Chapter 9

Facility management of hospitals

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Introduction

All countries in Europe face the challenge of finding sustainable sources of funding in response to upward pressure on health care expenditure. Hospitals account for a substantial proportion of overall health expenditure, with facility management costs making up 20–30% of expenditure on hospitals. However, facility management costs have so far failed to attract significant attention from health care providers and policy-makers in many countries. There is surprisingly little comparative information on facility management costs of hospitals and even less is known about how to take account of these costs when designing new hospitals. This chapter describes the experience of a study that has been ongoing since 2001 that has quantified facility management costs and related them to the medical services provided by hospitals. It argues for a more transparent accounting of facility management costs, which may be a step towards substantial cost savings. It also emphasizes the need to consider facility management costs in the design of new facilities.

There are several factors that seem to distinguish hospitals from many other business ventures. First, they are facilities which are open 24 hours a day, 7 days a week; second, they produce particularly complex services; and third, a mistake in a hospital can cost a life. These characteristics create exceptional operating conditions, generating a range of objectives that are much more complex than those that are contained in the profit-maximizing vision of most business ventures. Hospitals must also constantly update their equipment to meet the highest technical and safety standards, even though this can come at exorbitant prices.

What possibilities does the field of facility management offer? In many ways hospitals are moving in the direction of becoming health production industries. A greater number of patients are being treated every year, while the number of beds in hospital facilities is steadily decreasing. This is being achieved by reducing significantly the length of hospital stay and by treating many more patients on an ambulatory basis. Throughout Europe, this demands better coordinated treatment and greater efficiency, increasing the importance of facility management.

How can this greater efficiency be achieved? Approximately 20–30% of hospital costs are not related to core processes, that is, health services performed in order to cure patients. All remaining services can be considered non-core processes and can be defined as falling within the facility management process (Lennerts et al. 2003; Lennerts et al. 2005). In Germany, the volume of these processes corresponds to approximately €18 billion annually (Statistisches Bundesamt 2006).

Core processes and facility management processes thus both contribute to the patient's path through the hospital facility. From this patient-focused perspective, a comprehensive model can be developed to estimate facility management costs and to relate them to activity, based on case-mix measures, such as DRGs. The required information for these calculations can be generated by using a facility management product model for all facility management services.

This chapter presents the results of the research project "Optimization of processes in hospitals" (OPIK), established in 2000 at the University of Karlsruhe, Germany, in cooperation with 30 hospitals and industry partners. A total of 28 of the hospitals are located in Germany, with one each in Luxembourg and Switzerland. Although primarily focused on Germany, the approach is likely to be suitable for hospitals in other countries that have appropriate information systems, irrespective of location or size of hospital. This chapter describes how the results of the research project were used to optimize facility management, in particular by benchmarking performance.

Facility management

The European Standard on facility management (CEN/TC 348), drawn up by the European Committee for Standardization in 2006 (European Committee for Standardization 2006), states that:

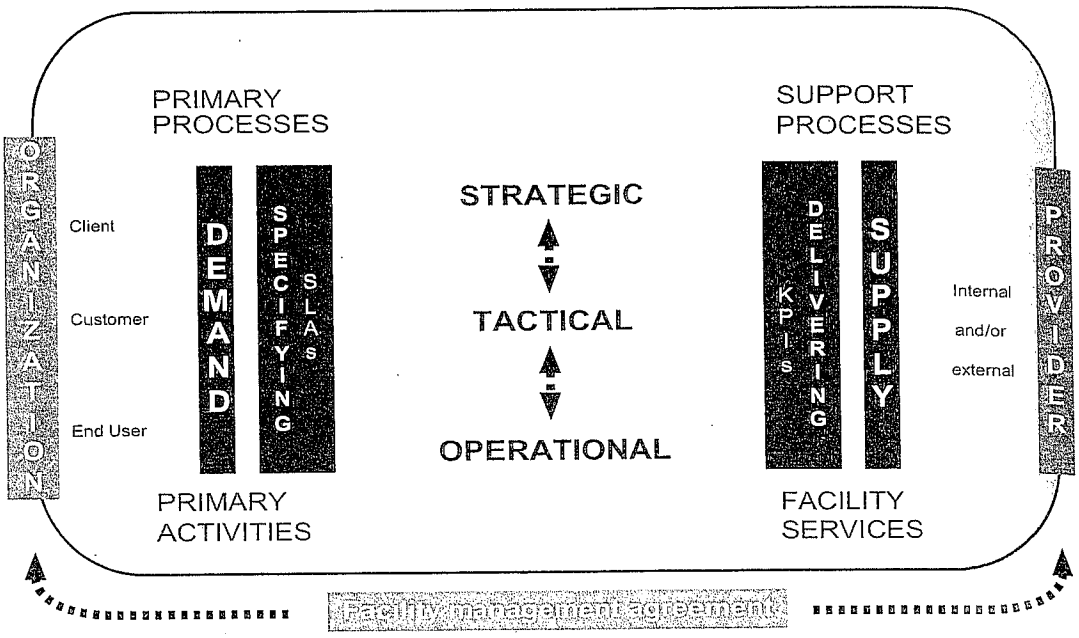
> Facility Management is developing in various European countries. Driven by certain historical and cultural circumstances, organizations and business areas have built different understandings and approaches. In general, all organizations,

whether public or private, use buildings, assets and services (facility services) to support their primary activities. By coordinating these assets and services, using management skills and handling many changes in the organization's environment, Facility Management influences its ability to act proactively and meet all its requirements. This is also done to optimize the costs and performance of assets and services. The main benefits of Facility Management approaches in organizations are:

- a clear and transparent communication between the demand side and the supply side by dedicating persons as single points of contact for all services, which are defined in a Facility Management agreement;
- a most effective use of synergies amongst different services, which will help to improve performance and reduce costs of an organization;
- a simple and manageable concept of internal and external responsibilities for services, based on strategic decisions, which leads to systematic in- or outsourcing procedures;
- a reduction of conflicts between internal and external service providers;
- an integration and coordination of all required support services;
- a transparent knowledge and information on service levels and costs, which can be clearly communicated to the end users;
- an improvement of the sustainability of an organization by the implementation of life-cycle analysis for the facilities.

