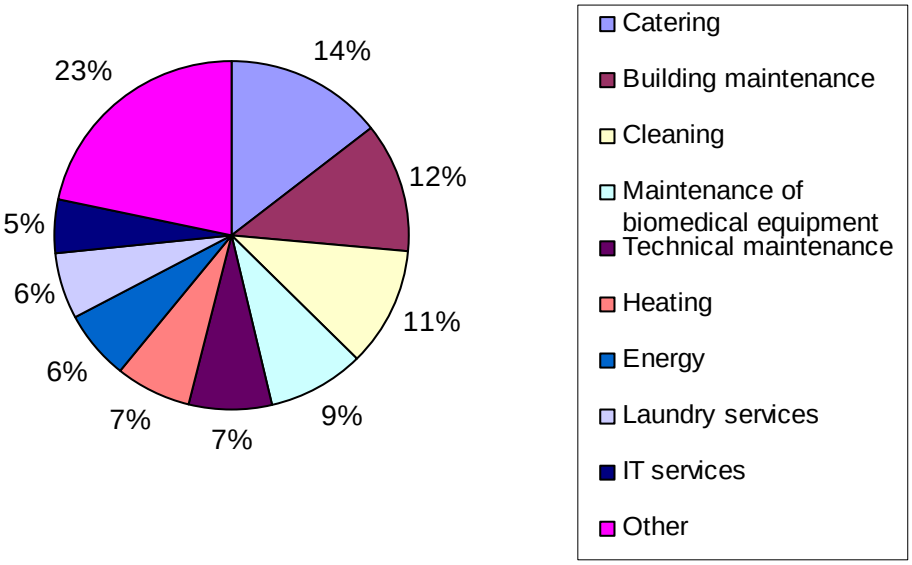

Figure 1: Cost share of facility management products in the hospital

FACILITY MANAGEMENT COST IN THE OPERATION UNIT

The share of costs in the operation unit is different to the distribution of cost for the whole asset. In figure 2 the average cost shares of the FM cost for the operation units for a sample of 4 hospitals are shown.

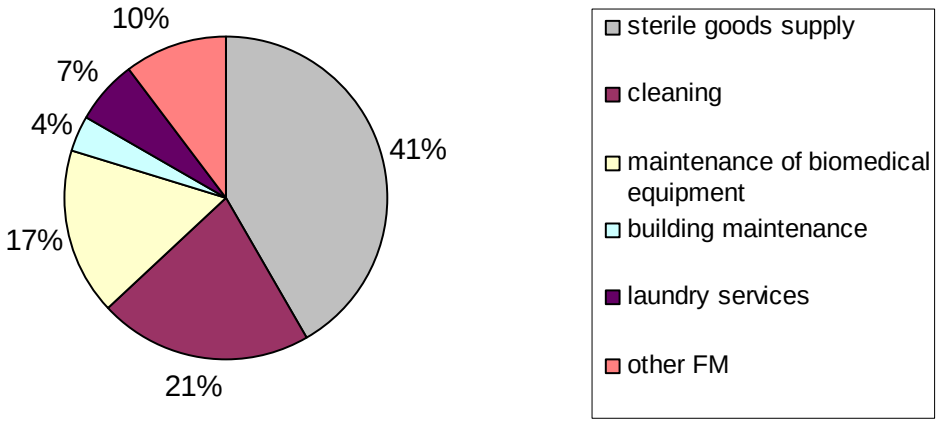

Figure 2: Cost share of facility management products in the operation unit

41% of the cost is being related to the product “sterile goods supply”. This product has in relation to the whole asset no relevant cost share, but for the operation unit it is dominant. 21% of the cost is related to „cleaning“, followed up by “maintenance of medical equipment” with 17%, “building maintenance” with 4%, as well as “laundry services” with a cost share of 7%. 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”.
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 69%. When changing operation time of the operation unit from one shift to two shifts per day and assuming to have similar workload, these costs would 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 (compare [3] appendices S.20).
This approach is simplifying in assuming that all infrastructure cost are in linear dependency to the length of the operation. Time would be 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.
Cleaning of the operation theatre is happening after the operation of the patient during the phase of postprocessing. 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. Assuming that the personal is related to the operation theatre and possibly just waiting during operation procedure time, the 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” (compare [5], S.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 (compare [7] S.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 4 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 – operation theatre linen - are direct cost. Surgeons, anaesthetists, and supporting personal are changing dresses, when 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 laundry services is the number of operations.

