
MAKING AN IMPACT: IMPROVING THE USE OF ICT IN A LEADING CONSTRUCTION COMPANY THROUGH AN INDUSTRY-ACADEMIA PARTNERSHIP

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ABSTRACT

This paper reflects on the use of ICT in a leading Irish construction company as part of an Industry-Academia partnership. It specifically addresses the need to improve the use of ICT within the company through identifying current practices, available options and the most appropriate actions in the short to medium term. The partners are BAM Contractors, who are part of the wider Royal BAM Group based in the Netherlands, and Waterford Institute of Technology (WIT). The 2-year part-time bespoke MSc in Construction Project Management (MScCPM) programme that was developed through this partnership involves a number of modules, including one on 'ICT in Construction'.

The 20 participants selected were a mix of civil engineers, quantity surveyors and construction managers. There were 5 females and 15 males in the group and they ranged in age from 25 to 38. Each of the participants were working on live projects that were geographically dispersed across Ireland and the UK. The use of WIT's online learning management system Moodle was key to ensuring good communication and access to the relevant information.

The majority of the required assessments on the bespoke programme related specifically to BAM business activities. BAM saw the benefits of getting the group to investigate issues that are of importance to the company. In the case of the 'ICT in Construction' module the WIT Module Leader agreed the topics and approach with the BAM ICT Manager and his team. The 20 participants were divided up into six mini-groups of three people and the other two participants were given individual projects. Prior to the completion of the projects the group took part in two seminars and also attended a presentation by the Royal BAM Group ICT Director.

The background to the 'ICT in Construction' assessment topics, the publication of the associated reports and the oral presentations to WIT and BAM Senior Management are described in this paper. Most importantly, the subsequent impact of these ICT projects on the company, the participants and WIT are also considered. The content and conclusions are expected to be of use to other Industry-Academia partnerships who are seeking to make a positive impact on the construction sector, specifically in relation to the improved use of ICT.

Keywords: ICT, Construction, Industry-Academia Partnership, Work-Integrated Learning

1. INTRODUCTION

The economic context to the past three years has been extremely difficult for many countries in the world and this has been particularly true for Ireland. While all stakeholders are devising strategies to cope with the short-term

challenges there are also other medium to long-term issues to be accommodated. All construction organisations will need to continuously improve if they are to survive and prosper and central to achieving such improvements is 'learning'. The combination of current economic and other influences is encouraging individuals to step-up their knowledge and qualifications. In Ireland and elsewhere there is a growing realisation of the need for professional and managerial staff to have postgraduate qualifications. While learning doesn't necessarily have to involve qualifications, there are many advantages to both employees and employers. Qualifications for an individual can fulfill a personal desire and in most cases enhance their career opportunities. The need for construction client groups to be assured that they are giving work to the best company is also a major factor in encouraging employers to enhance the qualifications of their employees. The challenge for enlightened companies is therefore to attract, retain and develop their employees' learning and qualifications, while continuing to use their talents on live projects.

In parallel to companies improving their learning, the higher education sector globally in recent years, and certainly in Ireland, is actively seeking stronger links with industry. Many of these links are being encouraged by government, particularly with an emphasis on research and development. The influence in Europe of the EU's policies on 'lifelong learning' is also significant. 'Work Integrated Learning' is therefore a growing issue for both industry and academia and the boundaries between the two are blurring. Lees (2009) summarized the current situation nicely by stating *'the message is clear; engagement between industry and higher education in the built environment is not optimized and needs to be improved. The debate about whether to take action is over; now we must determine how to change.'*

This paper concerns an 'ICT in Construction' module that is part of a bespoke two-year part-time postgraduate MSc in Construction Project Management programme (MScCPM). The programme was developed for a leading construction company in Ireland through an Industry-Academia partnership. The two partners are BAM Contractors, a member of the Royal BAM Group, and Waterford Institute of Technology (WIT).