This standard defines facility management as the integration of processes within an organization to maintain and develop agreed services which support and improve the effectiveness of its primary activities. Facility management therefore covers and integrates a particularly broad range of processes, services, activities and facilities. The distinction between primary activities and support services depends on the organization. With regard to health facilities, as already noted, all services not related directly to patient care can be defined as facility management services or products (although of course this depends on what is considered direct patient care, which may vary). Facility management aims to provide integrated management at strategic and tactical levels to coordinate the provision of agreed support services (facility services). This requires specific competences and distinguishes the facility management from the isolated provision of one or more services (Fig. 9.1).

Fig. 9.1 *Facility management model*



Source: European Committee for Standardization 2006.

Notes: SLA: Service level agreement(s); KPI: Key performance indicators.

Clinical pathways in hospitals

Clinical pathways were developed widely in the late 1980s as a basis for activity-based cost management, especially in the United States, following the introduction of the DRG system, which offered a means of specifying the product of health care (Strobel 2004). Coffey and LeRoy (2001) define clinical pathways as an optimized sequence of interventions by health care workers in response to a diagnosis. The core element of the clinical pathway is the standardization of procedures. By extension, this offers a basis for standardizing the utilization of facilities in hospitals, taking account of the differing needs of each department.

Cost allocation for facility management in hospitals

The delivery of health care in a hospital involves many "customers". The ultimate "customer" is the patient, whose interests are represented by a purchaser of care, such as a sickness fund, but there are also intermediate customers who, in terms of facility management, assume greater importance. These are the clinical units that deliver care and which are supported by those managing the facilities. The clinical units utilize the facilities of the hospital and, in some countries, it is their work that generates the revenue for the hospital, with income based on the number of patients treated, adjusted for case-mix, typically using a system

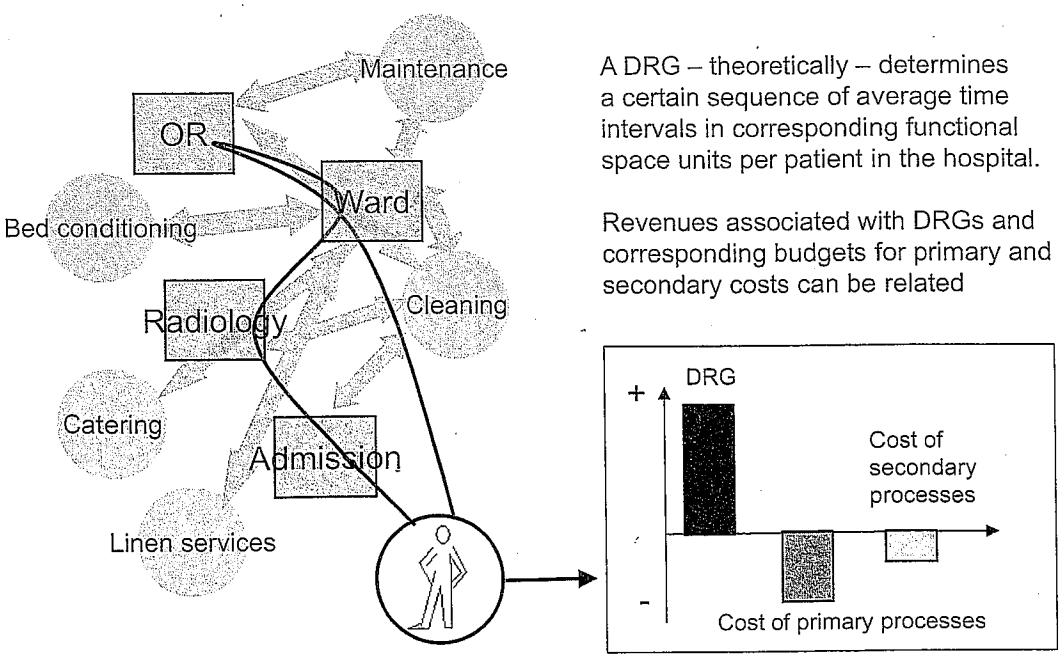
such as DRGs. The challenge is how to link the clinical activity (and related revenue) to the facilities being used.

The OPIK research project has developed a cost allocation system for facility management which is based on the idea of products that can be measured in terms of value and quantity. Through this system, transparency is generated and the customer–provider relationship is strengthened. The project has shown that it is possible to generate savings without any negative impact on the quality of core clinical processes.

The link between clinical pathways and facility management

The OPIK project focused on the link between primary care processes and facility management costs (Diez, Lennerts & Abel 2007). Figure 9.2 shows graphically a patient's stay as a sequence of time intervals in different functional spaces within the hospital. Depending on the nature of each of the space units, different quantities and qualities of secondary services are needed. Costs can then be allocated to the patient according to the utilization of space units.

Fig. 9.2 *DRGs and use of functional space units*



Source: Diez, Lennerts & Abel 2007.

Note: OR: Operating room.

Primary and secondary costs must be differentiated. Whereas hospitals in some countries mostly have detailed data on the use of primary services (such as the direct cost of treating different types of patient), data on the use of secondary

services, such as the cost of medical and nonmedical infrastructure, are often scarce (Deutsche Krankenhausgesellschaft 2002). Hospitals may not allocate these costs to functional units, but instead combine them in an overhead category. These costs are then allocated by means of a formula, such as patient days in each unit. In this way, the relationship between the amount of facility management services and functional units becomes blurred.

The direct allocation of costs to each functional unit allows for a more accurate cost allocation and therefore a usable product model has to be developed for the secondary services.

Transparent facility management using a product model

The product of facility management is the delivery of services (European Committee for Standardization 2005) in response to needs (Gabler 2000). Taking the definition of quality developed by the European Committee for Standardization (2005), it becomes clear that the product is the service delivered to the customer by the service provider. As the aim of facility management is to provide optimal support to the core process of a business, the requirements of facility management are defined by the primary processes it supports.

