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THE ECONOMIC CASE FOR EARLY ADOPTION OF FACILITIES MANAGEMENT

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The construction industry in Ireland has been the sector hit the hardest during the recession with a potential return to output volumes of the mid-1990s. In order to compete within this struggling construction sector the traditional way of doing business must be re-engineered. One of the ways to achieve this is by introducing the Facilities Management (FM) process much earlier into the construction process, in order to maximize long term sustainability, and above all whole life construction costs. This paper will focus on a recently constructed sports clinic in Dublin, in which an aggressive programme was introduced around energy management savings.The data collation methodology included in depth structured interviews with members of the Architectural/ Engineering/ Construction and Facilities Management (AEC /FM) teams involved in the original construction and current operation of this building. There was also additional data collected and analyzed through the use of a questionnaire survey distributed to a number of senior academics and professionals within the AEC / FM sector, in order to triangulate all the research findings. The research findings strongly advocate that the FM process should be applied as a business strategy throughout the design and construction stage, so as to reduce possible sustainability impacts and life cycle costs. This approach could potentially maximise the usability of the structure and ensure that criteria that are usually overlooked at construction are properly addressed at the outset of a project.

Keywords: facilities management, sustainability, whole life cycle costs

INTRODUCTION

The poor state of the Irish construction industry is highlighted by the DKM Economic Consultants report on an industry that has experienced a severe contraction in construction output since it peaked in 2007 at €38.4 billion, to a return to output volumes of around €10.5 billion by the end of 2011. Garvey (2010) highlighted that as the construction recession deepens, it will result in major implications not just for the public finances but also for future levels of employment and economic growth. These figures have prompted the need for better savings through a sustainable future in buildings, as outlined by Sustainable Energy Ireland (SEI, 2009). SEI outlined that in Ireland small businesses could save €300 million a year through simple actions to reduce energy costs, such as, lighting, refrigeration, heating and air conditioning. The importance of sustainability and the return to economic growth was enforced by Lewis (2009) who stressed the link between economic activity and energy usage. Lewis (2009) believed that it was critical that the return to economic growth was not matched by a corresponding growth in energy demand, where Ireland's future economic successes are not undermined by deteriorating environmental patterns and unsustainable energy usage. The DKM report (2009) also identified niche opportunities in regard to the climate change/sustainability agenda, such as, improving the energy performance of the stock of buildings in the public and private sectors. The Irish Government is also trying to promote sustainable practices by stating that environmentally-friendly policies are to get priority in competing for State contracts worth up to €16 billion a year. The harsh reality of the country's current situation along with the realisation of the need for a more sustainable future have shown that the traditional method of construction needs to be re-engineered and a more innovative approach has to be adopted. One of the best ways to achieve these savings in today's environment is through the emerging discipline of FM, which can help to provide a new focus for the study of buildings. This approach was voiced by Shah (2007), who believed that FM, if integrated early into the construction process, can help maximise sustainable construction potential, as well as providing a new cost focus for buildings. The importance of FM playing a role within the construction management stage is further advocated by Wu et al. (2006) who claimed that the maintenance and operating costs can be five times the capital costs, with the business operating costs reaching up to two hundred times the capital costs over the life of the building. This fact is further expanded on by Hallberg and Tarnardi (2011) who cite the National Institute of Building Sciences (2007) report, to convey, that a total of 3.8 % of improvements in productivity of the facilities

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of a building would be equal to the total cost of design, construction and operation of the facility. The Facilities Manager is in a position to address some of these improvements and help increase productivity. The reason for this was further explained by Hodges (2005) who outlined that the Facilities Manager is in a unique position to view the entire process and with the proper financial and strategic planning tools can create long-lasting value to the organisation by developing, implementing and maintaining sustainable facility practices. Despite these potential benefits, this profession still remains largely undeveloped and holds little recognition within the Irish AEC /FM sector, despite the establishment of professional FM institutions around the world e.g. International Facilities Management Association (IFMA), British Institute of Facilities Management (BIFM), etc. The aim of this paper is to set out the economic case for introducing the process of FM at an early stage in the construction management process, in order to increase usability and sustainability, so as to reduce overall lifecycle costs. The authors will provide recommendations as to what particular stage in construction management the Facilities Manager could have the most beneficial economic impact.