2. THE BAM-WIT INDUSTRY PARTNERSHIP

BAM Contractors is currently ranked as the second largest construction company in Ireland (McDonnell 2010). The company is a wholly owned subsidiary of Royal BAM Group based in the Netherlands which has other operating companies in the UK, Germany and Belgium. The 2009 turnover for BAM Contractors was €460 million which represented approximately 5% of the overall Royal BAM Group for that year. The Royal BAM Group generally, and BAM Contractors in Ireland specifically, believe that one of the key factors that contributes to current and future business success is the continuous development of its young professionals and middle management staff members. Indeed their 2010-12 Policy and Strategy (Van Oosten, 2010) targets *'the development of management potential at every level in the Group'* and that *'all staff members must be able to apply the knowledge and experience widely available within the Group'*.

The School of Engineering at Waterford Institute of Technology (WIT) has always worked closely with industry in the development and running of its education and research activities. The first postgraduate programme in the School was the MSc in European Construction Management. The setting-up and delivery of this one-year full-time programme in 1993 involved partnerships with educational institutions in the UK, France and Germany. This programme subsequently evolved into the MSc in International Construction Management and a total number of 190 participants from 24 different countries graduated between 1993 and 2007. The 2-year part-time MSc in Construction Project Management commenced in 2005 and this was developed in response to a demand from practitioners in the Irish Construction Industry who wanted to develop their Construction Project Management knowledge and skills at postgraduate level without leaving their employment.

BAM Contractors and WIT have had a long association that stretches back to the early 1990s through internships, site visits, graduate employment, guest lectures and external examiners. In 2007 BAM Contractors made a decision to further strengthen the development of talent by providing a postgraduate education opportunity to middle management staff members in the area of Construction Project Management. This learning and development initiative was conceived as a vehicle to encourage talent development after graduate training has been completed. It was expected that it would provide BAM with motivated and reliable project managers who

could continue to deliver quality projects on time and within budget to satisfied clients. The subsequent development of the bespoke MScCPM programme is described in the next section.

3. THE BESPOKE MSC PROGRAMME

In any Industry-Academia partnership the need to clearly articulate the requirements of both parties is vital. The process of developing the bespoke MSc CPM programme formally commenced in September 2007. By that time however the HRM Department in BAM Contractors had already developed the general objectives and indicative content of a programme that they wanted to implement. WIT was running the MSc CPM programme and it was clear that there was significant overlap between this programme and the BAM concept. A series of meetings were subsequently arranged between senior staff in the company and WIT.

The challenge of aligning the existing programme and the BAM objectives through an approved academic MScCPM framework was an interesting exercise for both parties. WIT were conscious of the need to develop a solution that would accommodate both the bespoke MScCPM programme (appropriate to the needs of one employer - BAM) and a general ‘open’ programme (appropriate to a variety of participants from a range of employment backgrounds). While BAM through its Supervisory Council had strong views as to what was important and what needed to be included, based on three fundamental pillars of ‘Operational Expertise’, ‘Financial Expertise’ and ‘People Expertise’. The participants in the agreed bespoke programme not only get the opportunity to review theory and practice relating to Construction Project Management (Irish and global), but they also are encouraged to reflect on their role with the company.

Another interesting aspect to the alignment of the company’s requirements with the WIT academic requirements was the required flexibility for the bespoke programme. Costley (2001) explored some of the tensions that existed between the employer organization and the individual employee on work-based programmes and concluded that ‘*partnership between and organization and a university or college means universities adhering to their level criteria and quality standards of process and assessment as well as being flexible enough to apply them to the needs of a particular organizational contexts.*’ More recently Virolainen (2007) highlighted the potential problem of learning outcomes becoming ‘*compromised*’ by too great an emphasis on the technical aspects of industry-academia agreements. While the difficulties of successfully incorporating industry practitioners into an academically validated programme were acknowledged, the potential upside of including such experience and expertise was far greater. In their study of the EU Construction Sector qualifications and skills needs the Danish Technological Institute (2009) identified that flexible Master’s course targeting full-time employees ‘*should be a way forward*’. They also highlighted the need for improved adoption of technology, specifically ‘*sector-relevant ICT*’. Tranfield et al. (2004) referred to the gap between academic knowledge and its relevance for practice as an ‘*enduring problem*’. They stated that this was particularly the case in academic management research and its relationship to management practice. However a potential solution to this problem that they proposed was a ‘*co-production model*’ which included a synthesis of academic research, practitioner experience and professional practice.