LINKAGE TO THE PRIMARY PROCESS – PROCESS MODEL

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. Table 2 shows the resulting cost for each product and unit and the type of cost.
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 postprocessing time of the patient in the operation unit (compare [3] S.135). This time interval is defined as "overall operation time".
A certain variance of the cost figures in table 2 is visible. Optimization potential seems to be obvious for some hospitals. Sterile goods supply has an important impact on the total cost. Related to the number of operations the span between these figures of the hospitals is about 33,- Euro.

Table 2: Costs

Hospital / Product	1	2	3	4	Dependency on utilization	Dependency on procedure	Reference figure
Sterile goods supply	33,84	43,49	66,75	67,03	variable	fix	Operation [€/ICPM]
Laundry Services	6,64	5,61	11,82	8,83	variable	fix	Operation [€/ICPM]
Cleaning	0,19	0,15	0,38	0,14	variable	variable	Time [€/overall operation time
Miantenance of med. equipment	0,14	0,13	0,26	0,13	fix	variable	Time [€/overall operation time
Building Maintenance	0,01	0,03	0,07	0,05	variable	variable	Time [€/overall operation time

The relation of FM cost to the primary process can be described by the following mathematical term:

$$\sum_{i=1}^{5} FM\,\mathrm{cost}Patient_i = \sum_{i=1}^{3} FM\,\mathrm{cost}Patient_{iVariable} \cdot time_{ICPM} + \sum_{i=4}^{5} FM\,\mathrm{cost}Patient_{iFix}$$

This term is basis of the cost estimation model. The model is tested for two types of operations. Process related costs should be compared preferably for standardized operation types that are performed often. The implant of a hip joint is a highly standardized and often performed operation type (compare [4], S.195). For hip joint operations (ICPM 5-820.*), the average costs for 5 relevant FM-products are being calculated, according to the four hospitals' individual cost figures (see table 2) and their average primary process data.
Figure 3 shows the resulting cost share for the 5 relevant FM products. It has to be considered that these products have a share of about 89% of the total facility management costs.
Most of the cases of these hip joint operations are grouped in 2005 and 2006 to either the German DRG I48Z or I05Z (compare [6]). For the infrastructure cost of the operation unit the cost target for I48Z is about 250,- Euro, for I05Z it is 344,- Euro.

The individual share of the so grouped cases for the 4 hospitals of this sample is shown in table 3, as well as the target proceeds by InEK, diminished by 20% in response to the missing FM products (about 10%) and an estimated share for Administration.