RESEARCH METHODOLOGY

The research methodology adopted is a combination of a case study with interviews and a subsequent questionnaire. These different forms of research methodologies are then triangulated, as this will further increase confidence in research data, creating innovative ways of understanding a phenomenon, challenging or integrating theories, and providing a clearer understanding of the problem (Jick, 1979). This research methodology is further advocated by Thurmond (2004), who notes that the intent of using triangulation is to decrease, negate, or counterbalance the deficiency of a single strategy, thereby increasing the ability to interpret the findings. This method will be applied, so as to combine both sets of results, in order to produce a richer and more detailed conclusion.

CASE STUDY

The case study selected was a newly constructed sports surgery clinic in Dublin. The building was opened in 2007 and was constructed for an initial €60 million. The four storey building consists of an underground car park, four multi-operating theatres blocks, inpatient and outpatient facilities, muti-media solutions, an onsite diagnostic department and twenty consultant rooms. The FM team in 2010 were formally appointed after the clinic had been in operation for three years to implement a financial plan. The financial plan was created through a number of saving initiatives and small works projects based around environmental improvements and more conscious energy management. This financial plan proposed to the owner saving initiatives in the region of €1.2 million over three years. The FM team targeted the following areas to concentrate on generating energy and environmental savings:

- Reducing consumption through efficient working practices i.e. re-education of staff in terms of energy usage / waste disposal.
- Installation of a waste compactor on site.
- Liaison with vendors in relation to renegotiating current service level agreements.
- Building Management System (BMS) monitoring and management.
- Re-configuration of the boiler arrangement to decrease operation hours / consumption.
- More frequent use of the generator at peak demands.
- Increased HVAC efficiency through BMS.

The Facilities team also undertook a programme of investment totalling €182,000 that generated savings of approximately € 360,350 over the three year period. The proposed savings over three years are outlined in Table 1 below.

Table 1 Better Energy Management Plan

ITEM	DESCRIPTION	INITIAL COST	SAVINGS
1	The changing of all current lights in the downstairs car park to PIRS. This will result in a microwave signal being emitted and in turn will optimize the efficiency of the lighting, as it will only be used on a needs basis.	€9,141	€27,215
2	Replace all 50watt A.R. 11type lamps with 35Watt energy efficient type.	€6,873	€10,039
3	Replacement of 120 x 35 Watt capsule halogen downlighter fittings in Consultant suites and throughout the building to 2 Watt LED downlight with equal Lux level performance.	€8,591	€10,479
4	Modification of all corridor and back house light fittings to incorporate 2 tube electronic start T5 tubes in place of 4 tube T8 type. This will reduce the power consumption by approximately 50% and increase the lifespan of the fittings and components by approximately. 50%.	€13,233	€41,454

ITEM	DESCRIPTION	INITIAL COST	SAVINGS
5	Installing key switches throughout the building that will prevent the staff and patients from leaving unnecessary lights on. This will enable reduction of electrical waste.	€7,900	€31,971
6	Reconfiguration of the boiler plant to incorporate a combined Heat and Power system. The proposed installation of a CHP system will eliminate the three boilers which have no connection between the domestic hot water calorifiers and the main headers, resulting in significant savings in gas.	€32,905	€47,916
7	Installation of two port valves on the existing LTHW and their associating controllers. This will prevent boilers becoming heat sinks.	€10,590	€29,040
8	Updating the microprocessors in the BMS to encompass a complete re-programming of the existing BMS and include every item of plant in the facility. Also the installation of additional BMS control instruments and the associated I/O cards and programming. This will allow closer control and interaction between the user and the system on the Plant and Equipment set points.	€29,755	€57,692
9	Design and installation of a new control system for the compressors that will create an "on demand" scenario ensuring the compressors only operate when needed.	€16,790	€15,700
10	Advanced training on critical equipment i.e. BMS, Medical Equipment, wheel chairs.	€14,500	€24,100
11	Medical Air Compressor re-design and re-build.	€16,790	€15,700

2.1.1 Data Collection

The case study was selected in order to establish if some of these saving savings could have been realised during the initial construction stage of the project by earlier introduction of the Facilities Manager. To achieve this, semi-structured open interviews where used as the main tool of analysis, as they give the interviewer the power to explore, probe and ask questions deemed interesting to the researcher (Berry, 1999). Five interviews were conducted in order to validate this claim (Table 2).

