

# Geomatics and Developments in BIM Education in Ireland

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**Key words:** Geomatics, education, BIM, Ireland.

## SUMMARY

BIM (Building Information Modelling) is the process of designing and managing buildings, and other structures, using one coherent system of 3D virtual models. It offers significant savings in cost and time, greater accuracy in estimation, and the avoidance of error, alterations and rework due to information loss. To achieve these benefits surveyors, architects, engineers, constructors and others engaged in the process must work collaboratively. In response, third level educational programmes need to adapt traditional, isolated and un-collaborative modules to a more interdisciplinary approach.

The Dublin Institute of Technology (DIT) is located in Ireland and, with over 20,000 registered students, provides full-time and part-time programmes from apprenticeship to doctoral levels. Within DIT, the College of Engineering & Built Environment represents all the major disciplines involved with BIM in one location. Previously, the various disciplines tended to function in isolation. Recently, however, a new School of Multidisciplinary Technologies has been created to provide and manage interdisciplinary (and multidisciplinary) programmes and modules within the College.

This paper describes the design and implementation of a new programme, located within the School of Multidisciplinary Technologies, that leverages the knowledge available within the College to produce programmes in the BIM domain that are discipline-specific but are placed within a genuinely collaborative framework. The academic model is highly innovative in the sense that collaboration is central to the design and the collaborative modules within the programmes are core. This paper also describes the integration of Geomatics within the new programme and the more recent design of a separate Geomatics stream within the programme.

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## 1. INTRODUCTION

BIM (Building Information Modelling) is the process of designing and managing buildings, and other structures, using one coherent system of 3D virtual models. BIM offers significant savings in cost and time, greater accuracy in estimation, and the avoidance of error, alterations and rework due to poor or missing information. There is a considerable increase in the use of BIM worldwide. A recent report from the National Building Specification organisation in the United Kingdom (theNBS, 2013), in which 1,350 industry professionals were polled, showed that 39% of respondents were regularly using BIM while in the United States the General Services Administration has mandated that new buildings designed through the Public Buildings Service use BIM (Wong et al., 2011). To achieve the benefits of BIM surveyors, architects, engineers, constructors and others engaged in the process must work collaboratively. In response, third level educational programmes need to adapt traditional, isolated and un-collaborative modules to a more interdisciplinary approach.

The Dublin Institute of Technology (DIT) is located in Ireland and, with over 20,000 students, provides full-time and part-time programmes from apprenticeship to doctoral levels. DIT comprises a number of Colleges that are distributed throughout the city of Dublin. Among them is the College of Engineering & Built Environment (CoEBE) which represents all the major disciplines involved with BIM in one location. Previously, the various disciplines tended to function in isolation. Recently, however, a new School of Multi-Disciplinary Technologies has been created to provide and manage interdisciplinary (and multidisciplinary) programmes and modules within the College. Developments within the School of Multi-Disciplinary Technologies leverage the knowledge available within the College to produce modules and programmes in the BIM domain that are discipline-specific but are placed within a genuinely collaborative framework. The academic model used throughout is considered innovative in the sense that collaboration is central to the design and the collaborative modules within the programmes are core.

Spatial information plays a central role in the BIM process, particularly in the context of creating a building model (especially of existing buildings), providing dimensional control during construction and maintaining model currency over the life of a building. This central role was recognised during the design process for these BIM modules and programmes and Geomatics skills were embedded in both the discipline-specific and the collaborative elements. This level of integration of Geomatics skills within streams representing the other disciplines within the BIM domain is hugely significant in terms of raising awareness of Geomatics skills amongst peers. Indeed, as a reflection of the significance of Geomatics within the BIM process, a further stream has been added within the BIM courses to be known as Geomatics Engineering. This will be a discipline-specific stream but will be fully integrated within the collaborative modules and represents a significant development for the profession of Geomatics in Ireland. This paper describes the development of BIM studies in

CoEBE and highlights the integration of Geomatics therein.

