Supporting Decision Making Tool within the Process of Replacement and Incorporation of New Technologies to the Health Area

F. Santos [1], R. Garcia[1]

[1] Instituto de Engenharia Biomédica – IEB-UFSC, Florianópolis, Brasil

Abstract — **Information systems used in clinical engineering structures can be considered usual nowadays. The use of these software tools is not just justified by the convenience in executing daily tasks and to manage routine operations, but also by the advantages in creating indexes to decision making. New researches show that investments in computerized managing systems in Medical Hospital Technology – MHT represent a market of approximately $ 100 million annually, of what 35% of investments are done by users who are acquiring these systems for the first time, and 65% for updating and replacing their systems of technology managing. This work show a software computing tool developed to create indexes that can help in decision making in replacing and incorporation of new technologies to the health area, based on the concept of technology life cycle. This tool is part of an information system to the Managing of Medical Hospital Technology – MMHT and applied in the public health system of Santa Catarina, together with the Clinical Engineering structures. The use of this developed software tool is targeted to the management of technologies in the health area and helps the medical entities to do a forecast of needs in replacing the HMT.**

Keywords — **Clinical Engineering, Life Cycle, Medical Hospital Technology.**

I. Introduction

The Biomedical Engineering Institute of the Federal University of Santa Catarina – IEB-UFSC, through the Managing and Developing of Medical Hospital Technology Center – Ceged-MHT has been developing a work of medical hospital technology management since 1998 in the public hospitals of Santa Catarina. Recently, in 2007, this work has been extended to 54 health care centers and policlinics in the city system of the state capital, Florianópolis. Due to the responsibility imbued in the managing of 5.400 equipments it has been necessary the study and the implementation of a helping tool to the Clinical Engineering in making it first place the replacement of medical hospital equipments. The equipments life cycle studies, analysis of the necessities in the hospital unities and the procedures in the analysis of new equipments acquisition have been done and it demands a constant updating in the existing information system.

In order to implement the expected tool, the study of the medical hospital technology life cycle and the use of indexes have become essential. The life cycle allows one to identify in which part of it the technology is used or will be incorporated in the Health Assistance Establishment. If one knows in which phase of the life cycle the medical hospital technology is it is possible to offer to the decision making crew enough basis to identify what actions related to technology should be taken, such as verifying the necessity of replacement and incorporation of new technology [1, 2]

Indexes are tools of such that can evaluate the activities done within the clinical engineering structures that are responsible for the management or managing, and in this way allowing to getting to know the real costs and performance of the medical hospital technologies [3].

The use of indexes involves a long process in the case of medical hospital equipments that is to evaluate what is best and can be a referential to new discoveries. The indexes help in the constant improvement to the internal processes within the clinical engineering. They help to know the real conditions of the whole structure, and through it one can search for means to improve the favorable points as well as solve the unfavorable ones to the organization, aiming then to the optimization in service quality through evaluations, decision making and implementation of correcting preventing actions.

An index must be a variable well defined, easy to be measured, objective, and based on previous knowledge (throughout the historical ones) and recent ones.

The importance of the use of indexes is that its help in decision making within clinical engineering structures as a tool take adequate internal monitoring and evaluating procedures in order to make it possible to visualize all the costs involved to keep the technology working in good conditions of usage [3, 4, 5].

II. Methodology and materials

It has been done bibliographical researches to the completion of this work which refer to the life cycle of the medical hospital technologies through the publications coming from the Biomedical Engineering Institute – IEB-UFSC in itself as well as other clinical engineering centers, aiming to get reliable information and that would allow a significant contribution to the development of this work. Researches in publications were made necessary to obtain

O. Dössel and W.C. Schlegel (Eds.): WC 2009, IFMBE Proceedings 25/VII, pp. 453–456, 2009.
www.springerlink.com

concepts, data and descriptions about the use of indexes and methodologies to the replacement and incorporation of new technologies in the health area. The researches were developed with the use of internet as a helping tool to search data.

The development of a helping tool in decision making about replacement and incorporation of new technologies in the health area was done along with the implementation of methodologies found in the bibliography.

A field research using a questionnaire was made with 99 professionals in the health area, among physicians, nurses and clinical engineers in order to validate the results found in the use of the referred tool.

III. Results

During the implementation of the computerized system three methodologies were used: the Life Index methodology with the MEL value (*Maintenance and Expenditure Limits*) and the calculus of EUAC (Equivalent Uniform Annual Cost). The implemented system has functions of collecting data, registration of equipments, calculus of the useful life index, remaining useful life, value of replacement of the evaluated equipment, calculus of the equivalent uniform annual cost (EUAC) and the MEL calculus.

Figure 1 shows the first interface of the system.