A set of criteria for products supplied was compiled. These are (Lennerts, Abel & Pfründer 2004):

- services need to be performed for the benefit of the customer
- it must be possible to define a comprehensible basis for allocation
- the effort to acquire the quantities needed must be reasonable
- the customer should be able to influence the quantity of the product.

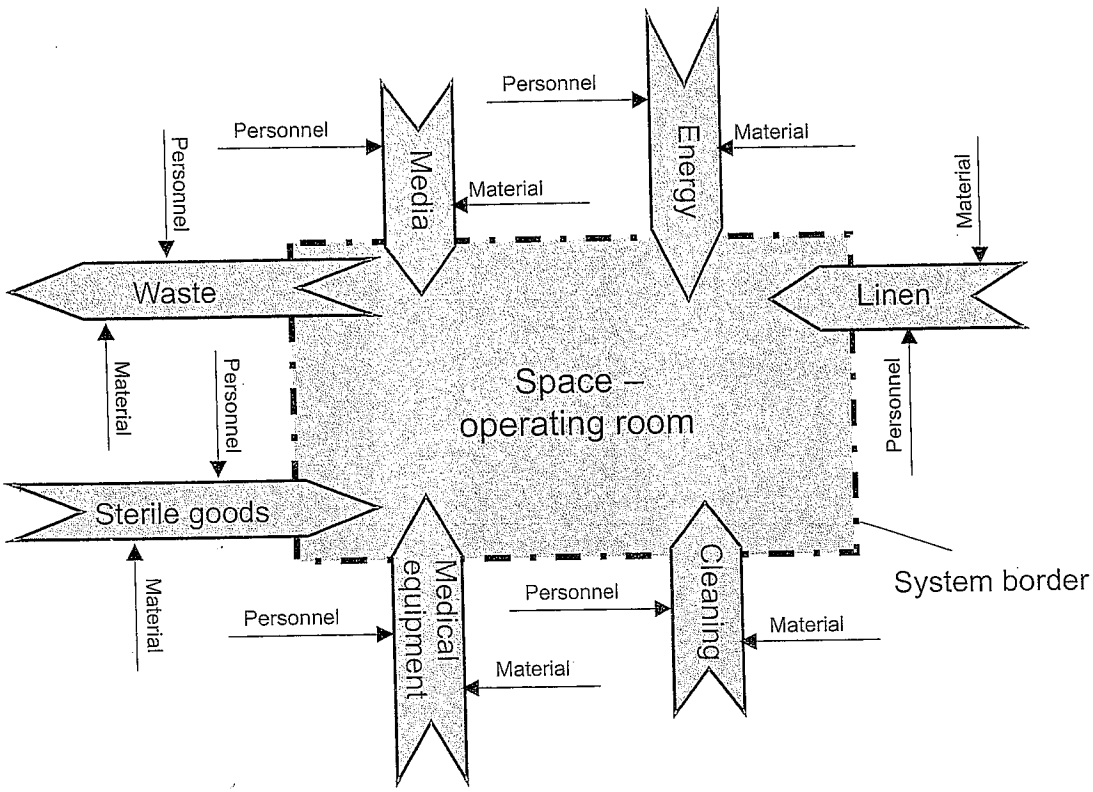
To develop a product "catalogue", two principles came to the fore. On the one hand, the product needs to be measurable in a way that costs can be allocated to it. On the other hand, the product is a service that is necessary for the performance of core processes. These considerations can be illustrated using the example of an operating room.

In terms of facility management, the main requirement for performing an operation is space, which therefore is the basic product of facility management. Because of the need for high security and hygiene standards, the construction of operating rooms involves a high degree of specification and tends to be expensive. Furthermore, the accompanying technical equipment must be maintained in an absolutely reliable condition, as do the characteristics of the space itself, such as ventilation and communication systems. During the operation, medical gases, electrical power and heating are required; the surgeon

requires an appropriate set of sterile instruments; and, following the operation, surgical waste must be disposed of.

Drawing on models from thermodynamics, the operating room can be regarded as an open system, where different products cross the system border (Fig. 9.3). Corresponding to the criteria set out earlier, the quantity should be easy to measure and it must be possible to establish the monetary value of the product.

Fig. 9.3 *Performance of facility management services for an operation*



The basis of this model is the customer–provider relationship. A medical unit, as the recipient of facility management services, can be equated with a zoned space. This zoned space requires facility management services, which are provided by different facility management units. By assigning facility management products to cost centres, while defining zoned spaces as the service recipient, a simple customer–provider relationship emerges between the service recipient on the primary side and the service provider on the facility management side. The individual facility management units can thus be represented by cost centres, to which responsibility for certain processes and products can be assigned (Braun 1999). This allows for process-oriented cost allocation. The cost centre provides its product for other cost centres and procures necessary products from other cost centres for its own production.

Table 9.1 *Classification of the 29 facility management products in Germany*

Product list – cost proportions

Allocation basis: floor space in m²	**Allocated on quantity basis**	
outside facilities	waste disposal	ton of waste
operation	bed conditioning	bed
building maintenance	information technology services	personal computer
technical maintenance	fleet management	vehicle
basic rent	hygiene advice	analysis
cleaning	maintenance of medical equipment	value
pest control	cooling service	kilowatt-hour
security	broadcasting services	television
	catering	meal
Order-related allocation	sterilization service	sterile unit
	power supply	kWh
office supplies	telephone services	extension
caretaker services	patient transport	transport
reprographics services	heating supply	kWh
mail services	laundry services	ton linen
removal services	water supply	m^3

In Germany, the authors have concluded that it is possible to represent the entire range of services performed for the benefit of customers in hospitals through 29 facility management products, although this number might be slightly different in other countries. The 29 facility management products can be clustered into three categories. The first cluster consists of products that can reasonably be assigned using space as the basis for allocation. The second cluster comprises products that can be quantified numerically, although data and system constraints mean that some products that can, in theory, be quantified must be allocated on a space basis. The third cluster is generated by products that are only utilized or carried out at the request of the customer or are not used on a regular basis. For these products, the customer is charged on the basis of products ordered. An overview of the product classification is given in Table 9.1.

Optimization potential

The optimization of secondary processes can take a number of forms. In addition to cost savings from optimization of individual facility management activities, savings can also be achieved from improved coordination of primary and secondary processes. Benchmarking with other health care facilities offers a means of identifying processes that can be improved.

