A STANDARD DATABASE MODEL FOR COMPUTER AIDED FACILITY MANAGEMENT IN HOSPITALS

Jochen Abel[1] , Karin Diez[2] Kunibert Lennerts[3]

ABSTRACT

The professional Facility Management (FM) is in need of the appropriate support through a Computer Aided Facility Management (CAFM) system. Technical solutions and corresponding systems are available on the market but still many Facility Managers have no integrated support by a CAFM system. Why are there still so many facilities without the appropriate computer support? Possible reasons are the uncertainty, which FM processes should be supported by a CAFM system and the high implementation cost for a CAFM system. Knowing that there are many other reasons why the introduction of a CAFM system is rejected or even fails, this paper focuses on the topic how the day to day business of facility mangers in hospitals can be supported and what an accordingly database model would look like. This should result in a reduction of the introduction effort and therefore lower the introduction threshold.

Aim of this research is to design a standard database model that can be used as a ready to start pre configured system that reduces data acquisition and customizing efforts to a minimum.

KEY WORDS

CAFM, database model, introduction strategy, hospital, entity-relationship-model

INTRODUCTION

The efficient operation of facilities is tightly connected to the efficient storage, provision and processing of data. Out of the need to accomplish this task, CAFM has been developed. The shared use across process and lifecycle borders is unimaginable without an assisting computer system.

Meanwhile the market of computer systems committed to this topic is able to look back on a history. Together with personal computers also CAD systems found more and more users. At the same time database management systems were developed. The cross linking of databases and graphical information systems might be defined as the birth of CAFM. Consecutively the CAFM market has developed as fast as the computer market itself. Taking

[1] Research Fellow, Universität Karlsruhe (TH), Facility Management (TMB), 76128 Karlsruhe, Germany, Phone +49-721-608-8226, FAX +49-721-608-4351, jochen.abel@uni-karlsruhe.de

[2] Research Fellow, Universität Karlsruhe (TH), Facility Management (TMB), 76128 Karlsruhe, Germany, Phone +49-721-608-8226, FAX +49-721-608-4351, Karin.diez@uni-karlsruhe.de

[3] Professor, Department of Civil Engineering, Geo- and Environmental Sciences, Universität Karlsruhe (TH), Facility Management (TMB), 76128 Karlsruhe, Germany, Phone +49-721-608-8225, FAX +49-721-608-4351, kunibert.lennerts@uni-karlsruhe.de

the literal interpretation of CAFM into consideration, computer support in FM can nowadays be found in every company. However, in terms of an integrated support of all FM processes through a single comprehensive system, CAFM is still the exception rather than the rule.

One of the major problems while introducing a CAFM system is to keep focused on the goal. While CAFM is supposed to be all embracing by definition, the user is damned to concentrate on a precise field of application. If the user does not focus on a limited field, he runs the risk of being confronted with two problems at the same time. Teicholz und Ikeda (Teicholz and Ikeda 1995) name high cost of CAFM tools as the main impediment for the introduction of CAFM. But also an average success rate of 60% (Abel and Lennerts 2005a) regarding the achievement of objectives point to the fact that goals have not been defined precise enough. Thus exploding costs and post introductive frustration are the main threats coming along with the introduction of a CAFM system.

POSED PROBLEM

The posed problem can be clarified through the differing perceptions regarding expectations and possibilities connected to CAFM. The CAFM manufacturer has a multiplicity of solutions for almost every problem within FM processes imaginable due to his experience in heterogeneous projects. The customer on the other hand seldom is that advanced in defining his goals that he can simply balance his needs with the possibilities of the current systems available on the market. This gap between customer and supplier conditions inevitably great communicational problems and often leads to high costs and great disappointment.

AIM

Aim of this research is the reduction of CAFM possibilities on a common level, which can be used in the fashion of a starter kit. Hence introduction costs should be reduced, introduction speed should be increased and quality should be improved as standard goals can be reached instantaneous.