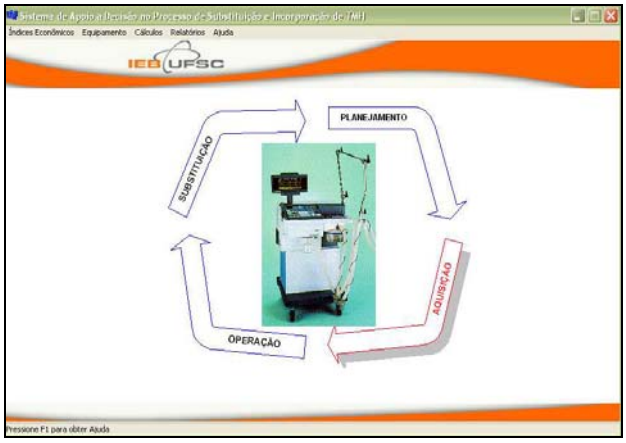

Fig. 1.First interface of the system

The data feeding within the system is done through the collecting data function which imports equipment data created in another system that is in the SQL extension. The tool also has the registration of equipments function to isolated cases.

Through the EUAC function the calculus to each the expected useful life of the equipment is done, the year in which the EUAC has been lower, and it means that the equipment, from this year ahead, ceases to be economically viable due to the increase in maintenance and repair and consequently the decrease in the value of retailing of the equipment [6].

The function of useful life index calculus aims to calculate the ratio between the age of the equipment and its useful life estimated in its years. If the obtained value is higher or equal to 1,00 it means that the equipment has reached the end of its useful life. The remaining useful life refers to the remaining useful life years time in years still existing to the equipment [2, 7].

In the MEL value function the maximum possible value in maintenance expenses is obtained in which the pieces replacement and workmanship is considered.

Figure 2 shows interface of the MEL value calculus.

Fig. 2 Interface of the MEL value calculus

The MEL value refers to the maximum possible value in maintenance expenses until the end of the useful life of the equipment, so it is possible to obtain the maximum possible annual maintenance expenses value. The calculus of the MEL value might be useful in a technological updating or replacement process and in analysis of maintenance contracts based on the maximum possible annual values to the maintenance of the medical hospital equipments throughout their useful life [7].

In order to process the calculus of the MEL value, the name of the equipment, acquisition date, acquisition price, expected time of useful life, first and final GIP-IA (General Index Price – Internal Availability) are necessary as entrance data. The first GIP-IA economical indexes are the installation data of the equipment and the final GIP-IA refers to the date when the calculus was made. Excepting the GIP-IA indexes shown at the first time (with the option to alter it afterwards) in the MEL value calculus, the other parameters are shown at the moment of equipment registration or collected through the collecting data option. The

GIP-IA indexes are updated and made available monthly by the Getúlio Vargas Foundation [8].

It is possible through the MEL value interface create a table to compare visually the acquisition cost values, replacement cost, possible annual maintenance cost and MEL value.

As an example the tool has been used with the study case of an anesthesia appliance that has an equipment acquisition cost of R$ 42.000,00 in February 2001, useful life time of 10 years and an effective annual maintenance cost of R$ 6.630,00. The software has processed the data through the MEL function and has determined the replacement value of R$ 86.809,73, MEL value of R$ 15.197,65 and a possible annual cost of R$ 8.980,66 to February 2009. In the study case has been proved that the effective annual maintenance cost is acceptable because it is lower than the maximum possible annual cost. It is important to highlight that these final values are dependent to the useful life indexes and GIP-IA.

The tool shows these values through a technical table, as shown in figure 3.

Fig. 3 Technical table of MHE

The technical table offers all identification data of the equipment, such as name of equipment, brand, model, serial number, property, installation date, acquisition cost, annual maintenance cost, remaining time of useful life and evaluation date. In order to offer indexes to the MHT managers, and so helping in the decision making process to replacement and incorporation of MHT the technical table shows the replacement values, MEL value and time of remaining useful life. To make it clear the acknowledgment of the values shown, the technical table has two observations containing explicitly how long the evaluated equipment has of remaining useful life and the maximum possible value of maintenance in “reais” until the end of its annual and useful life.

The system has the available equipments reports creation function, equipment remaining useful life index and equipments MEL value. The system has also the help function that offers the user resources to visualize all the system functions, necessary parameters of entrance, as well as a research tool to look up technical terms.

Figure 4 shows the help function interface.

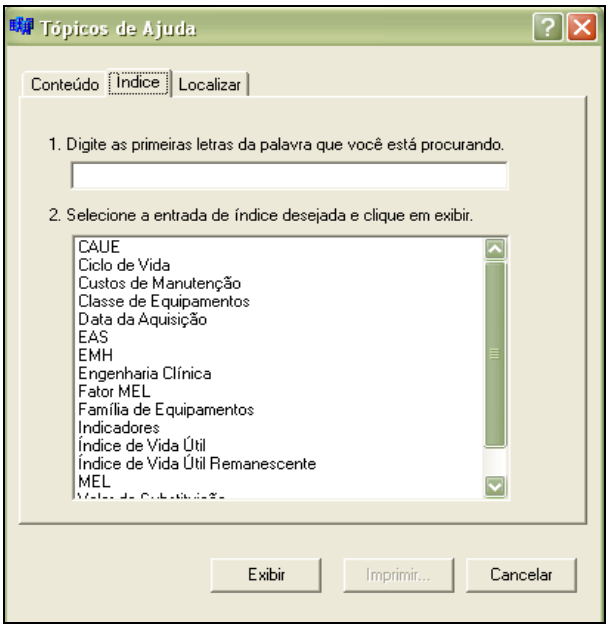

Fig. 4 Help function interface

The interface help topics function has windows, content, index and find. Through the content window it is possible to visualize the system functions, entrance parameters, available reports, system exits and technical terms. In the index window it is possible to search for technical terms, if the searched word is found its respective meaning is shown also/or its function in the system.

