Information Systems Undergraduate Degree Project: Gaining a Better Understanding of the Final Year Project Module

Roberts, P., Modi, S., Roubert, F., Simeonova, B. and Stefanidis, A.

This is an author's accepted manuscript of an article published in Wrycza, S. (ed.) The 8th SIGSAND/PLAIS EuroSymposium on Systems Analysis and Design, Gdansk, Poland, 25 Sep 2015, Springer doi:10.1007/978-3-319-24366-5_11.

The final authenticated publication is available at Springer via:

https://dx.doi.org/10.1007/978-3-319-24366-5_11

Information Systems undergraduate degree project: gaining a better understanding of the final year project module

Dr Patricia Roberts
School of Computing, Engineering and Mathematics,
University of Brighton, Lewes Road, Brighton UK
p.e.roberts@brighton.ac.uk

Sunila Modi
University of Westminster
s.modi1@westminster.ac.uk

Francois Roubert
University of Westminster
f.roubert@westminster.ac.uk

Dr Boyka Simeonova
Royal Holloway, University of London
Boyka.Simeonova.2010@rhul.ac.uk

Dr Angelos Stefanidis
University of South Wales
angelos.stefandis@southwales.ac.uk

ABSTRACT
The place of an individual project in the final year of Information Systems (IS) undergraduate degrees at UK universities is well established. In this paper we compare the final year project modules at four UK universities: the University of Brighton, the University of South Wales, University of West London and the University of Westminster. We find that the aims of the projects are similar, emphasising the application of the knowledge and skills from the taught element of their course in a complex development project, often including interactions with a real client. Although we show in this analysis that projects serve a similar purpose in the IS degree courses, the associated learning outcomes and the assessment practice varies across the institutions. We identify some gaps in the skills and abilities that are not being assessed. In further work we are planning to consult final year students undertaking their projects and their supervisors, in order to gain an understanding of how project assessment criteria are actually put to use.

Keywords: Final year project, capstone, undergraduate degree, information systems, teaching, IS education, IS curriculum

1. INTRODUCTION

A large majority of Information Systems (IS) undergraduate degree courses at UK universities include an individual project module in the final year of their programme (Stefanidis *et al.*, 2012). The importance of this element of these programmes is emphasised by the British Computer Society (BCS) accreditation which requires the successful completion of a project (Keller *et al.*, 2011). A successful project is often also required before an honours degree is awarded. When examining programme specifications (the publicly available document that defines UK degree programmes) it can be seen that the project module is credited with delivery of many of the aims of undergraduate degrees.

The ubiquity of the final year project, also referred to as "capstone" course in the literature, indicates that a substantial part of the usefulness to students of an IS degree is gained by applying the knowledge and skills from the taught element of their course in a complex development project, often including interactions with a real client. As (Gupta and Wachter, 1998) state: "a properly designed and taught capstone course offers curriculum flexibility and can satisfy the requirement of stimulate the creative mind to integrate various interrelated concepts, and acquisition of practical knowledge."

This brings us to the question of identifying what constitutes "a properly designed and taught" project module, which in turn brings to the fore certain other questions. Are project modules at UK universities delivering the best experiences for students to make the most of this opportunity? Is the project fundamentally the same in each institution or does each institution interpret the project module differently? How much is the project used to deliver the transferable skills that students are expected to gain in their degree? How flexible is the project in practice? While we are not able to answer all these questions within the scope of this paper we can begin to explore these issues by examining project modules in practice.

This study compares the final year project modules in Information Systems undergraduate degrees at four of the many UK universities that offer IS degrees: the University of Brighton, the University of South Wales, University of West London and the University of Westminster. A comparison is made of the project by looking at the learning objectives; the expected outcomes of the module and at the assessment criteria; how the quality of a student's project is judged. To make this comparison the Quality Assurance Agency (QAA) Computing subject benchmarks(QAA, 2007) have been used, in order to have an institution-independent analysis. Although there are problems with using this as an analytical instrument (detailed later) this has been used because of a lack of clarity as to the desirable content, outcomes or direction of a project from other sources (Stefanidis and Fitzgerald, 2010). The data was gathered and analysed in 2013.

The rest of the paper is organised in the following way. First we examine some of the relevant previous work before we turn our attention to describing the project modules in the context of the degrees at the four institutions. We then go on to analyse the learning outcomes and assessment criteria against the QAA topics. Next, we present those findings that can be drawn. Finally, we reflect on the usefulness of the comparison and the scope for future work.

2. PREVIOUS WORK

The importance and value of a final year IS project is often linked to the ability of a degree programme to provide the necessary employability skills to its students. In their analysis of the

importance of project work in the final stages of IS courses (Gupta and Wachter, 1998) argued that a carefully designed capstone component can bridge the gap between academic knowledge and professional skills demanded by industry. This argument is further supported by (Clear *et al.*, 2001) who explain that the final year project offers experiential knowledge as part of a significant independent study undertaking, enabling students to reflect on knowledge and skills already accumulated.

Much of what the students can achieve depends on the nature of the project. (Olsson *et al.*, 2003) suggest that final year projects can have a research-orientated nature, requiring a carefully defined project with clearly outlined research deliverables. At the same time, an equally valid IS project can be closely aligned with a real-life setting where the work carried out by the students is designed to help improve a wide range of employability skills and aptitudes (Keller *et al.*, 2011).

Carefully designed project modules can often have less obvious benefits. (Reinicke *et al.*, 2012) argue that apart from providing the means for learning different skills, students are made to repeat and refresh many of the key concepts of IS which are crucial to their future careers. This point is further supported by (McGann and Cahill, 2005) who suggest that a well-designed project is capable of incorporating experiential and conceptual learning elements, thus ensuring that both theory and practice receive equal emphasis.

Like all other modules, final year projects need to be defined in a way which is determined by the aims and objectives that make up the module specification, and in addition, the way the project module in question is aligned with the remaining course modules of a given IS degree programme. (Clark and Boyle, 1999) make an important observation about the danger of using generic aims and objectives which are interpreted broadly, giving the impression that all projects could be the same. Indeed, it has been shown that it is possible to 'generalise' projects by sharing themes, ideas, delivery options and supervision techniques not just across courses in one department but also across institutions (Lancaster *et al.*, 2011). However, it is important to maintain a flexible approach in designing and administering projects for students in order to reflect the many different domains of IS which map to different aspect of the IS industry (Surendran and Schwieger, 2011).

3. PROJECT MODULE CONTEXT

To be able to determine the contribution of the project module across the IS courses in the four institutions considered in this study and to draw meaningful comparisons between these project modules across the four universities, we need to carefully examine these project modules in the context of their degree programmes. Thus the following section provides details of the undergraduate courses which use the project module as capstones and describes how the project module fits within the course. A comparison of the taught core content of the courses under investigation is then provided.

3.1 University of Westminster

The BSc (Hons) Business Information Systems (BSc BIS) offered at the University of Westminster, details can be found at http://www.westminster.ac.uk/courses/subjects/business-information-systems/undergraduate-courses/full-time/u09fubiy-bsc-honours-business-information-systems, aims at providing students with knowledge and skills both in the area of business and Information Technologies (IT). The course is designed to produce hybrid

graduates equipped to combine IT competencies with an understanding of business operations to undertake the analysis, design and development of information systems tailored to business organisations' needs. The course learning outcomes emphasise on the ability of the graduates to be able to comprehend business environments, business systems and management paradigms to apply this understanding to the resolution of business problems through the design and development of IT-driven solutions.

