ABSTRACT:

Biomedical engineering departments are emerging and growing fast in hospitals. These technical and supporting departments are a must nowadays especially if hospitals want to get accredited and stay updated in terms of technological advances. To be able to follow the rapid pace of technological change, to answer patients and physicians’ needs, and to maximize efficiency, the biomedical departments need to introduce change in their methodology of work and to reorient their role shifting it from low-added value activities to high-added value activities. They need specific managerial tools that enable them to minimize costs including hidden costs, to explore untapped potential, and to maximize the quality of the services provided and progress in the level of technology and medical sciences. This research will show that the Socio-Economic Approach to Management (SEAM) once applied can be a solution for biomedical departments to overcome the actual challenges and to increase the performance and the quality of their work.

Keywords: Socio-Economic Approach to Management, Biomedical Engineering, Hidden Costs, Untapped Potential, Reorienting Role.

INTRODUCTION

The biomedical engineering department in any hospital performs in theory important tasks such as planning for adequate level and use of biomedical technology in hospital, coordinating and collaborating with all kinds and level of internal users and external suppliers, and maintaining and repairing medical equipments. Although its functionality remains crucial for the smooth workflow and development of healthcare services, many average-sized hospitals view this department as a financial burden compared to other direct profit-generating departments such as clinical pathology departments, radiology departments, and pharmacy departments. It is true that the biomedical engineering departments are included in the category of running costs but they achieve indirect profit by providing quality healthcare services via optimum operations and proper maintenance of the medical equipment offering these services. Thus, they play a
crucial role in the well-being of the hospital, and it is important to make the best usage possible of this role. This research proposes an in-depth examination of biomedical engineering departments. It will investigate research questions concerning the expenses of the department including hidden costs and methods to reduce them. As a side note, hidden costs are not only limited to the biomedical department, hidden costs may be generated by biomedical departments and supported by other departments and vis versa, so the study will eventually affect not only the biomedical departments but also other departments. Moreover, the research will explore the overall (qualitative, quantitative and financial) revenues of the department and ways to increase them. It will move on to strategic questions concerning the department such as the relation between the expertise of the biomedical engineers/technicians and the revenues of the department, the impact of the selection of the equipments on the productivity of the department, and finally the effect of the partnership between the clients that is the hospital staff and the biomedical department. The last three aspects will aid in developing a strategic action plan for the biomedical department. All these research questions will be addressed through an intervention-research study methodology of the biomedical engineering department of a large university hospital of 400 beds in Lebanon and an intervention-research study of a small hospital of 120 beds also in Lebanon. Moreover, the Socio-Economic Approach to Management (SEAM) methodology will be followed to assess the performance of the biomedical department and provide recommendations for change. The results will have implications for the biomedical managers to enhance different aspects of their departments such as working conditions, work organizations, communication-coordination-cooperation, time management, integrated training, and strategic implementation to render their departments more productive and efficient.

PROBLEM STATEMENT

The relation between biomedical engineering staff and other actors remains tense in many hospitals. Nurses complain about the incompetence of biomedical technicians. Doctors undermine the opinion of biomedical engineers when purchasing medical equipments. Financial managers regard the department as a financial burden. This low level of integration and cooperation among hospital actors is limiting the biomedical engineering department to low-added value functions such as solving minor user-related or user-caused defects. It hampers the performance of the department which should focus on developing technical expertise to perform high-added value tasks such as equipment maintenance, servicing and repairs, technical evaluation of purchasing offers, and developing and planning for adequate level and use of biomedical technology in the hospital. Although the technical department plays a supporting role and is not deemed the core business of a hospital, it highly contributes to the services offered to patients bearing in mind that medical services today rely more and more on medical equipments for diagnosing disease and for patient treatment. Hence, an optimally functioning medical department greatly enhances the performance of the hospital.
AIMS

The researcher’s experience in the biomedical engineering field gained from the different positions held as a biomedical engineer in different hospitals in Lebanon was marked by the eternal conflict between business-oriented CEOs and financial managers on one hand and biomedical managers on the other hand. The rise within the biomedical engineering department hierarchy was accompanied with frequently overhearing narrow-minded hospital directors arguing that the biomedical department mainly incurs running costs for the hospital without achieving tangible profits. For instance, the radiology department seems to have most of its budget analysis comprised of revenues from patient hospitalization bills whereas the biomedical team has most of it comprised of expenses: salaries of engineers and technicians, training costs, annual maintenance contracts for medical equipments and purchase of spare parts. The years spent working within different biomedical departments allowed the researcher to observe some of the flaws suffered and generated an interest to study this issue deeper especially that as one draws closer to the upper management, the financial aspect of the department appears within his field of vision.

