AC 2009-1500: TEACHING FACILITY-MANAGEMENT PRACTICES: A CASE STUDY

Sarel Lavy, Texas A&M University

Dr. Sarel Lavy (corresponding author), Assistant Professor, Department of Construction Science, College of Architecture, Texas A&M University, College Station, TX 77843-3137, USA, e-mail address: slavy@archmail.tamu.edu.

Dr. Lavy is a faculty member in the Department of Construction Science, which is one of four departments in the College of Architecture at Texas A&M University. He also serves as the Associate Director of the CRS Center for Leadership and Management in the Design and Construction Industry. Dr. Lavy is a member of the International Facility Management Association (IFMA), the American Society of Civil Engineers (ASCE), and the American Society for Engineering Education (ASEE). Dr. Lavy's principal research interests are: facilities management in the healthcare and education sectors, maintenance management, and performance and condition assessment of buildings.

Teaching Facility Management Practices – A Case Study

Abstract: The significance of facility management to the business success of companies and organizations is steadily increasing. Nowadays, teaching facility management is often spread over a number of disciplines, among them engineering, architecture, management, business, and construction. This paper presents a case study of a project completed by teams of undergraduate and graduate students in the courses "Specialty Capstone" and "Introduction to Facility Management," offered by a large university in the US in the spring 2008 semester.

Facility management, if well-organized and well-structured, has the potential to not only improve the physical performance and appearance of a building and its systems, but also to increase the users' level of satisfaction, and to improve the efficiency with which buildings are maintained, operated, and managed along their service lives. These two courses offered students an opportunity to encounter real problems and dilemmas that facility managers witness on a daily basis. Students were asked to offer creative solutions to these dilemmas.

The students studied several aspects of facility management, such as strategic and tactical planning, maintenance and repair, operations and energy management, benchmarking and condition assessment, space allocation, and Life Cycle Costing on a local hospital campus. The students in each course were given different assignments, based on their skills and level of knowledge. Assisted by the Director of Plant Operations Maintenance and Engineering at the hospital, and using software contributed by an external commercial engineering and construction company, the students collected the data and conducted the analyses shown in this paper as part of their course assignments. The concepts of teaching facility management, as implemented in these courses, are discussed in this paper, and demonstrated through real life cases.

Keywords: Graduate Education, Undergraduate Education, Facility Management, Case Study, Condition Assessment.

Introduction

The significance of facility management (FM) to the business success of companies and organizations is steadily increasing. Business success is characterized not only by annual revenue and profit margins, but also by the way various aspects of the building portfolio and environment are maintained and operated. Examples for this include, but are not limited to, monitoring daily maintenance, operations, and energy consumption; conducting condition assessments and benchmarking studies; adapting and complying with policies and regulations; and assisting with the implementation of the organization's strategic and tactical planning. Often, facility managers also confront stringent budget constraints; therefore, tools to assist in their decision making should be developed and offered.

Universities, in a broad sense, are educational entities imparting higher education at undergraduate and graduate levels and providing opportunities for research and development. Universities offer academic programs to fulfill their goals of providing relevant education in the desired field. Academic programs are formulated with a required course structure and generally provided with a degree or certificate. One can argue that a higher level of educational outcome and usefulness of courses offered in a program are very essential for universities[1]; however, not only academic programs, but also the course and the curriculum, must align with program

objectives[2]. Programs differ greatly in terms of their aims and objectives, structure, available resources and degree or certificate offered for different universities. Such factors are actually indicative of varying standards and levels. Typically, teaching facility management encompasses several disciplines, among them engineering, architecture, management, business, and construction. As a result, it has not traditionally been well developed enough in any of these programs to a level that covers the large variety of topics and aspects of facility management.

Today, there are only six universities in the US that offer a degree in facility management; several other universities offer courses in facility management. Those with full degree programs are Brigham Young University (College of Engineering and Technology), Cornell University (College of Human Ecology), Ferris State University (College of Engineering Technology), Georgia Institute of Technology (College of Architecture), Pratt Institute (School of Architecture), and Wentworth Institute of Technology (Department of Design and Facilities). Cornell University is the only one that offers both undergraduate and graduate level degrees in facility management. While Georgia Institute of Technology and Pratt Institute offer only graduate programs, the other three universities offer only an undergraduate degree program in facility management.