The BSc BIS Project module aims at providing the students with the opportunity to utilise their understanding of business practices and their IT skills to resolve a real-life business information systems problem. The project student is typically expected to locate a functioning business organisation which is experiencing a certain number of limitations in the way their business operations are supported and to identify the potential for improvement through the rethink of the business processes and the introduction of a bespoke IT solution. Under the guidance of a supervisor, the student needs to conduct an investigation of the current business practices, to design the specifications of an information system to better support the business operations and to develop and evaluate a prototype for this IT solution. The work should normally include a significant analytical component in which the student demonstrates their comprehension of the real complexities of the problem and can justify the solution strategy both in terms of system requirements and of the wider context of current practice.

The project module which runs throughout the final year of the degree accounts for 30 credits. This represents 8% of the overall credits available in the course and 25% of the credits at level 6. The module is not explicitly supported by any prior module. The module is assessed through the evaluation of three components: (1) a *Project Initiation Document* which defines the project objectives and sets out the methods to be used, (2) an *Interim Progress Report* which documents the analysis stage and discusses the student's progresses towards the objectives and (3) a *Final Project Report* providing the entire documentation to support the analysis, design and development of the bespoke IT solution.

3.2 University of Brighton

At the University of Brighton there are two Information Systems courses offered in the School of Computing, Engineering and Mathematics (CEM); these are BA (Hons) Business Information Systems (BA BIS)seen at https://www.brighton.ac.uk/courses/study/business-information-systems-ba-hons.aspx and BSc (Hons) Business Computer Systems(BSc BCS) which can be found at (https://www.brighton.ac.uk/courses/study/business-computer-systems-mcomp.aspx).The courses have a largely common set of modules in the first year but they begin to change focus with increasing differentiation in the second and third years. Generic transferable skills in creative thinking, team-working and IT communications skills are a focus of both courses which are aimed at developing students' confidence in analysing real world business-related problems in order to design practical solutions.

BA BIS focuses on the skills to specify and develop the software components for a range of business systems and solutions. Modules develop technical skills in database, network management and web application development, which are then coupled with business-facing modules in systems analysis, marketing, e-commerce and project management. Employability is enhanced because of the combination of technical, business and interpersonal skills.

BSc BCS focuses on the skills to become hands-on computing professionals, and the course is designed to give the transferable skills and practical knowledge for such a career. Students

develop skills to develop and maintain the software components of business systems, with an emphasis on technical and programming skills needed to construct these systems, which are often web-based.

The individual project module for both courses has common aims and objectives. It is undertaken in the final year of the degree and is worth 40 credits. This represents 11% of the credits available on the degree programme and 33% of the credits of the final year. The project can take a variety of forms. One of the most common forms for a project is analysis and design, based on a real client's problem. This will involve requirements analysis and design of a solution and the production of appropriate diagrams. A prototype software solution or 'proof of concept' is usually produced. Another typical project is based around a database design in a relational Database Management System (DBMS), with a front-end, design for a client or for a particular business context. A research paper is also a possible project, but this is less common. The paper would explore a particular technology or business information systems issue. The project is assessed as a single entity with the marks being allocated on the whole project without any breakdown into component parts although there is a pass/fail element of a proposal and viva within the first two months of the project.

3.3 University of West London

The BSc Computing & Information Systems (BSc CIS) seen here http://www.uwl.ac.uk/course/computing-and-information-systems-3/32907 and BSc Information Systems for Business (BSc ISB) http://www.uwl.ac.uk/course/information-systems-business-2/33768 offered by the University of West London provide a generic coverage of theory, practice and applications of computing and information systems in relation to the changing environment of use within a variety of businesses and also other organisations. The courses seek to enable students to develop knowledge, practical skills and understanding in relation to computer systems from both hardware and systems software perspectives. Overall, the courses learning outcomes give importance to providing students with a blend of key generic underpinning knowledge in the Computing and IS field including professional and ethical issues in ICT development and implementation. The BSc CIS course places an emphasis on developing student's ability to design and construct computer based solutions in order to improve their understanding and appreciation of IT technologies applied to client needs, objectives, development, operations and maintenance. Whereas the BSc ISB course provides the fundamentals of computing and information systems with a core focus on business and management skills to produce graduates who can become 'hybrid' managers. Therefore, providing the students with an understanding of IS in a wider managerial and business context so that they will be able to apply this knowledge in the selection and design of systems appropriate to management requirements with an awareness of organisational and human implications.

The Project module in both courses is preceded by a Project Preparation module worth 10 credits which runs in the first semester of the final year (level 6). This preparation module is worth 3% of the credits of the entire course and 6% of the level 6 credits. The Project module represents the twice amount of credits i.e. 6% of the credits of the degree and 12% of the credits of the final year. The Project module provides an opportunity for the students to integrate various aspects of the course and undertake an in-depth investigation of a topic of particular interest in the field of computing and information systems. It is intended to develop the skills of planning, organisation and communication in the context of a self-managed project. The investigation may include the development of software and/or systems analysis following a

standard methodology and may be associated with work done for an organisation as part of an internship or placement. The assessment of the module is divided into four components. There are two intermediate progress reports which aim at providing the students with two separate opportunities to receive feedback on the ongoing project development process. The main summative element of the assessment consists of the production of a large project report which requires for the student to construct the necessary documentation to support the analysis work and/or the design and development work at the core of their project. Finally depending on the emphasis of the work – analysis or design and development – the student needs to produce a poster or deliver a software demonstration.

3.4 University of South Wales

The BSc (Hons) Information and Communication Technology (BSc ICT) http://courses.southwales.ac.uk/courses/509-bsc-hons-information-communication-technology, at the University of South Wales is a practical technology course that covers the development and use of business systems for industry. The course focuses on how to apply practical computer-based skills to an organisation's technical requirements. It includes elements of computer programming, analysis and design, databases and project management, which provide the necessary knowledge for a career in the IT business and industry. The overall aims of the course place emphasis on developing the students' ability to cultivate a critical appreciation of the processes and disciplines involved in large-scale IS management, including the alignment of IS with business strategy and the delivery of IS products and services. At the same time, an integral part of the course provides students with the experience to develop data models and database systems, and apply related concepts to advanced database systems applications.

A compulsory component that is the culmination of all the taught elements exists in the form of the final year project. Its primary purpose is to enable students to develop and demonstrate the application of their computing, ICT, research, analysis, evaluation skills, presentation skills and knowledge acquired during their studies to a significant topic or problem. The successful completion of the project relies heavily upon the student's ability with respect to time management and application of the skills and knowledge they have acquired during the first three years of study. At the early stages of the project, three lecture seminars are provided on topics such as research methodology, literature searching, information gathering, project management and referencing guidelines. This is supported by online material, with the main source of information for the development and assessment of the project being documented within the project handbook.

The assessment of the project module is carried out in three stages. As part of the first stage, students produce an interim research report that records the information gathering activities such as academic research, investigations, literature review, selection of appropriate tools and methods for the undertaken project. Also included within this report there is a design section, detailing the system design and project progress. The second stage includes a more detailed project report which documents the full process undertaken for the project. It covers the overall project management approach, research and literature reviews, analysis, development, evaluation and conclusion. The third and final stage involves a formal presentation (viva voce) which may include a poster presentation if it is deemed to be appropriate to the type of work undertaken. As a 30-credit module without any explicit pre-requisite module such as research methods, the project constitutes 8.3% of the overall credits available in the course and 25% of the credits at level 6.