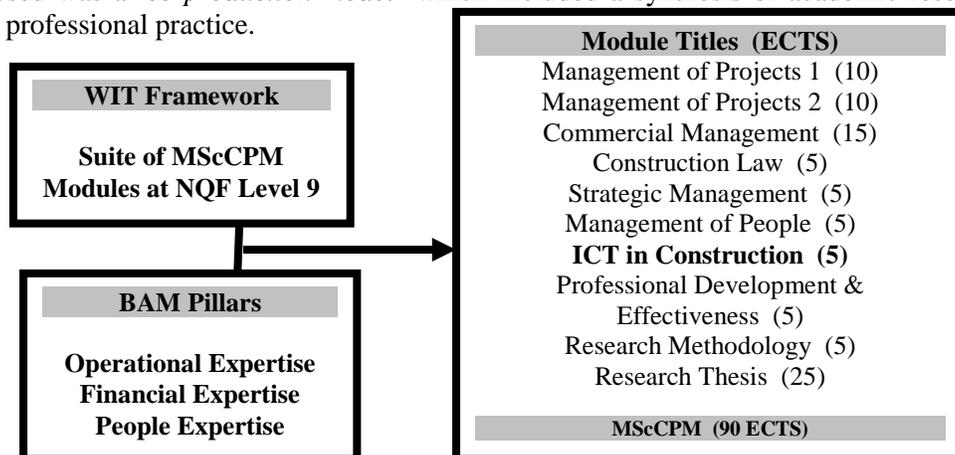


Figure 1 : MScCPM Modules on the bespoke programme and the associated academic credits (ECTS)

The programme was advertised during May 2008 throughout all of the BAM divisions and regional offices in Ireland. Many of those that subsequently applied were encouraged to do so by their Director or Senior Manager. The eventual 20 participants selected by the company in consultation with WIT during June/July 2008 were a mix of civil engineers, quantity surveyors and construction managers. The employees ranged in age from 25 to 38 and they all had been with the company for at least 3 years. There were more applicants than places and central to BAM Supervisory Committee's decision to make offers to the chosen 20 was that they were generally expected to be the future senior managers and leaders within BAM. The only exception to the criteria was the one participant who joined the group from a separate company, Suir Engineering. This arrangement suited everyone as the particular individual was anxious to complete the programme and there was a good relationship between BAM and Suir Engineering. The government backed 'Skillnets' initiative who were financially supporting the programme were also in favour.

The overall management of the programme was shared between the School of Engineering at WIT and the HRM Department at BAM. This required regular and frequent contact to ensure that all of the various elements (including the participants and indeed the various module facilitators, experts and mentors) were organised and co-ordinated. In line with the agreed MScCPM framework the participants were scheduled to attend classes at WIT on six number three-day occasions (Thursday/Friday/Saturday) throughout each academic year, i.e 12 sessions in total. However an additional 13th session was held in the Royal BAM Group headquarters during the second year of the programme. This extra session was added by agreement between BAM and WIT and it served a number of important purposes. The main objective was for the participants to realize that they work for an Irish company that is part of a major European construction group. By physically going to the headquarters in Bunnik, Netherlands and meeting many of the key staff, including the Royal BAM Group Managing Director Mr. Joop van Oosten and the ICT Director Mr. Wim Nijman, the three days had a profound effect on the group. The impact of the Irish participants on their hosts was also significant and many, including the in-house BAM Business School staff, were both curious and impressed that BAM in Ireland were running such an MScCPM programme. Other benefits from the visit included the team bonding aspects and indeed the insight that the traveling WIT staff got in relation to the Royal BAM Group activities.

4. ICT IN CONSTRUCTION MODULE

The need to ensure that modern construction project managers are aware of the various ICT tools that exist or that are likely to be developed in the future is the context to this module. The overall learning outcomes for the ICT in Construction module are shown below in Figure 2. While participants will not be ICT experts at the end of this module, they should understand the key issues associated with the use of ICT tools and the potential benefits to themselves, their projects, their companies and the industry in general. A core issue to the module is interoperability and the need for the various people, processes and ICT tools to interact in a seamless fashion. In practical terms this includes reflecting on the reality of where the industry is with ICT at present and where it needs to progress. It is worth noting that the work of CIB W78 was a particularly important reference source for the module.