This paper presents a case study (out of five that were developed) of a project completed by teams of undergraduate and graduate students in the courses "Specialty Capstone" and "Introduction to Facility Management," offered in the spring 2008 semester. The paper discusses the concepts of incorporating facility management aspects into both graduate and undergraduate

level courses, and presents a case study that demonstrates how facility management is implemented in one healthcare facility building.

Background

Many definitions exist for the term "facility management" (FM.) The International Facility Management Association defines FM as: "a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology"[3]. The British Institute of Facilities Management adds that: "facilities management is the integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities"[4]. Other definitions include: "The primary function of facility management is to manage and maintain the efficient operation of the built environment"[5]; "Professional FM involves the permanent analysis and optimisation of cost-relevant processes relating to construction-related assets, facilities and services provided in businesses… As assets become more and more sophisticated to manage, the challenges on FM are increasing, both in terms of services to be provided and relating the responsibilities involved"[6]. Additional definitions may be found in [7, 8, 9, 10, 11, 12], and others. From these definitions one can conclude that facility management:

- is a multi-disciplinary profession;
- supports businesses and organizations;
- ensures functionality and manages the efficient operation of the built environment;
- fulfills people's basic requirements at work;

- increases return on capital; and
- integrates people, place, process, and technology.

Nevertheless, the literature realizes three common paradoxes that still exist in the facility management profession: first, although facility management is recognized as a strategic discipline, most of its practitioners are found at the operational levels of their organizations; second, while FM aims to be at the heart of any organizational development, many services it offers are provided by external professionals; and third, although facility management seeks to manage changes within organizations, in most cases it is a more reactive discipline in nature than a proactive one[13, 14, 15, 16].

Methods

The courses "Specialty Capstone" (undergraduate level) and "Introduction to Facility Management" (graduate level) were offered in the spring 2008 semester by the university at which the author is a faculty member. Eleven and seventeen students participated in these courses, respectively, and they were grouped into five teams of 5-6 students each where 2-3 undergraduate students worked with 3-4 graduate students on each team. The students were asked to investigate how different aspects of facility management (as described hereafter) are implemented in hospital buildings. A local medium-size hospital was involved in the projects, and was asked to allow students to study its buildings. A commercial external engineering and construction company was also involved in the project, by contributing its on-line assessment

software to be used by the students. The company offered guidance and assistance to the students throughout the semester. The Director of the Plant Operations Maintenance and Engineering Department at the local hospital assigned five buildings for the purpose of these courses. Based on the literature of topics included under the definition of facility management, the students were asked to study the following aspects of the buildings assigned to them:

1. Strategic and tactical planning – long-term, mid-term, and short-term planning;
2. Benchmarking, Key Performance Indicators, and implementation of physical condition assessment – development, assessment, and use;
3. Maintenance and repair – policy setting and how it is implemented in the different building systems (structure, exterior and interior components, electro-mechanical systems, other);
4. Operations and energy management;
5. Workplace design, interior space planning – allocation, management, and forecasting;
6. Use of databases for the various aspects of facility management;
7. Life-Cycle Cost analysis of the building and its systems;
8. Architecture/Engineering services – assessment, programming, planning, design, estimating, documenting, and contracting;
9. Construction and project management;
10. Financial management – budgeting, accounting, forecasting, and implementing;
11. Alteration, renovation, and reconstruction management;
12. Information and Communication Technology – telecommunication, data-communication, and network management;
13. Security and life-safety management;

14. General administrative services – food, mail management, health programs; and
15. Other issues related to facility management – this remained open to the students' selection.