4. COMPARISON OF THE TAUGHT CORE CONTENT

A description of the project modules across the four universities under consideration has been provided along a brief outline of the IS courses which host them. At first glance, these courses appear to share a similar view of what an IS programme should be about. However, the project modules which are supposedly the capstones of these degrees seem to be operating quite differently. A more systematic comparative analysis of the degree courses is thus required and an overview of a comparison of the taught core elements of the degree programmes is presented in Table 1.

Institution/ Course Title	Subject Categories for Core Modules (%)					
	Software Development	Analysis &Design	Databases	Business &Organisations	Technology	Personal/ Management Skills
University of Brighton						
BA Business Information Systems	21%	25%	14%	21%	7%	11%
BSc Business Computing	29%	25%	21%	7%	7%	11%
University of South Wales						
BSc Information Communication Technology	15%	8%	15%	23%	23%	15%
University of West London						
BSc Computing & Information Systems	27%	23%	13%	10%	13%	13%
BSc Information Systems for Business	7%	23%	7%	37%	7%	20%
University of Westminster						
BSc Business Information Systems	17%	28%	6%	17%	22%	11%

Table 1: Comparison of the taught core modules across the four institutions

The taught core modules (excluding the project) of the six degree programmes under consideration were divided into six categories or subject areas. For every course, the contribution in terms of credit points was calculated and is presented as a percentage within the course.

All degree programmes have modules in each of the 6 categories but variations occur between courses. The S*oftware Development* and *Technology* subject areas which provide an indication of how technical a course is appear to have a wide range of variations – from 7% to 29% for *Software Development* and from 7% to 23% for *Technology*. The *Analysis and Design* subject area which can be considered as a core part of IS has a good consistency for five courses out of the six under consideration – from 23% to 28%. The outlier, the BSc Information Communication and Technology, only accounts for 8% in this subject area, which is perhaps indicative of the fact that IS is not reflected in the title of the course. *Business and Organisations*, which is also a key part of an IS degree programme, is another subject area which shows wide variations – from 7% to 37%. The BSc Information Systems for Business stands out as it accounts for 37% in this category which perhaps reflects the heavy business emphasis of this degree as it is delivered partially by the business school. The *Database* subject

area appears to have fairly low percentages comparatively to the other categories. This could be explained by the fact that most degrees appear to have databases related subjects as optional which were not considered in this comparative analysis. In reality, it is possible for students to study more database modules than it would appear here. Finally, the *Personal/ Management Skills* subject area appears to show a fairly good consistency between the courses – from 11% to 20% – which can be justified perhaps by the fact that that this category includes knowledge that underpins most IS courses.

5. METHOD

Having examined the general form and context of the project modules we now address the issue of finding a meaningful way of comparing them. To frame the discussion we will make use of several sources: QAA benchmarks, the work of the UKAIS and the professional body for IT professional, the BCS.

The QAA publish Subject Benchmark Statements (SBS) to support the Higher Education Academy (HEA) in their efforts to define the nature and characteristics of programmes by establishing a benchmark that delineates the standard of quality for a given programme. SBSs are provided for a wide range of subjects, drawing on the expertise of academics and professionals who are leading figures in their field.

Specifically for Computing, a term which in this context encapsulates the entire field of ICT, the QAA published the first Subject Benchmark Statements in Computing (SBSC) in 2001, with a subsequent revision in 2007(QAA, 2007). SBSCs consider the scope and the nature of the computing discipline, the abilities and wider skills that computing students should develop by being exposed to courses driven by assessable learning and teaching strategies. Therefore the SBSCs do not provide a template per se to design a computing or IS degree by providing detailed syllabi information; instead they offer a series of expectations about standards in the field. One of the challenges of using SBSCs as they are wide in scope, they need to be interpreted within the context of institution and the student cohort. Additionally, they recommend quality standards of the overall provision presented in a generic manner which means they need to be mapped to make them quantifiably comparable.

Even though the SBSC looks at the field of computing in a holistic way without differentiating between the various emerging fields of specialisation, it provides outline descriptors that attempt to capture the Body of Knowledge (BoK) of different aspects of computing, including IS. Influencing the development of these BoK descriptors can be found in the work of the UK Association for Information Systems (UKAIS) in their publication of the Scope of Domain of Study of IS(UKAIS, 1999). Neither the SBSC nor UKAIS's statements consider the final year project as a quantifiable element of knowledge. This is in line with the views held by (Clark and Boyle, 1999) who view projects as the culmination of the knowledge contained in the taught modules that make up a degree course, as opposed to a specific component of the discipline.

Despite its generic nature, the SBSC makes a significant contribution to our efforts to contextualise the parameters of our study and provide a common baseline against which the four project modules can be gauged. By considering the learning outcomes and assessment criteria that make up each for the four project modules in the four institutions it is possible to compare the contribution each project module makes to IS degree course, using a common benchmark.

The four project modules can be characterised by examining Learning Outcomes (LOs) and Assessment Criteria (AC). The skills and knowledge expected on the project module can be seen as a culmination of what students have gained from the taught elements of each course. LOs are defined as "...statements that predict what learners will have gained as a result of learning"(Jackson *et al.*, 2003). Similarly, (Ducrot *et al.*, 2008) explain that the purpose of LOs is to state the knowledge and skills which are expected to be cultivated by students through their curriculum by means of assessment. As a primary purpose, assessment could measure the extent to which students are successful in meeting their LOs. Criteria in assessment, commonly referred to as Assessment Criteria (AC), are "dimensions with which you will judge how well a student has achieved their learning goals [outcomes] of a course" (Isaacs, 2002).

The BCS, which is a body that accredits some undergraduate computing courses, offer guidelines on projects (http://wam.bcs.org/wam/coursesearch.aspx). This defines certain criteria such as the project must be at least 30 credits and must be passed at the first attempt. They also offer guidelines on the content and structure of the project report (http://www.bcs.org/category/5844) which have been used in the development of the assessment criteria by academics developing the project module. The list of the guidelines is shown in Appendix II.

6. ANALYSIS AND FINDINGS

In this section we examine the project modules in the four institutions in detail. We investigate whether the Aims, Learning Outcomes (LOs) and the Assessment Criteria (AC) correspond to the topics defined in the QAA Subject Benchmark Statements for the Computing subject area (SBSC). We do not expect the project module to map to all areas covered by the SBSC, as many of these will be delivered in the taught elements of the programmes. However, an opportunity offered by the project module, to bring together the elements of the programme, brings with it an expectation that some of the SBSC would be delivered by the project. We examine the extent to which this expectation is met.

In the following analysis we have used the following abbreviations: UoB – University of Brighton project module, UoW – University of Westminster project module, USW – University of South Wales project module and UWL University of West London project module.

6.1 General Observations

It is clear from the aims of the project modules that the different courses are using the project for similar aims in the degree programmes. The application of knowledge and skills is seen in UoB "*applying a range of knowledge and skills",* and in UoW *"integrate the different strands of the course" and "develop further the appropriate transferable skills"*, in UWL "*integrate various aspects, both of this course and of your prior knowledge*" and again in the USW stated more specifically to *"develop and demonstrate the application of their computing, ICT, research, analysis, evaluation skills".* The scale of the project is also emphasised, ruling out the more trivial projects as in UoB "*a major project*", UoW "*an extended piece of work*", a "*substantial piece of independent work*", in UWL and the depth is emphasised in USW "*opportunity to pursue a topic or problem in depth*". Another common theme is the importance of self-management as in UoB stating that it must be a "*largely self-managed, practical task*", in UoW students must "*manage the delivery of significant pieces of work*" and in USW "*specify a project goal and objectives, and a plan to achieve them*". Very specifically in UWL with

students "*intended to develop the skills of planning, organisation and communication in the context of a self-managed project*". We see in the project aims at all the institutions that there are three main strands to the project; that it is a large piece of work, in some depth; that it is applying and integrating the skills and knowledge from the course and that it is self-managed.