Table 2 Interview Process

INTERVIEW	INTERVIEWEE
1	The current Facilities Manager.
2	The Project Manager who worked on the Clinic during construction.
3	The Architect who worked on the Clinic during construction.
4	The current Facilities Mechanical Technician.
5	The current Facilities Electrical Technician.

The interview questions were based around a number of areas that were highlighted throughout the literature review. The questions were designed to test claims set out by Shah (2007), that the Facilities Manager can play a significant role in maximising sustainable construction potential, if FM is integrated at the beginning of the project lifecycle. This approach is also supported by Booty (2006), who explained that introducing the Facilities Manager at an early stage can benefit the whole life cycle costing by reducing such elements, as maintenance and energy costs components. The case study interviews also addressed claims made by Kelly et al. (2005) that by involving the Facilities Manager at the design stage will help avoid the long term needs of the client and other stakeholders being overlooked during the briefing process. There were also questions designed around the facilities department, in order to test the argument put forward by Price (2004) that the internal FM departments have fallen into the mind set of seeing themselves as commodities and unintentionally conspiring in a system of discourse that perpetuates and reinforces that view.

Case Study Results

There were a number of areas of concern within the energy management plan that were based around poor design choices and inadequate planning. The Facilities Manager could have done little to influence some of the poor design choices, but could have helped identify a number of areas at the beginning of the construction process that would have benefited the clinic over the life cycle of the structure. All of the interviewees believed that if the client had appointed a Facilities Manager from the beginning, some of the savings outlined in the Energy Management Scheme could have been realised during construction instead of resulting in an expensive retrofitting.

There was also a strong belief, that if early collaboration occurred between the Facilities Manager and the design team, costs over the

clinic's life cycle would have been reduced, as the Facilities Manager would have a strong idea of what was required for a building service to function efficiently. There was also evidence, through the analysis of the interviews, to support the view that the client had no prior knowledge of plant or operational requirements and was not made fully aware of the benefits of sustainable design. This resulted in additional monies being spent to rectify this through the current savings initiatives scheme, with all interviewees strongly agreeing that the Facilities Manager could have facilitated the avoidance of some aspects of this if introduced in an early capacity. The current Facilities Manager and former construction team both agreed that additional savings could have been realised through sustainability practices in cavity wall design, low LEDs installation and Combined Heat and Power (CHP). These answers supported the arguments put forward by Shah (2007), Booty (2006) and Kelly et al. (2005), as outlined above.

There were also a number of legacy issues within the clinic, with the respondents of the interview claiming that there was little that could be done to improve the materials selection from the Facility Manager's perspective. This question was asked, in order to test the claim put forward by Swaffield and McDonald (2008) that other professionals do not necessarily appreciate a buildings life cycle costs during construction leading to financial implications down the line. There was an opportunity, however, to reduce these implications through the internal fit-out of the clinic, had the Facilities Manager been involved during construction. The practical approach by the Facilities Manager, in some instances (according to the Construction Project Manager) could also have helped to avoid counterproductive design details, in favour of a more sustainable outcome.

The current FM team (according to the interviewees) provided a vital environmental experience for external visitors and were central to the clinics business goals. Despite this, the Facilities team, due to a lack of appreciation of its role by other professionals within the clinic, was only viewed as an operational service. The Facilities Manager was also viewed to be on a lower manager level and was not considered to be a key player in the clinic's business strategy. This resulted in the current Facilities Manager suffering from a managerial identify crisis having been confined to the lower levels of Management. This concurred with Price's (2004) claim and would add the concern, that Facilities Departments, despite their contribution to an organisation, see themselves as nothing more than commodities.

QUESTIONNAIRE

As the case study was adopted as one data collection strategy, it was decided in addition to distribute questionnaires, in order to gain a broader view and maximise research findings, in regards to FM and its possible contribution to improving the construction process. The target audience consisted of a number of senior academics and professionals within the Irish AEC / FM sector.