The above list also outlines the topics covered in the two courses. Emphasis was given to maintenance and repair, and Life-Cycle Cost analysis in the undergraduate course, where more in-depth study of these topics was conducted in the graduate level course. The topics were covered through class discussions, reading textbook materials and research papers, site visiting, and listening to lectures offered by guest speakers. During guest lectures during the semester, students had a chance to listen and learn from experts in different areas of facility management. The guest lecturers were representatives from the hospital, consulting companies, real-estate experts, and facility managers from other organizations. Students were expected to incorporate the topics listed above into their final projects. Their academic performance was assessed with a combination of their grades on the mid-term report, mid-term presentation, final report, and final presentation of the projects. The following paragraphs demonstrate some of the topics that were discussed in the class, in the context of a case study of facility management practices in hospital buildings.

Case Study

The hospital was built in 1912 with the construction taking one year; it was a three story building with a capacity of 25 beds and six bassinets. The hospital was purchased by two doctors in 1934,

and was later purchased by the Sisters of St. Francis in 1936. The hospital currently has 235 acute-care beds, and a 61-bed rehabilitation and skilled nursing facility. The hospital owns three rural hospitals and two long-term care facilities. This case study focuses on the Administration Wing, which is part of the main building complex.

Areas and Organizational Structure

The Administration Wing, built in 1991 with an area of approximately 63,000 sq-ft, is part of the main building complex and it houses offices, laboratories, education centers, and meeting rooms. The building is comprised of a basement and three floors. The Education Center of the hospital is located in the basement of this building. The first floor, also known as the main floor, contains the main hospital entrance, a gift shop, cafeteria and some offices. Laboratories are located on the second floor of the building, and the administration office is located on the third floor. Apart from the overall administration of the hospital, the services offered in the building are the laboratories. A breakdown of the areas in the building is shown in Table 1.

The hospital is run by a Board of Trustees, which is in charge of the overall management of the facility. Under the Board of Trustees, the hospital has a President and a Chief Executive Officer (CEO), who make the strategic plans, policies, etc. The Chief Operating Officer (COO) is responsible for the daily operations of the organization, and reports to the President and the CEO. Lower management is comprised of people in-charge/managers looking after safety, security, materials, emergency, utilities, etc.

Floor	Area (sq-ft)							
	Hospit.[a]	**Admin.[b]**	**Utility[c]**	**Energy[d]**	**Labs[e]**	**Outpat. Clinics[f]**	**Other[g]**	**Total**
Basement		1,500		600			11,242	13,342
1		12,000	1,500	600			11,072	25,172
2		1,500		600	9,986			12,086
3		11,486		600				12,086
Total		26,486	1,500	2,400	9,986		22,314	62,686

Table 1: Breakdown of floor areas in the building studied

[a] – Hospitalization areas include all hospital wards, emergency rooms, operation rooms, maternity wards, premature infant care units, etc.

[b] – Administration areas include management and administrative offices.

[c] – Utility areas include laundry, kitchen, warehouse, etc.

[d] – Energy-related areas include energy spaces and room, electricity rooms, machine rooms, gases storage areas, water treatment, etc.

[e] – Laboratory areas include blood laboratories, chemotherapy, MRI, etc.

[f] – Outpatient clinic areas include outpatient and day-care clinics (areas that usually do not provide services during the night).

[g] – Other areas include areas that cannot be attributed to any of the previous categories, such as lobby, entrance hall, cafeteria, etc.

The facility management department (officially called “Plant Operations Maintenance and Engineering Department”) is extremely active in a job which ranges from picking up trash, to landscaping and demolition of buildings, to constructing a new building. The students were asked to interview the director of the Plant Operations Maintenance and Engineering Department, where the various challenges faced by the department due to the shortage of funds and the prioritizing of budgets were all discussed during these interviews. The department consists of 34 employees in the following disciplines (the number of employees in each discipline is in parentheses): facility managers (2); secretary (1); telecom coordinators (2); supervisors (3); electricians (4); plumbers (2); HVAC technicians (2); general mechanics for all purpose maintenance (7); carpenters and painters (9); plant operator (1); and groundskeeper (1).