The QAA SBSC are "not intended to constrain the development of new courses" but they do state that "there are three key ideas which constitute a certain ethos that can be expected to characterise any honours degree programme in computing"(QAA, 2007). These expected characteristics translate into three main categories of abilities and skills that students are expected to develop in their degree programmes: computer-related cognitive abilities and skills, computer-related practical abilities and skills and additionally, transferable skills. These three broad categories are then expanded into several statements given in full in Appendix III.

6.2 Analysis of Learning Outcomes and Assessment Criteria

6.2.1 University of Westminster project module

The project module at the University of Westminster is driven by the expected completion of 5 LOs (see Appendix IV). If the level of granularity of these outcomes may not be the finest between the project modules across the four institutions, this is certainly compensated by the introduction of 16 AC which are used to assess the outputs of the students. As shown in Appendix IV, every LO has been meticulously mapped to a series of AC to ensure a thorough Constructive Alignment (Biggs, 1999). In addition, every criterion is assessed on a seven-level scale from 'Fail' to 'Excellent'. This way, the evaluation of the completion of a group of precise criteria is meant to assess the level attainment of every single LO and thus of the overall completion of the module.

When examining the mapping of the LO to the QAA SBSC, it is important to note that some of the AC which come under a particular LO may fit within more than one QAA benchmark. This may be due to the level of vagueness which characterises the phrasing of a particular LO which can be mapped to more than one QAA benchmark but also which can comprise AC which can be mapped to multiple QAA SBSC. The cognitive abilities category of the QAA benchmarks appears to be quite extensively covered by both the LOs and corresponding AC. If modelling does not appear to be assessed explicitly, the deployment of methods and tools – as well as the analysis of requirement/specifications to a certain extent – is addressed by LO1 which overtly refers to the ability of the students to select and justify an appropriate method, technique and tool for the problem or opportunity type (LO1). This is very clearly reflected by AC1, AC2 and AC3. The benchmarks *critical evaluation & testing* and *reflection & communication* appear to be covered by all the LOs and a large number of associated AC which can be explained perhaps by the fact that these benchmarks refer to very generic and transferrable skills which should be assessed throughout the duration of the project.

The computing practical abilities category of the QA benchmarks appear to be only explicitly covered by one LO i.e. LO5 "*Develop a prototype testable model or a research analysis and report these and other project activities in a scholarly way"*. Yet this coverage is only partial as there is the possibility for a student to undertake a more analysis-based project which necessitates less the use of practical IT skills. This said, when looking at the lower level and closely inspecting the list of AC, it was found than a certain number of them assessed this group of abilities mentioned by the QAA. These include "*Description of specific planning, analysis, design and implementation techniques used within the context of the project*" (AC2),

"*Appropriate software products and tools chosen"* (AC3) and "*Implementation/Solution: Prototype, solution, implementation model/blueprint/other as appropriate"* (AC13).

Finally the Transferable Skills benchmarks did not seem to be greatly mapped by the LOs. Only the benchmark *"Managing own learning and development"* appeared to be covered by the LOs as it can be found in LO1, LO2, LO4 and LO5. This can be justified by the fact that the project module aims at fostering independent learning among the students. When looking at the AC, the transferrable skills seems to be covered in fact by 5 different AC which can be explained by the fact that these skills are assessed at the micro-level and that it was not deemed necessary for them to feature at the more global level of the module learning outcomes.

6.2.2 University of Brighton project module

The University of Brighton projects module has ten Learning Outcomes, the highest of all the modules considered here (the full list of LOs and AC is shown in Appendix V). This is a fine granularity in LOs but not necessarily a divergence from other institutions in the expectations for the projects. The next point of note is that there is substantial alignment with the QAA SBSC categories. All the LOs can be related to the QAA categories to a greater or lesser extent. The principle practical ability in computing disciplines might be considered as the first of the QAA SBSC: *"The ability to specify, design and construct computer-based systems*". However, this does not appear in the LOs except tangentially in LO5 - develop and work to a specification and set of requirements. The lack of a specific reference to *"design and construction"* is necessary as it allows for variation in projects. This is needed where the end-product might be a report to a business, making the case for using a particular solution to a problem, rather than the construction of the solution itself.

The cognitive abilities from the QAA SBSC are mapped more explicitly to the LOs as the project is used to develop these abilities. The project module LOs show that a student is expected to demonstrate knowledge and understanding of essential facts, concepts, principles and theories (LOs 3 and 4), to employ critical evaluation and testing in the problem area (LOs 2, 3 and specifically 10) and to show that they can reflect and communicate (LOs 1 and 10). One of the cognitive abilities that is directly related to a LO is that of Professional considerations. This is reflected in LO9 – "*demonstrate an awareness of the relevant professional, social, legal and ethical aspects*". This is indicative that the courses at UoB are accredited by the BCS which places emphasis on these professional considerations. (The BCS accreditation guidelines are shown in Appendix VIII).

When examining the QAA SBSC Additional Transferable Skills it is clear that one aspect features strongly in the project (LO6 and 7): Managing one's own learning and development including time management and organisational skills. It is interesting that effective information-retrieval skills do not feature in the LOs although they are relevant to one of the AC which we now go on to consider.

The UoB project module is assessed under six broad headings, which are made known to the students throughout their project: 1. Technical grasp; 2. Understanding of problem area; 3. Project management; 4. Report quality; 5. Evidence of learning; 6. Research effort. These are each assessed on a scale from F- up to A+. The additional factor, that the ethical and legal considerations of the project need to have been considered, is also mentioned but not assessed against a scale. The first two headings are considered most important but there is no formal percentages applied and marking is carried out on the project as a whole. This allows for

flexibility in project selection and provides scope for students to carry out original and innovative work.

In mapping the AC to the QAA SBSC we can see that there is a much clearer relationship than with many of the LOs although the LOs are also seen reflected in the AC. In "*Technical grasp*" there is a relationship to the practical ability to specify, design and construct computer-based systems and "*Understanding of problem area*" relates to the cognitive ability to demonstrate knowledge and understanding. "*Project management*" relates to LOs 6 and 7 and to the transferable skill of "*Managing one's own learning and development"*. "*Report quality*" relates to LO 4, 8 and 10. "*Evidence of learning*" is not related directly to LOs but acknowledges the journey that the student has undertaken in the project. Research effort is not a learning outcome but is related to the transferable skill of Effective information-retrieval skills. The ethical and legal considerations of the project relate to the QAA SBSC cognitive ability of Professional considerations.

The UoB projects module has a fine-grained set of Learning Outcomes but a holistic approach to assessing projects. This allows for flexibility and a wide scope of projects but there is a danger in that markers need to be aware that LOs need to be met as well as using the AC to grade the students' projects.

6.2.3 University of South Wales project module

Final year students undertaking a project at the University of South Wales are guided by a set of documents which outline the overall expectations, nature and practical aspects of the project module. As is the case with all other modules, the crux of the project is captured by a set of learning outcomes and assessment criteria which describe the level of attainment expected from students.