A key goal is to provide the best working environment for the core process, orienting facility management processes specifically towards the medical work flow. Detailed process analysis makes it possible to reduce friction between primary and secondary processes. It also makes it possible to guide optimization of clinical pathways, ensuring that they are patient-oriented and based on the optimal layout for patient treatment and movement. All of these different approaches have been analysed and tested within the OPIK project.

The "Optimization of processes in hospitals" research project

The OPIK research project was launched in 2001. The University of Karlsruhe, Germany, in cooperation with the Professional Association of Hospital Engineering (*Fachvereinigung Krankenhaustechnik*, or FKT), selected 30 hospitals and facility management service providers to participate in the project. The project is entirely financed through private funds, made available by the participating service providers. The objective of the research is to analyse the business processes in the participating hospitals, with a focus on the interaction between primary (medical) and secondary (facility management) business processes. The hypothesis of the OPIK partnership was that a real potential for savings cannot be generated by focusing on single processes or steps within processes. Instead, a more holistic approach would be needed, based on a comprehensive framework for analysing business processes.

This allowed for the extensive analysis of processes in hospitals and the generation of a detailed process matrix, enabling the establishment of far-reaching standards for the performance of facility management services. The project seeks to create a basis for the introduction of efficient, holistic facility management structures and processes for German hospitals (Lennerts et al. 2003; Lennerts et al. 2005).

Benchmarking of overall facility management performance

In order to determine the relative importance of the costs of facility management products, an ABC (or Pareto) analysis was carried out (Fig. 9.4). This chart has two scales. The left-hand scale, ranging from 0% to 50%, applies to the bars in the chart, which show the relative values of facility management products. The right-hand scale, ranging from 0% to 100%, applies to the curve and indicates the accumulated costs of facility management products.

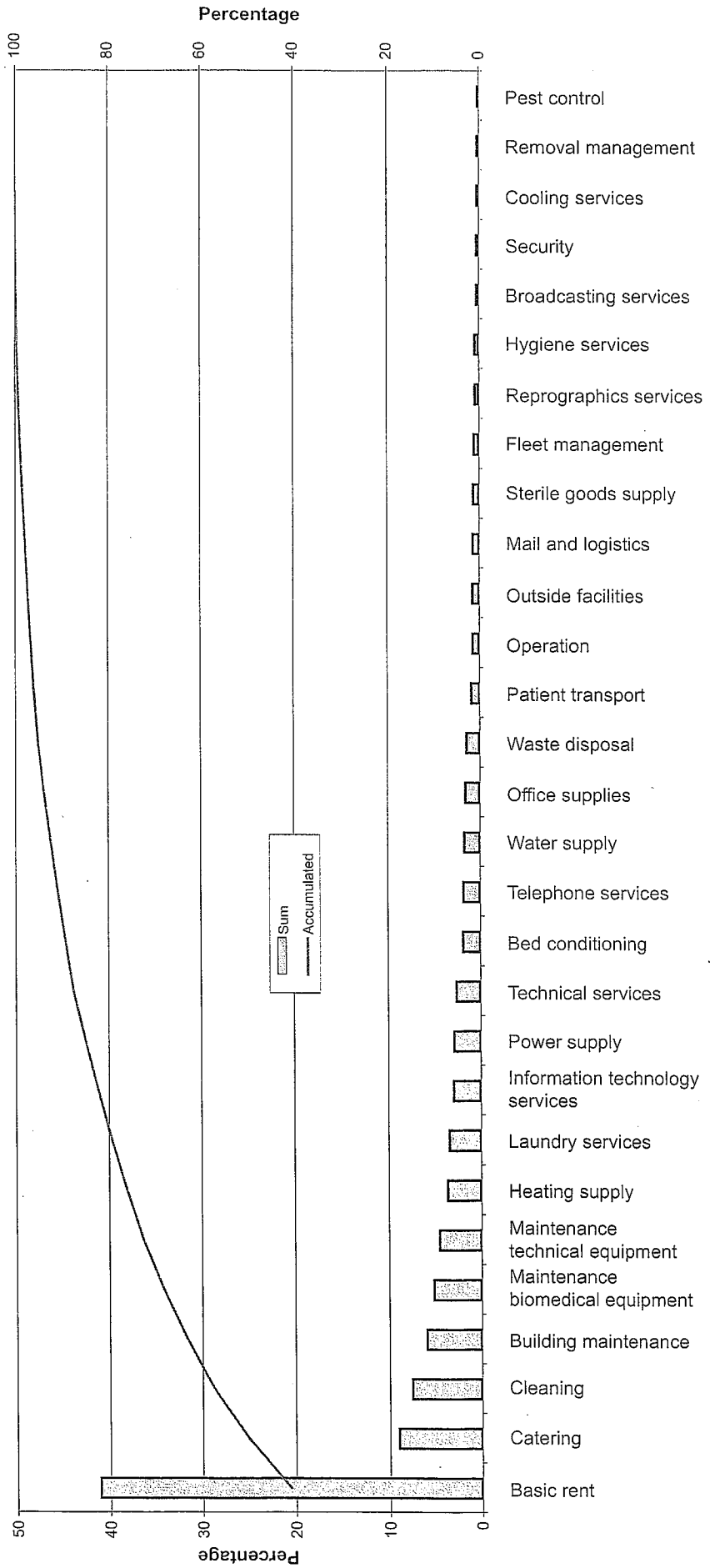


Fig. 9.4 *ABC analysis of facility management costs*

Source: Abel & Lennerts 2005.

The ABC analysis demonstrates that a large number of facility management products contribute only marginally to overall costs. By far the biggest share of overall facility management costs is due to the basic rent or capital cost of available space (that is, annuitizing the capital cost over the lifetime of the facility). Almost 41% of facility management costs can be attributed to this element, followed by catering (8.62%), cleaning (7.49%), maintenance (building maintenance 6.33%, maintenance of biomedical equipment 5.07% and technical maintenance 4.48%), heating supply (3.45%) and linen services (3.14%). These eight facility management products account for 79.35% of overall costs, almost reaching the 80% threshold that is commonly used in ABC analyses to identify the most important categories of items. With regard to Fig. 9.4, it is possible to allocate about 60% of the facility management costs to space-related products, 35% to quantity-related products and 5% to order-related products. It therefore makes sense to start the process of optimizing the facility management process with the correct allocation of square metres to the different cost centres.