The hospital uses both in-house and outsourced service providers. The basic services like plumbing, electricity, painting, mechanical, etc., are provided by in-house employees, while the “large scale” services, like flooring, roofing installation, etc., are outsourced. According to the master electrician, any activity which takes three weeks or longer, and requires three or more workers is outsourced.

The responsibilities of the department are wide-ranging: the department is responsible for providing maximum comfort to all people, be they patients or employees. The department is in charge of providing their best service to keep the environment of the hospital as comfortable as possible. This ranges from keeping track on the age of the carpet, the chillers, or the boilers, to the installation of new roofing material, or landscaping flower beds around the exterior.

Strategic and Tactical Planning

The hospital's 30-year strategic plan includes extensive plans to renovate and expand its campus to create a Health District campus. Negotiations are currently in place to acquire property from surrounding owners to accomplish the strategic plan. The Administrative Wing, in comparison, has no strategic plans aligning with the future growth of the organization as a whole. Conversations with administrators and managers of the facility led the students to believe that the Administrative Wing will continue to serve its current purpose of housing senior executive staff and in-house laboratory facilities.

The expansion plan depends on forecasts of population growth in the area. Authorities have concluded that there was a 15% increase in the population over the previous 15 years. When administrators see an increase in patient intake capacity, then a proportionate increase in the staff members is authorized. As far as the facility management department, the Director of Plant Operations Maintenance and Engineering commented that they happen to be minimally involved in strategic planning development for the hospital. He explains this by the fact that strategic planning is too broad and less technical. This contradicts the literature that argues that the facility management department should play an important role in developing strategic and tactical planning for the organization it serves.

Maintenance and Repair

As the availability of operational equipment in a safe and comfortable environment directly affects patient care and the hospital's mission, it is departmental policy "to make repairs to equipment in a timely and cost efficient manner." The rapid completion of repairs to equipment and preventive maintenance also have a direct impact on the budget; therefore, repairs are prioritized in the following order: (1) safety related work requests; (2) patient care related work requests; (3) periodic work and preventive maintenance; and (4) corrective maintenance, as prioritized by supervisors.

All work order requests are assigned to an individual for repair. An open work order request remains in the work order binder until completion. To assist in the tracking and completion of work orders, the FM department utilizes an array of performance indicators. When an outsourced vendor is utilized to complete or assist in the completion of repairs, a copy of the receipt or vendor work order is reviewed by the director and given to the FM department's secretary for recording purposes. Each activity must be documented appropriately, whereas departmental policy is that a job is not complete until the documentation is completed. The department maintains several logs in which all maintenance items should be reflected; for example, Emergency Generator Log, Fire Sprinkler Log, Filter Log, Daily Rounds, Electrical Receptacle Test Log, Kitchen Hood Inspection, Water Chemistry Test Log, and Vehicle Log.

The students were asked to review maintenance records and find out different performance indicators, such as the percentage of in-house vs. outsourcing work orders performed, percentage of in-house vs. outsourcing costs, and the percentage of preventive vs. corrective maintenance conducted. The following text is quoted from the students' report: "The first component that we

focused on was the computerized facility maintenance system, or should we say a lack there of. When we first started researching this matter we found that the only records kept by the facility manager and his staff were really of no help at all. The records that were kept dealt with man-hours and specified in which rooms work had been completed. There was no detail describing what activity was conducted or what was fixed. On top of this, the information that was recorded had been put in a format that only the director could read, which made if very difficult for the rest of his staff and ourselves to comprehend. When we consulted with him about this, the only excuse he had is that it wasn't cost effective for him or anyone else to keep such detailed records. As a response to this we came up with a few suggestions. First of all, any maintenance management system is better than nothing, even if it is a very simple form. It needs to include whether the work was done in-house or outsourced, the date it was completed, and the cost of the repair (both man-hours and materials). We also suggested he keep some type of data sheet that contained information on the life expectancy of repairs and the budget for future repairs and replacements." From this text, one can learn that even though there are policies in place, regulating how these records of maintenance activities should be stored and kept, the data is not easily tracked and/or followed by someone outside the system.