On successful completion of this module the student will be able to:

- *Critically evaluate the available ICT that is particularly relevant to the management of construction projects, including relevant case studies/best practice examples from Ireland and around the world.*
- *Reflect on the future development of ICT in general and its potential impact on construction project management.*
- *Reflect on the overall impact to-date of ICT on construction and the factors associated with the rate of exploitation of ICT by participants in the construction sector.*
- *Analyse the processes of capturing and matching construction project needs with available technology.*
- *Apply appropriate strategies (including those for knowledge/information management) for managing information requirements for construction projects and firms in the construction industry.*

Figure 2 : ICT in Construction - Module Learning Outcomes

Indicative Syllabus: The need to ensure that modern construction project managers are aware of the various ICT tools that exist or that are likely to be developed in the future is the context to this module. While they will not be ICT experts at the end of this module the participants should understand the key issues associated with the use of ICT tools and the potential benefits to themselves, their projects, their company and the industry in general. A core issue that will be a feature of this module is 'interoperability' and the need for the various people, processes and ICT tools to interact in a seamless fashion. In practical terms this will include reflecting on the reality of where the industry is with ICT at present and where it needs to progress.

The context for the delivery of this module will be influenced by the group of participants (e.g. background disciplines) but the topics that are likely to be covered in order to achieve the learning outcomes include:

- *Available ICT hardware solutions for construction project management activities (inc. PCs, Laptops, PDAs, phones, networks, servers).*
- *Available ICT software solutions for construction project management activities (inc. design, finance/cost control, time management, BIM solutions).*
- *The ICT infrastructure in Ireland and associated issues (inc. broadband, landlines, mobile, copper vs. fiber).*
- *International research work related to the next generation of ICT tools for construction project management.*
- *Factors encouraging the exploitation of ICT by the construction sector and factors inhibiting the exploitation of ICT by the construction sector (inc. costs, people, training, role of clients, CITA).*
- *The use of Project Management software for the effective planning and controlling of construction projects.*
- *The use of Project Extranet service to track and improve the flow and storage of information on a construction project*
- *The use of ICT to manage data, information and knowledge related to construction projects.*

Assessment Approach: The assessment of this module will include a written report relating to the actual and potential use of ICT in the student's workplace (70%) and a subsequent oral presentation (30%) on this report. The presentations will be attended by all participants, senior company staff and relevant WIT staff. The presentations session will be an opportunity to demonstrate presentation skills and will also be a peer-learning experience for all.

Figure 3 : ICT in Construction - Module Indicative Content and Assessment Approach

The sequence of the main activities in the ICT in Construction module is shown in Figure 3 below. The fact that each of the participants were working on live projects that were geographically dispersed across Ireland and the UK meant that the use of WIT's online learning management system Moodle was imperative. This hub provided the central access point to the relevant information and helped to ensure good and consistent communications over the period for the ICT in Construction module, September 2009 to March 2010. It also re-enforced the concept of learning about ICT through using ICT (Thomas et al. 2007).

The first activities were the 2 seminars that were facilitated by the WIT Module Leader in September and November 2009. The first of these seminars was an review of current ICT use in the Irish and global construction industry under the three broad headings of design, construction and management. These subsequent discussions not only included the leading-edge technologies, but also the changes required in processes and people in order to bring about improvements. The second seminar focused on BIM. Given the limited use of BIM in the Irish construction industry the majority of the case studies discussed were from other parts of the world. The crucial role of clients such as the GSA in the US and the Danish government in driving design and construction firms to using BIM was identified as key to its adoption. The group also reflected on the cost-benefit analysis of BIM without a client requirement from a contractor's perspective, including the use of 4D and 5D to plan and manage construction projects more effectively.