APPROACH

The goal is supposed to be reached through the development of a standard based upon the most common demands of CAFM users. These demands should result in a database model giving basic specifications for the configuration of CAFM systems accordingly.

In the first step an inquiry of facility managers serves the purpose of determining which processes are to be supported by an EDP system in particular. In two further steps it is investigated which objects and belonging attributes are of high need in an EDP system.

The results of theses surveys need to be balanced whether and to what extent the priorities regarding objects and attributes are consistent with the goals.

Using this awareness a database model with a minimum of necessary entities and relations between them is developed.

METHODOLOGY

In advance to the performance of the survey, comprehensive research on objects and attributes used in facilities management was carried out. Based upon this knowledge data collection forms were generated. The forms were kept as simple as possible in order to minimize handling effort for the respondent. Only closed-ended questions were being used with only one choice possible. Upon all processes, objects and attributes, an assessment of the necessity was carried out. The assessment scale ranged from 1 – "not necessary" to 6 – "absolutely necessary". The forms were the sent to 17 Facility Managers participating in the OPIK research project (optimization and analysis of processes in hospitals) (Lennerts and others 2005). Within the OPIK framework FM processes in hospitals are being researched. The – with the exception of the fact that all respondents are members of the OPIK project – independent group of respondents represents the universal set of potential users of CAFM in a responsible position in a hospital.

Three surveys have been carried out. The first survey was aiming for the identification of areas of operation within the FM in hospitals that are in need of support by an EDP system according to users. The areas of operation were specified by using the products defined within OPIK (Abel and Lennerts 2005b). These products as a result of FM processes are to represent areas of operation. Parallel to this survey the second survey on objects was carried out. Both surveys had a response rate of 65 %.

The third query aimed for the necessary attributes to describe the objects. Also in this case the effort for the respondent was minimized. Only objects that passed a certain threshold in terms of necessity in the previous survey were taken into consideration. Therefore this query could only be carried out subsequent to the first two surveys. However the form was with 11 pages of much higher volume than the first two. This might also be a reason for the response rate of 41% being much lower than in the other cases.

For the modeling of the database several display formats have been taken into consideration. The Chen-notation (Chen 1976; Chen and Knöll 1991), the notation according to Schlageter/Stucky (Schlageter and Stucky 1983), the display format according to ISO and the IDEF1X-notation.

The development of the database model was enriched with know-how on the interrelationship between processes, objects and attributes in order to avoid that pursued goals might not be achieved because of a lack of necessary data or information.

For important attributes, that have a key position regarding the guaranty of an interinstallational usability of data, catalogues were defined. At the same time these catalogues increase the easy and efficient use of the database by operative personell.

RESULTS

SURVEY RESULTS

As already mentioned, the list of processes that was sent to facility managers for assessment was created within the OPIK research project (Abel and Lennerts 2005b). Origin of this list is the question about products that have an added value to the customer, so that the customer is willing to pay money for the service. In terms of the ISO 9000 (ISO 9000 2000) a product is defined as the "result of a process" and a customer is an "organization or person that receives a product. The list can therefore also be interpreted as a compilation of value creating processes in facilities management.

From an economical standpoint CAFM should support these value crating processes according to their importance in the first place. The importance according to the facility managers opinion was upraised in the survey. The result is given in Table 1. Besides the average, by which the list is ordered, the 25% and 75% quantile as well as the standard deviation are given. The result shows that the maintenance processes are according to the facility managers view of high importance. An interesting fact is that the provision of space as one of the most cost intensive processes and core of many CAFM systems is not of that high importance for facility managers in hospitals.

Fields of application that are of high importance according to CAFM providers are to be found on the lower ranks except for maintenance and energy management. May et al. (May 2004) for example name the inventory documentation, space management, contract management, cleaning management, move management, energy management, maintenance management, master key system administration, lease management and controlling as fields of application for CAFM.