## 2. THE DEVELOPMENT OF BIM EDUCATION AT DIT

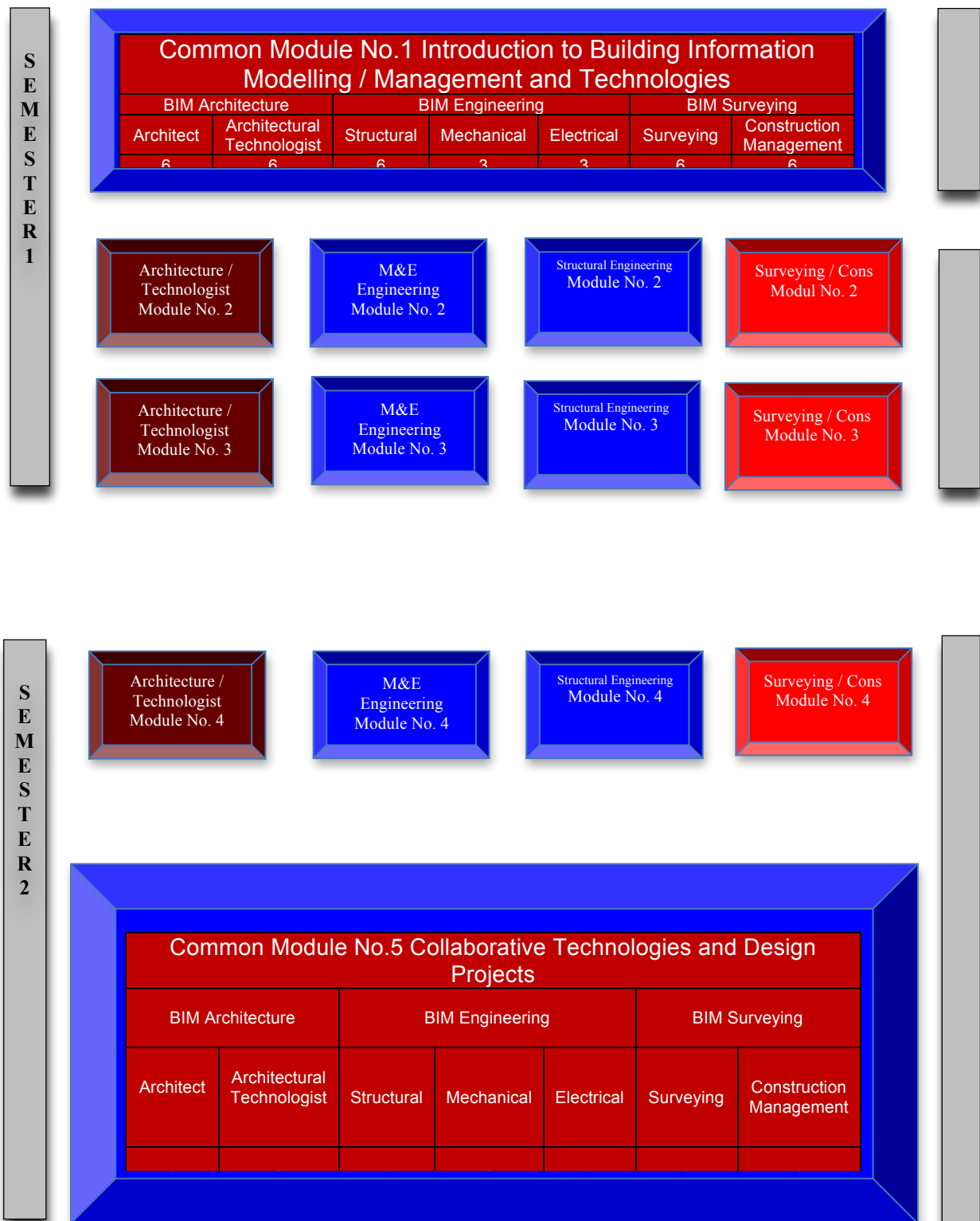
The College of Engineering & Built Environment at DIT runs programmes in, *inter alia*, engineering, architecture, surveying and construction management. Computer Aided Design (CAD) and Information and Communications Technology (ICT) are included as subjects in these programmes. In recent years, BIM has been introduced on an *ad hoc*, and usually introductory, basis on a number of these programmes. The recent global economic crisis was particularly hard-felt in Ireland which had an overreliance on the building and construction sector and employment in this sector dropped by 50% between 2007 and 2012 (O'Farrell, 2013). In response to this crisis the CoEBE set-up a number of programmes intended to support the up-skilling of unemployed professionals in the AEC domain. Recognising the growing importance of BIM, and the opportunity that existed of having all the disciplines immediately relevant to BIM in the one physical and administrative location, a two-year, part-time CPD Diploma was designed in Collaborative BIM Technologies. The first intake of the programme contained 65 students who were a mixture of recently unemployed, and employed, AEC (Architecture, Engineering, and Construction) professionals seeking to upskill in BIM. The structure of the programme for year 1 is shown in Figure 1.