Data Collection

The questionnaire was created online, in the hope of encouraging more respondents to reply. There were a total of 90 emails sent out, which in turn generated 51 responses. The response from each profession is shown in Table 3.

Table 3 Questionnaire Response

PROFESSION	QUESTIONNAIRES RETURNED	PERCENTAGE OF QUESTIONNAIRES RETURNED
Facilities Managers	19	37 %
Project Managers	26	51%
Architects	6	12%

The questions were formatted around the same statements and claims as put forward in the case study section. The questionnaire also aimed to test and expand on further claims put forward by Brown et al. (2001) that the FM and the Project Management (PM) professions need to amalgamate to some degree. The questionnaire was designed to find out if respondents believed that this was a valid claim and at what stage the FM and PM could best collaborate. The questionnaire also aimed to expand on the general view of the FM process and to establish whether or not the Facilities Manager is considered as a key business manager. This claim is argued favourably by Barrett and Bawdry (2003), in that the FM process was not constrained by the physical elements of the building and could make a positive contribution to the primary business. This question will give an indication of how the current profession of FM is viewed in the Irish AEC sector.

Questionnaire Results

The questionnaire was broken into five different sections, in order, to properly address areas of the literature research that were deemed relevant. The first part of the questionnaire explored the claim that early integration of FM can reduce the life cycle cost of a building. This investigated the claim by Swaffield and McDonald (2008) that other professionals do not fully appreciate a building's life cycle during construction. This question generated a 94% response rate in agreement with this statement, leading on to the next

question, that the Facilities Manager is well placed to influence if not decide on all building-related expenditures through its life time (Wood, 2006). All of the respondents agreed in some form with this claim, which further advocated the approach of introducing the Facility Manager into the construction management stage at an early level.

The second part of the questionnaire tested the claim by Shah (2007) and Booty (2006) that the early integration of the Facilities Manager at the design and construction stage can help highlight best environmental practices. This would then help reduce the maintenance and operation costs over the building's lifecycle. There was a 98% positive response rate for both questions, with respondents agreeing either fully or partially with the combined theories, as outlined by Shah and Booty. The Architect and Project Management professions both had a significant percentage of responses that only weakly agreed with this statement. This may suggest that they felt threatened by the possibility of the Facilities Manager upsetting current construction practices. There was also evidence in other areas of the questionnaire to support this view where suggestions of early FM involvement are put forward.

The third part of the questionnaire investigated the current construction ethos towards FM and the need for a more innovative approach, as originally highlighted by Lindahl and Ryd (2006). This section also tested the current practice towards outsourcing of FM after construction. There was a 98% response rate that partially agreed with the claim that the outsourcing of the FM function results in a gap in the client's needs. An innovative approach was suggested within the questionnaire to involve a partnering of the Project and Facilities Manager along with the Design Team throughout the construction stage. This resulted in a 92% agreement rating. This suggested that the current construction ethos is not maximizing client's needs, and a more efficient approach would involve the early integration of the Facilities Manager into the construction process.

The fourth part of the questionnaire investigated the role that the Facilities Manager could play if they were integrated into the construction process. This section of the questionnaire effectively set out to examine the statement put forward by Brown et al. (2001), that the Facilities Manager, instead of the Consultant Project Manager, should be appointed to the lead role in the management of new building procurement. This statement generated a mixed response, in that over half of the respondents were in partial agreement with Brown et al. The strongest indication from the questionnaire is that the Facilities Manager would best serve if he/she were integrated into the design stage in a consultant role.

The final part of the questionnaire was designed to investigate FM in general and addressed claims made by Cotts (2009) that FM is a quintessential business function. There was a total of 88% of the respondents who believed that FM should be applied as a business strategy in helping to reduce financial, environmental and social impacts. However, despite this, 86% of the respondents believed that irrespective of its potential as a business strategy, it was still not considered an actual profession. This falls in line with the claim made by Jensen (2010), that FM needs to create added value, and if it is going to survive as a discipline, it now needs to offer more to the client than just lower operational costs.