Examining the LOs and AC in Appendix VI reveals a highly abstract set of statements that, in the first instance, could be seen as generic guidelines without sufficient focus to support the students' appreciation of the module. In particular, the assessment criteria which simply state "*Written Assignment*" suggest that the document has been written in a way which does not necessarily follow the convention found in other institutions.

Despite the initial impression of relative ambiguity, the project documents include within their narrative contents a series of statements that elaborate the generic LOs and AC statements. Assessing the overall quality of the project is based on the methods utilised by the student for referencing and overall presentation, and their ability to present the overall project process with clarity and as a highly professional output.

Further examination of the project documents uncovers a series of guidelines that qualify the abstract AC heading by explaining that project students need to meet certain assessable requirements in order to be successful:

1. Set objectives
2. Research and assimilate of information from a variety of sources
3. Analyse requirements
4. Synthesise and take significant design decisions
5. Develop and implementation an end product
6. Justify the rationale and decisions taken
7. Evaluate and critically appraise outputs

8. Be creative and show reflective thinking
9. Do planning and monitoring

By considering these explanatory assessment requirements as an extension of the LOs it is possible to ascertain their combined impact in relation to their alignment with the QAA SBSC categories. The abstract nature of the LOs, however, makes it relatively hard to offer a detailed mapping. The subject related cognitive abilities can be seen to map closely to the first two LOs which aim to develop student's initiative, self-reliance and independence in pursuing an investigation on an appropriate topic, and achieving a solution of high quality with minimum supervision by producing an acceptable project report within a specified deadline. Similarly, the QAA's subject related practical abilities are addressed through the main aim of the final year project which is to allow the student to develop and demonstrate the application of their computing, research, analysis and evaluation abilities. Finally, with regard to the QAA's additional transferable skills, there is demonstrably good mapping with LO4 which is realised through the development of problem-solving skills that are a necessary complement to formal academic skills, and are the specific characteristics of a graduate.

6.2.4 University of West London project module

The project module within the two courses offered by University of West London (UWL) aims to give the students an opportunity to integrate various taught parts of the course in order to completing a substantial piece of work independently. It enables the students to undertake an in-depth investigation of a topic of their particular interest in the field of computing. The investigation may include the development of software and/or systems analysis following a standard methodology and may be associated with work done for an organisation as part of an internship or placement. The module has eight learning outcomes (LOs) given in Appendix VII.

Using the QAA SBSCs categories overall : (a) cognitive abilities (b) practical abilities and (c) additional transferable skills and sub-categories as a tool to evaluate how closely the LOs have been mapped in terms of granularity. The UWL project module LOs can be said to have quite fine granularity. Further examination within the cognitive abilities category, reveals that majority of the LOs are mapped quite extensively within this category. It can be seen that all but two sub-categories are reflected in the LOs to some extent. The sub-category modelling has not been specifically identified, the main reason for this is that LOs of the project module are generic to cover both undergraduate courses and the ISB course is aimed to provide a more of a business flavour where the students do not have carry out modelling of computer systems specifically. Additionally the sub-category professional considerations also are not reflected in LOs. Considering the overall SBSC practical abilities category, here not all LOs are explicitly mapped as they have been constructed to be generic to fit into aims of both the courses. Yet, they provide a necessary structure to have loose mapping which can be seen in one of sub-categories *"specify, design & construct computer-based systems"* where LO3 has been somewhat reflected (*"Identify complex problems and develop and/or propose appropriate solutions").*

While examining the third QAA SBSC category "*Additional transferable skills*", it can be clearly seen that one particular sub-category: "*managing one's own learning and development including time management and organisational skills"* is emphasised specifically in UWL project LOs 4 "*review critically the outcome and process of own work*" and LO8 "*complete a self-managed project according to a defined plan*". This strongly indicates the necessity for the students to demonstrate the ability to self-manage their time in order to complete their chosen project.

The assessment elements for the UWL final year project have been broken down into four elements. Where element 1 and 2 are progress reports where each has weighting of 5%. These are produced by the students to demonstrate their ability to managing the progress of their project and it is very much tied to the third category of the QAA SBSC category of additionally transferable skills. Whereas element 3 consists of the project report and has a weighting of 70% of the total marks. The AC for this element are given as *(i) Structure and Organisation, (ii) Method, (iii) Literature Review, (iv) Use of evidence (v) Presentation, (vi) Analysis of results and (vii) Conclusions drawn*. These are further elaborated into issues to incorporate a much clearer mapping between the AC and QAA SBSC sub-categories. One such example of this can be seen in the AC "*Use of Evidence*" where part of the issue is "*clarity of evidence of progress towards project aims and objectives e.g. prototype, demonstration, evaluation instrument, software coding, UML models*" this reflects the QAA SBSC cognitive abilities sub-category of "*Modelling, Requirements and Methods and Tools*". Element 4 requires the students to either give a demonstration or produce a project poster; this has a weighting of 20%.

6.3Comparative Observations

There are many similarities between the project modules across the four institutions as indicated by the module aims which focus on three things:

- Integration of the knowledge and skills constructed throughout the course
- Conducting a study in depth
- Independent learning

The aims are all developed into Learning Outcomes which can be assessed but we have seen from this analysis that the transformation into LOs produces very different results, some which map closely onto the QAA SBSC and some which are less close. These differences are to be expected as the projects are part of courses in different institutions that would have their own traditions and different cohorts of students. However, if the project module is serving a similar purpose, to bring together the elements of the degree programme, we can make observations of divergence from the QAA SBSC expectations.

One such area is the topic of Modelling within the Subject-related cognitive abilities in the QAA SBSC: "Modelling: use such knowledge and understanding in the modelling and design of computer-based systems for the purposes of comprehension, communication, prediction and the understanding of trade-offs"(QAA, 2007).Although this seems very pertinent as an ability that would be expected in an IS graduate it is not explicitly addressed by the Learning Outcomes in any of the project modules analysed. Another cognitive ability in the QAA SBSC is: "Professional considerations: recognise the professional, economic, social, environmental, moral and ethical issues involved in the sustainable exploitation of computer technology and be guided by the adoption of appropriate professional, ethical and legal practices" (QAA, 2007).

This is only specified where BCS accreditation is present for a course. This is an ability that IS graduates should have and should be recognised more widely. It may be the difficulty of assessing such an ability that is the reason for its absence in Learning Outcomes. One of the Additional Transferable skills that is not explicitly assessed is: "Effective information-retrieval skills (including the use of browsers, search engines and catalogues)".

Perhaps a student on an IS would be expected to have good skills in this area before undertaking their project, which might explain its absence. The aims of the project modules emphasise its importance in showing that a student has reached the level expected of an honours student. While skills of self-management, developing complex solutions and communicating ideas are strongly represented in the learning outcomes, other qualities that might be expected are not being explicitly required. Perhaps this is a missed opportunity.