Renovation and reconstruction is taken care by the facility management department of the hospital. The hospital has a five year renovation plan for the entire Administration Wing building. Since the building under study is not very old construction, there has been no tremendous renovation, as compared to the other buildings of the hospital. However the interiors of the building demand repairs and renovation quite often, for the leaking roof or the torn carpet, for example. The carpet on the first floor of the building is changed every year due to heavy

traffic, while that on upper floors is changed every two years. The boilers and chillers are replaced every ten years; this is performed by an outsourced service provider.

Operations and Energy Management

The Director of Plant Operations Maintenance and Engineering Department acknowledged that energy management systems are lagging, compared to other best practice organizations. However, the department uses Energy Star® appliances throughout the laboratory installations, the office spaces, and the lavatories. There are plans, in the form of capital projects, which include the acquisition of an automated Energy Management system. Costs are currently being calculated for the present Administration Wing building, since allocation plans intend to capture this facility as a stand-alone profit center rather than a standard expense center.

Workplace Design and Interior Space Planning

The workplace is designed, keeping in mind the safety and comfort of patients and employees of the facility. Safety is given top priority in the organization and the hospital offers no compromise for the same. The facility was designed by architects/designers with prior experience in the healthcare industry, which is a very specialized field. It was a teamwork process, in which the authorities from the hospital sat with the architects and designers to give their requirements. The users of the facility were also involved in the design, as suggestions were solicited from department heads, physicians, and nurses. The hospital was designed as per the codes set by local authorities.

The work place is designed in such a fashion that changes to the existing structure can be easily accommodated. As the healthcare industry experiences frequent technological advancements, incorporating changes is difficult at times; therefore, the design of the hospital is such that any change would not have an adverse effect on the building shell.

Financial Management

Operations at the hospital accrued a total annual distribution of almost $3 million for the entire main campus for the FY2008. Financial budgets are developed at the senior management level. They do not, usually, allocate any funds to the facility management department for preventive maintenance, but do allocate funds to finance capital projects, such as chiller or boiler replacements. The preventive maintenance budgets are established on an “as needed” policy and arise from annual budget meetings as designated by the Executive Committee. The “as needed” budgets are determined on the basis of request for work-orders and upon the monthly maintenance inspection of equipment. The maintenance inspections are performed by the maintenance staff possessing specific skills. In any case, the budgets are mostly projected from the life-cycle cost of each product/material expended.

Life Safety Management

The life safety systems, like fire hydrants, are regularly inspected by the local fire marshals, the state Department of Health, and relevant federal agencies. Three regular drills for all the life

safety devices are conducted every month. There is a fire drill every three months where the proper functioning of the devices are checked. These inspections are performed by staff and the local fire marshal.

The sprinkler system plays a critical role during fires; thus, this system must be in excellent condition, and must be checked on a weekly basis. If there is any malfunction in the system, it should be rectified as soon as possible. In addition, the smoke detectors are components of the life safety management. In case of fire, this system should alert building occupants and the authorities of the danger. On inspecting these systems, visually, it was found that the sprinkler system in the basement floor needs to be replaced within the next year. The smoke detectors are in good condition on all floors.

Security is of prime importance to this hospital, which has hired seven security officers who are in charge of security around the clock. The visiting hours are between 9am and 9pm; the doors are equipped with remote computer locks and they are closed by 9pm. The hospital is patrolled by these security personnel at regular intervals.

Benchmarking and Key Performance Indicators (KPI's)

The hospital uses an array of benchmarks to stay current with quality practices. The facility management department benchmarks with 500 best-in-practice organizations in the United States through the use of a common database. The benchmark metrics compare the main factors of productivity and efficiency on a regular basis. This comparison tool provides access to databases

with information in four primary categories -- clinical services, business operations, patient satisfaction, and safety. The comparison tool is Internet-based, and it allows the hospital to evaluate their performance against internal goals, peer groups and national benchmarks. Examples of the main KPI's used within the FM department include the average time for a work order to be completed, and the percent of maintenance inspection completed in the facility within a given period of time. Using this comparison strategy, the hospital aims to stay within the top 25% of organizations in these various performance indicators. The performance is recorded quarterly, and later an annual performance chart is prepared and analyzed internally for planning future activities, and evaluating employees. Based on the benchmarking results, the hospital received the 2007 Award for Performance Excellence from the state in which it is located.