Results of benchmarking

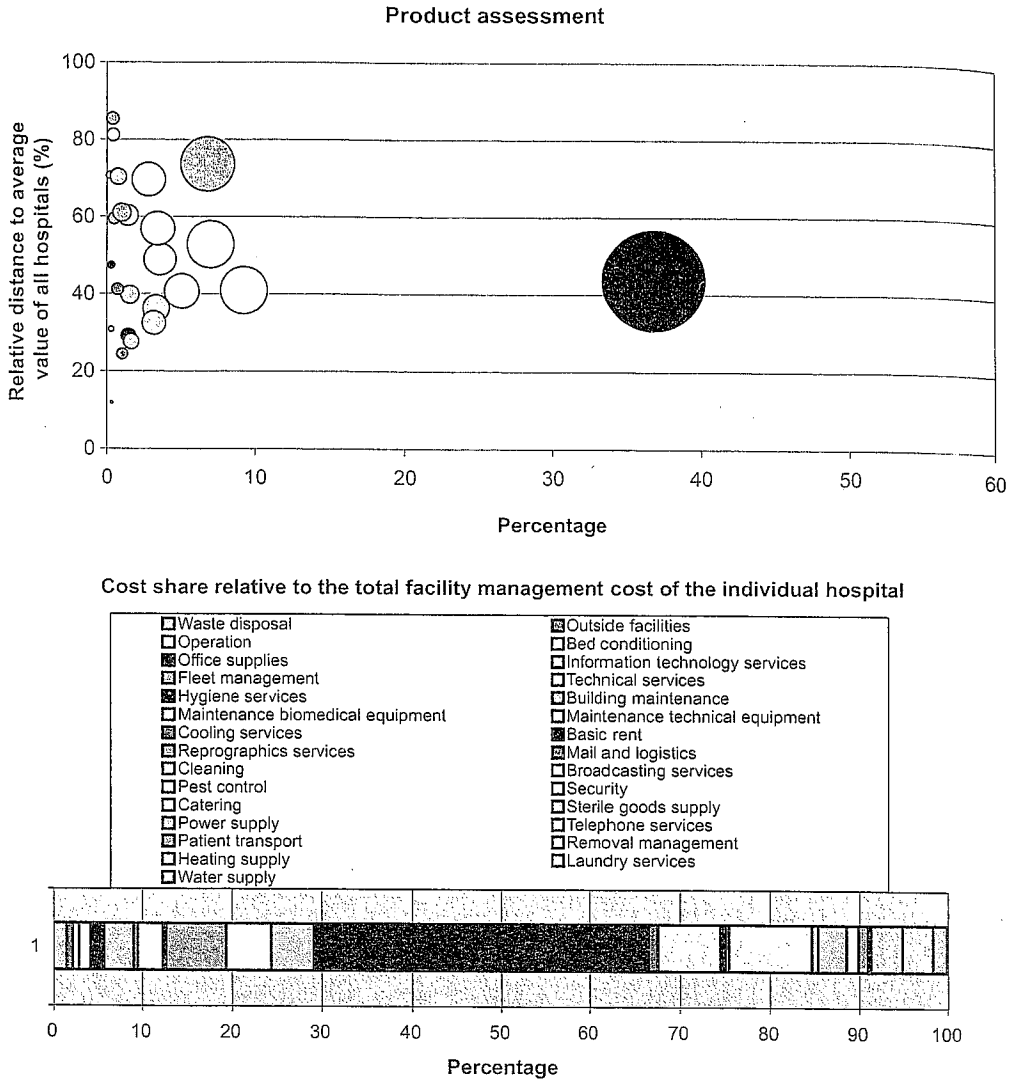
To illustrate the use of this approach in benchmarking, results are shown for all hospitals included in the study. Standard deviation was used as a measure of the statistical dispersion of the savings potential, which assumes that the dispersion of product prices is a result of the different ways in which services are performed. To ensure that this is the case, two requirements need to be met. On the one hand, the average needs to rest on a statistically valid basis; on the other hand, data on unit costs and product quantities must be valid. The examination of the facility management product portfolio of all participating hospitals produces the results shown in Fig. 9.5. This graph indicates the relative importance of the cost share of the various products and their associated savings potential. Taken together, these two indicators clarify where the greatest cost savings can be achieved.

Figure 9.5 shows that the maximum impact factor with regard to overall facility management costs of all hospitals included in the study can be found in the basic rent (12.8%), followed by building maintenance (4.8%), catering (3.7%) and cleaning (3.2%).

At the level of the individual hospital the picture becomes much more detailed.

Figure 9.6 shows a hospital with a high potential for savings.