From Figure 1 it can be seen that year 1 of the programme is divided into two twelve-week semesters. Semester 1 starts with a four-week common module which introduces the students collectively to BIM. Over the following twelve weeks the students divide into their separate streams to learn the BIM competencies related to their respective specialisms. In the last eight weeks of year 1, the students are divided into teams that represent a mix of professions and, through integrated project work, these teams are exposed to the BIM methodologies used by the other professions. In this way, an individual in the student cohort, coming from a particular professional background, develops an understanding of the technical work undertaken by the other professions in the BIM process.

In Figure 2 it can be seen that in the first twelve week semester of year 2 of the programme the students, working collectively, are exposed to the wider issues associated with working in the BIM environment. Finally, in the second twelve week semester course participants mimic real-world industry practice bringing together all of the technologies from Year 1 along with their theoretical knowledge of multi-disciplinary collaboration gained already in year 2 to collectively design a building project. BIM is, by its nature, a collaborative process so this programme is designed to provide practitioners with a deep appreciation of collaborative working to enable them to become effective participants in the BIM process.

Informed by the successful design, development and implementation this programme, and the lessons learned therefrom, and the growing importance of BIM to graduates, the CoEBE has now identified a strategy of developing core BIM skills amongst all undergraduate students to enable collaborative, multi-disciplinary studies through the medium of BIM in the later semesters of all programmes in the College. This is considered achievable through the replacement of existing CAD and soft ICT modules with BIM-led ICT modules. As BIM

develops as a cross-disciplinary and multi-disciplinary area within the CoEBE, and is integrated into undergraduate teaching and learning, individual modules are now being identified for delivery at postgraduate level in a variety of formats to suit graduate requirements including as standalone CPD (Continuing Professional Development) and diploma modules, and as nested postgraduate certificate, diploma and masters programmes. Further specialisations within the BIM domain, e.g. 'Green BIM', are also envisaged.



**Figure 1.** Course structure Year 1.

**Semester 3 – 15 ECTS Credits – Design**

**Common Module No. 6 Advanced Building Information Modelling Processes and Management**

Key Concepts of Collaborative Construction; BIM as a Building Process; BIM as a Business Process; BIM-Based Workflows; BIM Within the Project; BIM Implementation Strategies; Business Opportunities with BIM; The Client and BIM; The Ingredients of BIM; FM and BIM; How to Implement BIM; Collaborative BIM in a Legal Context; BIM Contracts; Building Life Cycles; The Future of BIM; Multidisciplinary Collaborative Design; Change Management and Frameworks; BIM Tools; Interoperability; BIM for Various Disciplines:  
This Module links to Module No. 7 in Preparation and Programming for

**Semester 4 – 15 ECTS Credits – Design Studio**

**Common Module No. 7 Collaborative Multidisciplinary Design Project**

In Teams of Six, course participants will mimic real industry practice to bring together all of the Technologies from Year 1 along with their theoretical knowledge of multidisciplinary collaboration gained from Module No. 6 to collectively design a building project. Using the planning programmes, contracts and design templates produced in Module No. 6, participants will create not only a workable design model but will also produce all of the appropriate contractual documents typical of a medium sized construction contract.