Figure 1 illustrates the way that the three common aims of the projects are mapped to a number of learning outcomes and then on their measurement using assessment criteria. This shows the wide differences in granularity of the courses

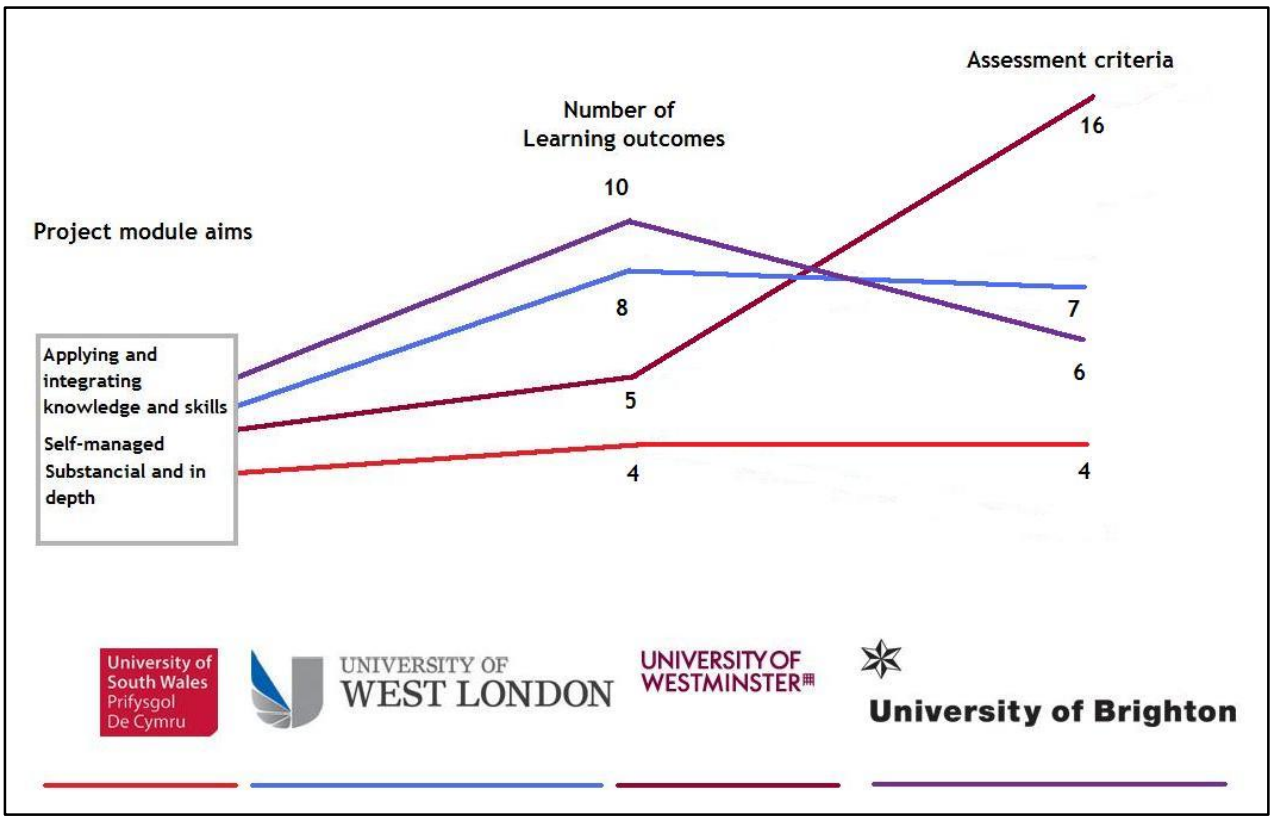

Figure 1: Comparison of projects across all institutions.

7. CONCLUSIONS

The final year project has a very significant role to play in IS undergraduate degree programmes. Projects enable students to synthesise disparate knowledge and apply it in a way which gives rise to important employability skills. Professional bodies, such as the BCS, see final year projects in computing and IS as an integral part of a degree course in this area.

Like all other modules, IS final year projects are defined in course handbooks using aims, objectives, Learning Outcomes and Assessment Criteria which often appear as generic statements applicable to different settings. In an attempt to understand how such definitions are interpreted and how projects are being put to use, this paper has taken a detailed look at the project provision across four UK institutions.

We have looked at the project module at three levels of detail; firstly at the broad aims, then at the Learning Outcomes which are more explicit and can be assessed and finally, at the specific

Assessment Criteria that are used to grade student projects. It is clear from the analysis that projects serve a similar purpose in the IS degree courses but that assessment practice varies across the institutions. We have been able to identify some gaps in the skills and abilities that are not (based on the evidence here) being assessed. Of course, actual practice in grading student projects has not been examined. Nor have we examined how the students experience the project modules.

We have found that the granularity of the LOs and AC varies greatly, with some stating rather vague expectations and others being more prescriptive. The advantage of vaguely stated expectations is that it allows a variety of forms of projects which can encourage creativity and originality. We might on the other hand be concerned that vague expectations might lead to poor projects to be undertaken because the AC are not tight enough to exclude them. Vague expectations may be disadvantageous for weaker students, as they may be unsure of the expectations for their projects. However, we have not examined other support documents and practices that may be used in different courses that may alleviate the problem in practice.

Wanting to further validate the findings of our work, we plan to conduct deeper analysis of the current data, and to expand the scope of our research to include information from various sources. Specifically, we are planning to consult final year students undertaking their projects and their supervisors, in order to gain a deeper understanding of how the specifications we studied in this paper are actually put to use. In addition, we plan to pursue a study which will engage employers, regarding their views on the values of projects and the way they are delivered.

APPENDIX I – COMMONLY USED TERMS

British Computer Society (BCS): The Chartered Institute for IT. http://www.bcs.org/

Course: A complete programme of undergraduate study that normally lasts at least three years and is defined by a curriculum. In US terminology courses are called 'programs'.

Credit: Credit is awarded to a learner in recognition of the verified achievement of designated learning outcomes at a specified level.http://www.qaa.ac.uk/england/credit/creditframework.pdf

Credit level: An indicator of the relative complexity, demand and/or depth of learning and of learner autonomy.http://www.qaa.ac.uk/england/credit/creditframework.pdf

Credit value: The number of credits, at a particular level, assigned to a body of learning. The number of credits is based on the estimated notional learning hours (where one credit represents 10 notional hours of learning).http://www.qaa.ac.uk/england/credit/creditframework.pdf

Higher Education Statistics Agency (HESA): Government agency responsible for managing statistical data about Higher Education in the UK. http://www.hesa.ac.uk/

Module: A unit of teaching that normally lasts one term or semester. The size (credits) of module can sometimes determine its duration. In US terminology a module is often called a 'course'.

Programme Specification: A programme specification is a concise description of the intended learning outcomes from a higher education programme, and how these outcomes can be achieved and demonstrated.
http://www.qaa.ac.uk/academicinfrastructure/programSpec/default.asp:

Quality Assurance Agency (QAA): UK agency that facilitates checks on university academic standards and quality. http://www.qaa.ac.uk/

Subject Benchmark Statement: Expectations about standards.
http://www.qaa.ac.uk/academicinfrastructure/benchmark/default.asp

UK Academy for Information Systems (UKAIS): A society trying to promote IS in the UK. http://www.ukais.org/

APPENDIX II–BCS accreditation requirements for projects

Section 11 Project requirements
11.1.1 Students must be provided with written guidance on all aspects of the project, including selection, conduct, supervision, milestones, format of the report and the criteria for assessment
11.1.2 The project report must meet the requirements set out in section 2.5 of the Guidelines
11.1.3 The individual project within an **undergraduate honours** or **integrated masters** degree should be a piece of work of at least 30 credit points at level 6 The individual project within an **ordinary or foundation degree** for IEng should be a piece of work of at least 20 credit points level 5 or above The individual project within a **specialist masters** degree should be a piece of work of at least 60 credit points at level 7 The individual project within a **generalist masters** programme should be a piece of work of at least 60 credit points at level 6 or above
11.1.4 All projects should reflect the title and the aims and learning outcomes which characterise the programme
as set out in the programme specification
11.1.5 A project undertaken at masters level should reflect the ethos of advanced study and scholarship appropriate to a masters degree
11.1.6 The project must be passed without compensation
11.1.7 In the event of this major activity being undertaken as a group enterprise, there is a requirement that the assessment is such that the individual contribution of each student is measured against the learning outcomes