Condition Assessment

The condition of the building is assessed by the in-house employees on a weekly basis. Based on the deficiencies and the funds available, priorities are set, and based on these priorities, the work is carried out. To complete their assignment, the students were asked to go over a list of items and conduct a visual condition assessment in the building they studied. The following paragraphs summarize the findings of the students' condition assessment in the Administration Wing.

"During the visual assessment of the building, except for some minor defects, the building and its different components looked in good shape. The interiors components of the building, such as walls, ceiling are in good condition, as they are renovated every five years. The carpet is changed every year. Picture 1 shows that there is a leak on the first floor, where the leak should be

repaired and the acoustic tiles need to be replaced. In some of the areas, the wallpaper is peeling off and needs to be replaced. Normally, the wall paper is replaced every five years. In some areas the paint is peeling off (see Picture 2), which could have happened by impact on the wall by some hard objects. The intensity is, however, low, and this is not a top-priority repair. No leaks were found while inspecting the restrooms. Overall, the interior of the building, except some minor defects, is in good condition and maintained periodically."

Picture 1: Acoustic tiles on the first floor

"The physical condition of the structure was examined from the basement and the elevator shaft. In these mentioned areas, the walls have not been painted or covered by wall paper. By examining, it was found that the building is in good condition. The structure does not have any structural cracks; the concrete does not have any irregularities. If the hospital assessors identify any defects visible in any component of the structure, then it is given top-priority and the work is rectified as soon as possible."

Picture 2: Paint peeling off an interior wall

"The next area we focused on was the plumbing and electrical systems of the building. All systems and fixtures seemed to be in good condition and running well. We walked through the electrical rooms, as well as the mechanical room and elevator room. After consulting with the director, we realized that there were no records for the plumbing and electrical systems either. He said that any problems that arose with either one of these systems was dealt with on an "as needed" basis, and the work is usually outsourced to specialty contractors. One item that was mentioned to us was the fact that they will be replacing the two cooling towers on top of the building within the next year. Apparently they are failing due to poor cooling connections and will cost them around $250,000 to replace."

The students were asked to log all building component conditions into the FM software that was contributed to the two courses by a commercial engineering and construction company. The total

annual expenditures through the year 2018, along with capital and system replacement costs, were estimated for each year over the next ten years, as shown in Table 2. The costs were categorized by building system, where each building was broken down into four major systems: substructure (including foundations); shell (including superstructure, exterior enclosures, and roofing); interiors (including interior construction, stairs, and interior finishes); and services (including conveying, plumbing, HVAC, fire protection, and electrical). The value for 2008 represents the current deficiencies in the building (at the time of this study), while the costs for all other years are based on the service lives of the building components, with an assumption that the cost will increase by 3% per year over the next 10 years.

Building System	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Substructure											
Shell				134,125							
Interiors		729,432							69,882		633,541
Services	492,101	147,216									661,342
Total	492,101	876,648		134,125					69,882		1,294,883

Table 2: Capital renewal schedule

Also using the condition assessment software, the Facility Condition Index (FCI) was calculated. This is done by dividing the total costs of all building deficiencies by the replacement value of a building, and this represents the financial value of deficiencies. The FCI may vary from 0% (for a brand new building) to 100% (theoretically, where each and every component should be

replaced, so the deficiency cost equals the replacement value): the lower the FCI, the better the condition of the building, and vice versa. The FCI for the building discussed in this case study was found to be 4.3%. This is evidence that the building is in very good condition, and it does not needs more than some minor work.