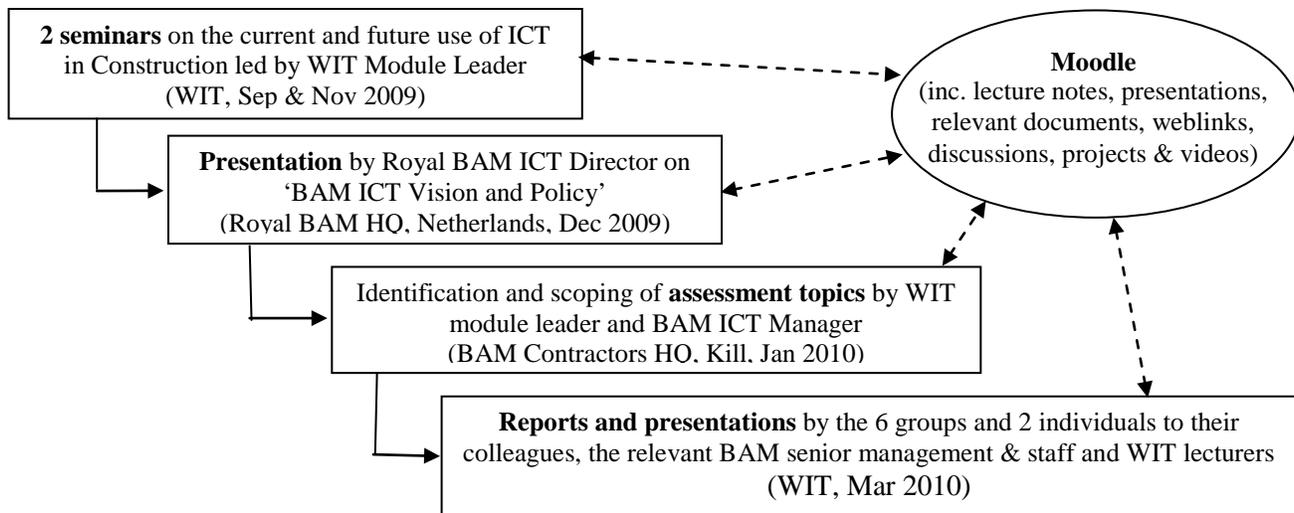


Figure 4: Summary of the key activities in the ICT in Construction module

In December 2009 the Royal BAM Group ICT Director Mr. Wim Nijman gave a presentation the group as part of the 3-day visit to the BAM Headquarters in Bunnik, Netherlands. This presentation and subsequent Q&A session proved very valuable in giving an overall context to the role and importance of ICT with the organisation. The 'BAM ICT Vision & Policy' presented placed emphasis on specific issues including:

- supporting business process and business–IT alignment ;
- more flexible and reliable information systems;
- supporting synergy within and between operating companies;
- uniform ICT infrastructure (per country);
- BAM operating company interest = BAM interest;
- optimal use of ICT resources for BAM;
- not reinventing the wheel!

5. ASSESSEMENT SELECTION & COMPLETION

Each assessment on the bespoke MScCPM programme was designed and agreed by the relevant WIT Module Leader and the associated BAM Expert in accordance with the agreed framework. The processes of aligning the required programme assessments with topics and problems of direct interest to the company were not always be straightforward, the potential benefits were clear. *'The 'learning by doing' approach is an important factor in the successful research knowledge transfer from the company's perspective but also enhances the academic research and teaching activities'* (Sas 2009). The advantages of such an approach from the participants' perspective are also supported by the academic literature. Williams and Thurairajah (2009) advise that *'when designing work-based assessment it is always useful to review the work students are currently doing in their jobs. If you make opportunities to assess real work, this will provide an efficient use of time for students and their employees.'*

In this case of the ICT in Construction module the WIT Module Leader agreed the topics and approach with the BAM ICT Manager and his team. This agreement took some time however and there were some lively debates as to what topics were to be included, as well as the specific structure of each project. The 20 participants were divided up into 6 groups of three and the other two participants were given individual projects (see Figure 4 below). Significant thought was given to the arrangement of the groups and ensuring that the participant's were allocated topics that were of personal relevance.