How can this result be correctly interpreted from the CAFM viewpoint? Two characteristics that define the shape of FM in hospitals decisively are on the one hand that space is not of the same importance neither as a strategic resource nor as a factor of production as it is in other branches. On the other hand, compared to other branches maintenance is much more vital for a hospital. This is also expressed by the high amount of rules and regulations existing for the maintenance management in hospitals.

For the definition of future trends it is important to know, whether this point of view will change. Healthcare costs continue to play a more and more important role. Thus FM costs in healthcare will be of high importance in the future.

Questionable is, whether the customer orientation within healthcare FM will increase. On closer examination it becomes apparent that the strongly customer related processes such as the move management, mail and logistic services or the patient transport are way back in the ranking. For the configuration of a CAFM system the lived customer supplier relationship is of great importance. Up until now the customer related processes are not in focus therefore a CAFM system needs to be configured according to this demand.

For the introduction of a CAFM system in a hospital this result also provides a big advantage. Because of the given focus, the areas of application that come along with high effort on the data acquisition can be disregarded in the beginning and therefore reduce the costs for system introduction significantly.

Table 1: Result of process evaluation

Process	Average	25% quantil	75% quantil	Standard-deviation
Maintenance of biomedical equipment	5,73	5,50	6,00	0,47
Maintenance of technical equipment	5,64	5,00	6,00	0,50
Building maintenance	5,55	5,00	6,00	0,52
Power supply	5,45	5,00	6,00	0,93
Caretaker services	5,36	5,00	6,00	1,03
Water supply	5,27	4,50	6,00	0,90
Heating supply	5,18	5,00	6,00	0,98
Sterile goods supply	5,00	4,50	6,00	1,41
Cooling services	4,73	3,50	5,50	1,27
Operation	4,73	4,00	5,50	1,10
Linen services	4,73	4,00	5,50	1,19
Provision of space	4,64	4,00	5,00	1,36
Catering	4,64	3,00	5,50	1,36
IT services	4,36	3,50	5,00	1,50
Cleaning	4,36	3,00	5,50	1,57
Office supplies (purchasing and delivery)	4,00	2,50	5,50	1,90
Waste disposal	3,73	3,00	3,86	1,35
Repro services	3,73	2,00	5,00	1,79
Phone services	3,73	3,00	4,50	1,35
Patient transport	3,64	2,50	4,50	1,36
Bed conditioning	3,50	3,00	4,00	1,43
Fleet management	3,36	2,50	4,00	1,43
Hygiene services	3,27	3,00	3,64	1,19
Security services	3,27	2,50	3,14	1,56
Removal services	3,18	2,00	3,59	1,47
Broadcasting services	2,82	2,00	3,00	1,47
Mail and logistic services	2,73	2,00	3,00	1,56
Pest control	2,45	1,50	2,73	1,51
Outside facilities	2,27	1,50	2,14	1,27

The result of the query on objects that need to be represented by a CAFM system does not conflict with the first query on processes. The identified emphasis was confirmed (see Table 2). The five first places are all taken by objects that are maintained by the facility manager or, in case of the work order, is the basis for documenting these activities. Of high interest is the evaluation of the building and its separate parts. The fact that the building itself takes the second place, the subunits floor and room however are to be found among the last four places is a noticeable signal. The facility manager is willing to document the building related activities; however a detailed differentiation of these doesn't greatly matter to him.

Further it is recognizable that labor and organizational units are less important in terms of a representation in a database.