Figure 1 shows the estimated costs required annually in order to maintain the current FCI (of 4.3%), as well as the costs required to reduce the FCI to 3% and 1% within 10 years, reading the columns from left to right. This table only captures capital renewal and replacement costs; maintenance costs, not shown in this table, were figured separately by the students. This figure shows that the investment required from the hospital in order to keep the FCI in its current condition is estimated at $2.38 million over the next 10 years (where regular maintenance and operations alone are budgeted at approximately $3 million per year). If the hospital's board would like to improve its FCI to 3% and 1%, they will have to invest $2.55 million, and $2.82 million, respectively. Major cost items in all of these three alternatives include current deficiencies, as well as a large replacement of wall finishes and the domestic water distribution system in 2018. These figures could be used by decision-makers at the hospital in order to devise strategic plans about the level of building performance they would like to attain.

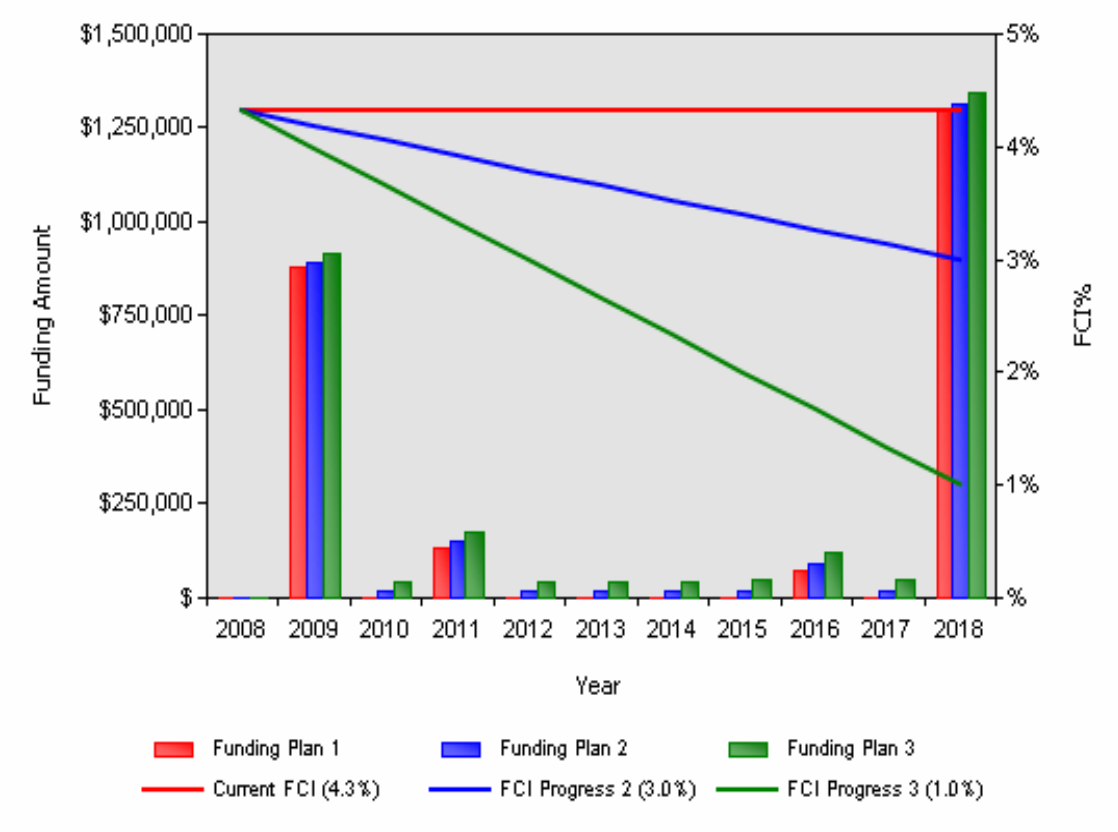

Figure 1: FCI strategies for 2008-2018

Conclusions

The case study discussed in this paper is one of five case studies that the students in the courses "Specialty Capstone" and "Introduction to Facility Management" studied in detail during the spring 2008 semester. The various topics covered in these courses (as demonstrated above) identified the scope of the project the students were required to conduct for studying facility management systems, processes and procedures, as implemented in one hospital building. Each team developed its own ideas and conclusions about the way that FM was implemented in each specific case, and these ideas were presented and discussed with the entire group at the end of the

semester. From the case study discussed in this paper, it can be seen that structured and organized facility management has great potential to do the following: (1) increase the level of satisfaction that the users feel while being in a building; (2) improve the efficiency with which a building is maintained and operated; and (3) improve the physical performance and appearance of a building and its systems.