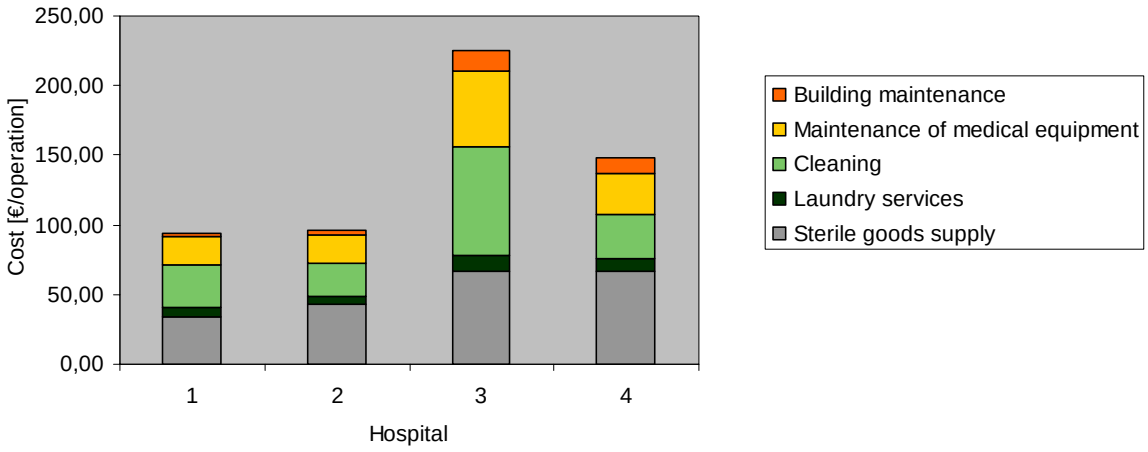

Figure 3: Average FM costs for type hip joint operation in the operation unit

Table 3: Hip joint operation

Hospital	1	2	3	4
FM-cost function	f(x)=0,34x+40	f(x)=0,30x+49	f(x)=0,70x+79	f(x)=0,34x+76
Costs (5 FM-products) per operation ICPM hip joint operation	93,53	96,49	224,91	148,11
Percentage of ICPM in DRG I48Z [%]	73	67	18	5
InEK-proceeds I48Z (80%) for operation unit	200,34	200,34	200,34	200,34
Percentage of ICPM in DRG I05Z [%]	10	28	46	38
InEK-proceeds I05Z (80%) for operation unit	274,93	274,93	274,93	274,93

The target proceeds by InEK are for all four hospitals high above the calculated costs. Laundry services and sterile goods supply are calculated as fix costs per operation, independent of time. Especially for sterile goods supply, hospitals 3 and 4 have high costs. Optimization potential should be considered. Hip joint operations are a type of operation with an average length of 150 to 300 minutes, which is not a short time span. For operations that need only for example 30 minutes of time, the fix costs for laundry and sterile goods supply have the dominant share.

The cost for cleaning in hospital 3 has a high impact on the total costs. The price per minute overall operation time is about 0,38 Euro. As variable, time dependent costs, the cost for cleaning reach for an average overall operation time of 300 minutes quite a high share.

To test the calculation model further, a different type of operation with a shorter average overall operation time has been chosen as example, the appendectomy (ICPM 5-470.*). The

results of the calculation can be seen in figure 4 and table 4. For this type of operation and the relevant diagnosis related groups (G23Z, G22Z, G23B) hospital 4 meets the target proceeds by InEK, hospital 1 and 2 are lower, hospital 3 is more than 40,- Euro above it.

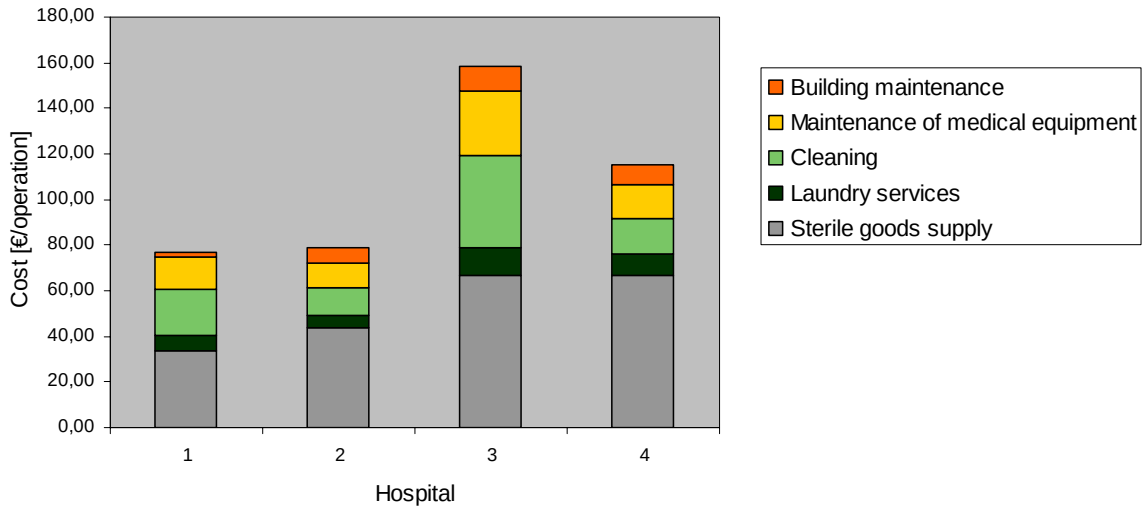

Figure 4: Average cost of FM products for operation type appendectomy in the operation unit