TRIANGULATION OF RESULTS

The case study results showed a number of areas of poor design, which the Facilities Manager could have done little to rectify, but did highlight a number of other areas where their early presence would have greatly benefited the life – cycle costs of the clinic. The analysis of the case study of the sports surgery clinic resulted in the Facilities Manager and the former construction team stating that early collaboration between the Facilities Manager and the design team would have resulted in reduced costs over the clinics lifecycle, as the Facilities Manager would have a strong idea of what is required for a building to function sustainably. This approach could have further helped prevent the current savings initiatives scheme that was retrospectively implemented in the clinic and reduced costs over the clinics life cycle. The questionnaire results further verified, either fully or partially, that there is a belief that the Facilities Manager can play a key role in sustainability and increasing construction potential.

Apart from an initial exercise carried out at the beginning of the project by the joint Mechanical and Electrical consultant, there was no further assessment made on best environmental practice, leading the authors to conclude that the client was not made fully aware of the possible savings that a more sustainable approach could have realised. The clinic has also been plagued with legacy issues, with the majority of respondents believing that there was little that could have been done to avoid these construction problems, as they resulted from poor workmanship. There was an opportunity, however, to reduce future financial implications through the internal fit out of the clinic if the Facilities Manager had an early input into materials selection. The response from the architects would indicate that there would be territorial conflict in regards to allowing the Facilities Manager participation in the materials selection process. The Construction Project Manager believes that architectural enhancement is counter to operating cost, and that the Facilities Manager could be able to adopt a more practical approach in avoiding these counterproductive designs in favour of a more passive building. The Facilities Manager without undermining the role of the Architect, who would still be responsible for

meeting most of the Client's needs, could help the Client understand, as in this case, that design enhancement may result in increased operational costs, throughout the building's life cycle.

The survey results supported the innovative approach of partnering the Project and Facilities Manager along with the Design team throughout the construction stage. This resulted in a 92% agreement that the Facilities Manager could work alongside these professionals in helping to create a whole life – cycle costing model, in which their practical knowledge and approach could be used to reduce future expenses. This approach depends on a level of foresight from the client, as there may initially be an additional spend, in order, to produce a more sustainable and beneficial structure. However, there are elements that the Facilities Manager can contribute through his practical knowledge, without significant additional monies needing to be spent, which include, as outlined in the previous section, energy management, space planning, plant room design and the internal fit out.

The triangulation of the results also showed that the FM team within the clinic provided a vital experience to external visitors and was central to the clinics business goals. The questionnaires backed up this belief with 88% of the respondents claiming that FM should not be confined to an operational level but should be applied as a business strategy. However, it would seem that Facilities departments are still only viewed at an operational level, which is further reinforced by 86% of the respondents' believing that despite its potential as a business strategy, FM is still not considered an actual separate profession.

CONCLUSION

This paper effectively set out to investigate whether or not the Facilities Manager could play an active role in the construction process, in order, to help reduce life-cycle costs. Throughout the course of the research it was concluded that the Facilities Manager, if introduced at the beginning of a structure's life-cycle, has the potential to increase sustainability and, in the process, promote best construction practice. This approach would make sure that all the operational needs of the client are addressed at the onset of construction, as the Facilities Manager would adopt a longer term perspective on the facilities created, in the construction and design of the structure. The introduction of the Facilities Manager at an earlier stage should not diminish the role of the Architect, who would still be responsible for most of the Client's needs and generating design solutions for life cycle costs, but will instead offer an alternative methodology towards achieving a more innovative approach in realising the Clients needs. This collaboration process could result in substantial monies been saved by the Client throughout the structure's life cycle. An organisation that fully realises the potential of its FM department and includes it as a key player in their business strategy can benefit across the board in regards to not just reduce financial inputs but also environmental and social impacts for that organisation.

However, throughout the course of the research, it was also concluded that particularly in the Irish AEC / FM sector, FM will continue to play the silent partner, unless it begins to promote itself as the key business strategy. This can be overcome, in some aspects, where the Facilities Departments can promote themselves within an organisation through monthly financial reports highlighting the monies saved from better energy management. In order to further this research, it is recommended that the FM process begins to move towards creating interactive capabilities, in order to portray its financial worth to an organisation.