These two courses offered students insight into the growing area of facility management. Although facility management is not given much attention in higher education, it is expected to increase its share in world economies, particularly in developed countries, and more importantly, with the current economic downturn and calls to "save" the environment from the effects of human activities. Some learning outcomes that the different teams acquired in these courses include: (1) learning how to manage limited resources allowed for the maintenance activities and operations of buildings; (2) learning what and how benchmarks can be used, and how their results can be translated and implemented; (3) learning about the whole Life-Cycle Cost approach that takes into consideration the maintenance and operations of a building, in addition to its design and construction initial costs; and (4) learning how to use their knowledge in developing strategic and tactical plans in order to improve the short- and long-term outcomes of the buildings they are going to manage as owner representatives. As these two courses are introductory courses in nature, students who showed interest in these topics were encouraged to take advanced courses in order to enhance their knowledge and develop a better understanding of specific topics.

As a summary of these class projects, the author believes that real life cases with actual data are better for students to comprehend, as it gives them an opportunity to see how processes are developed and implemented in the real world. With the continuing increase of facility management awareness, the author believes that these discussions are very important and that they should be included and even expanded in graduate and undergraduate studies in engineering, construction and architecture programs.

List of References

1. Blass, E. (2001), "What's in a name? A comparative study of the traditional public university and the corporate university", *Human Resource Development International*, 4(3), 153-172.
2. Allen, M.J. (2004), *Assessing Academic Programs in Higher Education*, Anker Publishing Company, Inc., Bolton, MA.
3. International Facility Management Association (IFMA) (2008), *Definition of Facility Management*, retrieved from: http://www.ifma.org/what_is_fm/index.cfm on September 12, 2008.
4. British Institute of Facilities Management (BIFM) (2008), *Facilities Management Introduction*, retrieved from: http://www.bifm.org.uk/bifm/about/facilities on September 12, 2008.
5. Facility Management Association of Australia (FMA) (2008), *What is Facility Management?*, retrieved from: http://www.fma.com.au/cms/index.php?option=com_content&task=view&id=45&Itemid=59 on September 12, 2008.
6. German Facility Management Association (GEFMA) (2008), *May we introduce GEFMA?*, retrieved from: http://www.gefma.de/english.html on September 12, 2008.

7. Christian, J. and Chan, Y.C. (1993), "Use of an expert system in facilities management", *Proceedings of the 8th International Conference on Applications of Artificial Intelligence in Engineering*, Toulouse, France, Vol. 2, 193-201.
8. Alexander, K. (1996), *Facilities Management: Theory and Practice*, E&FN Spon, London, U.K.
9. Neely, A. (1998), *Measuring Business Performance*, Economist Books, London, U.K.
10. Then, D.S.S. (1999), "An integrated resource management view of facilities management", *Facilities*, 17(12/13), 462-469.
11. Atkin, B. and Brooks, A. (2000), *Total Facilities Management*, Blackwell Science, Oxford, U.K.
12. Barrett, P. (2000), "Achieving strategic facilities management through strong relationship", *Facilities*, 18(10/11/12), 421-426.
13. Cairns, G. (2003), "Seeking a facilities management philosophy for the changing workplace", *Facilities*, 21(5/6), 95-105.
14. Grimshaw, B. (1999), "Facilities management: the wider implications of managing change", *Facilities*, 17(1/2), 24-30.
15. Grimshaw, R.W. (2003), "FM: The professional interface", *Facilities*, 21(3/4), 50-57.
16. Price, I. (2002), "Can FM evolve? If not, what future?", *Journal of Facilities Management*, 1(1), 56-69.