Table 2: Result of object evaluation

Object	Average	25% quantil	75% quantil	Standard-deviation
Biomedical system	5,09	4,50	6,00	1,04
Building	5,00	4,50	6,00	1,00
Biomedical device	5,00	4,50	6,00	1,00
Technical system	4,91	4,00	6,00	1,04
Work order	4,82	4,00	6,00	1,17
Company	4,73	4,00	5,50	1,10
Technical device	4,73	4,00	6,00	1,19
Document (drawing, hanbook)	4,64	4,00	5,50	1,29
Labor	4,64	3,50	6,00	1,43
Real estate	4,55	4,00	5,00	1,04
Department (organizational unit))	4,50	4,00	5,00	1,18
Floor	4,45	3,50	6,00	1,57
Contract	4,27	4,00	5,00	0,90
Room	4,09	3,00	5,00	1,38
Inventory	3,27	2,50	4,00	1,19

Regarding a standard for a CAFM database model, the result of the query can simply be abstracted. Lowest common denominator among facility managers is a system that supports the day to day maintenance activities. A starter kit for the support of FM in hospitals should therefore include a simple workflow management system that can be operated with a small data basis.

The result of the survey about single attributes is not shown to its full extent because of its large volume. Qualitative the result shows very little attributes are classified nonrelevant. The proportion of attributes graded 3.5 or less in average lies below 6%. Nevertheless the result can well be used for the concentration on the basic attributes as a limitation of the used attributes to those that are graded 5 or better in average cuts the total amount of attributes in half.

DATABASE MODEL

The developed database model is more characterized by what it does not have but what it features. The model is neither a holistic one nor is it characterized by its high complexity. The fact worth mentioning is that the model – in its simplicity – provides complete functionality without eliminating future development possibilities or the holistic approach of CAFM.

As the focal point of demands lies on the documentation of work orders, the object ‘work order’ was defined as the central entity (see Figure 1). Every work order is assigned to either technical entity or the building in form of a mandatory relationship. The work order can only be assigned to one of the objects. The entity ‘company’ is related to all attributes that contain supplier, manufacturer or service partner information.

For all technical entities the cost center was named as an important attribute. Yet the department or organizational unit was not considered fundamental. Therefore the cost center should be kept in a catalogue that is regularly updated through an export out of the

controlling system. By this means generated information about expenditure of human labor can be used for controlling purposes and the future integration of controlling functions in the system remains possible.