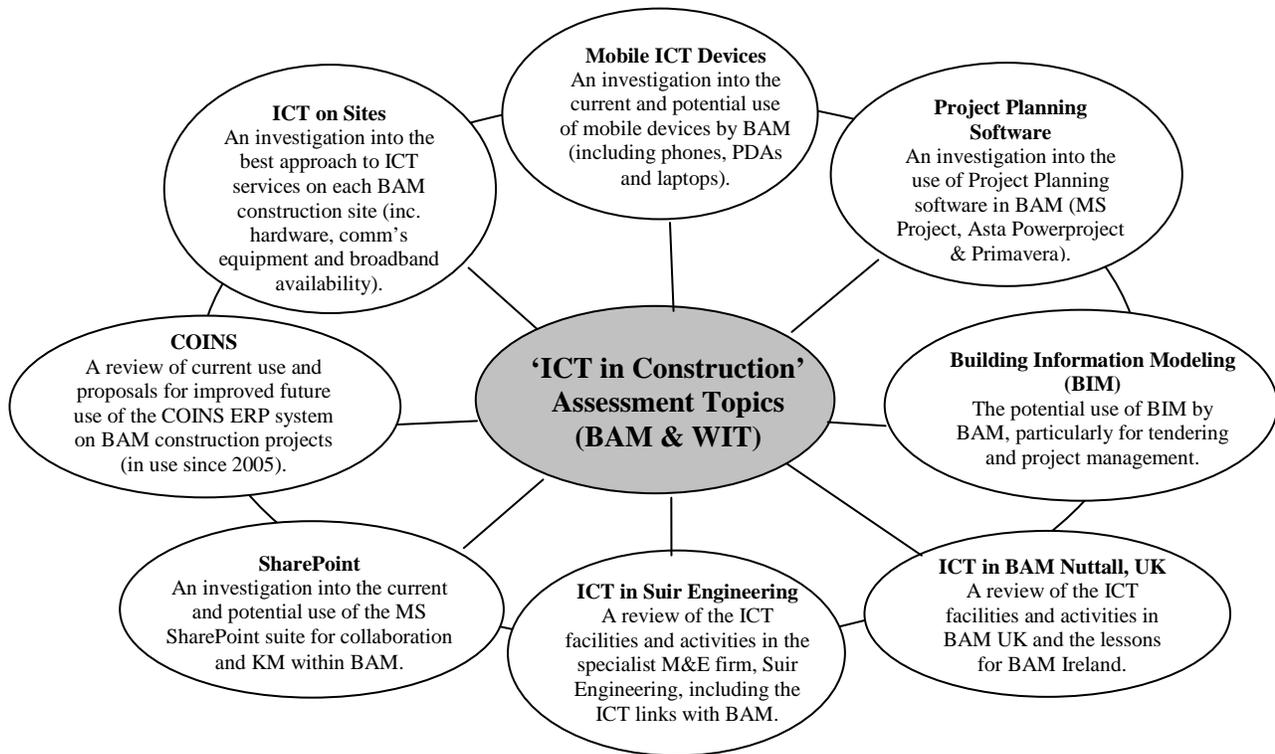


Figure 5 : 'ICT in Construction' assessment topics

Each topic was given a project mentor from either the BAM ICT Department or WIT. The role of this mentor was to give guidance and advice where required to the group or individual. For example there were specific BAM ICT Staff with responsibilities for COINS and SharePoint respectively and these were the sponsors for those projects. While the specification for each investigation was tailored to suit the particular topic, they all adhered to the a general structure. The BIM project specification is shown below in Figure 5 as an example.

Topic	Building Information Modeling (BIM) – The potential use of BIM by BAM Contractors
Background	This report should take into account the BIM experience and know-how within the wider BAM Group. It should also include how BIM is currently being used by the construction industry (Irish & global) and identify the associated advantages and disadvantages. The team should also identify the specific actions that BAM Contractors need to take to use BIM in the short to medium-term.
Key Questions	What is BIM? Who in the BAM group actually uses BIM? What are they using BIM for? What are the associated costs? What are the associated technological challenges? How are other international companies using BIM? How are other Irish companies using BIM? Is BIM suitable for all construction projects? How quickly should BAM Ireland introduce and implement the use of BIM? What specific actions should be taken by BAM Ireland in the short to medium-term in relation to BIM?
Expected Output	The team members should develop their knowledge of the current and potential use of BIM within both the International and Irish construction industry. All of the key questions listed above should be addressed as part of the review and the final report (3,000 words approx) should conclude with a related list of proposed actions for implementation. In addition to the report the team will also make a 15 minute presentation to their colleagues, the relevant senior BAM staff and the relevant WIT staff.