APPENDIX III – QAA SBS Computing

Subject-related cognitive abilities

- Computational thinking including its relevance to everyday life.
- Knowledge and understanding: demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to computing and computer applications as appropriate to the programme of study.
- Modelling: use such knowledge and understanding in the modelling and design of computer-based systems for the purposes of comprehension, communication, prediction and the understanding of trade-offs.
- Requirements, practical constraints and computer-based systems (and this includes computer systems, information systems, embedded systems and distributed systems) in their context: recognise and analyse criteria and specifications appropriate to specific problems, and plan strategies for their solution.
- Critical evaluation and testing: analyse the extent to which a computer-based system meets the criteria defined for its current use and future development.
- Methods and tools: deploy appropriate theory, practices and tools for the specification, design, implementation and evaluation of computer-based systems.
- Reflection and communication: present succinctly to a range of audiences (orally, electronically or in writing) rational and reasoned arguments that address a given information handling problem or opportunity. This should include assessment of the impact of new technologies.
- Professional considerations: recognise the professional, economic, social, environmental, moral and ethical issues involved in the sustainable exploitation of computer technology and be guided by the adoption of appropriate professional, ethical and legal practices.

Subject-related practical abilities

- The ability to specify, design and construct computer-based systems.
- The ability to evaluate systems in terms of general quality attributes and possible trade-offs presented within the given problem.
- The ability to recognise any risks or safety aspects that may be involved in the operation of computing equipment within a given context.
- The ability to deploy effectively the tools used for the construction and documentation of computer applications, with particular emphasis on understanding the whole process involved in the effective deployment of computers to solve practical problems.
- The ability to operate computing equipment effectively, taking into account its logical and physical properties.

Additional transferable skills

- Effective information-retrieval skills (including the use of browsers, search engines and catalogues).
- Numeracy and literacy in both understanding and presenting cases involving a quantitative and qualitative dimension.
- Effective use of general information technology (IT) facilities.
- The ability to work as a member of a development team, recognising the different roles within a team and different ways of organising teams.
- Managing one's own learning and development including time management and organisational skills.

- Appreciating the need for continuing professional development in recognition of the need for lifelong learning.

APPENDIX IV – Learning Outcomes and Assessment Criteria (University of Westminster undergraduate project).

LO1 Select and justify an appropriate method, technique and tool for the problem or opportunity type.
LO2 Develop a project plan that schedules their own activities and time.
LO3 Critically assess and reflect on relevant current practice and the work conducted, what new skills have been acquired and the effectiveness of the project plan.
LO4 Ensure and demonstrate consideration of professional issues wherever relevant.
LO5 Develop a prototype testable model or a research analysis and report these and other project activities in a scholarly way.

Assessment criteria
LO1 Select and justify an appropriate method, technique and tool for the problem or opportunity type.

APPROACH
- AC1: The chosen project method (approach, methodology, other) as appropriate and its application
- AC2: Description of specific planning, analysis, design and implementation techniques used within the context of the project
- AC3: Appropriate software products and tools chosen (if applicable) or other as applicable

LO2 Develop a project plan that schedules their own activities and time.

PROJECT PLANNING AND MANAGEMENT
- AC4: The project plan (if applicable with revisions), and its execution
- AC5: Use of established project planning and management tools/techniques followed as appropriate
- AC6: Evidence of regular contact / meetings with supervisor and regular work carried out or other evidence of managing own time

LO3 Critically assess and reflect on relevant current practice and the work conducted, what new skills have been acquired and the effectiveness of the project plan.

AND

LO4 Ensure and demonstrate consideration of professional issues wherever relevant.

LITERATURE REVIEW
- AC7: Appropriate choice of books, research papers, reports and/or other sources used in support of project
- AC8: Contribution of each component from the above list and critical evaluation of the literature used as appropriate
- AC9: Is the reference list in the right format?

PROJECT ENVIRONMENT, PROBLEM DOMAIN AND OBJECTIVES
- AC10: Description of project environment, problem domain, project objectives and discussion of related issues

- AC11: Final changes to problem domain and/or project objectives (if applicable) discussed

LO5 Develop a prototype testable model or a research analysis and report these and other project activities in a scholarly way.

RESULTS/DELIVERABLES

- AC12: Appropriate evidence of support materials for project and their critical analysis (including discussion on project objectives, approach, methodology, other) as appropriate; Investigation and Design; Research findings and analysis / design deliverables / products/other as appropriate
- AC13: Implementation / Solution: Prototype, solution, implementation model / blueprint/other as appropriate
- AC14: Appropriate and well thought through recommendations and future work

REPORT PRESENTATION

- AC15: Structure, format and writing style for this type of report
- AC16: Use of language, vocabulary, spelling and grammar accuracy/appropriateness

APPENDIX V – Learning Outcomes and Assessment Criteria (University of Brighton undergraduate project).

- LO1 discuss the process of identifying a relevant project, and appraise his or her own performance in this respect
- LO2 justify the choice of project made, identifying its relationship both to the student's own interests and to the learning that has taken place in other parts of the course
- LO3 identify the methodological, organisational and technological challenges to the successful planning and carrying out of the project, and justify the approaches taken on these issues
- LO4 demonstrate a clear grasp of the subject matter and a full understanding of the principles that will be applied
- LO5 develop and work to a specification and set of requirements
- LO6 demonstrate a capacity for self-management and sustained independent work
- LO7 coordinate all the activities needed to produce the agreed deliverables
- LO8 show competence to document appropriately and demonstrate the results of their work
- LO9 demonstrate an awareness of the relevant professional, social, legal and ethical aspects
- LO10 critically appraise his or her own performance in undertaking the project itself and identify the lessons learned from undertaking it

Assessment criteria

At the highest grade projects would be expected to have the following profile:

1. Technical grasp: for A grade, an excellent technical insight demonstrated to a professional level
2. Understanding of problem area: for A grade showed a professional level of insight into the whole area in which the project is embedded
3. Project management: for A grade, completely successful and entirely self-managed
4. Report quality: for A grade, excellent – clear, substantial, fluent, correctly organised, convincing and with no omissions
5. Evidence of learning: for A grade, mature reflection on the whole process, showing professional level of insight
6. Research effort: for A grade, competent and thorough coverage of the field with excellent research in many areas. Research clearly influenced outcomes

Ethical and legal considerations of the project also considered.

APPENDIX VI – Learning Outcomes and Assessment Criteria (University of South Wales undergraduate project).

1. To specify a project goal and objectives, and a plan to achieve them.
2. To apply research and investigation skills and analyse the outcomes.
3. To use and document appropriate analysis, design, implementation and evaluation methods to realise the project specification.
4. To reflect on the success or otherwise of the work and demonstrate what has been learnt during the process.

Assessment Criteria

Assessment criteria of the University of South Wales undergraduate computing project (covers all computing and IS projects)

Written Assignment
Project Management
Understanding of Problem and Use of Material
Quality of Final Report
Evaluation and Conclusions

APPENDIX VII–Learning Outcomes and Assessment Criteria (University of West London undergraduate project).

Aims

This project provides the opportunity for you to integrate various aspects, both of this course and of your prior knowledge and experience by completing a substantial piece of independent work. It is intended to develop the skills of planning, organisation and communication in the context of a self-managed project.