Fig. 9.5 *Portfolio analysis of all participating hospitals*

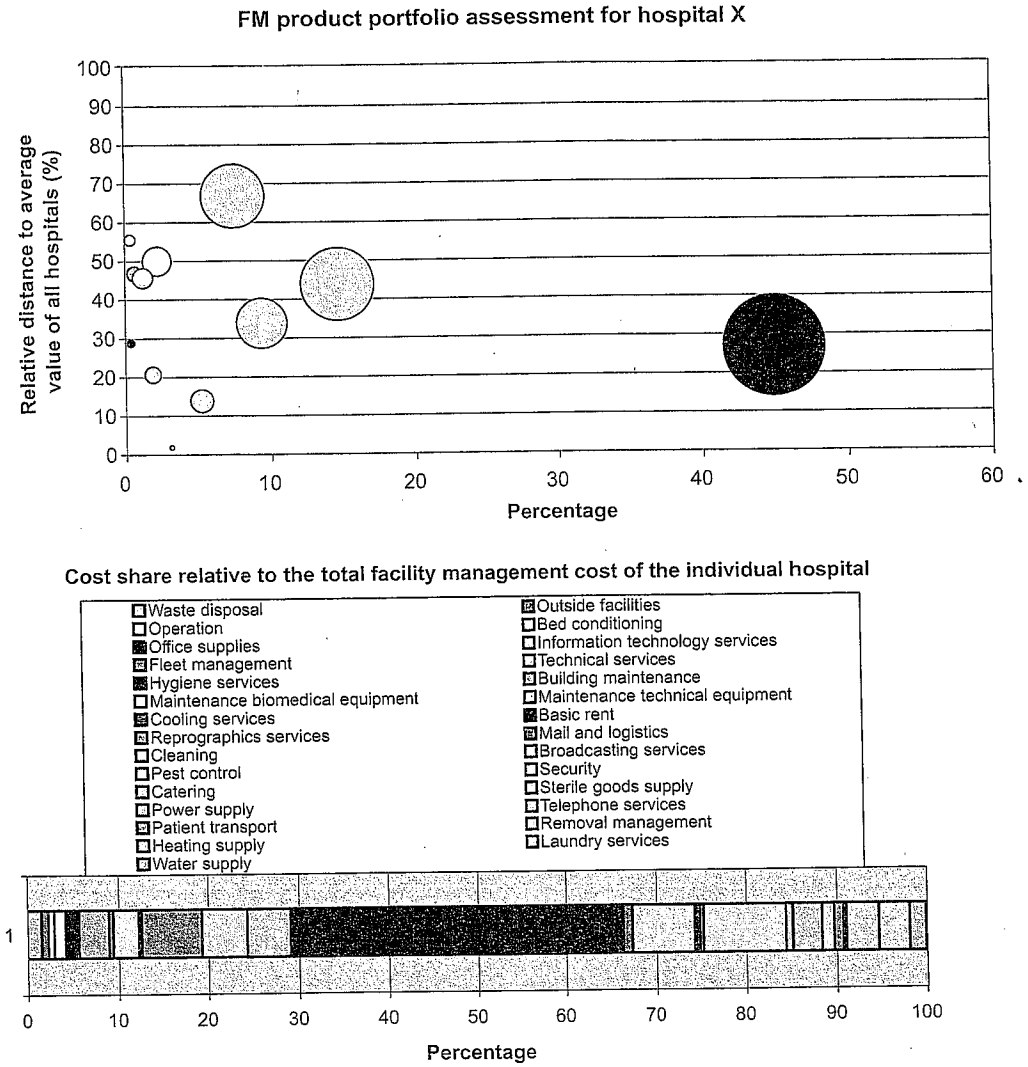


Source: Abel & Lennerts 2006.

The graph shows three areas with an impact factor of over 5%. These are the basic rent, with an impact factor of 6.9%; catering, with an impact factor of 6.6%; and technical services, with an impact factor of 5.2%. Achieving these savings would result in a reduction of overall facility management costs of 18.7%. The complete results of the analysis of hospital X are shown in Table 9.2.

In summary, the results suggest the potential to save over 24% of facility management costs in this hospital (subject to detailed examination of the processes involved). This approach is helpful in selecting processes that should be considered for optimization. The higher the cost share, the greater the impact on overall facility management costs will be.

Fig. 9.6 *Portfolio analysis for a hospital with a high savings potential*



Source: Abel & Lennerts 2006.

Another result of the analysis is a price that can be allocated to each product. For example, it is possible to calculate a price for the basic rent and all space-related costs. This price per square metre can be adjusted for the nature of the space. The DIN standard 277 (Deutsches Institut für Normung 2005) subdivides the net floor area of German hospitals into seven subgroups. These are:

1. DIN 1: residential floor area
2. DIN 2: office floor area
3. DIN 3: production and laboratory floor area
4. DIN 4: storage and distribution floor area

Table 9.2 *Results of the analysis of the hospital shown in Fig. 9.6*

Product	Cost share (%)	Savings potential (%)	Impact factor (%)
Basic rent	44.9	15.3	6.9
Catering	14.6	44.9	6.6
Technical services	7.5	69.8	5.2
Cleaning services	9.4	25.3	2.4
Bed conditioning	2.2	31.4	0.7
Supply of sterile goods	1.2	57.0	0.7
Maintenance of biomedical equipment	5.2	9.2	0.5
Water supply	1.8	23.5	0.4
Copy and print services	0.7	50.4	0.3
Linen services	3.1	6.0	0.2
Broadcasting services	0.4	57.0	0.2
Hygiene services	0.4	17.6	0.1

Source: Abel & Lennerts 2006.

5. DIN 5: education and culture
6. DIN 6: healing and nursing floor area
7. DIN 7: other utilization.

In a second step, the treatment area, for example, can be subdivided into different types of utilization. A sample of different types of utilization and respective prices is given in Table 9.3.

Table 9.3 *Space prices per cluster in all participating hospitals*

Utilization	Price (€)
DIN 1 – Live and lounge	7.99
DIN 2 – Office space	14.48
DIN 3 – Production, hand- and machine work, experiments	28.80
DIN 4 – Store, distribute, sell	10.04
DIN 5 – Education and culture	22.47
DIN 6 – Rooms with general medical equipment	19.81
DIN 6 – Rooms with special medical equipment	30.18
DIN 6 – Rooms for operations, endoscopy and delivery	88.39
DIN 6 – Rooms for radiology	46.42
DIN 6 – Rooms for radiation therapy	87.38
DIN 6 – Rooms for physiotherapy and rehabilitation	14.59
DIN 6 – Patient rooms with general equipment	27.66
DIN 6 – Patient rooms with special equipment	64.64

Benchmarking operating room performance

To benchmark operating room performance, real time performance data were collected on both planned and emergency operations. The primary process in the operation is typically structured through the steps accounted for by DRGs, as exemplified in Fig. 9.7. After the patient has been called from the accommodation ward, s/he arrives in the functional unit "operation" (end of black time span, start of first white block). The patient will then be transferred from the bed onto an operating table. This is the start of the patient's presence in the unit, which ends with the second white block in the chart, when the patient is placed back in bed and the period in the anaesthetic recovery room begins. The presence of the patient in the operating room is calculated as the sum of the operation time and the pre- and post-operative preparation time, resulting in an "overall operation time".