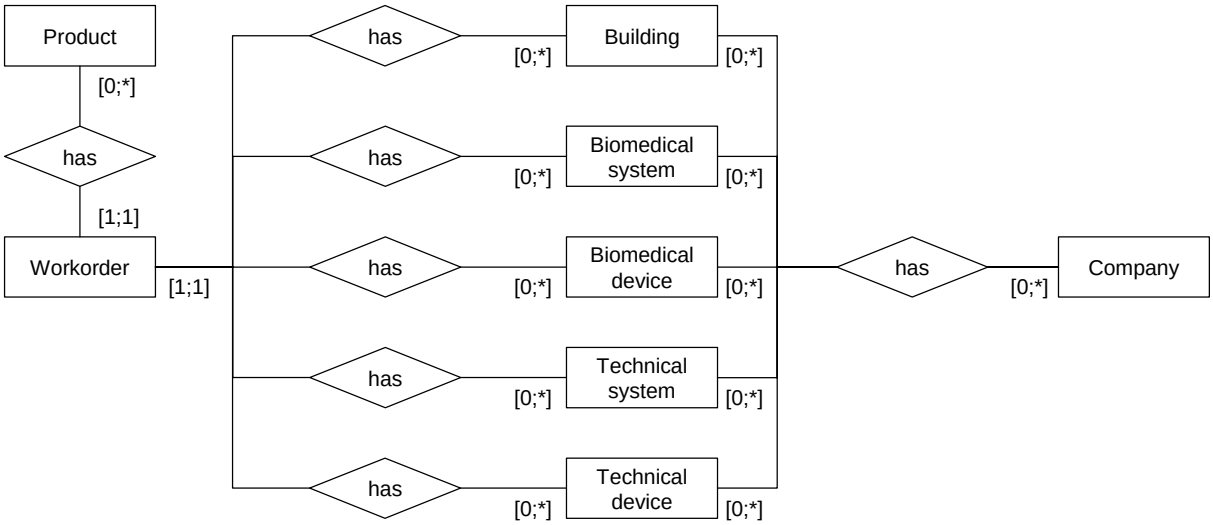

Figure 1: Database model

The given database model can be seen as the origin for a holistic CAFM system. Therewith this database model is far away of the original intentions of CAFM. A work order management system is only a very small part of mapping all FM processes over a complete lifecycle with simultaneous storage, provision and processing of all relevant information. However all further entities that might be introduced later are relatable to an existing entity or can be subordinated to one. For example floors and rooms can smoothly be assigned to buildings later. Staff members or departments can be created as an independent entity and afterwards be related to technical entities or the building and assigned to work orders respectively. The ‘company’ entity provides the basis for all further development potentialities regarding all external business transactions to be covered by a CAFM system.

In the early stage of introducing a CAFM system however the facility manager is relieved of the burden to pass through extensive preparative actions before a system gets productive. Side effect is that every data that is not recorded in the database needs not to be updated on a regular basis. If the specific information is not used by processes that are supported by the system, it should not be integrated.

The problem is that the complexity of FM gets clear during the implementation process while processes are being mapped. The facility manager is then often overstrained with this sudden confrontation. Consequences are over dimensioned and overpriced projects that in the end produce a resigned facility manager who gets the impression that he is incapable of carrying the workload that got visible during the implementation process with the given workforce. Through a successive introduction in manageable fields of application that deliver direct benefit, existing resources are used more efficient and capacities are made available that are necessary for future extensions.

CONCLUSIONS

CAFM to the facility manager in a hospital is not the same as to a facility manager in other FM branches. Main request is not the maintenance of the facility documentation in terms of drawings, contracts and other facility related information in a database but the documentation of service calls and the maintenance of biomedical and technical objects.

The space management as one of the crucial points commonly associated with CAFM is not of high interest in hospitals. Major investments coming along with substantial restructuring activities are unlikely to happen in hospitals. Therefore the strategy of introduction for CAFM systems in hospitals needs to be completely different. Survey results have shown that a simple work order management system is favorable to be introduced first.

The proposed database model based upon this knowledge can be introduced with economically justifiable effort as it shows immediate results. However in the long term hospitals will face a more process, product, price and therefore customer oriented view on FM services. With the proposed model the hospital facility manger is well prepared to react to these changes on demand.

REFERENCES

Abel, J. and Lennerts, K. (2005a). "Where does CAFM really help? - Current fields of application and future trends according to system users." cib W78 22nd Conference on Information Technology in Construction, Dresden, pp.

Abel, J. and Lennerts, K. (2005b). "Cost allocation for FM services in hospitals." Facility Management, VDE Verlag GmbH, Berlin, pp . 531-541.

Chen, P. P. S. and Knöll, H.-D. (1991). Der Entity-Relationship-Ansatz zum logischen Systementwurf, BI - Wissenschaftsverlag, Mannheim; Wien; Zürich.

Chen, P. P.-S. (1976). "The entity-relationship model - toward a unified view of data." ACM Transactions on Database Systems (TODS), 1(1), 9-36.

ISO 9000 . ISO 9000. Norm ISO 9000:2000, Qualitätsmanagement und Begriffe. 2000. Brüssel, Europäisches Komitee für Normung.

Lennerts, K., Abel, J., Pfründer, U., and Sharma, V. (2005). "Step-by-step process analysis for hospital facility management: An insight into the OPIK research project." Facilities , 23(3), 167-175.

May, M. (2004). IT im Facility Management erfolgreich einsezten: Das CAFM-Handbuch, Springer-Verlag, Berlin.

Schlageter, G. and Stucky, W. (1983). Datenbanksysteme: Konzepte und Modelle, B. G. Teubner, Stuttgart.

Teicholz, E. and Ikeda, T. (1995). Facility management technology : lessons from the U.S. and Japan, Wiley, New York .