Figure 6 : Example of Project Specification - BIM

6. IMPACT

The impact of the ICT in Construction module is considered from the perspective of the three main cohorts, i.e. BAM, the participants and WIT. In general terms the 8 reports and presentations, as well as the subsequent discussions have in most cases reinforced many of the existing ICT initiatives that were underway in BAM. The module has certainly increased awareness within the company of the strategic and operational importance of ICT. It has also been the catalyst for a number of certain developments and changes to existing processes. One of the key consequences was the fact that the ICT Manager was asked to make a presentation to the BAM Contractors Board of Directors soon after the completion of the module. The content of the presentation included the proposed actions and the very fact that the conclusions of the ICT in Construction module helped to table ICT on the Board's Agenda added to the perceived importance of ICT to the company's business development. Given the context of an extremely competitive industry and a shrinking market, the need for ICT to help with the 'bottom line' was seen as key in the short-term. This complicated balancing act of the need for quick wins while also having some regard for medium to long-term initiatives has been referred to by a number of researchers (e.g. Moum et al. 2007; Brewer et al. 2008).

The most striking impact has been the strengthening of links between the ICT Department and the BAM sites. As a direct result of the ICT in Construction module on the bespoke MScCPM programme, each new BAM project now has an ICT Co-ordinator appointed at the start (contract award stage). While the skills-sets of this person will vary from project to project, with scale and complexity being the major influences, the ICT Co-ordinator has to have a good overall knowledge of ICT. He is effectively the 'go to' person on the BAM site if there are problems with ICT and is also the identified link with the ICT Department in Head Office. This development emphasises the importance of ICT on BAM construction sites and the role of ICT Co-ordinator is similar in many respects to the 'Project Information Officer' proposed by Froese (2004).

The 'ICT in Construction' module has also added significant impetus to the greater integration of ICT systems in the Royal BAM Group. This has particularly been the case of BAM Contractors in Ireland with the two operating companies in the UK, BAM Nuttall and BAM Construct. A number of joint working groups have been established to facilitate the sharing of information and successful technologies. While these working groups generally involve personnel in the different ICT Departments at present, the intention is to get to the point where links can be established at all levels and disciplines to ensure that ICT is being used as effectively as possible in each operating company. It is also worth noting that a 'BIM Business Team' has been formed in 2010 within the BAM Group, headed by a Main Board Director in the Netherlands. Each operating company has representation on this team and it is currently developing a common BAM Project Extranet system that could be deployed in the various countries.

The need for increased and more focused training was a common recommendation within the various reports. In the case of COINS for example, (the ERP system that they have been using since 2005), there has been a subsequent roll-out of training to quantity surveyors on construction sites in order that they can do more with the software at local level. This change will avoid duplication and time-delays of entering information by technical and administrative staff in the Head Office. The Project Planning Software group reviewed the three main systems currently being used by the company, namely MS Project, Asta Powerproject and Primavera. In addition to specific recommendations on how BAM could improve the associated training, they also reflected on whether the company should migrate to using one system only instead of three. They concluded that due to specific individual client requirements they should retain all three systems, but that BAM should increasingly focus on using Asta Powerproject as the main tool for all projects.

Of all the specific technologies that were reviewed in the module, the one that was identified as being the most important in the short-term was SharePoint. A BAM Contractors Director has been appointed to be the 'sponsor' to ensure that the potential for real added-value through the increased and better use of SharePoint is realised. A significant element of this added-value is Knowledge Management (KM). BAM have a vast amount of explicit and tacit knowledge that could be captured and used more effectively for a variety of activities. The exploitation of this knowledge to win new contracts and to perform current projects more successfully are required now more than ever. SharePoint has been identified as the vehicle to drive this exploitation and it is expected that with the Director's impetus there will be significant progress in the short-term.