The second time span that is relevant for the utilization of the operating theatre, and therefore for facility management costs, is the "operation procedure time" (defined as the interval between the first incision and the final suture), marked in horizontal stripes in Fig. 9.7. Data on these two time intervals are collected in most of the hospitals covered by the OPIK study and could therefore be used in the analysis of facility management processes.

There can be more patients in the unit than there are operating theatres. To optimize workflow and maximize utilization of theatres, it is common to maintain a queue of patients. The overall operating time may therefore overlap between patients being operated on in the same operating theatre. The definition of operation procedure time determines the core activity of the operating medical staff, excluding preparation activities. The procedure time only takes place in the operating theatre, where only one patient can be at any one time.

Results of a case study of six hospitals

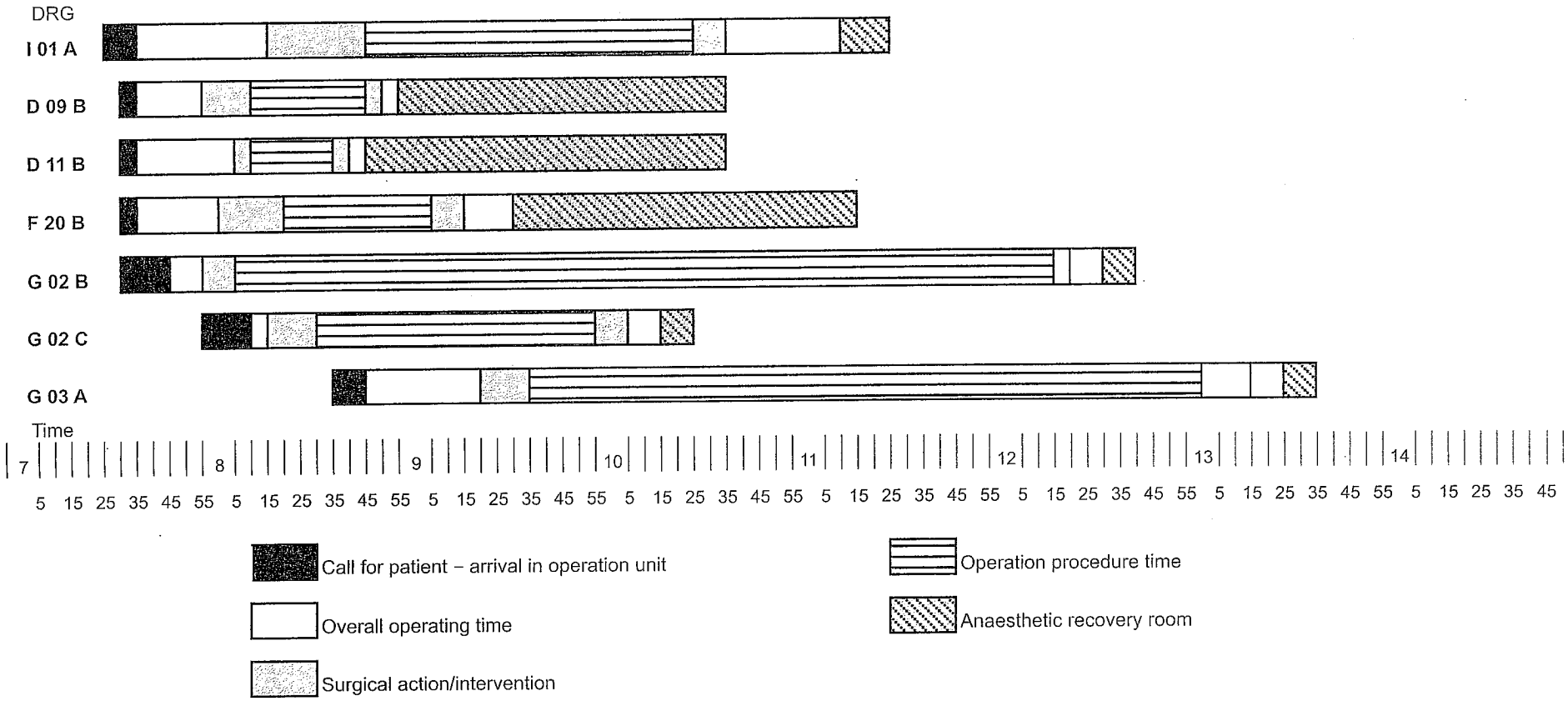
The allocation model has been applied in a case study of six German hospitals. The sample of hospitals includes three different sizes of hospital. Two each were in the ranges 300–350 beds, 550–700 beds and 1200–1300 beds, as shown in Table 9.4.

Table 9.4 *Size of selected hospitals, according to bed numbers*

Hospital	1	2	3	4	5	6
Number of beds	310	1300	317	695	555	1273

Source: Diez, Lennerts & Abel 2007.

Fig. 9.7 *Time intervals of the primary operating theatre process*

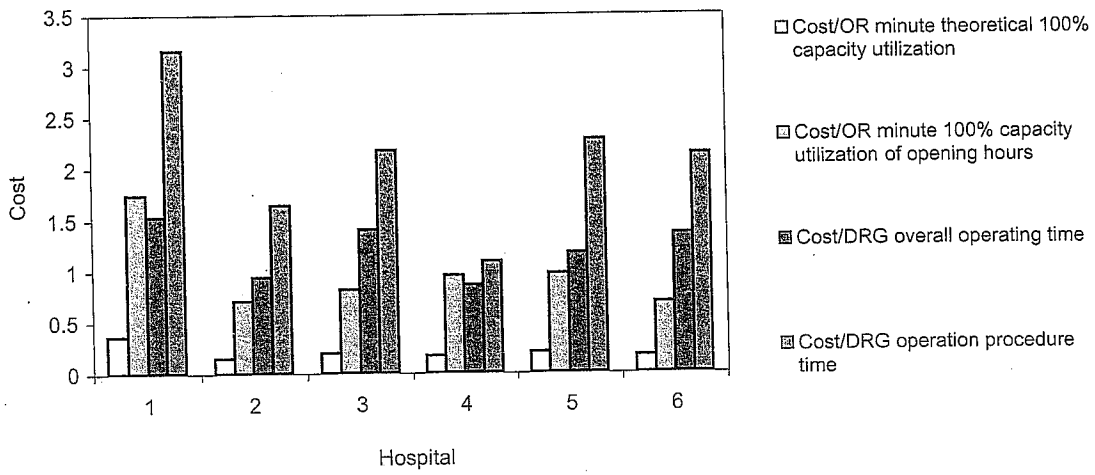


Source: Diez, Lennerts & Abel 2007.