The application of Building Information Modeling (BIM) and other IT tools will be further explored by the authors, in order to promote the profession and process of FM in the near future, so as to, establish more firmly the FM process, and its early adoption in the construction process within the Irish AEC sector.

REFERENCES

Barratt, P. & Baldry, D. (2003) "Facilities Management towards best practice", 2nd edition, Oxford: Blackwell Science Ltd.

Berry, R.S.Y. (1999) Collecting data by in-depth interviewing, "British Educational Research Association Annual Conference", University of Sussex at Brighton, September 2 – 5.

Booty, F. (2006) "Facilities Management Handbook, 3rd Edition", Oxford: Butterworth – Heinemann Publications.

Brown, A., Hinks, J. and Sneddon, J. (2001) The facilities management role in new building procurement, "Facilities", Volume 19, No 3/4, pp. 119–130.

Cotts, D. (1999) "The Facility Management Handbook", 2nd Ed, New York: AMACOM, DKM Economic Consultants Ltd (2009) "Report for the review of construction in 2009 and outlook for 2011-2012", Department of the Environment Heritage and Local Government, <http://www.environ.ie/en/Publications/StatisticsandRegularPublications/ConstructionIndustryStatistics/FileDownLoad,24473,en.pdf> (accessed 07/10/12)

Garvey, G. (2010) Ireland must learn to live with a smaller construction sector, "Irish Independent.ie", available at < http://www.independent.ie/business/irish/ireland-must-learn-to-live-with-a-smaller-construction-sector-2250385.html> (accessed 5/08/2010)

Hallberg, D. and Tarandi, V. (2011) On the use of open BIM and 4d visualization in a predictive life cycle management system for construction works, "ITcon" Vol. 16, pg. 445.

Hodges, C.P. (2005) A facility manager's approach to sustainability, "Journal of Facilities Management", Vol 3, Iss 4, pp 312- 324.

Jensen, PA. (2010) The Facilities Management Value Map – A Conceptual Framework, "Facilities", Vol 28, Iss 3/4.

Jick, T. (1979) Mixing Qualitative and Quantitative Methods: Triangulation in Action, "Administrative Science Quarterly", December, Vol 24.

Kelly, J., Hunter, K., Shen, G. and Yu, A. (2005) Briefing from a Facilities Management Perspective, "Facilities", Vol 23, No 7/8, pp 356–367.

Lewis, O. (2009) "Energy in Ireland 1990-2008", Energy policy Statically Support Unit, SEI, pp 3-4.

Lindahl, G & Ryd, N (2006) Clients goals and the construction management process, "Facilities", Vol 25, No 3/4, pp147-156.

National Institute of Building Sciences (2007) National Building Information Modeling Standard – Version 1 – Part1: Overview, principles and methodologies, "National Institute of Building Sciences", Facilities Information Council, Washington, USA.

Price, I. (2004) Business Critical FM, "Facilities", Volume 22, Number 13/14 , pp. 353–358.

Shah, S. (2007) "Sustainable Practice for the Facility Manager", Blackwell Publishing Ltd, Oxford.

Sustainable Energy Ireland (2009) €300 million in energy costs could be saved by Irish business every year, , Available from http://www.seai.ie/News_Events/Press_Releases/2011/Chambers_Event-SME_Programme.pdf, Accessed (07/10/2011).

Swaffield, L.M. and McDonald, A.M. (2008) The contractor's use of life cycle costing on PFI projects, "Construction and Architectural Management", Vol. 15 No. 2, pp. 132-148.

The Irish Independent (2010) Green firms to get priority in contracts, says Gormley, "The Irish Independent", Available at <http://www.irishtimes.com/newspaper/ireland/2010/0522/1224270894108.html> Accessed (07/10/2011)

Thurmond, V. (2004) The point of Triangulation, "Journal of Nursing Scholarship", Vol 13, Iss 3, pp. 253–258.

Wood, B. (2006) The role of existing buildings in the Sustainability Agenda, "Facilities", Vol 21, Iss 1/ 2, pp 61–67.

Wu, S., Croome, D.C., Fairey, V., Albany, B., Sidhu, J., Desmond, D. and Neale, K. (2006) Reliability in the whole life cycle of building systems, "Engineering Construction and Architectural Management", Vol 13, No 2, pp136-153.