This generated an interest in the operations management of biomedical engineering departments specifically investigating how to increase the indirect revenues of the technical team and how to reduce its hidden costs. Furthermore, the interest extended to examining the indirect revenue achieved by the technical team, highlighting its importance. The main goal of this research is devising strategies within an overall vision for the biomedical department to maximize its performance through the SEAM intervention. It can be divided into the following main aims:

- reducing hidden costs of the department by cleaning-up low-added value tasks.
- increasing its productivity by improving the time-management of the biomedical employees, freeing them to perform high-added value tasks
- applying modern management tools to enhance the overall performance
- shifting the role of the department to perform more development activities

As the SEAM intervention is carried out in a sample biomedical department in a Lebanese hospital, it will provide a pilot or model for other biomedical departments in other hospitals to follow. The passion about this subject stems from the experience working in the domain. Although the biomedical engineers and technicians work hard and contribute to the hospital well-being, they remain relatively underappreciated as a team. The investigation of this research problem will develop the researcher’s managerial and business skills. Moreover, it will enhance his research skills, communication skills, and auditing skills.

This topic is gaining importance with the ever-increasing emergence of new complex medical equipments and thus organizing the biomedical departments that provide technology transfer and technology management services in a cost-effective manner and in accordance with international standards within the hospitals constitutes a high priority for upper management. With the advent of the accreditation era in Lebanon, it is not only important to employ a biomedical
department in the hospital. It is a necessity to employ a biomedical engineering department that is standing up to achieve its full potential.

**HYPOTHESES**

Biomedical departments were introduced relatively recently in Lebanese hospitals. The concept was imported from hospitals in the West along with the accreditation that was imposed on hospitals, especially that the accrediting committee is usually composed of Western specialists. Unfortunately, there remains confusion among the hospital management and staff about the actual functionality of this department especially in average-sized healthcare institutions. Moreover, even the biomedical staff do not focus on the core functions either due to their lack of awareness of what their responsibilities should consist of or due to pressure from other hospital actors that tend to limit the privileges of the biomedical engineers.

*Core hypothesis:*

In some hospitals, the biomedical engineering department is not performing at the required level due to a lack of competencies in time management and to a high concentration on current low-added value tasks rather than on development and strategic actions. Biomedical departments can achieve a high level of performance if they convert low-added value activities into high-added value activities and if they apply modern managerial tools. Hence, they will better contribute to the strategy of the hospital aimed at serving its stakeholders.

Descriptive hypothesis: The biomedical engineering department suffers from many dysfunctions and hidden costs such as nonquality and noncreation of potential.

Explicative hypothesis: The root reasons are lack of sensitization and lack of awareness to the opportunity cost of devoting much of the time for user-caused equipment defects in a context of adversity and lack of integration.

Prescriptive hypothesis: The biomedical engineering department must reorient its role to perform high-added value tasks synchronized with a renewed internal and external strategic plan. Low-added value activities must be cleaned-up via delegating tasks of first line maintenance and troubleshooting to other hospital staff. Thus, the biomedical department will maximize its performance along greater integration and respect from other hospital actors. Thus, once SEAM is applied to the biomedical department, not only a positive change will result in the activities of the department and its work method. There will result a change in its relation to other hospital actors and a better understanding and acceptance of the important role of biomedical departments.

**RESEARCH FIELD**

A horizontal diagnosis will be undertaken in a small hospital A to be compared with a large university hospital B (already performed in previous research work). Moreover, vertical diagnosis of the biomedical engineering department in the large university hospital B will be performed to analyze
dysfunctions and calculate hidden costs. A strategic and priority action plan will be devised and implemented in the department. The results will be evaluated and positioned regarding the existing literature in the field of biomedical engineering departments’ performance.

Hospital A:
It was established in 1976. It consists of 120 beds and employs 156 people. Its main activities include hemodialysis, rehabilitation, and physiotherapy. Much of its budget is comprised of donations.