Table 4: Appendectomy

Hospital FM-cost function	1 f(x)=0,34x+40	2 f(x)=0,30x+49	3 f(x)=0,70x+79	4 f(x)=0,34x+76
Costs (5 FM-products) per operation ICPM appendectomy	76,78	79,17	158,42	113,37
Percentage of ICPM in DRG G23Z [%]	68	67	28	0
InEK-proceeds G23Z (80%) for operation unit	91,44	91,44	91,44	91,44
Percentage of ICPM in DRG G22Z [%]	22	17	15	0
InEK-proceeds G22Z (80%) for operation unit	111,12	111,19	111,19	111,19
Percentage of ICPM in DRG G23B [%]	0	0	22	39
InEK-proceeds G23B (80%) for operation unit	101,52	101,52	101,52	101,52

In general, the different cost results for using the cost estimation model considering a share of FM cost as fix to using the cost allocation approach by InEK can be seen when looking at the time related mathematical functions of each approach. In figure 5 the two functions can be seen. Both functions are based on the average data of the four hospitals of this research. The functions intersect at an overall operation time span of about 130 minutes. Operations that take a shorter time span can not cover the fix costs that are spent primarily. On the other hand

long operations profit by the InEK approach through the steeper slope of the InEK function. This may result in cost risks for hospitals depending on the operation portfolio.

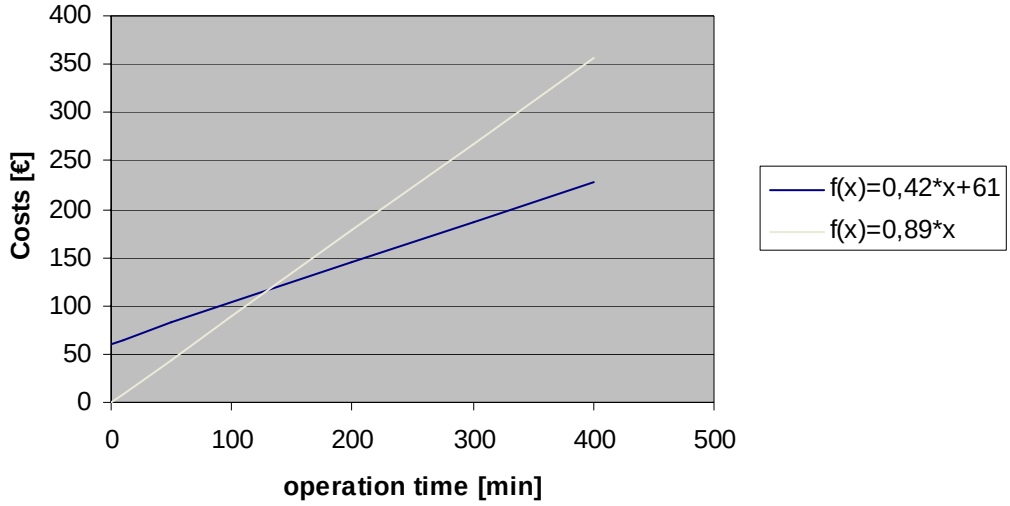

Figure 5: Cost functions in relation to operation time (based on average figures of four hospitals)

CONCLUSIONS

The relevant infrastructure costs for the operation unit in hospitals are covered by five facility management products. The cost distribution of the facility management products is different for the operation unit according to its function than for the total asset. Catering, the product with the highest cost share for the total hospital is not relevant for the operation unit. Nevertheless sterilization services dominate the cost of the operation unit, but do not for the hospital in total.
The analysis of the single relevant FM products and their individual cost drivers gives an activity based transparent cost allocation base. The analysis results in a primary performance dependent FM cost estimation model. Variation of costs per operation in regards to the InEK target proceeds and therefore cost risks are being discussed. The FM cost estimation model presented in this paper allows not only to transparently allocate facility management costs with regards to the relevant cost driver but also to estimate costs in relation to changes of primary performance portfolios.

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