**Figure 2.** Course structure Year 2.

### 3. GEOMATICS AND BIM EDUCATION AT DIT

Geomatics, formerly known as Geo-Surveying, has been taught at DIT since the 1960's. In that time it has developed from a three-year diploma to a four-year Honours Degree programme with, more recently, the addition of Masters programmes in Geo-Spatial Engineering and Geographical Information Science. Although residing in the CoEBE, Geomatics has always been considered a particularly specialised discipline area somewhat removed from the more mainstream discipline areas of architecture, engineering and construction and property economics. For instance, Thomas et al. (2006) in a review of ICT learning at all level 7 (ordinary degree level) and higher programmes in the Republic of Ireland did not include the B.Sc. (Hons.) Geomatics degree at DIT in their review. BIM is changing that perception with all participants now appreciating the importance of the BIM model being developed from accurate and reliable information, including spatial information. As a result, Geomatics has been embedded, from the start, in the design philosophy of the new Collaborative BIM Technologies programme and proposed spin-off modules and programmes, as highlighted in the previous section, and in the development of the CoEBE's BIM strategy.

In the original design of the Collaborative BIM programme, participants were introduced to Geomatics technologies and Geomatics was included, as appropriate, in the collaborative modules in year 2. In a more recent development, a separate Geomatics stream has been designed and is now offered to complement the existing streams as seen in Fig. 1. The three discipline-specific Geomatics modules are (i) Point Cloud Science for BIM, (ii) Point Cloud Systems and Practice for BIM and (iii) Scan to BIM to Field. There is an emphasis on the latest data collection technologies and platforms appropriate to BIM including laser scanning, dense image matching and innovative solutions such as remotely piloted aerial systems (RPAS). To support the delivery of these modules, DIT, through an initiative with the Topcon Educational Partnership Program (Topcon, 2014) has access to the suite of BIM-related Topcon surveying hardware and software solutions including terrestrial laser scanners and imaging total stations.

### 4. CONCLUSION

BIM is fast becoming a standard process within the building and construction industries and many of those working in the associated professions are having to upskill to participate in the coming years. As an educational institute DIT has been proactive in the adoption of BIM and the development of a College-wide BIM strategy that is fully collaborative, reflecting the philosophical basis of BIM. Geomatics is fully embedded within these developments and this represents a significant recognition of the role and importance of BIM.

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## BIOGRAPHICAL NOTES

Dr. Eugene McGovern is a chartered surveyor and lecturer at the Dublin Institute of Technology in the area of Geomatics. He previously worked internationally as a land surveyor before coming a director of a survey company in Ireland. He holds a PhD from University College Dublin in satellite image processing. He is a committee member of the Society of Chartered Surveyors Ireland Geomatics Professional Group and is the RICS representative on FIG Commission 5.

Dr. Avril Behan has been a lecturer at DIT since 2003 when she joined the staff after periods of work with public and private bodies specialising in the areas of close range and digital photogrammetry. She holds a diploma in Geo-Surveying, a post-graduate certificate in Professional Studies in Education, a MSc in Remote Sensing, Digital Image Processing and



Applications, and a doctorate in the application of geomatics technologies to the study of medieval architecture. Avril's professional activities include membership of the Remote Sensing & Photogrammetry Society and fellowship of the Irish Institution of Surveyors. Avril teaches in the areas of geomatics BIM, remote sensing, geomatics for architectural technology and professional development. Her research interests and fields of publication include integration of BIM and GIS, geomatics for cultural heritage applications, applications of point clouds, and geomatics education.

Kevin Furlong is a lecturer in the School of Multi-Disciplinary Technologies at DIT having previously been attached to the Department of Construction Skills.. He holds an M.A. in Third Level Learning and Teaching from DIT.

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