A questionnaire has been applied to 99 professionals who work and manage medical hospital equipment so that the implemented tool could be validated [9]. In this manner in collecting enough data to verify whether the information shown through the obtained indexes is truly related to the management of some class of medical hospital equipments.

The statistical processing of the questionnaire has been done in each question due to the fact that many of those interviewed did not answer to all of them, and it is because they do not use the same class of equipment.

This research has helped to verify that the professionals who work with MHT are worried about the identification process of the need of replacement and incorporation of new MHT in which the professionals among physicians, nurses and clinical engineers show the real situation of the technological park of the institutions where they are related to.

The equipment families searched were anesthesia appliance, electric scalpel, cardiac monitor, electrocardiograph appliance, surgical microscope and pulse oximeter. After the statistical process of the obtained answers it was possible to identify that an average value of 20% of researched equipments are used after their useful life time. This is caused by economical, burocratical reasons and even the inexistence of helping tools to the process of identification of needs to replacement and incorporation of MHT, showing to the professionals and managers who work with MHT indexes such as useful life index and maximum possible costs in maintenance and repair.

The main factor at the moment of deciding for medical hospital equipment replacement was the Technology Updating with 60, 61% of answer opposing to 39, and 39% of Costs Related to Usage. It shows the importance of managing the MTH considering the equipment useful life as one of the parameters, calling attention of the managers to when they should predict replacements because of technological obsolescence.

In general lines, the results obtained through this research tool were satisfactory because the higher frequency of answers is in the gaps of percentage figures come from the tool, for instance, the maximum possible costs in maintenance (MEL value) to each equipment class which means that the tool is showing values that are favorable to the real values considered by the interviewed people.

IV. CONCLUSIONS

The use of helping decision making systems in clinical engineering structures is vital to obtain an excellent management of MHT, even though there are still some restrictions. The lack of essential data to the processing of supporting methodologies to the decision making is a strong threat to block the application of those tools. This factor is caused by the few or sometimes none history and documentation of the equipments, mainly within the public health system. However, as an initiative to look for solutions to this problem, this research allures to the strengthening of data processing, showing the importance and repercussion of having indexes to support decision making.

ACKNOWLEDGMENTS

To the CNPQ (Brazilian National Council for Scientific and Technological Development) for the financial support, to FASS, to the IEB-UFSC for the motivation and support to the research.

REFERENCES

1. Antuzes S (2000) Planejamento estratégico para substituição e incorporação de tecnologias na área de saúde. Dissertação de mestrado em engenharia elétrica, centro tecnológico, Universidade Federal de Santa Catarina. Florianópolis, Brasil, 2000.
2. Albornoz L J C (2000) Determinação do ciclo de vida dos equipamentos médicos-hospitalares. Dissertação de mestrado em engenharia elétrica – centro tecnológico, Universidade Federal de Santa Catarina, 2000.
3. Cohen C, Friedman S. B. et al (1995) Benchmark indicators for medical equipament repair and maintenance. Biomedical intrumentation & technology, 1995, pp 307 – 323.
4. Camp R C (1998) Benchmarking: the Search for Industry Best Pratices that Lead to Superior Performance. Milwakee, ASQC Quality Press. 1998. pp. 235 - 248.
5. Rocco E De (1998) Definição de procedimentos para levantamento de produtividade e eficiência em serviços de manutenção de EEM. MSc. Dissertação de mestrado em engenharia Elétrica, centro tecnológico, Universidade Federal de Santa Catarina. Florianópolis, Brasil, 1998.
6. Casaroto N F, Kopitke B H (1984) Analise de Investimentos, 3ª edição, editora atlas, São Paulo, 1984, pp 128-145.
7. Albornoz L J C (2006) Aplicación del factor MEL como metodología para evaluación económica durante la vida útil de equipamientos médico-hospitalares, II congreso internacional de investigaciones biomédicas del Caribe Colombiano, 2006.
8. FGV at http://www.fgv.br/ibre/fgvdados/
9. Richardson R J (2007) Pesquisa social, métodos e técnicas, 3ª 3dição, editora atlas, São Paulo, 2007, pp 135-191

Authors : Francisco de Assis Souza dos Santos and Renato Garcia
Institute: Instituto de Engenharia Biomédica – IEB-UFSC
Street: Campus Universitário
City: Florianópolis
Country: Brasil
Emails: franciscoassis@ieb.ufsc.br and
renato@ieb.ufsc.br