Hospital B:
It was established in 1878. It consists of 400 beds and is still expanding. It is a university hospital and provides all of the medical services currently available in the medical world in addition to performing medical research in the different medical domains. Some of its main activities include cardiac care, physiotherapy with hydrotherapy, helipad for trauma and emergency cases needing rapid evacuation by helicopter, genetic unit, neuroscience unit, oncology center…

Biomedical Engineering Department in Hospital B:
It consists of 15 employees according to the organizational chart inserted below. The main functions of the department according to in its mission statement include:

- Providing optimum operations and proper maintenance of the medical equipment
- Assuring quality and safety to patients, operators and doctors while using medical equipment
- Continuously training all users by certified trainers on medical equipments
- Offering corrective and preventive repair services for medical equipments 24/7
- Conducting technology assessment and comparison for proper purchase of best suitable advanced technology
The process is referred to as Intervention-Research and is a more transformative process than traditional action research. Before the intervention, SEAM consultants meet with the organization’s leader, educating the leader about SEAM. When the leader decides to use the SEAM process, one or more SEAM consultants enter an organization, gather data from participants, synthesize the data, and feed the synthesized data back to the participants. The next important step is to work with the participants to assist them to identify the necessary changes and ways to implement these changes. The last step is to assess the effectiveness of the change process. Essentially SEAM is a deliberate process which includes a very specific approach, using data from over 35 years of research to shape an intervention that will involve actors from throughout the organization to uncover hidden costs and potential and make changes that will increase the organizational effectiveness. The SEAM design first involves top leadership to get their support and understanding, and then cascades the change work through the organization as needed. The outcome is an intervention that flows two ways: a) horizontal diagnosis or top-down, when leaders begin and support the change work; and b) vertical diagnosis or bottom-up when all actors are engaged in identifying and reducing hidden costs and performance issues. This is the French blend of top down and participative OD. The intervention begins with the commitment of top management and modeling of new practices, and then moves on to extend the intervention to the rest of the organization in a highly participative manner. The assumption behind this is that the actors have the knowledge and ability to do the changes necessary to improve the climate and effectiveness of the organization.\textsuperscript{10}
RESEARCH METHOD

The research intervention will start with the diagnostic phase including the interviews with the principal key actors (mentioned below) for the vertical diagnosis in hospital A, which will be compared with the horizontal diagnosis in hospital B (already performed by another researcher). The next step will be performing the vertical diagnosis in the biomedical department of hospital B. The interviews and observation will uncover the dysfunctions related to the six themes set by SEAM that are working conditions, work organization, communication-coordination-cooperation, time management, integrated training, and strategic implementation. Then, the indicators such as absenteeism, occupational injuries and diseases, staff turnover, nonquality, direct productivity gaps that decrease the performance will be investigated. Finally, hidden costs will be calculated and there will be an attempt to recycle them into added value. The biomedical manager showed interest in the management tools such as the time management, the competency grid. He will be trained on these tools so he can apply them in the everyday management activities of the department. After interviewing the actors in the biomedical department, the employees’ comments will be reflected in written to the biomedical manager in addition to the researcher’s expert opinion due to the observation and from the experience gained working in the field for more than five years and knowing all the knitty-gritty details about biomedical engineering departments in general.

RESEARCH QUESTIONS

As mentioned before, the research questions focus on the expenses of the department including hidden costs and methods to reduce them, the overall (indirect) revenues of the department and ways to increase them, the relation between the expertise of the technical support engineers/technicians and the revenues of the department, the impact of the selection of the equipments on the productivity of the department, and finally the effect of the partnership between the clients (hospital staff) and the biomedical department. These overlap with the SEAM key concepts of hidden costs, integrated training, strategic plan, and profits.

OBJECTIVES

An informal research contract has been negotiated and approved with both hospitals. They will provide the field where the researcher tends to intervene to study the biomedical department and attain the aims mentioned before.

- reducing hidden costs of the department by cleaning-up low-added value tasks.
- increasing its productivity by improving the time-management of the biomedical employees, freeing them to perform high-added value tasks
- applying modern management tools to enhance the overall performance
- shifting the role of the department to perform more development activities
**Horizontal Diagnosis:**

The following people will be interviewed in Hospital A as part of the horizontal diagnosis. Please note that the hospital being small, the executive people hold more than one function at the same time.

- The medical director: is responsible for medical supervision and overall regulation of all medical facets that may affect the institutional healthcare system.
- The doctor in charge of the nephrology unit: which is a very active and successful department in the hospital. He prescribes and supervises hemodialysis treatment to patients. He is very powerful and has a large say in the decisions of the hospital. The services offered by the nephrology department in hospital A compete with those offered in much larger hospitals in Lebanon.
- The nursing director: who is responsible of all nursing staff in the hospital. She presides over 74 registered and practical nurses and is also involved in infection control procedures and quality control procedures.
- The technical support director: who is responsible for the maintenance and repair of all electrical and biomedical equipments in the hospital in addition to IT support.