This module provides the opportunity for you to carry out an appropriate research and/or development exercise which addresses an academic issue. It will enable you to undertake an in-depth investigation of a topic of particular interest to you in the field of computing. The investigation may include the development of software and/or systems analysis following a standard methodology and may be associated with work done for an organisation as part of an internship or placement.

Learning outcomes

LO1 Have a comprehensive knowledge of a chosen area of study.
LO2 Independently analyse and critically review relevant source material such as published journals
LO3 Identify complex problems and develop and/or propose appropriate solutions
LO4 Conduct some element of primary research (based upon issues identified in the literature survey) and to critically appraise the results
LO5 Communicate results and conclusions of their own work by means of a presentation and in writing through a project report and to develop presentation skills
LO6 Review critically the outcome and process of own work
LO7 Develop the skills to critically review primary and secondary sources and to develop cogent arguments from a synthesis of sources
LO8 Complete a self-managed project according to a defined plan

Assessment Criteria

Criteria	**Issues**	**Mark**
Structure and Organisation	planned sequence of sections – e.g., contents list, abstract, introduction, discussion, conclusions provides links between sections has written an understandable report	5
Method	appropriateness of method to the topic [5] has understood the method and explains any variations used [5] applied method appropriately and correctly [5] demonstrated the ability to evaluate their own use of the method [5]	20
Literature Review	shows an understanding of the background topic [5] distinguishes between facts, speculations, opinion [5] quality and quantity of selected references to support argument [10]	20
Use of evidence	clarity of evidence of progress towards project aims and objectives e.g. prototype, demonstration, evaluation instrument, software coding, UML models [10]	

	EITHER Distinguishes between different types of evidence collected [10] OR Provides app. evidence of software analysis / design / development / quality / testing [10]	20
Presentation	appropriate layout (see guide) grammar, syntax and spelling language free from jargon clear headings, introductory statements and summaries diagrams clearly labelled and explained in text	10
Analysis of results	conceptual grasp of topic, clear arguments [5] shows awareness of underlying assumptions [5] indicates limits of method chosen for investigation or software development [3] review critically the outcome and progress of your own work, suggests further work [2]	15
Conclusions drawn	quality of conclusions based on evidence collected	10
Total		100

APPENDIX VIII – BCS accreditation guidelines

2.5.1 General project requirements
An individual project is an expectation within undergraduate, integrated masters, and postgraduate masters programmes. Students must be provided with written guidance on all aspects of the project, including selection, conduct, supervision, milestones, format of the report and the criteria for assessment. All projects should reflect the aims and learning outcomes which characterise the programme to which they contribute as set out in the programme specification.
Project reports
Projects must involve the production of a report which should include:
• elucidation of the problem and the objectives of the project
• an in-depth investigation of the context and literature, and where appropriate, other similar products (this section is likely to be emphasised less for an IEng project)
• where appropriate, a clear description of the stages of the life cycle undertaken
• where appropriate, a description of how verification and validation were applied at these stages
• where appropriate, a description of the use of tools to support the development process
• a critical appraisal of the project, indicating the rationale for any design/implementation decisions, lessons learnt during the course of the project, and evaluation (with hindsight) of the project outcome and the process of its production (including a review of the plan and any deviations from it)
• a description of any research hypothesis
• in the event that the individual work is part of a group enterprise, a clear indication of the part played by the author in achieving the goals of the project and its effectiveness
• references
2.5.2 Undergraduate individual project requirements
It is expected that within an undergraduate programme, students will undertake a major computing project, normally in their final year and normally as an individual activity, giving them the opportunity to demonstrate:
• their ability to apply practical and analytical skills present in the programme as a whole
• innovation and/or creativity

• synthesis of information, ideas and practices to provide a quality solution together with an evaluation of that solution
• that their project meets a real need in a wider context
• the ability to self-manage a significant piece of work
• critical self-evaluation of the process
In the event of this major activity being undertaken as part of a group enterprise, there is a requirement that the assessment is such that the individual contribution of each student is measured against all the above learning outcomes.
For accreditation for CITP, CEng or CSci, the individual project should be worth at least 30 credit points at level 6 or above. The project must be passed without compensation.
For accreditation for IEng the individual project should be worth at least 20 credit points at level 5 or above.
The project must be passed without compensation.

Clark, M. and Boyle, R. D. (1999), "A personal theory of teaching computing through final year projects", *Computer Science Education*, Vol. 9 No. 3, pp. 200-14.

Clear, T., Goldweber, M., Young, F. H., Leidig, P. M. and Scott, K. (2001), Resources for instructors of capstone courses in computing, *Working group reports from ITiCSE on Innovation and technology in computer science education.* Canterbury, UK: ACM.

Ducrot, J., Miller, S. and Goodman, P. S. (2008), "Learning outcomes for a business information systems undergraduate program", *Communications of AIS*, Vol. 2008 No. 23, pp. 95-122.

Gupta, J. N. D. and Wachter, R. M. (1998), "A capstone course in the information systems curriculum", *International Journal of Information Management*, Vol. 18 No. 6, pp. 427-41.

Isaacs, G. 2002. *Assessing group tasks*, Teaching and Educational Development Institute, The University of Queensland.

Jackson, N., Wisdom, J. and Shaw, M. (2003), "Using learning outcomes to design a course and assess learning", *Guide for Busy Academics Produced by Learning and Teaching Support Network Generic Centre*, Vol. 20 No. pp.

Keller, S., Parker, C. M. and Chan, C. (2011), "Employability skills: Student perceptions of an is final year capstone subject", *Innovation in Teaching and Learning in Information and Computer Sciences*, Vol. 10 No. 2, pp. 4-15.

Lancaster, T., Jenkins, T., Barroca, L., Calvert, M., Devlin, S., Foley, R., Horton, J., Moore, J. and Sturdy, P. Some good ideas for student projects from the disciplinary commons. Proceedings of 12th Annual Conference of the Higher Education Academy Subject Centre for Information and Computer Sciences, Belfast, (2011).

Mcgann, S. T. and Cahill, M. A. (2005), "An is capstone course for the 21st century emphasizing experiential & conceptual aspects, soft skills and career readiness", *Issues in Information Systems*, Vol. 6 No. 1, pp. 6.

Olsson, B., Berndtsson, M., Lundell, B. and Hansson, J. Running research-oriented final year projects for cs and is students. ACM SIGCSE Bulletin, (2003). ACM, 79-83.

Qaa (2007), Subject benchmark statement: Computing.

Reinicke, B., Janicki, T. and Geber, J. Implementing an integrated curriculum with an iterative process to support a capstone course in information systems. Proceedings of the Information Systems Educators Conference ISSN, (2012). 1435.

Stefanidis, A. and Fitzgerald, G. (2010), "Mapping the information systems curricula in uk universities", *Journal of Information Systems Education*, Vol. 21 No. 4, pp. 391-410.

Stefanidis, A., Fitzgerald, G. and Counsell, S. (2012), "A comprehensive survey of is undergraduate degree courses in the uk", *International Journal of Information Management*, Vol. 32 No. 4, pp. 318-25.

Surendran, K. and Schwieger, D. (2011), "Incorporating capstone courses in programs based upon is2010 model curriculum", *Information Systems Education Journal*, Vol. 9 No. 2, pp. 9.

Ukais. 1999. *The definition of information systems* [Online]. UKAIS. Available: http://www.ukais.org/.