Using the definitions set out earlier, the facility management cost for each functional unit operation was estimated for the years 2004 and 2005, with the data on performance of operations collected according to the DRG to which each patient was allocated.

When combined with the dimensions of the operating room unit and the daily utilization schedule established by the operating room management, this analysis indicates greatly varying operating room costs per minute across the six hospitals, ranging from €0.60 per minute to €1.74 per minute. The results are shown in Fig. 9.8, which also depicts capacity-related figures. Operating costs are mainly influenced by daily working hours and available space, but also by facility management performance (Diez, Lennerts & Abel 2007).

Fig. 9.8 *Cost per OR minute (performance-related)*

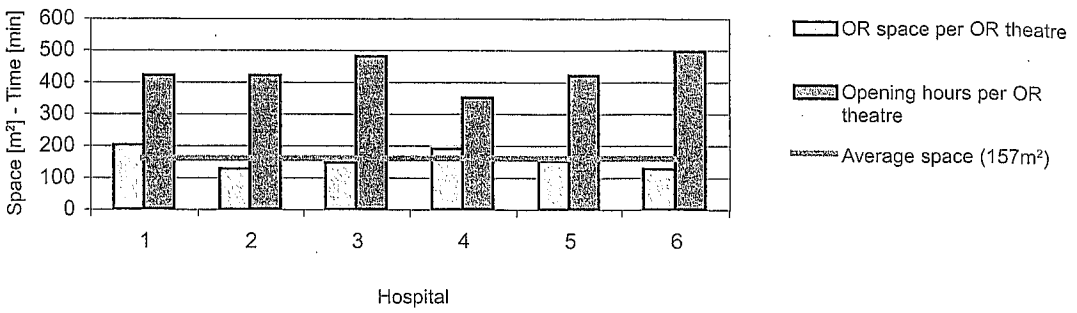


Source: Diez, Lennerts & Abel 2007.

Notes: OR: Operating room; DRG: Diagnosis-related group; The facility management cost of the functional unit per minute has been calculated as the facility management cost per year in relation to the overall operating time.

Figure 9.9 indicates that the space related to the operating theatres in hospital 1 is about 50% larger than in Hospital 2. The reason may be that large hospitals with many operating theatres can make more flexible and efficient use of the space available, especially in relation to supporting spaces, such as changing rooms, lockers and storage. On average, the space per operating theatre in the six hospitals was 157 m^2. This figure is similar to the results obtained by Chai (2000), who analysed the floor plans of 39 German hospitals and found an average floor space of the functional unit operating theatre of 160 m^2. When considering Hospital 4, it can be seen that not only is the space per operating theatre relatively large, but also the daily working hours are relatively short. While the effects of these two factors are to some degree compensated by good facility management performance, Hospital 4 still has the third highest cost per operating minute (see the second columns for each

Fig. 9.9 *OR space dimensions and daily working hours*



Source: Diez, Lennerts & Abel 2007.

hospital in Fig. 9.8). Obviously, poor efficiency in the utilization of space has a considerable influence on the eventual cost. Further investigations should be undertaken to analyse the impact that changes of these parameters cause, as well as to analyse the relationship between space for operating activities and space for supporting functions within operating units.

By combining facility management costs and primary process data, individual prices per minute have been calculated, as shown in Fig. 9.8. The operating room cost per minute per DRG ranges from €0.86 to €1.53 per minute. When using the procedure time as the cost allocation basis, prices per minute differ even more, ranging from €1.09 to €3.15 per minute, with Hospital 4 coming out at lowest cost.

An overview of the workflow in the operating room unit can be gained when comparing these figures. In Hospital 4 the lengths of operating (procedure) time and overall operating time are similar, which contrasts with Hospital 1. There are two possible interpretations of this: Hospital 1 may have a particularly slow work flow, in which the preparation of patients takes a lot of time, or they may have an extended holding area policy, with patients waiting and considerable overlaps.

Further work is needed to capture data on primary processes. Improved operating room management systems are facilitating this (Bethge 2004). In all cases, a distinction has to be made between having patients on hold, activity involving the patient, and the use of the operating theatre itself, as well as between fixed and variable facility management costs in the operating room unit.

Conclusions

The challenge posed by upward pressure on health care costs is evident not only in Europe, but also all over the world. There is a clear need to maximize the efficiency of health care facilities. Facility management costs in hospitals account for 20–30% of overall hospital expenditure. By improving the relevant processes, it is possible to reduce costs without negatively affecting the quality of the core business.

The OPIK research project presented in this chapter has generated a model for facility management that can be used elsewhere in cost and process benchmarking. Furthermore, the project has produced a tool that makes it possible to check rapidly the costs of facility management in a hospital, so as to identify the key cost drivers that should be optimized, without wasting time on other elements that will not generate significant savings.

By combining data on activity (using the DRG system), it is possible to specify the optimal layout of a hospital in terms of, for example, the number of operating theatres or the size of food preparation areas. By connecting facility management products with the primary medical process, it becomes possible to compute the benefit of a facility management product as a share of the supported DRGs. This makes it possible to pay providers of facility management services on the basis of medical services, rather than according to cleaning or technical support, for example. Their income is then linked to the fortunes of the hospital, creating an alignment of incentives. Where there are public–private partnerships, this innovative approach permits a fairer distribution of risks while introducing the possibility of changing facility management costs, in line with changing medical activity.

This chapter has argued for more transparent accounting of facility management costs. However, there is surprisingly little comparative information available on the facility management costs of hospitals in Europe. Even less is known about how to take account of these costs when designing new hospitals. Filling these evidence gaps promises to generate substantial cost savings.

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