**Vertical Diagnosis:**

The biomedical manager in the university hospital has expressed his enthusiasm about implementing the SEAM research methodology in his department after the successful implementation of the SEAM in another department in the same hospital.

The following people will be interviewed in the biomedical engineering department in the Hospital B as part of the vertical diagnosis:

- The biomedical manager
- Supervisor
- Three biomedical engineers
- Senior technicians
- Technicians

**Project Implementation Phase:**

*Reorienting the Role of the Department:*

The following implementation is based on assumptions. It may change after the vertical diagnosis has been completed. The following changes might be implemented:

- Delegating tasks of first line maintenance and troubleshooting to other hospital staff such as nurses
- Freeing the time of biomedical engineers and technicians to perform high-added value tasks such as repairs.
- Developing and increasing the expertise of the engineers and technicians through integrated trainings and forcing the external companies to conduct technical trainings to engineers upon purchasing of new medical equipments.
• Involving the biomedical department in the purchase of new equipments as their technical expertise develops to determine what features should be purchased and compare between offers.
• Redistributing the tasks within the biomedical department in a manner that no employee performs a task that could be performed by a subordinate

**Evaluation Phase:**

This phase includes recalculating the hidden costs after the changes have been implemented to evaluate the results of the SEAM intervention.

**BIBLIOGRAPHY AND POSITIONING**

Since technical support departments such as biomedical engineering departments provide a competitive advantage for organizations as explored by Goffin (1994), there have been various studies about the different aspects of the technical support department such as the distribution channels, the role of the customers in relation to the technical department, spare part management, knowledge repositories, etc. The researches were characterized by an in-depth study of one of the tasks of the technical department. For instance, Goffin and Price (1996) investigated the importance of high-quality service documentation in biomedical engineering departments. Goffin (1999) focused on the different distribution channels of support (direct, indirect /dealers) and their advantages. Other researchers examined the role of customers in relation with the technical departments. For example, Bitner, Mary, et al. (1997) investigated the customer contributions in creating the service experience. Davenport and Klahr (1998) studied how organizations are extending their own support knowledge to customers for self-service. Amit Das (2003) explored the role of customer knowledge in enhancing the productivity of technical support work. Gronholdt, Lars, Mørtensen, and Kristensen (2000) studied how customer satisfaction affects loyalty.

Other studies include Janne and Huiskenson et al (2001) who surveyed a sample of high-technology companies’ practices in spare parts management, and Gray and Durcikova (2005) who investigated the role of knowledge repositories in improving service quality.

However, none of the research was systematic, namely covering all aspects of the technical department in the light of their financial contribution. Thus, studying the whole picture becomes necessary. Moreover there exists an opportunity to comprehensively analyze the productivity of the technical department through the SEAM research methodology.

I intend to focus mainly on biomedical engineering departments in hospitals in Lebanon that present different challenges. Moreover, I will conduct a profound study to devise a strategic plan to improve the performance of the biomedical engineering department, decreasing costs, increasing productivity and quality using the SEAM methodology.

Many medium-sized hospitals in the non-industrialized nations struggle to maintain or extract productivity from their biomedical engineering departments. The results of this study will generate ideas and criteria for the reorganization of
such departments and for improving the employees’ performance. It will assist managers of such departments to eliminate hidden costs and to generate or increase (indirect) profit. Since no such a comprehensive study exists for the biomedical teams in this part of the world through SEAM, it would be a novelty. I will disseminate my results to the community through publications and would provide my recommendations to the CEOs and biomedical managers of the hospitals included in my intervention-research study.

**TIMELINE OF THE IMPLEMENTATION**

The following Gantt chart illustrates a tentative timeline for completing the SEAM field intervention process in hospitals A and B. It extends over one year and the following phases will be completed:
- Horizontal diagnosis in hospital A: 1 month
- Vertical diagnosis in hospital B plus mirror effect plus training manager on SEAM management tools: 2 months
- Project Phase: 2 months
- Project Implementation Phase: 6 months
- Project Evaluation Phase: 2 months

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<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
<th>Resource Names</th>
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<td>Thu 31-05-18</td>
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REFERENCES