One of the biggest surprises for BAM Contractors has been the impact of the BIM report and presentation. Initially this was seen as a potentially interesting assignment that would only be of relevance in the medium to long-term. However over the past 6 months BIM has moved to the top of the Royal BAM Group strategic radar and each of the operating companies in the various countries have been surveyed regarding their readiness to deploy the associated technologies.

In addition to the organisational learning and development, the individual participants have also benefited significantly from their participation in the 'ICT in Construction' module. Their own assessment work has not only forced them to investigate their BAM's use of specific ICT, but also to personally reflect on the wider use of ICT within the company in Ireland and the wider Royal BAM Group. The assignments were generally very successful from their own perspective as they were allocated in a manner that took into account each participant's role in the company. Furthermore the 'ICT in Construction' module has demonstrably led to developing each participant's innovative thinking and this is also a vital feature for an industry that needs to improve (van Nederveen et al. 2007; Armitt and Baldwin 2008; MacLeod 2010).

The impact of the 'ICT in Construction' module on the School of Engineering at WIT has also been significant. While WIT have received fees from BAM under the agreement to deliver the bespoke MScCPM programme and its constituent modules, these fees have not covered all of the direct costs. The management and co-ordination activities required to make the programme operate successfully have been at a greater level than originally envisaged. However the overall WIT learning experience of the Industry-Academia partnership and the associated knowledge benefits are also far greater. It has assisted in ensuring that the WIT teaching at undergraduate and postgraduate levels is relevant and up-to-date. It has also reinforced WIT's reputation as a proactive leader in assisting the Irish construction sector to continuously improve. These benefits for BAM and WIT are in keeping with Ryan (2009) who explored the increasing number of university-corporate education partnerships which included quantitative research from North America, UK and Australia. The primary reasons for such partnerships was the desire from the employer organisations to have a recognised university award for their programme and also the 'strength and credibility' that a university can add to such programmes. Ryan conclusions supported the 'win-win' argument for both the company and the university. *'Rather than compromising the content of a university's programmes, the closer the working relationship between a university and its corporate education partner, the more a university can evolve programmes.'* The 'ICT in Construction' module has been a tremendous learning experience for the WIT staff that have been directly involved and the future benefits will be in the delivery of more informed teaching and research at the Institute.

7. CONCLUSION

The joint delivery and assessment of the 'ICT in Construction' module described in this paper has demonstrated value to both of the partners, i.e. BAM Contractors and WIT, but also the individual participants. The dramatic economic developments during 2007-2010 period and the associated collapse in the output of the Irish construction industry over that period was something that was unforeseen by most stakeholders, including BAM and WIT. This context was foremost in everyone's mind throughout the delivery of the programme. The need for BAM to be more competitive in all aspects of its operations gave a particular emphasis to much of the content delivery and the associated assessment activity. Learning is central to that competitiveness (Alsakini et al. 2008) and ICT learning and development is now high on the strategic agenda of both BAM Contractors in Ireland and the wider Royal BAM Group. The impact of the 'ICT in Construction' module has resulted in a number of important short-term actions (including the appointment of an ICT Co-ordinator for all BAM sites) as well as medium-term initiatives (including the greater integration of systems with those in the wider Royal BAM Group). While these actions and initiatives may have happened without the 'ICT in Construction' module, the module activities have accelerated and fine-tuned the company's approach.

The learning and the qualification gained from the full MScCPM programme and the specific 'ICT in Construction' module reports and presentations should result in significant opportunities both within BAM and potentially elsewhere. Even allowing for the difficult current economic context this likely development is supported by Walker (2009) who identified the need *'to promote and instil culture of training, life long learning*

and continuous professional development' and argued that 'this is essential if the managers and professionals of the future are to attain the necessary awareness and capabilities to deliver a built environment appropriate for the 21st century'. The knowledge gained by the individual participants through their own investigations and group reflection on the current and future use of ICT should help with the identification of the 'clear purpose' that Toor and Ofori (2008) consider as central to the authentic leadership style of construction project managers. The 'ICT in Construction' module has also opened up the participant's eyes to the potentially 'exciting set of tools and processes' (Fischer 2007) that can lead to a better industry for all stakeholders.

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